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Parent perceptions of child sleep: a study of 10 000 Swedish children. (title)

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Short title: Parent perceptions of child sleep

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Abstract

Aim: To gather normative data on parent-reported child sleep and investigate what influences it. *Methods:* Subjective sleep report data on night wakings, sleep quality, bedtime and risetime were gathered from parents of around 10'000 children from birth to age 5 in a cohort questionnaire study. The data were analysed for trends and sleep measures were compared to background factors such as child temperament, foreign origin, family situation, parents' age and education, and night feedings. *Results:* Population trends were towards improved sleep with increasing age. Individual sleep patterns show some stability. Reports of frequent night wakings and low sleep quality were strongly associated with each other within and between age groups (ORs 2.8-60.2; $ps < .001$). Perception of poor child sleep was influenced by child temperament at ages 1 and 3 (ORs 2.2-4.4; $ps < .001$), foreign origin at age 1 (ORs 2.1-2.3; $p < .001$), and to some extent parents' age and education at ages 1-3 (ORs 1.4-2.1 $p < .05$ or stronger), but not by single parent status or infant night feedings. Reporting multiple or unspecific causes of night wakings was associated with reporting low sleep quality (ORs 1.8-4.7 $p < .05$ or stronger).

Conclusions: With increasing age, fewer wakings, improved sleep quality and a more uniform sleep schedule seems normal. However, frequent wakings and low quality sleep at early ages seem surprisingly stable. A difficult temperament and foreign origin was associated with lower quality sleep and more frequent wakings in early ages, whereas being a single parent was not. Finally, night feeding does not seem to condition children to frequent wakings.

INTRODUCTION

The idea that sleep has a great impact on human health is supported both by everyday experience and by science. Several studies indicate that disturbed sleep not only increases the risk for conditions such as lowered glucose tolerance at least in adults (1) and obesity in both adults and children (2, 3), which in turn are related to e.g. development of diabetes, but sleep disturbances also negatively influence cognitive functions such as academic performance (4).

Sleep disturbance in children is rather common: 25-30% of all children are estimated by Ward & Mason (5) to have some sort of sleep disturbance. In most cases these disturbances disappear of their own, nevertheless they seem to be somewhat stable over time ($r = 0.29$ according to Gregory & O'Connor (6)). Other studies indicate that childhood sleep disturbance may have effects that linger into adulthood, such as increased risk for depression (7, 8). Therefore, identifying and treating disturbed sleep in children may be cost-beneficial in the long run by paving the way for improved health in adulthood.

Sleep disturbances may be caused by treatable medical conditions such as obstructive sleep apnoea, but also by psychological or social factors (5). In clinical cases, it is important to get detailed information about the nature of the disturbance before drawing conclusions as to its causes. However, the predominant sleep disturbances in children consist of unspecified difficulties in falling and staying asleep -- dyssomnias -- or parasomnias such as sleep terrors, nightmares and sleepwalking (5). The current study deals with unspecified sleep disturbances, since

the cohort study (ABIS, see Methods section) upon which this article is based has the main aim to study the cause of diabetes in children.

Night-wakings may not be a problem for the child, even though it may be one for the parents, causing undue concern and/or sleep disruption on their part if the child does not soothe itself. Brief night wakings are normal (5) and occur 5-8 times in the typical sleep pattern even of a ten-year-old (9), usually without being noticed by neither child nor parent. In infants, McKenna (10) has proposed that night wakings are a necessary component of normal brain development. In light of this, information about normal sleep patterns could be useful for parents and paediatricians alike.

Considering the high prevalence of sleep disturbances in children, it would be fruitful to establish criteria for when the disturbance should be considered a clinical problem needing special attention, as distinguished from a problem perceived only by the parents, which might be remedied by counselling. One step towards finding such criteria is to investigate current child sleep patterns, with the caveat that the current patterns need not necessarily be healthy ones. A few studies have gathered normative sleep data, primarily on nightly wakings, bedtime, risetime and time spent in sleep/in bed. Numbers differ between studies, which could partly be an effect of differences in methodology, but also of the studies being made in different cultures and/or different decades. For example, according to one longitudinal study in Switzerland, sleep duration in children and adolescents has decreased and bedtimes become later over the past few decades (11). Also, the average Japanese child went to bed markedly later than the Australian (12, 13) as well as Icelandic children and

youths compared to the average European (14). The current article adds the sleep patterns of a large number of Swedish children to these data.

If we can find factors associated with lingering sleep disturbances, these might be useful to screen for possible clinical cases of non-transient sleep problems. Previous studies have found associations between sleep disturbances and environmental factors such as parents' marital conflict (15), parents' lower educational level (16, 17), geographical origin of parents (16, 18), excessive night feedings (19, 20) and child temperament rating (21, 22).

The purpose of the current study is to describe the sleep patterns of a large cohort of Swedish children and to investigate some background factors that may influence these patterns.

METHODS

Participants

The current study is part of the ABIS project (All Babies in south-east Sweden). Out of 21700 children born in the area between October 1, 1997, and October 1, 1999, 17055 (78.6%) were included in the project after informed consent by the parents.

The aim of the ABIS project is to study the importance of environmental factors for the development of immune-mediated diseases, especially Type I diabetes. The starting point of the project was at the birth of the child and the cohort has been

followed prospectively at 1, 2-3, and 5-6 years of age (henceforth referred to as age 0, age 1, age 3 and age 5) with collection of biological samples and questionnaires.

