Angelman and Fragile X Syndromes Early Sleep Patterns

Maelyn Fulton[1], Dea Garic[2], Zumin Chen[2], Julia Gross[2], Yinuo Xu[2], Caisi Hecht[2], Amy Janis[1], Moon West[1], Jamie Capal[2]*, Mark Shen[2]*, & A.J. Schwichtenberg[1]*
[1] Purdue University [2] Carolina Institute for Developmental Disabilities, University of North Carolina at Chapel Hill *Senior authors

Background

Angelman Syndrome (AS) and Fragile X Syndrome (FXS) are rare genetic, neurodevelopmental disorders in which sleep problems are common. Up to 80% of children with AS or FXS have parent-reported sleep problems (Budimirovic et al., 2022; Goldman et al., 2011). However, studies of infant/toddler sleep patterns are limited because of the rare occurrence of these syndromes and the inherent difficulties in infant sleep assessment. Although sleep problems impact individuals with various neurodevelopmental concerns, the nature of these sleep problems are not universal and detailed descriptions of early sleep patterns or problems can inform family support efforts.

In this study, infant/toddler sleep patterns are documented simultaneously with three sleep assessment tools: (1) parent-report dairy, (2) actigraphy, and (3) Emfit.

Aims

The overall aims of the study were to:

(1) Describe AS and FXS infant and toddler sleep using three sleep assessment tools
(2) Report sleep data missingness patterns across the three assessment tools

Sample

A small cohort of infants and toddlers, mean age 13.7 months (*SD* = 7.2) with AS (*n* = 5) or FXS (*n* = 4) completed a detailed two-week sleep assessment in their typical care environment.

Table 1. *Sample demographic information.*

	AS	FXS	Total
Sex, Male, n(%)	3(60%)	2(50%)	6(67%)
SES Household, n(%)			
50K- 75K	1(20%)	0(0%)	1(11%)
100K-150K	2(40%)	2(50%)	4(44%)
150K-200K	0(0%)	1(25%)	1(11%)
Over 200K	2(40%)	1(25%)	3(33%)
Mother's Education, n(%)			
High School	0(0%)	0(0%)	0(0%)
Some College/ 2 y. Degree	1(11%)	1(20%)	0(0%)
College Degree	2(22%)	1(20%)	1(25%)
Graduate Degree	6(67%)	3(60%)	3(75%)

based out of the University of North Carolina, Chapel Hill - Carolina Institute for Developmental Disabilities. All families lived within the United States and were moderate to high resource families.

Measures

Parent-Report Dairy (PR): Each morning for roughly two weeks parents were asked to complete a 24-hour recall diary. The diary was delivered via text message and assessed morning rise time, bedtime, night wakings, and naps.
Actigraphy: Infant/toddlers wore an actigraph (Philips Actiwatch 2) on their ankle for roughly two weeks with removals for sand or water play, bathing, and clothing changes. Following best practice guidelines (Acebo et al., 2006), parent-report dairy entries were used to score actigraph data for bedtime, morning rise time, and 24-hour sleep durations.
Emfit: A multi-sensor (Emfit) was placed under the infant/toddler's primary sleep location (i.e., their mattress). Using a proprietary algorithm, movement, heart-rate, and respiration data were scored for bedtime, morning risetime, and total nighttime sleep duration.

Results

Table 2. *Descriptive statistics of sleep times and duration (Aim 1).*

	Parent Report	Actigraphy	Emfit
Angelman Syndrome			
Bedtime$_1$	8:28PM (0:37)	8:16PM (1:38)	7:09PM (0:23)$_2$
Wake time$_1$	6:59AM (0:45)	7:06AM (0:44)	7:38AM (0:20)$_2$
Duration$_1$	10h 31m (1:01)	7h 59m (1:01)	11h 47m (0:32)$_2$
Fragile X Syndrome			
Bedtime$_1$	7:25PM (0:21)	7:24PM (0:24)	7:30PM (0:32)
Wake time$_1$	7:01AM (0:39)	6:58AM (0:41)	7:07AM (0:47)
Duration$_1$	11h 37m (0:45)	8h 48m (0:49)	10h 2m (1:01)

Note. $_1$ M and SD units are HH:MM. $_2$ Only one infant had successful Emfit data.

Figure 1. *Angelman Syndrome nighttime period from bedtime to waketime.*

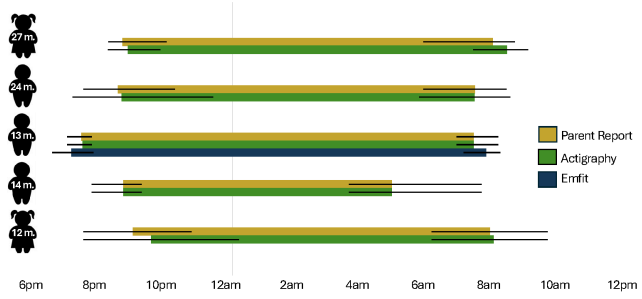
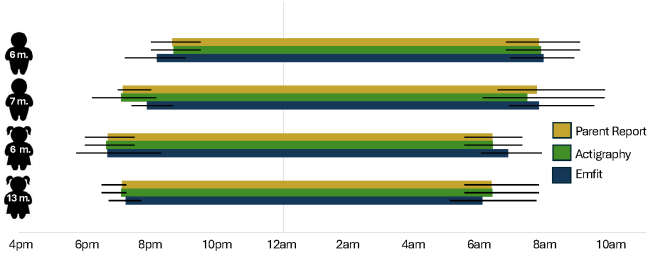


Figure 2. *Fragile X Syndrome nighttime period from bedtime to waketime*



Results continued

All data were assessed for missingness (Aim 2). For actigraphy and Emfit, if >20% of the nighttime period was missing then it was not used to generate sleep estimates and was considered 'missing'. For the parent-report diary all available data was used.

Table 3. *Successful nights of data collection across groups and measures.*

Measure	Total	AS	FXS
PR Diary	134/134 100%	75/75, 100%	59/59, 100%
Actigraphy	125/126, 99%	71/71, 100%	54/55, 98%
Emfit	50/102, 49%	14/48, 29%	36/54, 67%

Note. Reported ratios: successful nights/total attempted nights, percentage collected.

Discussion

In young children with AS and FXS, the precise patterns of sleep problems are understudied and 'target sleep' recommendations for families are not established. Within this small sample, the AS toddlers tended to have more variable sleep. They also had shorter sleep durations (on average), which may reflect the relatively older age of the AS group (i.e., the FX group were younger and therefore could have longer/more sleep need).

When sleep data were successfully collected, the three assessment tools used in this study were comparable. Especially when considering actigraphy almost always provides estimates that are shorter than parent-reports (owning to the fact that actigraphy captures arousals and short wakings parents are not likely to noticed and therefore report). When Emfit recordings were successful, their agreement with actigraphy and parent-report diaries were acceptable but Emfit had the highest rates of missingness in this study. Unlike Tjeertes et al (2023), Emfit was not a robust tool in this study. We had multiple nights (for most of the children) wherein the under-the-mattress multi-sensor had no data to report for large portions of the night.

Future studies can build on this work by considering more than sleep duration and timing. Sleep is a complex biosocial process and considerations for sleep regularity, variability, and context can help build family support models to improve child and ultimately family sleep.

NIH P50 HD103573-8084 (PI: Shen)
Angelman Syndrome Foundation (Co-PIs: Capal & Shen)
Purdue Institute for Integrative Neuroscience (PI: Schwichtenberg)