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SCIENTIFIC INVESTIGATIONS

Correspondence between Reported and Actigraphic Sleep Measures in Preschool Children: The Role of a Clinical Context

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Study Objectives: The aim of this study was to assess the role of clinical context in determining the correspondence between actigraphic and reported sleep measures in preschool children.

Methods: Sleep was assessed using actigraphy and parental reports in a clinical sample of 109 preschool children between the ages 4 and 6 years suffering from significant nighttime fears and in a sample of 30 healthy controls.

Results: In comparison to actigraphy, parents in both groups indicated that their children fell asleep earlier and overestimated their sleep period. These gaps were significantly larger in the control group than the clinical group. Parents from both groups similarly underestimated the time their child was awake during the night in comparison to actigraphy. Significant correlations were found in both groups between parental reports and actigraphy sleep schedule measures. Low correlations were found for wake after sleep onset in both groups and for the number of night wakings.

Conclusions: Clinicians and researchers should be highly aware that parental reports on their children's sleep may not be accurate, and that accuracy may be affected by the context of the study. The use of complimentary sleep assessment tools in clinical and research settings should be encouraged.

Keywords: Nighttime fears, sleep, actigraphy, sleep questionnaire, preschool

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BRIEF SUMMARY

Current Knowledge/Study Rationale: Parental reports on their children's sleep may not be accurate. The purpose was to assess the accuracy of parental sleep reports in preschool children and to examine to what extent this accuracy is related to the presence of a clinical sleep-related issue (nighttime fears).

Study Impact: There are general discrepancies between parental reports and objective sleep measures. These discrepancies may be affected by the presence of a clinical sleep related disorder. These results emphasize the need for clinicians and researchers to use complimentary sleep assessment tools.

Sleep problems are very common during childhood and constitute a source for major concern to parents and professionals.[1-3] These problems tend to be persistent[4-6] and associated with daytime behavior problems and parental distress.[2,5,7,8]

Seeking professional help is usually based on parental perception that their child has a sleep problem.[9] In most clinical settings, the child's sleep assessment is solely based on parental reports.[1,10] Parental reports may rely on realistic perceptions of the child's sleep characteristics; however, their accuracy may be compromised by situational and subjective factors.[10,11] Previous studies have suggested that parental perceptions and reports on their children's sleep may be influenced by factors such as unrealistic expectations and interpretations, lack of developmental knowledge, socioeconomic status, demographic factors, and broader cultural norms, beliefs, and attitudes.[9,12-15] A major limitation is that parents become aware of many events during the night (e.g., night wakings) only if the child signals and requires attention[11,16]; therefore, their knowledge may be significantly influenced by the child's tendency to signal. Recently, Gregory et al.[1] concluded that assessing sleep using exclusively the sleep items of the Child Behavior Checklist, which is one of the most popular parental reports on children's behavior problems, is insufficient for assessing sleep and should be combined with other sleep assessment methods.

The limitations of parental reports on children's sleep become more prominent in preschool children, who develop increased capacity for independent falling asleep and resuming sleep following night wakings.[2,10] In comparison to infants and toddlers, preschool children are, therefore, less likely to signal and require help, and their parents are less likely to be aware of these events during the nights. However, this picture may be different in preschool children with special clinical presentation who are more likely to signal. For instance, preschool children are very vulnerable to nighttime fears and nightmares.[17-20] Furthermore, it has been recently demonstrated that preschool children with nighttime fears are more likely than controls to wake up at night and signal and require parental assistance to resume sleep.[21]

The purpose of the present study was to assess the accuracy of parental reports on a brief questionnaire assessing sleep patterns in preschool children and to examine to what extent this accuracy is related to the presence of a clinical sleep-related issue (nighttime fears). The comparison of reported sleep was made against actigraphy-based sleep measures. To the best of

our knowledge, this is the first study assessing the correspondence between objective and subjective sleep assessment tools comparing clinical and healthy control groups of preschool children. We hypothesized that the reports of parents of children with nighttime fears would be more accurate than reports of parents of control children because children with nighttime fears require increased parental involvement during the night.

METHODS

Participants

Children and their parents were recruited from the local kindergarten system by informing them about a service for children with nighttime fears (NTF) and inviting parents of children with no fears to volunteer as well. The clinical group of children with severe NTF consisted of 109 preschool children (64 boys and 45 girls between the ages 4 and 6 years, mean age 58.91 months; SD 8.32). Inclusion criteria for the clinical group were: (a) NTF ≥ 2 months; (b) NTF exerted significant adverse impact on the child and family; (c) NTF requiring parental intervention ≥ 2 nights per week to comfort the child. NTF was determined solely by parent reports during the screening and intake interviews.[21]

The control group included 30 healthy children from the same age group who did not meet criteria for NTF (16 boys and 14 girls, mean age 58.93 months, SD 7.62 months). There were no group differences on any of the demographic variables.[21] Exclusion criteria for both samples were: (a) major health or neurological-developmental problems; (b) concurrent psychiatric treatment; (c) concurrent psychotherapy or similar interventions. Additional information on the participants is available in earlier publications.[21,22]