Thus the base of the current study is a series of broad questionnaires not specifically aimed at studying sleep problems, but rather investigating a wide range of environmental factors thought to be of potential interest concerning child health, such as socioeconomic factors medical history, psychological factors, as well as sleep habits. The questionnaires were given to the parents at the regular check-ups at the well-child clinics, at the above-mentioned time points. The parents filled out the questionnaires either during the visit at the clinic or later at home. No reminders were used.

Data from 16467 children at age 0 (birth), 11091 at age 1, 8805 at age 3 and 7443 at age 5 were consecutively entered into the questionnaire data base, i.e. no specific selection was made. The initial study cohort was representative of those contacted to take part concerning parental foreign origin, age and educational level. However, attrition analyses of the 5-year data indicate that parents not born in Sweden, mother without university education, and single mothers were less likely to continue in the ABIS-project.(23) At age 1, children whose reported age was less than 8 or more than 18 months have been excluded (70 cases), at age 3 the inclusion range was 24-48 months (133 cases excluded) and at age 5 49-76 months (44 cases.) More than 90% of the questionnaires were filled in by the mother.

Measures

It is important to bear in mind that what was measured with these questionnaires was the parent's perception of the child's sleep. Also, the cut-off points between categories have been chosen based on percentiles (e.g. 4 wakings per night is above the 95th percentile at age 1). When using percentiles on Likert scales, one problem is that the same percentile may conveniently cut off two values on one scale but cut through a single value on another, related scale and therefore be unusable as a cut-off value (e.g. 2 wakings per night spans from the 85th to the 97th percentile at age 3). In this study, different cut-off points than those presented have been tested and yield similar results.

Sleep measures used in the current study include the following:

Number of Wakings per Night was assessed with the question "How many times does your child usually wake up at night?" Answers were *Never*, *1*, *2*, *3*, *4*, *5 times*, and *6 times or more*. Based on percentage distributions, the results were then categorised into *None*, *Some* and *Many* Night Wakings. *Many* wakings was defined as ≥ 4 at age 1; ≥ 3 at age 3; and ≥ 2 at age 5. *Some* wakings means less than *Many* but more than *None*.

Sleep Quality was assessed with the question "How would you rate the quality of your child's night sleep?" At age 1 a 5-point Likert response scale was used and at ages 3 and 5, the scales used were 6-point, ranging from *Very good (1)* to *Very bad (5 or 6)*. The results were categorised into *High*, *Medium* and *Low* Sleep Quality. *Medium* sleep quality was defined as a value of 3 at age 1 and 3-4 at ages 3 and 5.

High and *Low* quality were defined as the two scale steps above and below medium, respectively. Defining *Low* sleep quality as above the 98:th percentile at all ages yields similar results.

Bedtime was assessed with the question "At about what time in the evening do you put your child to bed for the night?" Answers were in clock hours, starting at 4 pm and ending at 12 pm or later. Based on percentage distributions, the results were categorised into *Early* (17-18; below the 5:th or lower possible percentile), *Normal* (19-21) and *Late* (22 or later; above the 95:th or higher possible percentile).

Risetime was assessed with the question "At about what time in the morning do you take your child out of bed / your child rise?" Answers were in clock hours, starting at 4 am and ending at 12 am or later. By the same standards as for *Bedtime*, the results were categorised into *Early* (4-5), *Normal* (6-8) and *Late* (9 or later).

Number of Night Hours in Bed (Time in bed) was calculated as the number of hours between bedtime and risetime (this does not necessarily correspond to hours spent in actual sleep.) By the same standards as for *Bedtime*, the results were categorised into *Few* (5-9), *Normal* (10-12) and *Many* (13-15) *Night Hours in Bed*.

Reported *Cause of Wakings* at age 1 was measured with the question "If your child tends to wake up at night, what do you believe is the usual cause?". Options were "Hungry"; "Seems to be in pain"; "Worried"; "Woken by sibling"; "Woken by parent" and "Noise". Multiple choices were allowed. The answers were categorised into *Specific causes* (hunger, sibling, parent or noise) and *Unspecific causes* (worry or pain) based on the idea that the wordings "Seems to be in pain" and "Worried" appear to indicate a greater uncertainty about the cause of waking than the others.

Background factors were measured as follows.

Child Temperament was measured at age 1 by using the "Fussy-Difficult" subscale from the Child Characteristic Questionnaire (CCQ: 24). The instrument is composed of seven questions, with answers on Likert scales between 1-7, where 7 indicates a more "difficult" temperament. As a measure of Temperament, the mean of reported values was used. A difficult temperament was defined as a value above the 90:th percentile, at a mean of 4.50. Temperament statistics: Min = 1.00, Max = 6.86, Mean = 3.25, SD = 0.90. In our data, the CCQ showed a good internal consistency (Chronbach's alpha = 0.83).

Place of birth was assessed by the questions "Were You born in Sweden?" and "Was the child's father born in Sweden?". Options: Yes / No / Don't know. Answers were categorised into two categories: where both parents were born outside of Sweden (2.4%); and all others (97.6%; valid N = 12029).

