Sleep and Napping Patterns in 3-to-5-year old Children Attending Full-Day Childcare Centers

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Objective
To describe daytime naps and nighttime sleep–wake patterns in children attending full-day childcare centers.

Methods
A descriptive cross-sectional study of sleep and daytime nap patterns in 52 healthy children 3–5 years of age. Sleep and nap data were obtained over 3 days and nights (Tuesday, Wednesday, and Thursday) with continuous ankle actigraphy recording on children attending two university-affiliated childcare centers.

Results
Children averaged about 10 hr (610 min ± 38 SD) of total sleep in 24 hr, as estimated by actigraphy. For the 41 children who napped, average nap duration was 75.8 min (±20 SD). Nocturnal sleep was less for children who napped (9.0 hr ± 0.71 SD) compared to those who did not nap (9.8 hr ± 0.53 SD).

Conclusions
Findings indicate that the majority of 3-to-5-year-old children nap when given an opportunity. Preschool children’s sleep and napping patterns on weekends and in other types of childcare environments warrant further research to assess health effects and impact on growth and development.

Key words
actigraphy; childcare; naps; preschool children; sleep.

Several studies have described sleep–wake patterns in children during the first few years of life (Anders & Keener, 1985; Bes, Schultz, Navelet, & Salzarulo, 1991; Coons & Guillemainault, 1984; Kohler, Coddington, & Agnew, 1968; Louis, Cannard, Bastuji, & Challamel, 1997). However, few studies specifically describe objective sleep–wake patterns in preschool children who have the additional developmental task of attending childcare on a regular basis and interacting with peers (Acebo et al., 1999, 2005; Tikotzsky & Sadeh, 2001). Furthermore, much of the data on young children’s sleep patterns are based on parental reports (Crosby, LeBorgeouise, & Harsh, 2005; Jenni, Fuhrer, Iglovstein, Molinari, & Largo, 2005; Lozoff, Askew, & Wolf, 1996; Weissbluth, 1995).

Acebo and colleagues (2005) examined sleep–wake patterns in 1-to-5-year-old children using actigraphy and maternal reports over a 7-day period. Their sample consisted of equal numbers of boys and girls; most (91%) were Caucasian and lived with both parents (95%). Those younger than 3 years of age wore the actigraph on their ankle, and those over 3 years of age wore the actigraph on their nondominant wrist. On an average, nocturnal sleep time was 8.7 h per night, with less night wake time and nap sleep time in the older age groups. Night-to-night variability in children’s bedtime and sleep period time was associated with family socioeconomic status (SES). Children in families with lower SES had more nocturnal awakenings and later rise times than children in families with higher SES. There was no significant association between SES and duration of naps or nocturnal sleep time. In addition, longer nap duration was associated with less nighttime sleep and an earlier morning rise time. Considerable variability was noted in the duration of naps, but the effect of attending childcare was not assessed. Results from this study highlight the importance of family characteristics, such as SES, that may contribute to variability in children’s sleep patterns.

More than 60% of children attend childcare outside their home environment (Federal Interagency Forum on

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Child and Family Statistics, 2001). Yet, to our knowledge objective measures of preschool children’s napping patterns during childcare have not been reported. Preschool children are confronted with multiple challenges, such as transition to childcare, development of emotional regulation, peer interactions, and longer periods of parent–child separation that may influence their daily routine and sleep–wake schedules. The purpose of this study was: (a) to describe the daytime nap patterns and nocturnal sleep–wake patterns of 3-to-5-year-old children attending full-day childcare centers; and (b) to compare nappers to nonnappers.

Methods

Subjects and Study Design

The children attended childcare full-time (5 days per week) at either of two university-affiliated childcare centers in the San Francisco Bay Area. Childcare hours began at 7:00 a.m. and ended at 5:30 p.m. Most (89%, n = 48) attended childcare the previous year. Families were recruited during a “meet the researcher” meeting held in the two childcare centers. Of the 86 children enrolled in the childcare programs, the parents of 54 children (23 girls, 31 boys) agreed to participate (63% response rate). Two of the children did not complete the study due to actigraph failure or illness, resulting in a final sample of 21 girls and 31 boys. For each child, one parent was asked to complete the demographic and sleep questionnaires.

The children were selected on the following criteria: preregistered to attend preschool in the fall, no developmental delay or diagnosed hyperactivity, and understand English. Nine of the 52 children were diagnosed with medical problems including asthma (n = 5), nasal allergies (n = 1), Von Willebrand’s disease (n = 1), eczema (n = 1), and obstructive sleep apnea (n = 1). The child diagnosed with obstructive sleep apnea underwent a tonsillectomy and adenoidectomy several months prior to the start of the study, and one girl with asthma developed pneumonia and was excluded before beginning data collection; the other seven were on medications (corticosteroids).

