Sleep Patterns of Infants and Effects of Sleep Training: Longitudinal Single Center Experience from Turkey

Bebeklerin Uyku Düzeni ve Uyku Eğitiminin Etkileri: Türkiye'den Longitudinal Tek Merkez Deneyimi

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Abstract

Objective: To know cultural characteristics of infant sleep pattern and guide the families can be useful to prevent sleep problems. The aim of this study to determine the sleep habits during infancy and to evaluate the effectiveness of sleep training.

Materials and Methods: This longitudinal study included 127 healthy infants. Infants were randomly assigned to intervention group [(IG) n=33] or control group [(CG) n=94] and followed up from the 3rd to 18th months at well-child-visits. Face to face sleep training was given to the IG firstly in the 3rd month and then subsequent follow-ups. Families in both groups filled out a detailed questionnaire at each visit.

Results: Bed sharing was not detected in the IG. The frequency of rocking was lower in the IG in each period, the difference was significant only at the sixth month (p=0.006). The frequency of sleeping in the supine position compared to the side position was higher in the IG than CG at the 3rd, 6th and 9th months (p=0.013, p=0.005, p=0.003; respectively). Bedtime was earlier and duration to fall asleep after night awakenings was shorter in the IG than CG at 9 and 12 months (p=0.009, p=0.018; p<0.001, p=0.002; respectively).

Conclusion: Sleep training during the infancy provide to sleep supine position, prevents rocking during falling asleep, provide earlier bedtime, and shortens the duration to fall asleep again after night awakenings. Further studies are needed to determine the effectiveness of sleep training and to determine the main components of the training.

Keywords: Sleep pattern, infancy, sleep training

Öz

Amaç: Bebeklerin uyku düzeni ile ilgili kültürel özelliklerin bilinmesi ve ailelere rehberlik edilmesi uyku sorunlarının önlenmesinde faydalı olabilir. Bu çalışmanın amacı, bebeklik dönemindeki uyku alışkanlıklarını belirlemek ve uyku eğitiminin etkinliğini değerlendirmektir.

Gereç ve Yöntem: Longitudinal olarak yürütülen bu çalışmaya 127 sağlıklı bebek dahil edildi. Bebekler rastgele olacak şekilde müdahale grubu [(MG), n=33] ya da kontrol grubuna [(KG), n=94] ayrılarak 3. aydan 18. aya kadar çocuk sağlığı izlemlerinde takip edildi. MG'ye ilk 3. ayda olmak üzere sonraki tüm izlemlerde yüz yüze uyku eğitimi verildi. Her iki grupta da ailelerden her izlemde ayrıntılı bir anket doldurmaları istenildi.

Bulgular: MG'de ebeveyn ile aynı yatakta uyuyan bebek tespit edilmedi. Sallanarak uykuya dalma sıklığı MG'de her dönemde düşük olup, farklılık sadece altıncı ayda anlamlı bulundu (p=0,006). MG'de 3., 6. ve 9. aylarda sırt üstü uyuma sıklığı, yan pozisyonda uyumaya kıyasla KG'den yüksekti (sırasıyla; p=0,013, p=0,005, p=0,003). MG'de 9. ve 12. aylarda akşam uykusuna yatma saati KG'ye göre daha erken (sırasıyla; p=0,009, p=0,018) ve gece uyanmalarından sonra tekrar uykuya dalma süresi daha kısaydı (sırasıyla; p<0,001, p=0,002).

Sonuç: Bebeklik döneminde verilen uyku eğitimi sırt üstü uyumayı sağlamakta, sallanarak uykuya dalmayı engellemekte, daha erken yatağa yatmayı sağlamakta ve gece uyanmalarından sonra tekrar uykuya dalma süresini kısaltmaktadır. Uyku eğitiminin etkinliğini belirlemek ve eğitimin ana bileşenlerini saptamak için daha ileri çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Uyku düzeni, bebeklik, uyku eğitimi

Introduction

Because of the effects on physical and mental health, immune function and academic performance, regular sleep pattern is an important determinant of a healthy childhood. Sleep problems that may develop during the early period may show a tendency to persist throughout childhood. Sleep problems in the early childhood also have been associated with various behavioral problems such as anxiety, aggression, excessive activity and impulsivity (1). Furthermore, insufficient, inefficient or divided sleep increases the incidence of postnatal depression in the mother (2,3).

In early childhood, frequent night awakenings and difficulty falling asleep are reported as the most common sleep problems (4). Studies on sleep problems in infants demonstrated that excessive parental intervention and lack of the infant's self-soothing skills are closely related to nighttime awakenings and difficulty falling asleep (5). Healthy sleep habits can be developed by addressing sleep during the well child visits, informing families and simple behavioral intervention. Randomized controlled studies demonstrated that educating parents on how to manage the infant before going to sleep and during night awakenings can reduce problematic sleep behaviors and improve sleep (6,7). However, there are differences between cultures in terms of sleep habits and interventions (8). In Turkey, according to our knowledge it is the first study in which the sleep habits of infants are longitudinally monitored up to 18th months and also the effectiveness of sleep training is researched. In this study, it was aimed to determine the sleeping habits during infancy in our region and to evaluate the effectiveness of sleep training.