Caretaker's family situation was measured at all ages by the question "Which is your family situation?" Options: Single / Cohabiter / Married. These were categorised into Single / Not single. Valid percentages of singles were at age 0: 1.6%, age 3: 5.0% and age 5: 6.7%.

A question concerning the experience of any *Serious life events* included the option of reporting a *Divorce*. Answers were categorised into Serious life events / No Serious life events and Divorce / No divorce, respectively.

Parents' Age at birth of child was derived from the birth dates of parents and child, given by their civic registration numbers. Parents were divided into three categories:

Youth, Entry Age and Establishment (Est.) Age. These categories were taken from the Swedish Statistical Central Bureau (25). Entry Age is defined as the age group where 50% of the population are employed. Establishment Age is the same at 75%. These ages differed somewhat between years and genders. Youth is defined as below Entry age. See table 1 for cut-off values and distribution.

Table 1: Percentage distributions and statistics of parents' age and education at birth of child. For definition of groups, see text. N = 16467.

Parent	Theoretical education				Parental age group			
	None	Some	Higher	Missing	Youth	Entry age	Est. age	Missing
Mother	25.1	23.8	24.1	27.0	2.9	44.6	39.6	12.9
Father	37.4	16.8	17.8	27.9	0.5	7.7	78.4	13.5
Entry/Est. ages		Calendar year		Parental age statistics				
Parent		1997	1998-9	Min	Max	Mean	SD	
Mother		22/35	22/30	17	47	29.7	4.5	
Father		22/27	21/26	16	66	32.2	5.4	

Parents' levels of Theoretical Education was assessed by the question "Which is your level of education?". Options were "Elementary School"; "High School, theoretical program"; "High School, practical program"; "Folk High School"; "College 1-3 yrs"; and "College/University, 3.5 yrs or more". They were grouped into three categories of Theoretical Education: *None* (Elementary School and High School, practical program); *Some* (High School, theoretical program and Folk High School); and *Higher* (College 1-3 yrs and College/University, 3.5 yrs or more.) See table 1 for distribution.

Night feedings was measured at age 1 by the question: "How often does the child eat at night?" Options: Never; 1; 2; 3; 4; 5; and 6 times or more.

Associations tested

We tested the following trends and possible associations between a) different sleep measures and b) background factors and sleep measures.

Sleep patterns

- The trend in population sleep patterns with increasing age
- Individual sleep patterns:
 - Intra-individual stability of sleep measures
 - Association of Wakings per night to reported sleep Quality
 - Association of reported causes of Waking at age 1 to reported sleep Quality and number of Wakings per night

Background factors: Effect on sleep measures.

- Child temperament
- Parents' background with respect to their:
 - Place of birth (in / outside Sweden)
 - Family situation (single/not single and divorce)
 - Age at birth of child
 - Education
- Night feedings

Statistical analyses

Statistical tests were carried out in SPSS for Windows v11.5. χ^2 tests were used to check statistical significance. In large sample and a with a large number of analyses, even small differences between groups can be found to be significant at 95% confidence level, but may still not be clinically important. Therefore, only $p < 0.001$ was regarded as statistically significant, while lower degrees of significance were regarded as statistical trends.

As a value for the strength of the relationship, Odds Ratios (OR) were used and are given followed by 95% confidence interval in parentheses. For variables with three categories, the extreme category was usually compared to the rest of the population (e.g. *No Wakings* to *Some and Many Wakings*) to calculate the Odds Ratio. Which categories are being compared is specified when needed.

For statistical significance of population trends, Kruskal-Wallis was used.

Ethical considerations

The parents gave their consent after receiving oral and written information about the study as well as after being given the opportunity to see a video about the project.

Active return of a completed at-birth questionnaire and/or biological samples (in addition to routinely collected cord blood) was considered as informed consent.

The ABIS project and the current study were approved by the Research Ethics Committees of the Faculty of Health Science at the University of Linköping, Sweden, and the Medical Faculty at the University of Lund, Sweden.

RESULTS

Population patterns

There were definite trends in the population towards higher quality, less disturbed and more uniform sleep with increasing age. The differences between age groups were significant at $p < 0.001$ for all variables (Kruskal-Wallis).

Wakings per Night and Sleep Quality: The general trend is that with increasing age, the number of reported Night Wakings decreases and reported Sleep Quality improves. See figures 1a-b.

Bedtime, Risetime and Time in Bed: The general trend with increasing age is towards a more uniform Bedtime and Risetime (centred around 8 pm and 7 am, respectively) and also a more uniform Time in Bed (around 11 hrs.) See figures 1c-e.

Causes of Waking at age 1: see table 2 for distributions. Of those who reported No Wakings per night at age 1, 24.8% still reported one or more Causes of Waking. 69.9% had reported some cause of waking. "Worried" was reported by 44.7% and "Hungry" by 25.2%, whereas the other causes were rather uncommon (1.9-4.3%).

Table 2. Percentage of valid cases (N = 10942) who have reported causes of waking within the below groups.

Type of causes	%
None	30.1
Specific only	23.2
Both unspecific and specific	9.0
Unspecific only	37.7
Number of different causes reported.	%
0:	30.1
1:	58.6
2-5:	11.3

Fig. 1 a-e. Population percentage distributions of sleep measures for different age groups.