Measures

Brief Child Sleep Questionnaire (BCSQ)

The BCSQ provides information on children's sleep habits and problems. The questionnaire's items were derived from the Brief Infant Sleep Questionnaire (BISQ)[23] and from the Sleep Habits Questionnaire (SHQ).[24] The BISQ was developed and validated as a brief infant sleep screening tool for clinical and research purposes.[23] Measures of internal consistency (Cronbach α) for the SHQ scales range between 0.72 and 0.82.[24] The parents were instructed to refer to their child's sleep during the past week. The items assessed sleep time, total sleep duration during the night, number of night wakings, and total time awake during the night.

Actigraphy

Actigraphy is based on a small device that resembles a wristwatch that can be worn by the child for a substantial period of time and monitor sleep-wake patterns in the child's natural sleep environment.[25-27] The parents were instructed to attach the device (Mini Motionlogger, Ambulatory Monitoring Inc.) to their child's non-dominant wrist for a period of one week, during the evening before bedtime and to remove it in the morning after rise time. The actigraph collected data in 1-minute epochs. Sleep measures were derived from the raw data using the validated Sadeh algorithm.[28] Because of compliance problems and technical issues, actigraphy data were available for ≥ 4 nights[29] in 88% percent of the children. For the rest of the sample, actigraphy data were available in 4.5%, 3%, and 4.5% for 1, 2, or 3 nights, respectively.

Actigraphic measures included: (1) sleep onset time; (2) sleep period—total sleep period from sleep onset to morning rise time; (3) number of night wakings (lasting ≥ 5 min); (4) wake time after sleep onset (WASO)—total time of wakefulness during the night.

Family Background Information Questionnaire

This questionnaire includes 25 questions covering demographic and developmental data. This questionnaire has been extensively used in previous studies.[10,21,24]

Procedures

The study was approved by the departmental ethical committee and the Chief Scientist of the Israeli Ministry of Education. After signing the informed consent, parents completed the questionnaires. Parents were interviewed about nighttime fears. Parents were instructed to attach the actigraph to children's non-dominant wrist every evening before bedtime for a period of one week.

Data Analysis

Data analysis included the following components: (a) between-groups comparison of the actigraphy versus reported sleep discrepancies; (b) within-group correlations between actigraphy and reported sleep measures and comparison of the correlations between the groups using Fisher r to z transformations; and (c) discriminant analysis to assess the ability of actigraphic and reported sleep measures in predicting the clinical status (clinical versus control group) of the children. Because not all measures met normal distribution criteria, we used nonparametric methods, including Spearman correlations, univariate sign test for paired comparisons, and Wilcoxon rank sum test.[30]

RESULTS

Statistically significant and strong correlations were found between actigraphic and reported sleep schedule measures (sleep period and sleep onset time) in both groups (**Table 1**). The correlation for sleep period was significantly higher in the control group. In both groups, significant strong correlations between actigraphic and reported sleep measures were found for sleep onset time and sleep period. In both groups the correlations for night wakings and WASO were low and insignificant.

In considering the discrepancies between actigraphic and reported sleep measures (**Table 2**), it was clear that parents in both groups underestimated sleep onset time and overestimated sleep period. In the control group, parents also significantly underestimated the number of night wakings and WASO. With the exception of WASO, the discrepancies in the control group were significantly larger in the control group than the clinical group.

To assess whether parental nighttime fear-management strategies (e.g., cosleeping vs. limited presence near their child) affected the correspondence between actigraphy and reported

Table 1—Spearman correlations between actigraph and reported (BCSQ) sleep measures in each group and Z score for the comparison of correlations between groups using Fisher's r to z transformation

	Group		Fisher's r to z comparison
	Clinical	Control	
Measure			
Sleep onset time	0.56**	0.76**	1.6
Sleep period	0.54**	0.85**	3.6*
Night wakings	0.15	0.13	0.1
WASO	-0.02	-0.11	0.3

*p < 0.005, **p < 0.0001.

Table 2—Differences between actigraphic and reported sleep measures within each group and comparison of the discrepancies between groups

	Group		Wilcoxon Rank Sum Test
	Clinical	Control	
Measure			
Sleep onset time	41.87***	73.38***	2.89**
Sleep period	-13.25*	-33.20***	-2.42*
Night wakings	0.20	1.33***	3.58***
WASO	39.25***	33.40***	-0.54

The significance levels within each group indicate which discrepancy (actigraphy versus reports) within each group is statistically significant (univariate sign test for paired comparisons). The Wilcoxon rank sum test was used to assess group differences in these discrepancies. *p < 0.01, **p < 0.005, ***p < 0.0005.

sleep in the clinical sample, a new variable was composed based on a method used in a previous study.[21] Children were divided into 2 groups: cosleeping (i.e., children who, upon waking at night, fell asleep again in their parents' room and stayed there either throughout the night or for a limited time) and limited presence (i.e., children who, upon waking at night, fell asleep again with limited parental presence near their own bed). However, the results revealed that the fear-management strategies had no effect on the correspondence between actigraphy and reported sleep.