Materials and Methods

Infants who were monitored in Erciyes University Department of Pediatrics Well Child Clinic between July 2017 and June 2019 and met the inclusion criteria were included in this study. All families were informed about the study and confidentiality protocols. Written informed consent was obtained from all the families. This study was approved by the Erciyes University Ethics Committee's decision (2017/344).

Study protocol

This longitudinal study included 3-month-old 133 healthy infants who were born at least 36th week of pregnancy and with birth weight of over the 2.500 g. During the follow-up, six infants excluded from the study who were diagnosed any disease that could affect sleep patterns and finally 127 infants were included.

Three-month-old infants were included in the study and the nighttime-daytime sleep durations of the neonatal period were retrospectively questioned. The infants were longitudinally followed-up from the 3rd to the 18th months, at regular intervals (3rd month, 6th month, 9th month, 12th month, and 18th month). A detailed questionnaire was given to the families at each follow-up visit. Denver developmental screening test was performed on the infants at the 9th and 15th months by a trained psychologist. The flowchart of the study was shown in Figure 1.

Intervention and control groups (CG)

A subgroup randomly selected among the infants (n=33) was determined as the intervention group (IG). Sleep training was given to the IG at the first well child follow-up visit in the 3rd month and subsequent visits. Sleep training was given to the mothers or families of the infants by the same person (by the first author) through face-to-face interviews at the end of the well child visits in a separate room. A standard slide presentation of ~20-30 min was performed for the training, and an information note prepared for reading at home were given. The sleep training was repeated to the IG at the 6th, 9th, 12th and 18th month follow-ups with consideration given to the developmental characteristics of the babies as per their age in months. IG that received sleep training was compared with the CG who were followed up with routine well child visits (Figure 1).

Sleep training

During sleep training, the parents were informed about the physiological sleep durations and sleep-wake patterns of the infants, which were considered normal as per their age in months. Afterwards, evidence-based strategies for developing healthy sleep habits were presented as a slide presentation. The training was structured around four basic behavior and intervention styles.

(a) Providing a stable and safe environment for the infant to sleep (such as preventing sleeping in the parents' bed with parents; temperature, light and sound arrangements of the room; safe environment and sleeping position),

(b) Putting the infant in bed while sleepy but not fully asleep and allowing the infant to fall asleep on their own (except for infants who were breastfed and who fall asleep while breastfeeding, particularly during the first few months),

(c) Delaying reactions for waking up and crying,

(d) Developing consistent bedtime routine.

Statistical Analysis

Histogram, q-q plots were examined and Shapiro-Wilk's test was applied to assess the data normality. Levene test was used to test variance homogeneity. While the median, min and max values were given as descriptive statistics in the comparison of numerical data, the descriptors of the categorical data were given as percentage and "n". Normally distributed data were given as mean ± standard deviation. To compare the differences between groups, a two-sided independent samples t-test, Mann-Whitney U test and Two-Way ANOVA were used for continuous variables. Two-Way ANOVA analysis was performed in repeated measurements taken more than two times for the change of the measurements as per time; Pearson chi-square test and Fisher's Exact test were used for the comparison of categorical variables. Bonferronni multiple comparison test analysis were used for post-hoc test method. Hosmer-Lemeshow goodness of fit test was used for model calibration. All analyses were conducted using TURCOSA (Turcosa Analytics Ltd. Co., Turkey, www.turcosa.com.tr). A p-values less than 5% was considered as statistically significant.

Results

Baseline and socio-demographic characteristics of the IG and CG were shown in Table 1. Denver test results of all infants included in the study were normal (while a total of 8 infants from both groups had suspicious test results at the 9th month, they were evaluated as normal at the 15th month).

The sleep habits of the infants in the IG and CG were shown in Table 2. In the first year of life, it was observed that infants mostly slept in a crib in the parents' room, however at the 18th month, 50% of the infants in the IG and 23.7% of the infants in the CG slept in their own room (p=0.15).

Although the frequency of rocking was less in the IG compared to the CG in each period, the difference was reported to be significant only at the 6th month (p=0.006). The frequency of infants falling asleep alone was low across all periods in both groups (p>0.05). Despite the low number, the infants sleeping in parents' bed increased from the 6th month onward in the CG (p>0.05). It was observed that infants mostly to be breastfeed while falling asleep in both groups (p>0.05).