Figures:

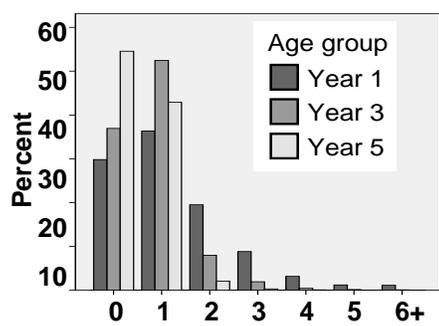


Fig 1a: Wakings per night

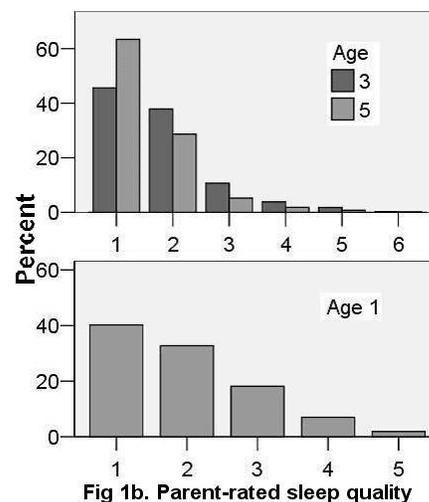


Fig 1b: Parent-rated sleep quality



Fig 1c: Bedtime

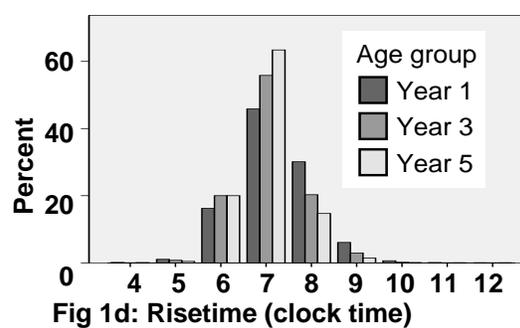


Fig 1d: Risetime (clock time)

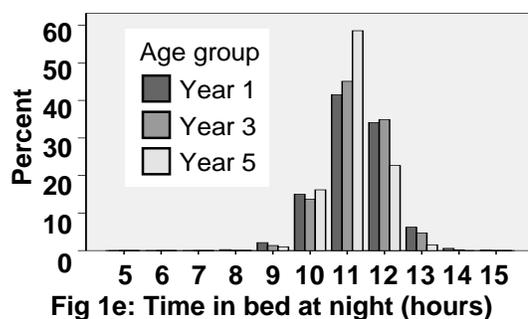


Fig 1e: Time in bed at night (hours)

Individual patterns

Odds Ratios for associations between sleep measures are given in tables 3a and b.

Some additional comments are appropriate.

- Parents who reported *Low Sleep Quality* and/or *Many Night Wakings* at lower ages were significantly more likely to report the same at higher ages.

- *Many Night Wakings* at all ages was significantly associated with higher Odds Ratios for *Low Sleep Quality* within but also between all ages.

- There were significant associations between on the one hand *Late Bedtimes*, *Early Risetimes* and *Few Night Hours in Bed* and on the other hand *Many Wakings* and *Low Sleep Quality*, especially within and between ages 1 and 3 but to a lesser extent also at age 5. Some of the strongest associations were between *Many Wakings* and *Late Bedtime* at age 3: OR 3.3 (1.8-6.1); *Low Sleep Quality* and *Late Bedtime* at age 3: OR 3.7 (1.9-7.1) and *Few Hours in Bed* at age 1: OR 3.1 (1.6-6.0). These and some other associations were significant at $p < 0.001$, and several other associations were significant at lower levels but all indicating the same pattern (data not shown).

- Parents who reported at least one *Unspecific Cause of Waking* at age 1 were more likely to report multiple *Causes of Waking* (OR = 8.8 (7.4-10.4)) than those who reported only *Specific Causes*.

The group which reported No Wakings and no *Causes of Waking* at age 1 (22.4%) were excluded from the analysis in table 3. This group had significantly lowered ORs for *Many Wakings* / *Low Sleep Quality* at all ages. Including this group in the analysis weakens the association very slightly between *Causes of Waking* and sleep variables at ages 3 and 5 but not age 1.

Table 3a. Odds ratios (95% confidence interval) of groups with differing sleep variables and background factors for being reported with many wakings (MW) or low sleep quality (LSQ) at different ages. For definitions of MW, LSQ and background factors, see Methods. Note that the ORs between the MW and LSQ variables are duplicated in the table, to facilitate reading in both directions.