The study was conducted from September to November 2005. Observations for the first childcare center occurred from September through mid-October. To avoid holidays and potential changes in the home or childcare environment, observations for the second childcare center began mid-October through mid-November with a break during the week of daylight savings time. During the daily visits, arrival times, departure times, meals, snack times, and nap times and behaviors were recorded. Data collection began during the fifth week at each childcare center, when an actigraph monitor was applied to each participating child’s ankle. To prevent excessive attention toward the monitor or playing with its event marker, each child selected a pair of socks to wear in order to conceal the actigraph. The first author also observed the children during nap times on the 3 days of actigraphy recordings.

All procedures were approved by the UCSF and UC Berkeley Institutional Review Boards for the Protection of Human Subjects, and parents provided informed consent for participants. Each child received a storybook for participation in the study.

Measures

Sleep Diary

A designated parent used the sleep diary each night to record their child’s sleep, and returned the diary to the researcher the following morning on arrival at the childcare center. Most of the designated parents were mothers (87%). If a parent forgot to return the sleep diary in the morning, they were given another diary to complete at that time. Diaries were checked for missing data each morning. Parents were instructed to keep the actigraph on continuously, remove it only during times when it could get wet (e.g., bathing), and record those removal times in the diary. The parent was also instructed to record detailed information regarding bedtimes, rise times, night awakenings, bedtime struggles, any other time(s) at which their child fell asleep (e.g., during car rides or on the couch), bedtime routine, and the sleep location(s) for the child (i.e., child’s bed or parent’s bed). If a child initially fell asleep in his or her own bed, but then transitioned to the parents’ bed, parents were instructed to also record the timing of this event. In addition, evening activities, medications, illness, and any unusual events that may have affected the child’s sleep (i.e., grandparent in town or parent out of town) were also recorded. Parents noted their child’s sleep in 30 min time blocks. Measures obtained from the sleep diary included: (a) Bedtime, defined as when the child was put down to bed for the night and (b) Rise time, defined as when they got out of bed in the morning.

Nap Observations

Nap duration was recorded by the first author each day in the childcare centers. Scheduled nap time for all children
in both centers was during a 150 min period between 13.00 and 15.30 hr. At both sites, every child was required to rest or nap during this time period. Nap patterns were recorded in 15 min intervals and coded as: S = Sleeping; L = Lying still; R = Restless; Q = Quietly reading; and T = Teacher interaction (i.e., rubbing child’s back). Due to children falling asleep and waking up on their own at various times, the exact sleep onset and offset time may have been underestimated by up to 15 min in some children. At the first childcare center, the 22 participating children were observed during nap time (10 at week 5 and 12 at week 6). At the second childcare center, the 31 participating children were observed during nap time (15 at week 12 and 16 at week 13). Nappers were defined as children who napped for any amount of time on 2 of the 3 days (n = 41). The 11 nonnappers included children who did not sleep during the rest periods (n = 5) or who may have briefly napped on 1 of the 3 days (n = 6). Of the nonnappers, none of the children exhibited a long nap on any of the 3 days.

**Actigraphy**

To control for potentially unstable weekend schedules that could affect sleep patterns on Mondays or Fridays, children wore their ankle actigraph on Tuesday, Wednesday, and Thursday for 72 continuous hours. Actigraphy provides continuous motion data using a wristwatch size microprocessor that senses motion with a piezo-electric beam accelerometer. Mini motionlogger actigraphs (Ambulatory Monitoring, Inc., Ardsley, NY, USA) were set for 1 min epochs and zero-crossing mode. Activity counts range from 0 to 280 each minute, when programmed for sleep analyses (Acebo et al., 1999, 2005). Activity counts were analyzed using the autoscorer program for sleep available in Action4 software (Ambulatory Monitoring, Inc., Ardsley, NY, USA) that yields the following sleep parameters using Sadeh’s algorithm validated for children in this age group (Acebo et al., 1999; Sadeh, Sharkey, & Carskadon, 1994; Tikotzky & Sadeh, 2001): (a) Sleep Start Time, defined as the time of the first of at least 3 consecutive minutes of sleep; (b) Sleep End Time, defined as the time of the last of at least 5 consecutive minutes of sleep; (c) Sleep Minutes, defined as the minutes during the sleep period scored as sleep; and (d) Percent Wake After Sleep Onset (WASO%), defined as the percent time spent awake after sleep onset occurred. Number of night awakenings was scored manually, with an awakening defined as at least 5 min in duration (Tikotzky & Sadeh, 2001).