The number of infants who fell asleep by listening to lullabies compared to a silent environment at the 3rd month was significantly higher in the IG compared to the CG (p=0.023). The bathing frequency of the infants was reported to be significantly higher in the IG at the 6th, 9th and 12th months compared to the CG (p=0.007, p=0.03 and p=0.01, respectively). There was no difference between the groups in terms of massage frequency. The frequency of using sleep transitional object was reported to be significantly higher in the IG compared to CG at the 18th month (p=0.02). There was no significant difference between the groups in terms of using pacifiers while falling asleep.

It was found that the frequency of sleeping in the supine position compared to the side position was higher in the IG compared to the CG at the 3rd, 6th and 9th months (p=0.013, p=0.005 and p=0.003) (Table 2).

Figure 2 shows the median daytime and nighttime sleep durations of infants for both groups from the newborn to the 18th month. Sleep durations in the newborn period of the infants participating in the study were retrospectively learned, and there was no difference between the groups (p=0.510).
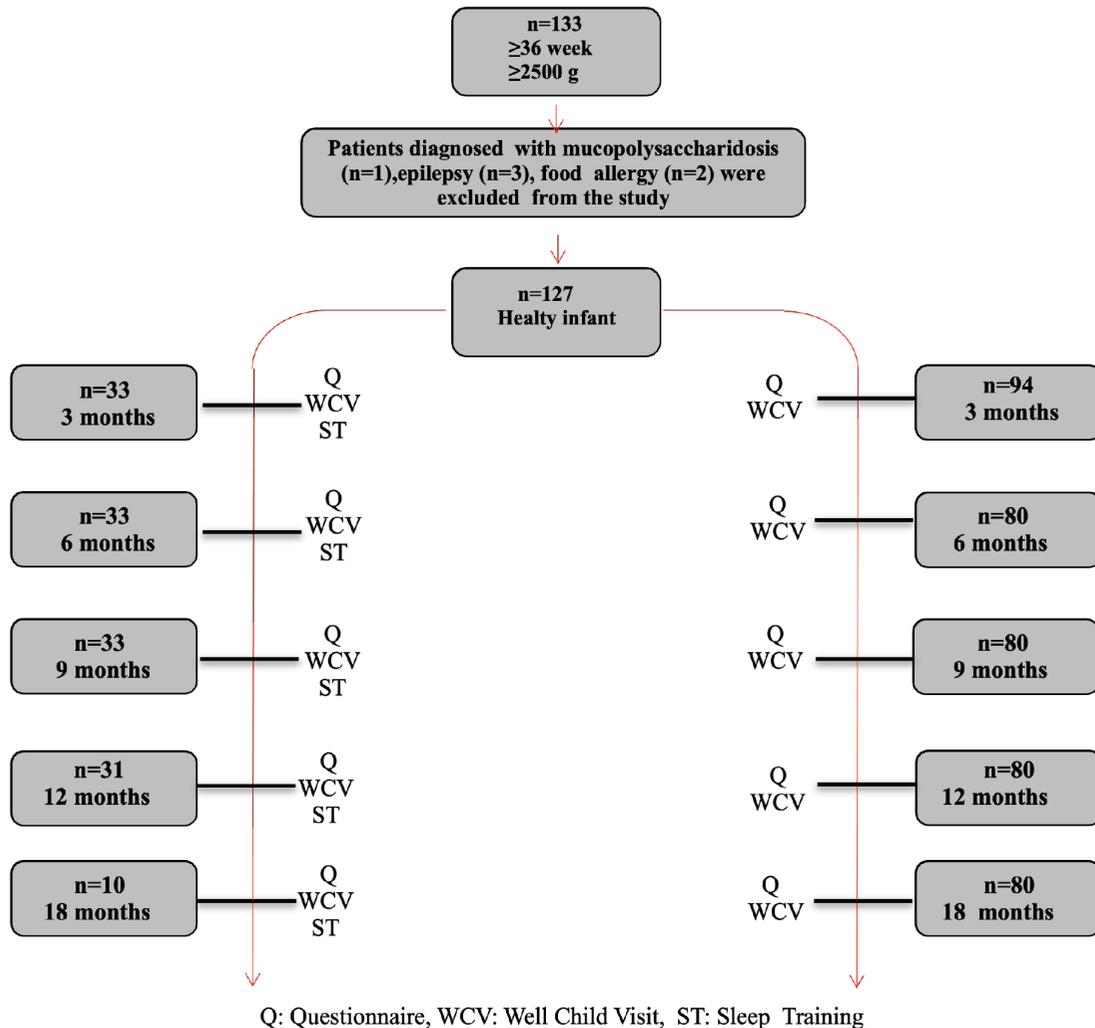

Figure 1. Flowchart of the study

Nighttime and daytime sleep durations of the infants at the 3rd, 6th, 9th and 12th months were similar between the groups. However, the daytime sleep durations of the infants in the IG were longer compared to the infants in the CG at the 18th month (p=0.031). There was no significant difference in the nighttime sleep duration. Daytime sleep had a decreasing tendency in both groups from the 3rd month to the 18th month (p<0.001). The increase in nighttime sleep duration was reported to be significant in the CG (p<0.001) (Table 3).