Sleep variable	Age 1		Age 3		Age 5	
	MW	LSQ	MW	LSQ	MW	LSQ
MW at age						4.3 (2.1-9.0)
1		26.5 (22.0-31.9)	9.8 (7.1-13.5)	6.3 (4.2-9.3)	5.5 (3.7-8.3)	
3	9.8 (7.1-13.5)	6.4 (4.7-8.6)		60.2 (42.8-84.7)	14.3 (9.4-21.9)	8.9 (4.3-18.8)
5	5.5 (3.7-8.3)	2.8 (1.9-4.2)	14.3 (9.4-21.9)	10.7 (6.5-17.6)		27.1 (15.9-46.1)
LSQ at age						5.2 (2.9-9.6)
1	26.5 (22.0-31.9)		6.4 (4.7-8.6)	7.1 (5.0-10.1)	2.8 (1.9-4.2)	
3	6.3 (4.2-9.3)	7.1 (5.0-10.1)	60.2 (42.8-84.7)		10.7 (6.5-17.6)	15.7 (7.8-31.5)
5	4.3 (2.1-9.0)	5.2 (2.9-9.6)	8.9 (4.3-18.8)	15.7 (7.8-31.5)	27.1 (15.9-46.1)	
At least one unspecific cause of waking	4.1 (3.4-5.0)	4.7 (4.0-5.5)	3.2 (2.3-4.4)	2.7 (1.8-3.8)	1.8 (1.3-2.5)	1.9 (1.1-3.5) ²
Multiple causes, at least one unspecific	3.0 (2.4-3.6)	3.2 (2.7-3.7)	3.4 (2.4-4.7)	3.0 (2.1-4.5)	1.8 (1.2-2.8) ¹	ns
Background factor						
Temperamental child	2.2 (1.7-2.9)	2.3 (1.8-2.8)	3.2 (2.4-4.4)	4.4 (3.1-6.1)	ns	ns
Two non-Swedish parents	2.1 (1.4-3.2)	2.3 (1.6-3.2)	ns	ns	ns	ns
Mother No Theor. Edu.	ns	ns	ns	1.5 (1.1-2.1) ¹	ns	ns
Mother High Theor. Edu.	ns	ns	ns	0.61 (0.45-0.83) ¹	ns	ns
Father of Est. age	2.1 (1.4-3.3)	1.4 (1.0-1.9) ²	ns	ns	ns	ns
Father of Entry age	0.45 (0.28-0.70)	ns	ns	ns	ns	ns
Significant at (χ^2):	¹ p < 0.01	² p < 0.05	else: p < 0.001			

Table 3b. Odds ratios (95% confidence interval) of groups with differing sleep variables and background factors for being reported with no wakings (NW) or high sleep quality (HSQ) at different ages. For definitions of NW, HSQ and background factors, see Methods.

Background factor	NW	HSQ	NW	HSQ	NW	HSQ
Single parent at age 0	1.5 (1.1-2.1) ²	ns	1.9 (1.3-2.7)	ns	ns	ns
Single parent at age 3	ns	ns	1.5 (1.2-1.8)	ns	1.6 (1.1-2.3) ²	ns
Single parent at age 5	ns	ns	ns	ns	1.8 (1.4-2.4)	ns
Temperamental child	0.68 (0.57-0.83)	0.57 (0.48-0.67)	0.64 (0.55-0.76)	0.39 (0.33-0.45)	0.80 (0.67-0.96) ²	0.65 (0.49-0.86) ¹
Two non-Swedish parents	0.65 (0.47-0.89) ¹	0.58 (0.44-0.77)	ns	0.67 (0.46-0.97) ²	ns	0.62 (0.45-0.86) ¹
Mother No Theor. Edu.	1.3 (1.2-1.4)	ns	1.2 (1.1-1.3)	ns	1.2 (1.1-1.3)	ns
Mother High Theor. Edu.	0.79 (0.72-0.86)	ns	0.82 (0.75-0.90)	ns	0.86 (0.78-0.94) ¹	ns
Father No Theor. Edu.	1.2 (1.1-1.3) ¹	ns	1.2 (1.1-1.3)	ns	1.2 (1.1-1.3)	ns
Father High Theor. Edu.	0.88 (0.81-0.96) ¹	ns	0.87 (0.79-0.95) ¹	ns	0.84 (0.77-0.93)	ns
Mother below Entry age	ns	ns	2.3 (1.7-3.2)	ns	ns	ns
Father of Est. age	ns	ns	0.74 (0.63-0.88)	ns	ns	ns
Father of Entry age	ns	ns	1.3 (1.1-1.5) ¹	ns	ns	ns
Father below Entry age	ns	ns	3.2 (1.3-8.0) ¹	ns	ns	ns
Significant at (χ^2):	¹ p < 0.01	² p < 0.05	else: p < 0.001			

Background factors

- As seen in table 3, the background factors were more associated with *Many Wakings (MW)* and *Low Sleep Quality (LSQ)* at lower ages, if at all. There were more associations between background factors and *No Wakings (NW) / High Sleep Quality (HSQ)* at all ages. High ORs for *MW* and *LSQ* were often but not always paired with low ORs for *NW* and *HSQ* at the same age.
- No indications were found that single parents reported *Lower Sleep Quality* or *More Wakings* per night than others for their child. No associations were found between serious life events and *Low Sleep Quality / Many Night Wakings*, neither specifically concerning divorce nor serious life events in general.
- Apart from the results given in table 3, we also found that parents with *Higher Theoretical Education* were more likely than other groups to report *Some Wakings* at all ages (i.e. neither None nor Many). ORs range from 1.1-1.4, significances at $p < 0.001$ or $p < 0.01$. This was also true for parents with *Some Theoretical Education* at age 5.
Mothers with *Higher Theoretical Education* were significantly more likely to report *Unspecific Causes of Waking* (OR 1.3 (1.2-1.4)).
- We found that children reported to feed at night at age 1 were significantly more likely to be reported as having *Low Sleep Quality* and *Many Wakings* at the following ages. However, when the association between night feedings and *Wakings* or *Quality* at later ages were tested within the different categories of *Wakings* at age 1, no association at all was found. Children reported with night feedings and *Many*

Wakings at age 1 were equally likely to be reported with *Many Wakings* at later ages, as children reported with **no** night feedings and *Many Wakings* at age 1. If anything, there was a trend that the group which was fed was more likely to be reported with *No Wakings* at age 3 (OR 1.2 (1.1-1.4)). The group which was reported as fed at each waking (i.e. number of wakings per night equals number of night feedings at age 1) had no significant difference in night wakings at later ages.