At the end of the week, the actigraphs were downloaded and checked against the sleep diaries. A follow-up phone call was made to parents to ask about any missing data or to resolve any discrepancies. If the actigraph was off for >4 hr on any given day of recording, that day’s actigraphy recording was not analyzed. This occurred with two children in the study.

**Statistical Analyses**

Descriptive statistics included mean values for continuous variables as well as frequencies and percentages for categorical variables. Intraclass correlations (ICC) were used to estimate the stability of sleep measures during the 3 days and nights of monitoring. Since the 3 nights of total sleep time were highly correlated (ICC = .83), and both actigraphy nap time (ICC = .75) and observed nap time (ICC = .69) were also highly stable, measures were averaged for the 3 days to obtain a mean and standard deviation for each child. Children who napped for any amount of time on 2 of the 3 days were classified as nappers (n = 41), while children who did not sleep during the any of the rest periods (n = 5) or who may have briefly napped on 1 of the 3 days (n = 6) were classified as nonnappers. Chi-squared tests of association were used to test for potential differences in child demographic variables between the two childcare sites. Analysis of variance (ANOVA) models were used to evaluate the differences in sleep outcomes of 24 hr sleep, nocturnal sleep duration, wake after sleep onset, and night awakenings by age, sex, childcare site, and napping status. Data were analyzed using SPSS for Windows version 12.0. A two-tailed a-level ≤ .05 was used to determine statistical significance for all tests.

**Results**

**Sample Characteristics**

Of the 54 children participating in the study, one girl had missing data due to actigraph problems and one girl had missing data due to illness. Our final sample consisted of 21 girls and 31 boys with actigraphy data. Eight of the 52 children did not wear the actigraphy on all 3 nights, so their mean sleep time for 2 nights was calculated and used in the analyses. Child demographic variables (age, sex, and medical problems) did not differ between the two childcare sites. Table I includes the child demographic characteristics. Mean age for the children was 46.4 ± 7.8 months and the age range was 30–59 months. Sixty-five percent (n = 35) of the children were first born and 62% (n = 32) slept alone.
Mean age for the participating parent was 39.2 ± 4.4 years. Fifty-five percent \( (n = 29) \) of the families were White, 14% \( (n = 7) \) Chinese, 12% Multi-ethnic \( (n = 6) \), and 8% \( (n = 4) \) were Latino/Hispanic American. Eight-nine percent \( (n = 46) \) of the families were married, 72\% \( (n = 39) \) earned a masters degree or higher, and 88\% \( (n = 46) \) had moderate to high income (>$61,000) for the San Francisco Bay area.

**Actigraphy Sleep Measures**

We first examined the actigraphy sleep variables (24 hr sleep, nocturnal sleep duration, wake after sleep onset, and night awakenings) for the entire sample and then by sex, age, and childcare site. Table II shows the actigraphy sleep variables for the entire sample, and by nappers and nonnappers.

**24 Hr Sleep**

Average 24 hr sleep time, including actigraphy-scored sleep minutes at night and during nap time, was 610 min (±38 SD) for the entire sample. The main effect of age \( (F_{(1.48)} = 5.3, p = .026) \) on 24 hr sleep was significant with sex and childcare site in the model.

| Table I. Child Demographics by Child Care Site \( (N = 52) \) |
|-----------------|-----------------|-----------------|
| Child Characteristics | Frequency \( (N) \) | Percent | Child Care \( A \) \( (n = 21) \) | Child Care \( B \) \( (n = 31) \) |
| Age (SD) | | 46.1 ± 9.1 | 46.7 ± 6.9 |
| Child ethnicity | | | |
| White | 23 | 44.2 | 8 | 15 |
| Multi-ethnic | 16 | 30.8 | 5 | 11 |
| Chinese | 7 | 13.5 | 4 | 3 |
| African American/Black | 2 | 3.8 | 2 | 0 |
| Latino/Hispanic American | 2 | 3.8 | 2 | 0 |
| Korean American | 1 | 1.9 | 0 | 1 |
| NA/American Indian | 1 | 1.9 | 0 | 1 |
| Gender | | | |
| Boys | 31 | 59.6 | 13 | 18 |
| Girls | 21 | 40.4 | 8 | 13 |
| Naps | | | |
| Nappers | 41 | 78.8 | 13 | 28 |
| Non-nappers | 11 | 21.2 | 8 | 3 |

**Nocturnal Sleep**

The average nocturnal sleep duration for the sample was 549 ± 45 (SD) min. The shortest nocturnal sleep duration was 448 min in a 36-month-old boy and the longest was 643 min in a 43-month-old girl. Nocturnal sleep duration was less for children who napped (538 min ± 42 SD) compared to the 11 children categorized as nonnappers (586 min ± 31 SD). The main effect of nap \( (F_{(1.50)} = 7.4, p = .02) \) on nocturnal sleep was significant with age and childcare site in the model.