The number of daytime naps in the IG and the CG were similar. The number of nighttime awakenings was higher in the IG compared to the CG at the 3rd month (p=0.009) (Table 3).

It was detected that the infants in the CG slept later in the evening compared to the infants in the IG at the 9th and 12th months (p=0.009, p=0.018). There was no significant difference between the groups in terms of waking time in the morning (Table 3).

Sleep onset latency was shorter in the IG compared to the CG at the 12th month (p=0.04). Duration to fall asleep again after night awakenings was reported to be longer in the IG at the 3rd month (p=0.002) compared to the CG but shorter at the 9th and 12th months (p<0.001, p=0.002; respectively) (Table 3).

Discussion

Regular sleep patterns start to shape from infancy period and infants experience rapid changes in their regulation of sleep/wakefulness patterns within the first years of their lives. These changes may be affected by the physiological maturation process of infants, their behavioral self-control ability, temperament traits and environmental factors. However, cultural and geographic differences influence sleep patterns and durations (9). Sleep development is a complex multi-component process, and the effectiveness of sleep training on this process is an ongoing issue.

In this study, the first of the basic strategies of sleep training was to create a stable and safe environment for sleep. The IG was informed about safe sleep environments for infants as per the updates of the American Academy of Pediatrics (AAP) (10). Although there are studies that mention certain positive physical and psychosocial aspects of parent-baby bed sharing, it is known to increase the risk of sudden infant death syndrome (SIDS) (11). AAP defined bed sharing, particularly in certain cases, as a risk condition in terms of SIDS (10). In this study, it was explained to the IG that bed sharing would not

Table 1. Main characteristics of the infants and families in the intervention and control groups			
Characters*	Intervention n (%)	Control n (%)	p
Gender Female Male	17 (51.5) 16 (48.5)	49 (52.1) 45 (47.9)	0.950
Mode of delivery Vaginal Caesarean section	13 (39.4) 20 (60.6)	37 (39.4) 57 (60.6)	0.999
Birth order 1 2 ≥3	20 (60.6) 6 (18.2) 7 (21.2)	41 (43.6) 27 (28.7) 26 (27.7)	0.498
Birth weight (gram)	3177.57±490	3284.94±453	0.254
Gestation week at birth	38.5±1.09	38.6±1.25	0.102
Maternal education ≤11 years >11 years	17 (51.5) 16 (48.5)	51 (54.3) 43 (45.7)	0.785
Maternal employment status Employee Housewife	14 (42.4) 19 (57.6)	26 (28) 67 (72)	0.124
Exclusive breastfeeding duration (months)	5.2±1.4	4.9±1.8	0.586
Formula-fed infants (at anytime)	13 (39.4)	46 (51.7)	0.318
Complementary feeding (month) 4-6 months End of the 6th month	7 (21.0) 26 (79.0)	19 (24.0) 61 (76.0)	0.769
Infantile colic at the 3rd month	9 (27.3)	31 (33)	0.538
Blood values of infants at 9th month; Hemoglobin (g/dL) Serum iron (μg/dL) Serum iron binding capacity (μg/dL)	11.7±0.66 43.6±19.5 311.6±54	11.6±0.88 51.5±21 323.7±60	0.815 0.119 0.410
*Descriptive statistics: Mean ± standard deviation, n (%)			

Table 2. Sleep habits of infants at 3rd, 6th, 9th, 12th and 18th months in the intervention and control groups