- We also tested association between sleep variables and a large number of other background variables on the grounds that sleep is a complex phenomenon and likely to be influenced by many factors. In many cases, we found significant associations or trends but with very low strength. For example, there was a weak trend that boys were reported with Lower Quality Sleep and More Wakings at age 1, and parents significantly reported better sleep in their children during the bright half of the year (April-September) than during the dark half.

DISCUSSION

The general trend with increasing age in the population was toward fewer night wakings (over 95% having 0-1 wakings per night at age 5), improving sleep quality (over 90% rated with high quality sleep at age 5) and a more uniform sleep schedule (a majority of the children being put to bed at 8pm and roused at 7am, thereby spending about 11 hrs in bed at night.) Clearly, attention must be paid to the age of the child when using these measures to diagnose possible sleep problems.

The trend in individual patterns was also usually towards improving sleep quality and fewer wakings. However, children who were reported with frequent wakings and low quality sleep at early ages were at a greatly elevated risk of having the same problems at later ages. This is supported by Gregory *et al* (6) who suggested that individual sleep patterns have a certain stability. It cannot be taken for granted that perceived problems will go away of their own even if they usually do.

The strong correlation between reporting many wakings and low sleep quality may be perceived as a bidirectional link. If the child often wakes at night, it is natural for its parents to rate its sleep quality as lower. However, if the parents already perceive their child's sleep quality as low for some other reason, this might sensitise them to wakings in their child and cause them to report them as more frequent. Still, the quality→wakings direction presupposes an alternate reason for reporting low sleep quality, while the opposite direction rests only on these two variables. Therefore, we suggest that the association is stronger in the wakings→quality direction.

Parents who reported unspecific and/or multiple causes of waking perceived their child's sleep quality as lower. Reporting unspecific causes of waking might be comparable to the reverse of the item "when my child wakes crying at night, I always know what he/she needs" in the Maternal Cognitions about Infant Sleep Questionnaire suggested by Morrell (26). This item loaded most strongly into two cognition categories termed "Doubt" and "Anger", both significantly associated with sleep problems according to both objective research and subjective maternal criteria. We suggest that parents who report multiple and unspecific causes of waking are more uncertain and therefore anxious about their child's sleep, and that this anxiety

is reflected in more reported wakings and lower sleep quality. Whether the parents' anxiety is well founded or not is another question.

It is interesting to note that theoretically educated mothers were more likely to report unspecific causes to their child's night wakings at age 1. This is discussed further below.

Children rated with a difficult temperament (see Methods) were reported with lower quality sleep and more frequent wakings. This finding is in accordance with previous studies using subjective sleep measures (21, 22, 27). It may be a purely subjective association: parents who perceive their children as more difficult during daytime may perceive them as such during nighttime as well.

Looking at objective sleep measures and temperament, previous studies are at odds: Keener *et al* reported that parental temperament ratings and objective sleep measures (using Infra-Red time-lapse photography) correspond (28), whereas Sadeh (using actigraph) reported that they do not (29). This discrepancy may be due to different ages of the subjects (6 months in the former and 12 in the latter study) or differences in the objective measure methods. Keener's study also suggested that children rated with a difficult temperament had more disrupted sleep according to objective measures, even though the parent-reported sleep measures did not correspond to objective measures. Both studies used the same scale of temperament.

Clearly, no consensus has been reached about the association between child temperament rating and sleep quality assessed with *objective* methods. However, the connection between temperament rating and sleep quality assessed with *subjective*

rating in the current study is clear: the sleep quality of children rated with a "difficult" temperament was perceived as lower.

Parents who were both born outside of Sweden were more likely to report their children with low quality sleep and frequent night wakings at age 1. This result is consistent with two previous studies (16, 18), in which English parents with certain non-English background reported higher frequency of sleep problems in their children than parents with English roots. However, the two studies do not agree on which specific origin of the parents that was associated with reporting sleep problems.

One reason for the current finding may be the life stress of adapting to a new country, which may spill over into the parents' perception of their child's sleep. It may also be an effect of different views on child sleep in different cultures. It is important to note that the current population may include parents from both European and non-European countries, and even from neighbouring Nordic countries. We do not have these data. Therefore, more detailed studies would be needed to confirm and qualify these results.

We expected single parents, if anything, to be more stressed and therefore perceive their child's sleep quality as lower and with more frequent wakings. In one previous study, children in single-mother households had poorer health than other groups (30). However, for poorer sleep no such correlation was found. Instead, single parents were more likely to report no wakings in their child. What the reason may be, we can for now only speculate.

A divorce did not affect the parents' perception of their child sleep in our study, neither before nor after the divorce. In El-Sheikh's *et al* study (15), actigraph was used to obtain objective measures of the studied children's sleep and relate them to reported marital conflict. It turned out that the greatest determining factor for sleep disturbance was the child's perception of parental conflict. Parents in conflict, such as may precede a divorce, may not notice the effect on their child's sleep, which would explain the absence of effect in our study.