WASO recorded by actigraphy averaged 7.1\% (±4.1 SD). The main effects of age, napping, and site were not significant for WASO. Overall, WASO was not significantly different for children who napped (7.7% ± 4 SD) compared to children who did not nap (5.1% ± 3 SD).

Number of night awakenings lasting at least 5 min per episode averaged 1.6 ± 0.96 (SD) across the 3 nights. A negative association was found between night awakenings and child age \( (r = -3.3, p = .021) \), such that younger children had more night awakenings than older children. There were no main effects by medical conditions. The number of night awakenings was significantly higher \( (t_{(49)} = -2.51, p = .016) \) for the children who napped \( (1.8 ± .95) \) compared to the nonnappers \( (1.0 ± .73) \).

**Daytime Naps**

Of the 52 children, 10\% \( (n = 5) \) did not nap on any of the 3 days, 11.5\% \( (n = 6) \) napped on 1 of the 3 days, 23\% \( (n = 12) \) napped on 2 of the 3 days, and 56\% \( (n = 29) \) napped on all 3 days. Napping frequency varied with age; 51 months for children who did not nap on any of the 3 days; 52 months for children who napped

| Table II. Actigraph Sleep Measures by Nonnappers and Nappers \( (N = 52) \) |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Actigraphy sleep variables (Mean ± SD) | Total sample \( (N = 52) \) | Nonnappers \( (n = 11) \) | Nappers \( (n = 41) \) | \( p \)-value |
| 24 hr sleep (min) | 610.6 ± 38 | 600 ± 25 | 613 ± 41 | .19 |
| Nocturnal sleep duration (min) | 549.0 ± 45 | 587 ± 32 | 539 ± 43 | <.001 |
| Nap duration (min)* | 62.6 ± 32 | 14 ± 13 | 76 ± 21 | <.001 |
| Wake after sleep onset (%) | 7.1 ± 4 | 5.1 ± 3 | 7.7 ± 4 | .06 |
| No. of night awakenings | 1.6 ± .96 | 1.0 ± .73 | 1.8 ± .98 | <.02 |

*Mean nap duration for total sample includes nap durations for nonnappers and nappers.
on 1 of the 3 days; 45 months for children who napped on 2 of the 3 days; and 42 months for children who napped on all 3 days. Nonnappers and nappers differed by age (t = 2.6, p < .01) such that the nonnappers were older (52 months) than the nappers (45 months).

There was a strong correlation between actigraphy and observed nap recordings (r = .84). Across the 3 days of recording, nap duration by actigraphy averaged 75.8 min (± 20 SD) for the 41 (79%) children who napped, compared to 71.3 min (± 21 SD) by observation. A negative association was found between child age and nap duration both by actigraphy (r = −.38, p = .006) and observation (r = −.44, p = .002), such that younger children had longer nap times (Fig. 1). Daytime nap duration did not differ by site. The number of children who did not nap differed by site: 15% (n = 8) at one site compared to 6% (n = 3) at the other site (\( \chi^2 = 6.1, p = .01 \)). The longest nap duration by actigraphy averaged 115 min in a 31-month-old girl and 126 min by observation in a 40-month-old boy.

Discussion

Regardless of age or napping behavior, total 24 hr sleep time was about 10 hr for this sample. This is consistent with previous studies of sleep in young children (Burnham & Harris, 2005; Iglowstein, Jenni, Molinari, & Largo, 2003; Liu, Liu, Owens, & Kaplan, 2005; Thorleifsdottir, Bjornsson, Benediktsdottir, Gislason, & Kristbjarnarson, 2002; Tikotzky & Sadeh, 2001). The children who napped had less nocturnal sleep than nonnapping children, which also replicates previous studies (Acebo et al., 2005; Crosby et al., 2005). It may be that sleep during the day decreased the need for more nighttime sleep, or that poor sleep during the night resulted in the need for more sleep during the day. Children in this study who napped did have more night awakenings compared to nonnappers. This could be associated with either physiological developmental, or it could be that some children had environmental disruptions during the night, thereby requiring a nap during the day to achieve a total of 10 hr sleep in a 24 hr period.