Characters*	3rd month IG n=33	CG n=94	p	6th month IG n=33	CG n=80	p	9th month IG n=33	CG n=80	p	12th month IG n=31	CG n=80	p	18th month IG n=10	CG n=80	p
Where infants sleep															
Infants' own room	-	3 (3.2)		-	-		1 (3)	2 (2.5)		6 (19)	7 (9)		5 (50)	19 (23.7)	
Crib in the parents' room	33 (100)	84 (89.4)	0.149	33 (100)	77 (96.2)	0.260	32 (97)	74 (92.5)	0.422	25 (81)	66 (82)	0.090	5 (50)	50 (62.5)	0.158
On parents' bed with parents	-	7 (7.4)		-	3 (3.8)		-	4 (5)		-	7 (9)		-	11 (13.8)	
Sleep initiation (falling asleep) methods															
Hold in arms†	23 (70)	45 (48)		27 (82)	41 (51)		22(67)	40(50)		21 (67.7)	37 (46.2)		5 (50)	28 (35.4)	
Rocking‡	8 (24)	43 (46)	0.083	6 (18)	35 (44)	0.010	8 (24)	34 (42.5)	0.172	7 (22.6)	33 (41.3)	0.231	3 (30)	28 (35.4)	0.647
Lie down on crib	2 (6)	6 (6)		-	4 (5)		3(9)	4 (5)		2 (6.5)	7 (8.7)		2 (20)	12 (15.2)	
Lie down on parents' bed	-	-		-	-		-	2 (2.5)		1 (3.2)	3 (3.8)		-	11 (14)	
Feeding while falling asleep															
Breastfeeding	27 (82)	78 (83)		28 (85)	60 (75)		24 (73)	56 (70)		23 (74)	51 (64)		5 (50)	39 (49)	
Formula feeding	2 (6)	7 (7.4)	0.900	3 (9)	16 (20)	0.370	4 (12)	18 (22.5)	0.150	1 (3)	11 (14)	0.430	-	-	0.930
No feeding‖	4 (12)	9 (9.6)		2 (6)	4 (5)		2 (6)	5 (6.5)		3 (10)	9 (11)		3 (30)	28 (35)	
Cow milk	-	-		-	-		3 (9)	1 (1)		4 (13)	9 (11)		2 (20)	13 (16)	
Bedtime routines															
Lullaby§	15 (45.5)	21 (22.3)		13 (39.4)	32 (40)		12 (36.5)	33 (41)		10 (32.3)	28 (35)		3 (30)	19 (23.8)	
Music + white noise	4 (12.1)	19 (20.2)	0.038	7 (21.2)	12 (15)	0.702	5 (15)	8 (10)	0.712	5 (16.1)	8 (10)	0.666	1 (10)	6 (7.4)	0.849
Silence‖	14 (42.4)	54 (57.4)		13 (39.4)	36 (45)		16 (48.5)	39 (49)		16 (51.6)	44 (55)		6 (60)	55 (68.8)	
Bath frequency (weekly)	3 (1-7)	2(1-7)	0.108	3 (1-7)	2(1-7)	0.007	3 (1-7)	2(1-7)	0.030	3 (1-7)	2(1-7)	0.010	3 (1-7)	2 (1-7)	0.070
Massage frequency (weekly)	4 (0-7)	7 (0-7)	0.549	3 (0-7)	2 (0-7)	0.230	2 (0-7)	1 (0-7)	0.080	2 (0-7)	1 (0-7)	0.090	1.5 (0-3)	0 (0-7)	0.180
Sleep transitional object															
Yes	-	-		2 (6)	3 (4)		4 (13)	6 (7)		5 (16)	7 (9)		3 (30)	6 (7)	
No	33 (100)	94 (100)	-	31 (94)	77 (96)	0.575	29 (87)	74 (93)	0.430	26 (84)	73 (91)	0.260	7 (70)	74 (93)	0.020
Pacifier using															
Just falling asleep	11 (33.4)	31 (33)		13 (39.4)	25 (31.2)		13 (39.4)	22 (27.5)		11 (35.5)	18 (22.5)		4 (40)	13 (16.2)	
During the night	1 (3)	5 (5.3)	0.868	2 (6.1)	-	0.050	1 (3)	1 (1.3)	0.343	1 (3.2)	3 (3.8)	0.380	-	-	0.070
No pacifier	21 (63.6)	58 (61.7)		18 (54.5)	55 (68.8)		19 (57.6)	57 (71.2)		19 (61.3)	59 (73.7)		6 (60)	67 (83.8)	
Sleep position															
Prone (belly)	1 (3)	3 (3)		2 (6)	5 (6.3)		7 (21.2)	14 (17)		13 (42)	23 (29)		6 (60)	21 (26.2)	
Supine (back)×	29 (87.9)	62 (66)	0.040	29 (88)	51 (63.7)	0.020	21 (63.6)	31 (39)	0.010	9 (29)	20 (25)	0.230	-	15 (18.8)	0.060
Sideʸ	3 (9.1)	29 (31)		2 (6)	24 (30)		5 (15.2)	35 (44)		9 (29)	37 (46)		4 (40)	44 (55)	

*Descriptive statistics were given as n (%) values, †/‡: at 6th month p=0,006, rocking (rocking the infants in a crib + in the lap + on the legs + in a blanket), §/‖: at 3rd month p=0.023, ×/ʸ: at 3rd month p=0.013, at 6th month p=0.005, at 9th month p=0.003, IG: Intervention group, CG: Control group

be safe. During the follow-up it was found that infants mostly slept in a crib in the parents' room. Moreover, there was no significant difference detected between the groups in terms of where infants sleep. It was observed that the number of infants sleeping in parent's bed with their parents gradually increased from the 6th to the 18th month in the CG; however, there was no infant sleeping in the parents' bed in the IG. The difference was not significant because of the low number of infants.