When the father was of establishment age, the parents (NB usually mothers) were more than twice more likely to report Many Wakings and also somewhat more likely to report Low Sleep Quality at age 1 than with younger fathers. We have found no previous studies to this effect; awaiting further research it remains speculation.

It seems that parents with higher theoretical education were somewhat less likely to report their children as sleeping the whole night through than parents with no theoretical education. Yet mothers with higher theoretical education were less likely to report their children as having *Low Quality Sleep* at age 3. It is difficult to draw any conclusions from this, but it might be interesting to directly study differences in perception of child sleep between parents with higher versus no theoretical education. Still, one clue from the current results is that mothers with higher theoretical education were more likely to report unspecific causes to their child's waking at age 1. This might indicate a greater uncertainty about the child's sleep: perhaps a by-product of the problem-posing quality of a theoretical education?

It may be noted that the *Specific vs Unspecific cause of waking* dichotomy is rather crude in its current form, yet its strong association to sleep measures over time lends it support and suggests that further elaboration may be rewarding.

The findings concerning education are *not* consistent with neither Rona's (16) nor Sadeh's (17) studies, which both showed that mothers with less education were more likely to report disturbed sleep in their children. Rona speculated that these mothers were also recently immigrated, which could explain the more frequent sleep disturbance reports (see above). Sadeh's study was set in Israel, a social context different from Sweden where education may have a different impact on life stress, and is therefore difficult to compare with the current findings.

In short, there appears to be some sort of association between the education and age of the parents and their perception of their child's sleep.

Pearl claimed that children who have "excessive" night meals during infancy tend to end up with "...conditioned awakenings and chronic sleep problems" (20).

Touchette *et al* reached the same conclusion (19). At first, our data seemed to support their hypothesis. However, when controlling for wakings per night at age 1, the association between night feedings at age 1 and night wakings at later ages vanished. One prediction from the hypothesis should be that children who are reported to be fed every time they wake up at nights should be maximally conditioned towards waking. However, in the present study, this group was no more likely than others to be reported with frequent night wakings at later ages. In Morrell's study, high loadings in the "Feeding" cognition category ("beliefs in the

importance of feeding to soothe the infant") (26) had no significant association with sleep disturbances.

The most plausible explanation seems to be that more night wakings at age 1 could be the underlying factor of both more night meals at age 1 and more wakings at later ages (as seen in the stability of individual sleep patterns previously discussed).

As noted before, parent-reported and objective sleep measures do not necessarily correspond. Previous studies have found no strong correlations between wakings per night as measured by parent-report and objective methods such as actigraph (an unintrusive device attached to the infant's leg) or Infra-Red time-lapse photography (28, 31). Thus, parent-reported child sleep patterns do not give a clear picture of the actual sleep patterns of the children. Nevertheless, the current data give valuable information about how the parents perceive their child's sleep -- a not unimportant factor in the life of parents.

What clinical implications might these data have? Firstly, since sleep patterns have some stability and show some connection to certain parent-reported background factors, it could be possible to screen for persistent sleep problems early in life and thereby, hopefully, prevent some health problems caused by disturbed sleep. If such screening is done by using parental questionnaires, our data suggest that ratings of the child's temperament, reporting unspecific and multiple causes of wakings, very frequent night wakings and sleep quality ratings of the child are possible markers. Secondly, it seems that certain parental background factors may have influence over their perception of their child's sleep. When advising parents on normal and disturbed sleep patterns, it could therefore be useful to pay attention to the

background of the parents with respect to place of birth, age, and education, since different subgroups seem to have somewhat different views on child sleep. The nature of these differences, however, needs to be qualitatively researched.

CONCLUSIONS

- While the general trend seems to be towards fewer wakings, improved sleep quality, and a more uniform sleep schedule with increasing age, we find that there is a persistence over time to an early pattern of being reported with many night wakings and low sleep quality.
- Frequency of night wakings seems to be one of the main factors by which parents judge the quality of their child's sleep.
- Uncertainty about the cause of night wakings at age 1 is associated with reporting frequent night wakings and low sleep quality even at later ages.
- Factors that showed an influence towards lower quality sleep and more frequent wakings in early ages on parent-reported child sleep were: a temperament rated as difficult; and parents of foreign origin. Parental age and education also seem to have some influence.
- Being a single parent was not associated with reporting frequent wakings or low sleep quality, nor does night feeding seem to condition children to frequent wakings.