Discriminant analysis was conducted separately for each group to examine how well equivalent reported and actigraphic sleep measures predicted group classification. Actigraphic sleep measures explained 11.6% of the variability and provided 60.8% correct group classifications. The reported sleep measures explained 31.8% of the variability and provided 81.2% correct group classifications.

DISCUSSION

To the best of our knowledge, this is the first study assessing the correspondence of sleep measures between actigraphy and parental sleep questionnaire, comparing a clinical group of preschool children with severe nighttime fears to healthy controls. The results of our study suggest that: (a) there are general discrepancies between reported and actigraphic sleep measures; and (b) the presence of a clinical sleep-related problem may have significant impact on the correspondence between reported and objective measures of sleep.

With regard to the sleep schedule measures, correlations between actigraphic and reported measures were relatively high and significant (range: 0.54-0.89). However, significant discrepancies existed between actigraphic and reported sleep measures in both groups. For instance, actigraphy estimated sleep onset time to be, on average, 50 or 75 minutes later than reported in the clinical and control groups, respectively. The discrepancies between actigraphic and reported sleep measures were significantly higher in the control group, suggesting that parents of children with nighttime fears are more accurate because of their higher involvement with the child around bedtime and during the night.[21]

When sleep quality measures are considered, poor correlations between actigraphic and reported measures were found for the number of night wakings and WASO in both groups. These findings further support the hypothesis that at this age group, parents have very limited knowledge about their children's sleep disruptions and time spent in wakefulness during the night.[10,31,32] However, it should be noted that the correlation between actigraphic and reported number of night wakings was statistically significant only in the clinical group, and the discrepancies were significantly smaller for this measure in the clinical group, suggesting that higher involvement required by the parents of children with nighttime fears leads to more accurate reporting about night wakings in this group.

Our results are in line with previous studies demonstrating the discrepancies between sleep measures obtained using different sleep assessment methods among clinical populations. Previous studies have revealed discrepancies in sleep measures based on actigraphy versus parental reports. For example a previous study assessed the quantity and quality of sleep in children with autism, developmental delay without autism, and typically developing children using actigraphy and parental reports.[33] Across all subjects, parent diaries and actigraphy data mean values differed. Parental reports underreported sleep onset latency times and wakefulness after sleep onset compared to actigraphy. Reports on sleep start times, morning rise time, and the number and duration of daytime naps were more similar to the objective measures. Another study compared sleep behaviors of children with autism spectrum disorders with sleep behaviors of typically developing children using the Children's Sleep Habits Questionnaire (CSHQ) and actigraphy.[34] According to parental reports 62.5% of children with autism, 76.2% of children with PDD-NOS, and 58.3% of children with Asperger disorder had sleep problems. However, 75%, 52.4%, 75% of the children, respectively, had disturbed sleep according to actigraphic data.

Additional studies revealed discrepancies on various sleep measures comparing actigraphy and PSG. For example, a large-scale study compared total sleep time derived from actigraphy and PSG in adolescents with and without sleep-disturbed breathing.[35] The results revealed that overall, actigraphy underestimated sleep time in comparison to PSG. Another study compared actigraphy and PSG in children with intellectual deficits and motor handicaps, sleep-disordered children without motor handicaps, and healthy controls.[36] In healthy children

without sleep disorders, there was good correspondence in sleep time assessment; however, in the sleep disturbed and the handicapped children, significant discrepancies existed between measures derived from PSG and actigraphy.

The discriminant analysis revealed that the reported sleep measures were better predictors of group classification (clinical versus control) in comparison to the equivalent actigraphic measures. This is not surprising considering the fact that parents decide to seek clinical help on the basis of their own perceptions regarding their child's sleep, regardless of how biased these perceptions may be.[9]

The results of our study highlight the limitations of studying sleep in young children with exclusive reliance on parental reports. Parental knowledge about sleep quality is very limited, and the accuracy of this knowledge is significantly influenced by the clinical context. In other words: the differences between the actual sleep quality of clinical versus control children may not be as large as manifested by parental reports. The parents of children with nighttime fears are much more likely to be involved with their child during the night (e.g., in different forms of cosleeping), and are therefore more likely to report more accurately on sleep-related events.

Our findings suggest that conclusions based on parental reports on children's sleep can be biased or misleading. However, parental reports are very informative in providing valuable information on behavioral consequences of sleep-wake patterns and the presentation of clinically relevant manifestations such as nighttime fears and their management.[21] Actigraphy can play a substantial complementary role in providing a more objective picture that is not affected by the clinical context and perceptual biases. Therefore, it is recommended that both methods be used as complementary sources in the evaluation of sleep in clinical and research settings.

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