Mindell et al. (8) reported significant differences between cultures in terms of the sleep environments of infants. It was reported that children in Asian countries tend to sleep in the same room and the same bed with their families, and this rate remains higher compared to European countries across all ages. In another study, the rate of bed sharing with parents among three-month-old infants was reported to be lower in Turkey compared to Asian, European and American countries (12). In that study, Istanbul was the sample for Turkey and the rate of bed sharing with parents was detected as 2% at the 3rd month (12). In our study, the rate of bed sharing at the 3rd month (before training) was 5.5% (7 of

Figure 2. Day and night time median sleep durations (minute) of the intervention and control groups

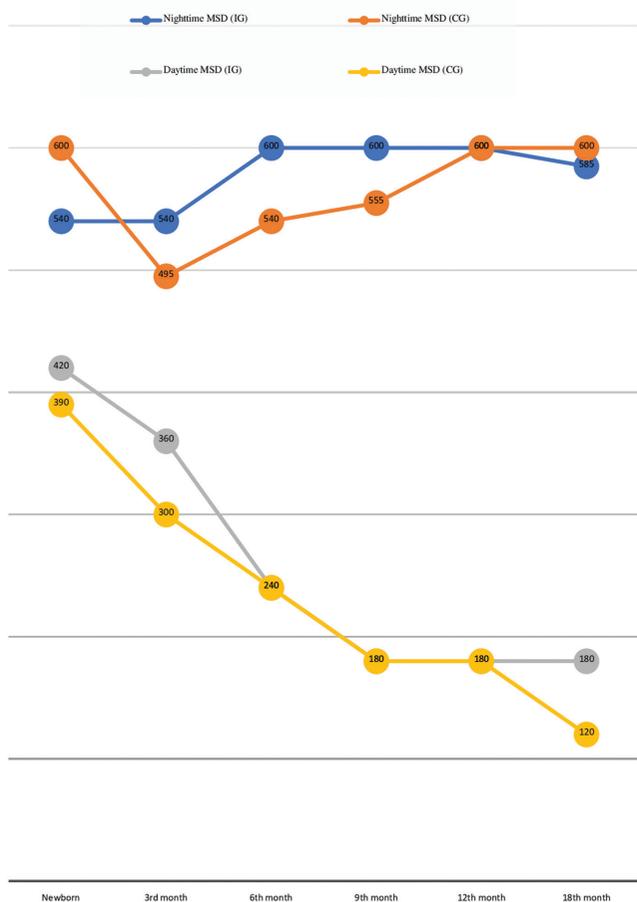MSD: Median sleep duration, IG: Intervention group, CG: Control group

127), suggesting that there may variations both between countries and regions.

Another safe sleeping position to prevent SIDS for the infants is to sleep in a supine position (wholly on the back) (10). In this study, the frequency of sleeping in a supine position compared to the side was detected to be higher in the IG compared to the CG at the 3rd, 6th, and 9th months. Later months, infant preferences become effective in the choice of position with the increase of the infants' mobilization ability. However, the frequency of sleeping in a supine position was also significantly higher at the 3rd month when the infants were enrolled in the study indicates that the awareness of the IG was higher before the training. This difference before training may affect possible beneficial of sleep training.

The American Sleep Academy ideally recommends room sharing with the infants up to the age of one (10). However, certain studies suggest that room allocation is more difficult for the mother and the infant after the 6th month because of separation anxiety and argue that room allocation should take place during the earlier months (9 months at the latest) (13). In this study, room sharing was recommended in the IG until the age of one, and it was suggested that room allocation time should be determined by considering factors such as the family feeling that they are ready, the infant's feeding type, and the level of maternal separation anxiety. We observed that at least 80% of the one-year-old infants in both groups slept in a crib in the parents' room. In the IG, 50% of the infants started to sleep in their own rooms at the 18th month, but the difference between the groups was not significant.

In this study, the number of nighttime awakenings of the infants was compatible with age-appropriate physiological sleep pattern and existing studies (14). At the 3rd month, the number of night awakenings was higher in the IG compared to the CG, but the number of night awakenings in the months after the training was similar between the groups. There are studies reporting that bedroom sharing with parents is associated with increased number of night awakenings in infants (15,16). In a longitudinal study, in which the assessment was made with actigraphy and sleep diaries, it was found that bedroom sharing does not create an objective difference in terms of the sleep quality of the baby (total sleep duration, number of night awakenings), but it is associated with poor sleep quality of the mother. In the same study, mothers who shared a room reported a higher frequency of night awakenings of their babies. However, since these awakenings were not confirmed by actigraphy, it was reported that the infant's activities during sleep (position change, making sounds) were evaluated as waking up because of the mother's proximity to the baby (17). Another possible condition that will explain the observation of increased number of night awakenings associated with bedroom sharing is the parent's presence in the same environment causing early intervention and preventing the development of the infant's self-soothing skills (17).