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REFERENCES

1. Spiegel K, Leproult R, Van Cauter E. Impact of sleep debt on metabolic and endocrine function. *Lancet* 1999;354(9188):1435-9.
2. Gangwisch JE, Malaspina D, Boden-Albala B, Heymsfield SB. Inadequate sleep as a risk factor for obesity: analyses of the NHANES I. *Sleep*. 2005;28(10):1289-96.
3. Snell EK, Adam EK, Duncan GJ. Sleep and the body mass index and overweight status of children and adolescents. *Child Dev*. 2007;78(1):309-23.
4. Taras H, Potts-Datema W, Pearson H. Sleep and student performance at school. *J Sch Health*. 2005;75(7):248-54.
5. Ward T, Mason TB, 2nd. Sleep disorders in children. *Nurs Clin North Am* 2002;37(4):693-706.
6. Gregory AM, O'Connor TG. Sleep problems in childhood: a longitudinal study of developmental change and association with behavioral problems. *J Am Acad Child Adolesc Psychiatry* 2002;41(8):964-71.
7. Gregory AM, Caspi A, Eley TC, Moffitt TE, O'Connor TG, Poulton R. Prospective longitudinal associations between persistent sleep problems in childhood and anxiety and depression disorders in adulthood. *J Abnorm Child Psychol*. 2005;33(2):157-63.
8. Ong SH, Wickramaratne P, Tang M, Weissman MM. Early childhood sleep and eating problems as predictors of adolescent and adult mood and anxiety disorders. *J Affect Disord*. 2006;96(1-2):1-8. Epub 2006 Jul 17.
9. Dahl RE. The development and disorders of sleep. *Adv Pediatr* 1998;45:73-90.
10. McKenna JJ, Thoman EB, Anders TF, Sadeh A, Schechtman VL, Glotzbach SF. Infant-parent co-sleeping in an evolutionary perspective: implications for understanding infant sleep development and the sudden infant death syndrome. *Sleep* 1993;16(3):263-82.
11. Iglowstein I, Jenni OG, Molinari L, Largo RH. Sleep duration from infancy to adolescence: reference values and generational trends. *Pediatrics* 2003;111(2):302-7.
12. Kohyama J, Shiiki T, Ohinata-Sugimoto J, Hasegawa T. Potentially harmful sleep habits of 3-year-old children in Japan. *J Dev Behav Pediatr* 2002;23(2):67-70.
13. Armstrong KL, Quinn RA, Dadds MR. The sleep patterns of normal children. *Med J Aust* 1994;161(3):202-6.
14. Thorleifsdottir B, Bjornsson JK, Benediktsdottir B, Gislason T, Kristbjarnarson H. Sleep and sleep habits from childhood to young adulthood over a 10-year period. *J Psychosom Res* 2002;53(1):529-37.
15. El-Sheikh M, Buckhalt JA, Mize J, Acebo C. Marital conflict and disruption of children's sleep. *Child Dev*. 2006;77(1):31-43.
16. Rona RJ, Li L, Gulliford MC, Chinn S. Disturbed sleep: effects of sociocultural factors and illness. *Arch Dis Child*. 1998;78(1):20-5.
17. Sadeh A, Raviv A, Gruber R. Sleep patterns and sleep disruptions in school-age children. *Dev Psychol*. 2000;36(3):291-301.
18. Zuckerman B, Stevenson J, Bailey V. Sleep problems in early childhood: continuities, predictive factors, and behavioral correlates. *Pediatrics*. 1987;80(5):664-71.
19. Touchette E, Petit D, Paquet J, Boivin M, Japel C, Tremblay RE, et al. Factors associated with fragmented sleep at night across early childhood. *Arch Pediatr Adolesc Med*. 2005;159(3):242-9.
20. Pearl PL. Childhood sleep disorders: diagnostic and therapeutic approaches. *Curr Neurol Neurosci Rep* 2002;2(2):150-7.
21. Atkinson E, Vetere A, Grayson K. Sleep disruption in young children. The influence of temperament on the sleep patterns of pre-school children. *Child Care Health Dev*. 1995;21(4):233-46.
22. Owens-Stively J, Frank N, Smith A, Hagino O, Spirito A, Arrigan M, et al. Child temperament, parenting discipline style, and daytime behavior in childhood sleep disorders. Sleep disruption in young children. The influence of temperament on the sleep patterns of pre-school children. *J Dev Behav Pediatr*. 1997;18(5):314-21.

23. Koch F-S, Sepa A, Ludvigsson J. Psychological stress and obesity in a large population of Swedish 5 to 6 year old children - a study within the ABIS-project. *Journal of Pediatrics* re-submitted: 2008-04-28.
24. Lee CL, Bates JE. Mother-child interaction at age two years and perceived difficult temperament. *Child Dev.* 1985;56(5):1314-25.
25. Arbetskraftprognos 2002: Swedish Statistical Central Bureau (SCB); 2002.
26. Morrell JM. The role of maternal cognitions in infant sleep problems as assessed by a new instrument, the maternal cognitions about infant sleep questionnaire. *J Child Psychol Psychiatry.* 1999;40(2):247-58.
27. Hayes MJ, Parker KG, Sallinen B, Davare AA. Bedsharing, temperament, and sleep disturbance in early childhood. *Sleep.* 2001;24(6):657-62.
28. Keener MA, Zeanah CH, Anders TF. Infant temperament, sleep organization, and nighttime parental interventions. *Pediatrics.* 1988;81(6):762-71.
29. Scher A, Tirosh E, Lavie P. The relationship between sleep and temperament revisited: evidence for 12-month-olds: a research note. *J Child Psychol Psychiatry* 1998;39(5):785-8.
30. Bramlett MD, Blumberg SJ. Family structure and children's physical and mental health. *Health Aff (Millwood).* 2007;26(2):549-58.
31. Sadeh A. Evaluating night wakings in sleep-disturbed infants: a methodological study of parental reports and actigraphy. *Sleep* 1996;19(10):757-62.