Our findings address an interesting dilemma for parents and childcare teachers regarding the tradeoff between daytime and nighttime sleep intervals. For example, some parents may prefer that their child not nap or not nap past a certain time due to the subsequent difficulty that may occur in getting their child to bed at night. A child who takes a long time to fall asleep at bedtime is an added family stressor for the parent with long work hours or a stressful home or work environment. Unstructured bedtime routines and lack of resources may also contribute to bedtime or naptime resistance. On the other hand, other parents may insist that their child nap during the afternoon, which may pose a challenge for the childcare teacher. Allocating a specific nap period at childcare may benefit some children, particularly the younger aged child. However, other children may have difficulty napping, become more restless trying to lie still, or not feel tired if they have already had 10 hr of sleep the previous night. Decisions regarding napping are complex from both the teacher’s and the parents’ perspectives.

An opportunity for a nap or rest period during the day could benefit most preschool aged children, particularly those who are younger or getting <10 hr of sleep at night. This rest period provides an opportunity for a child to unwind and recuperate from the morning’s activities. For the older child or child who does get 10 hr of sleep during the night, it may be difficult to settle down when required to do so, thereby acting restless, anxious, or aggressive during and after the afternoon rest period.

During naptime, childcare teachers supervise numerous children and a nonnapping or disruptive child can change the dynamics of the naptime environment. It may not be feasible for childcare teachers to simultaneously monitor children sleeping while others play. Child–teacher ratios, space, naptime sleep environment, age of the children in the childcare center (i.e., preschool only vs. infants and preschool), and daily routines vary within childcare centers, and may potentially influence a child’s ability to adequately rest or nap. Moreover, napping policies vary across the United States and within childcare settings, which may also influence a child’s nap duration (Daniel & Lewin, 2005). Nonetheless, decisions regarding napping from the perspective of the preschool and the parent are complex and require further study.

### Figure 1. Nap duration by actigraphy for age (N = 52).

![Nap Duration by Age](image-url)
Daytime Naps

Nap durations were shorter for older children in this sample, which supports previous reports (Acebo et al., 2005; Iglowstein et al., 2003; Weissbluth, 1995). Nap duration did not differ by childcare site; however, one childcare site had fewer nappers than the other, which may have influenced the environment for those children who did nap. The majority of children in our sample napped when given a 150 min window of opportunity for rest and napping. The two childcare centers had established daily routine activities and rest periods. The environment at these two sites was conducive to napping, with adequate space, cots, lighting, and teacher–child ratios. It would be interesting to replicate this study with a larger cohort of preschool children attending various childcare centers with varying quality of care and examine nighttime sleep and nap patterns over a longer interval (i.e., 2 weeks) to determine the stability of our findings.

Limitations

There are several limitations to this study, including the cross-sectional design and correlational nature, which limit any conclusions about directionality. The small sample size and narrow age-group distribution in which most of the children were more than 46 months of age limits our generalizability. Our sample was primarily Caucasian and multi-ethnic as reported by parents, and not representative of all racial groups. With a larger diverse sample, we may have had adequate power to detect racial differences in young children. We did not have a control group of children not attending childcare for comparison. We did not assess weekend sleep in our sample; therefore, it is possible that there is a subgroup of nonnappers in the childcare setting who nap at home on weekends. And lastly, most of the children in our sample napped, and our study may not have been adequately powered to examine these two groups separately. Nonetheless, additional studies of preschool children’s sleep patterns should include adjustments to starting childcare for the first time, intermittent childcare or part-time attendance, and changes in childcare settings to further our understanding about daytime nap and nocturnal sleep patterns in preschool children attending childcare centers.

Conclusions and Future Directions

In summary, the childcare environment is an important component of early development in which young children are confronted with peer interactions and development of emotional regulation that could potentially impact daytime nap and nocturnal sleep durations. A large component of young children’s development includes social contexts (i.e., childcare settings, family environments) associated with health and behavioral outcomes. Further study is warranted to examine the potential influence of childcare environments and napping policies, family and child characteristics, environmental conditions, as well as parent desires on preschool children’s daytime nap and nocturnal sleep patterns. Determining how well early sleep patterns and sleep behavior predicts later sleep patterns and behaviors, what changes and what remains stable as development progresses, and how biological and socio-environmental factors interact with child development remain a challenge for researchers and clinicians. Additional longitudinal studies are needed to further our understanding of the bidirectional interplay among all these domains, as well as the variability and adaptability in young children’s daytime nap and nighttime sleep patterns that can affect their overall health and development.

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