Another strategy of our sleep training was to delay reactions to waking up and crying, allowing time to infant to learn self-settle and fall asleep by one's own. In this study duration to fall asleep

after night awakenings was significantly shortened in the IG compared to the CG at the 9th and 12th months and sleep onset latency was shortened in the IG compared to the CG at the 12th month. Studies on sleep problems in infants demonstrated that excessive parental intervention and lack of the infant's self-soothing skills are closely related to difficulty falling asleep (5). Sleep training is considered to improve the sleep latency and duration to fall asleep again after night awakenings.

When the sleep initiation methods were examined, it was observed that very few infants fall asleep in their bed alone, ~90% of infants, particularly within the first year of life, required holding or rocking. While many of the infants in the CG fell asleep by being rocked, in the IG they fell asleep by being held

and the difference was significant at the 6th month. Similarly, to our results, current studies have been reported that infants in the first year of life need a sleep initiation method such as being held, mother's breast, rocking and pacifier (14,18,19). However, in the training, it was emphasized to place the infants in the bed while sleepy but not fully asleep, except for infants falling asleep while breastfeeding. One of the most important sleep behaviors to be learned in infancy is self-soothing and self-initiating sleep. Self-soothing ability allows babies to return to sleep more quickly after physiological awakenings occurring during the night, thus providing less interrupted night sleep (9). However, concerns have been raised about behavioral strategies (not to interfere while falling asleep) because of

Table 3. Sleep duration and sleep variables of infants at 3rd, 6th, 9th, 12th and 18th months in the intervention and control groups*

	Nighttime** sleep (min)	Daytime*** sleep (min)	Daytime naps	Number of night wakings	Bedtime	Wake time	Sleep latency (min)	Duration to fall asleep after night awakenings (min)
3rd month								
IG	540 (360-720)	360[a] (60-480)	4[a] (3-6)	3[a] (1-6)	21.30[a] (19.00-00.00)	07.00 (05.00-10.00)	30 (10-60)	30[a] (5-60)
CG	495[a] (300-720)	300[a] (30-600)	3[a] (2-6)	3[a] (1-6)	22.00[a] (19.00-00.30)	07.00[a] (03.00-11.00)	20[a] (5-60)	15[a] (5-60)
p	0.117	0.054	0.050	**0.009**	0.080	0.630	0.460	**0.002**
6th month								
IG	600 (360-750)	240[ab] (120-360)	3[a] (2-4)	3[a] (1-6)	21.30[a] (19.30-23.30)	07.30 (05.00-11.00)	15 (5-60)	15[ab] (5-60)
CG	540[bc] (240-840)	240[b] (30-480)	3[b] (2-4)	2[a] (1-5)	21.45[a] (19.00-00.30)	08.00[ab] (03.30-12.00)	15[ab] (5-30)	10[bc] (5-30)
p	0.857	0.363	0.050	0.400	0.130	0.290	0.790	0.110
9th month								
IG	600 (420-660)	180[abc] (60-300)	2[ab] (1-3)	3[ab] (0-6)	21.30[a] (19.30-23.30)	08.00 (05.00-11.00)	10 (5-40)	5[ab] (0-20)
CG	555[b] (240-720)	180[c] (0-360)	2[c] (1-3)	3[a] (0-6)	22.00[ab] (19.00-00.30)	08.00[ab] (03.30-10.00)	12.5[b] (5-60)	10[bc] (0-30)
p	0.194	0.234	0.920	0.230	**0.009**	0.590	0.140	**< 0.001**
12th month								
IG	600 (420-660)	180[bc] (60-300)	2[b] (1-3)	2[ab] (0-5)	21.30[a] (20.30-23.30)	08.00 (05.30-10.00)	5 (5-30)	5[ab] (0-20)
CG	600[cd] (240-690)	180[c] (30-360)	2[c] (1-3)	2[b] (0-5)	22.00[ab] (19.00-00.30)	08.00[bc] (03.30-10.30)	10[bc] (5-60)	10[c] (0-30)
p	0.749	0.907	0.250	0.930	**0.018**	0.510	**0.040**	**0.002**
18th month								
IG	585 (420-660)	180[c] (90-210)	1[b] (1-2)	1[b] (0-3)	22.00[a] (20.30-23.00)	07.30 (07.00-09.30)	15 (5-60)	5[b] (0-20)
CG	600[d] (420-720)	120[d] (30-270)	1[d] (1-2)	1[c] (0-3)	22.00[b] (20.30-00.30)	08.00[c] (05.30-11.00)	10[c] (0-30)	5[d] (0-30)
p	0.199	**0.031**	0.600	0.460	0.060	0.130	0.470	0.660
p*								
IG	0.605	<0.001	<0.001	<0.001	0.004	0.524	0.056	0.001
CG	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

*Descriptive statistics given as median (min-max) values, ** Nighttime: 19:00 to 07:00, ***Daytime: 07:00 to 19:00, IG: Intervention group, CG: Control group, p: Comparison results between groups (control and intervention), p*: Comparison results of sleep patterns and durations within groups were evaluated separately in the intervention and control groups, and shown with characters. The same characters show similarity, different characters show the difference between group

potential adverse impacts in areas of infant brain development, insecure mother-child relationship, and later child mental health problems (such as anxiety). These concerns have led to community reluctance to using behavioral strategies (6).

The other way recommended to promote self-soothing is encouragement of the use of sleep transitional object. The frequency of sleep transitional object use seems to vary culturally and be quite common among young children in Western cultures (20). After sleep training, frequency of using sleep transitional object was higher in the IG at 18th months. Pacifier use wasn't recommended during the sleep training, especially in the first months. If the families prefer to use later months, it was recommended only when falling asleep. The frequency of pacifier using were not different between the groups in this study. Although no feeding is recommended while falling asleep there were infants in both groups feeding by formula and cow milk. There was no difference between the groups, but it shows that families need extra information also after the 6th months about the risks of bottle use.

Our final training strategy was to set routine sleep times and to establish bedtime routines. There are studies demonstrating that bedtime routines are associated with shortened duration for falling asleep, decreased frequency of night awakenings, and increased total sleep duration and quality (21). Moreover, it was shown that the consistent use of bedtime routines is effective in providing self-control of sleep for the children during the following period (22). Mindell et al. (8) detected cultural differences in the application of bedtime routines, and while 80% of families in England were applying bedtime routines, this rate was reported to be 40% in India. In our study, singing lullabies was preferred more compared to the silence environment at the 3rd month in IG but later months there was no difference.

IG's bedtime was earlier compared to the CG and a significant difference was observed at the 9th and 12th months. Mindell et al. (23) stated that sleep should begin before 21:00 during infancy and childhood based on a study of National Sleep Foundation in America. Studies reported that late sleep time (after 21:00) is associated with poor sleep quality (short sleep duration, increased number of night awakenings, longer sleep latency) (23-25). In this study, the median sleep time was later than 21:00 in both groups. In a study examining bedtimes and total sleep durations by countries, striking differences were reported between countries/regions. In that study bedtime for children in Asian countries was ~3 h (170 min) late and their total sleep duration was 101 minutes shorter (8). In our study, nighttime sleep durations, the number of nighttime awakenings, and the linear decreases in the duration of daytime sleep through time were observed to be consistent with the literature (4,15,26). Moreover, it was shown that sleep training did not make a difference on nighttime sleep duration, number of night awakenings, and wake time.

Most of these studies focus on sleep performance (number of night awakenings, sleep durations) and show improvements in certain sleep parameters after the sleep training (27-29). In another study from Turkey, which evaluate the effect of sleep training program on sleep habits of infants at 5th and 6th months, has been reported findings that supporting the positive effects of the sleep training (19). However, there are studies demonstrating that sleep training is ineffective in preventing infant sleep problems and improving mother-infant sleep (30,31). Difference between the study designs may reveal conflicting results regarding the benefit of training therefore well-designed randomized controlled studies are required to determine the effectiveness of sleep training.

This study had certain advantages. Participants of the study were selected from families who applied for well-child-visits, therefore parental compliance was good. Sleep training was performed by the same trainer with face-to-face meetings and a standard presentation. This provided an advantage in terms of answering the questions of the parents. Furthermore, the repetitions of the trainings at the later months provided a significant contribution to reinforcing behavioral interventions. Moreover, compared to most of the existing studies, our study had a long follow-up period of 18 months (19,28,30,31).

Study Limitations

The most important limitation of the study was the low number of the included infants. Moreover, the decrease in the number of infants followed-up in the IG and CG made statistical evaluations difficult at the 18th month. Because the CG comprised families who regularly attended well child visits, they received basic recommendations regarding sleep during follow-ups. Moreover, sleep habits were learned with a questionnaire without verification by actigraphy or video.

Conclusion

Sleep habits of healthy infants were longitudinally monitored and cultural characteristics were attempted to be determined. This study shows that sleep training can be effective during infancy; 1) to provide sleeping supine position, 2) to prevent rocking during the falling asleep, 3) to provide earlier bedtime, 4) to shorten the sleep latency, 5) to shorten the duration to fall asleep again after night awakenings. However, further studies are needed to determine the effectiveness of sleep training and to determine the effective components of the training.

Ethics

Ethics Committee Approval: This study was approved by the Erciyes University Ethics Committee's decision (2017/344).

Informed Consent: Written informed consent was obtained from all the families.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: M.K., S.İ., G.C., Design: M.K., S.İ., G.C., Data Collection or Processing: G.C., Analysis or Interpretation: G.E.Z., Literature Search: G.C., N.E.Ş., Writing: G.C., N.E.Ş., M.K.

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