

Sleep: An Unrecognized Actor in Child Development

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QLSCD 1998-2010 in brief

This fascicle is based on data from the *Québec Longitudinal Study of Child Development* (QLSCD 1998-2010) which is being conducted by the Institut de la statistique du Québec (Québec Institute of Statistics) in collaboration with various partners (listed on the back cover). The goal of this study is to gain a better understanding of the trajectories which, during early childhood, lead to children's success or failure in the education system.

The target population of the QLSCD comprises children (singleton births) born to mothers residing in Québec in 1997-1998, with the exception of those whose mother, at the time of the child's birth, was living in certain administrative regions of the province (Nord-du-Québec, Terres-Cries-de-la-Baies-James and Nunavik) or on Indian reserves. Certain children were also excluded because of constraints related to the sample frame or major health problems. The initial sample eligible for longitudinal monitoring comprised 2,120 children. The children were followed annually from the age of 5 months to 8 years, and since then have been followed biannually to the age of 12. During the 2002 round, the data collection period was changed in order to visit all the children in the spring, namely during exam time in the education system. It should be noted that the QLSCD is the first large-scale study based on a sample of such magnitude, representative of Québec newborns, who are being monitored in such an intensive manner throughout childhood.

The QLSCD employs a variety of data collection instruments to gather data on the child, the person most knowledgeable of the child (PMK), her or his spouse/partner (if applicable), and the biological parent(s) not residing in the household (if applicable). During each data collection round, the child is asked to participate in a variety of activities designed to assess development. As of the 2004 round, the child's teacher is also being asked to respond to a questionnaire covering various aspects of the child's development and adjustment to school.

Further information on the methodology of the survey and the sources of data can be accessed on the website of the QLSCD (also known as "I Am, I'll Be"), at: www.jesuisjeserai.stat.gouv.qc.ca.



One of the topics that elicits the most discussion among new parents is their child's sleep. Everyone hopes that the newborn will rapidly start "sleeping through the night." The child would be considered "perfect" if by chance he or she would sleep about five or six hours straight a night. But would this be really "chance"? What are the factors associated with the sleep habits of children? And what is the impact of sleep problems on child development during the first few years in school? Children's sleep, although a legitimate concern for all parents, remains poorly known.

Sleep, however, is the silent but essential foundation of healthy physical and mental development. Therefore, a sleep disorder can have very diversified consequences and the effects can be felt in the cognitive (e.g. the ability to concentrate and reason), socio-emotional (e.g. emotional control), and physical (e.g. growth) spheres of development (Petit et al., 2000, 2002; Touchette et al., 2007, 2008). Unfortunately, the role of sleep is often underestimated. Our society, with its focus on productivity, is just beginning to realize the enormous impact of not getting enough sleep because "we are too busy." Indeed, an increasing amount of research has shown that short or poor sleep in adults has an impact on cardiovascular health, metabolism and cognitive abilities, in addition to amplifying existing health problems (for a review, see Léger and Pandi-Perumal, 2006; Sigurdson and Ayas, 2007). These consequences are even more important in children, whose bodies and minds are in full development.

Furthermore, sleep problems are one of the most common reasons for seeing a pediatrician. Indeed, vigilance is required because an untreated sleep problem at a young age risks becoming persistent over a long period of time (Jenkins et al., 1984). Fortunately, most of these problems can be corrected in relatively easy fashion. However, the implementation of effective intervention programs requires good knowledge of the normal evolution of sleep in children, the factors likely to foster or hinder the acquisition of appropriate sleep patterns, and the effects of insufficient sleep on child development.

The purpose of this fascicle is to document these various aspects. Presented here is a synthesis of certain research based on data from the *Québec Longitudinal Study of Child Development* (see the box entitled *QLSCD 1998-2010 in brief* and the Box on methodology). In addition, previously unpublished results are presented. Specifically, based on QLSCD data collected from the age of 5 months to 8 years, this fascicle covers: 1) duration of sleep and the frequency of sleep problems in children, 2) factors associated with sleep problems observed at school entry, and 3) the effects of lack of sleep at a young age on certain aspects of child development, notably vocabulary acquisition, hyperactivity and excess weight. Certain directions for intervention and further research are discussed in the conclusion.

Sleep: some basic notions

A child who comes into this world must “learn” how to sleep. His/her nervous system, still immature, acts in such a manner that the child presents sleep patterns which are age-appropriate and which will change over time. The term “sleep consolidation” is used to designate the fact that sleep organizes itself into longer and fewer periods. This consolidation of sleep rapidly evolves during the first few months of life. At the age of 1 month, a child usually presents a sleep-wake cycle that has an ultradian rhythm, namely he/she will sleep from three to four hours during both the day and the night (Anders and Keener, 1985). From the age of 1½ months, children are more awake than asleep during the day (Coons and Guilleminault, 1982; Navelet, Benoit and Bouard, 1982; Thoman and Whitney, 1989). The daytime wake period will gradually increase in the first few months of life. Daytime sleep will slowly be concentrated into well-defined naps. The fact of sleeping at least six consecutive hours corresponds to a consolidated circadian sleep-wake rhythm. This means the longest sleep period is at night and the longest wake period is during the day. The exact time when a veritable sleep-wake rhythm synchronized over 24 hours appears, varies according to the study. However we do know that it can be influenced by numerous factors such as the degree to which the nervous system has matured, the physical environment of sleep, and certain characteristics of the child or his/her family.

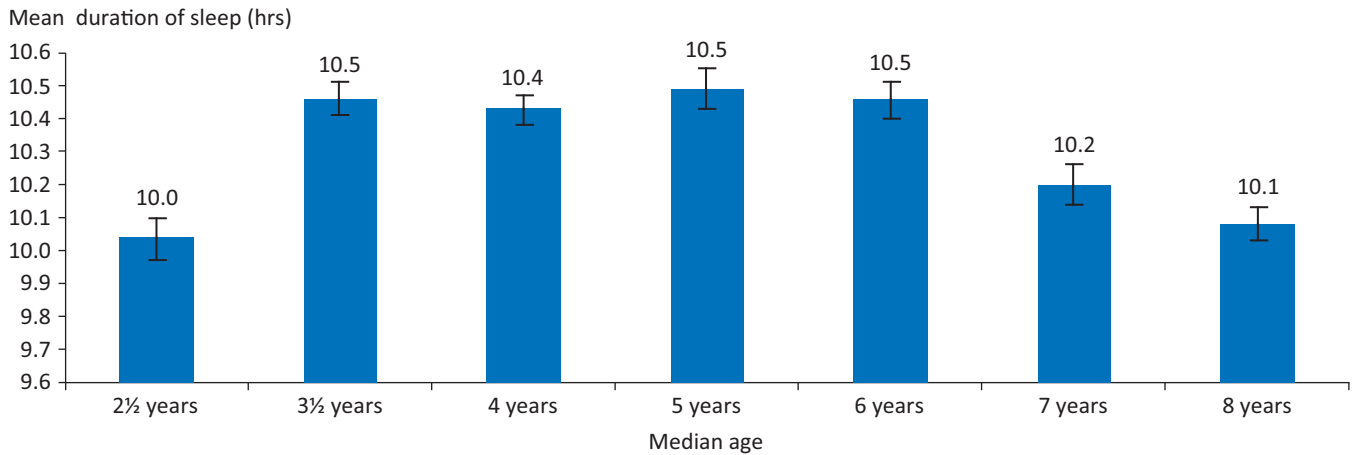
Other than short sleep duration, children can experience a certain number of sleep problems. The ones covered in this fascicle are divided into two categories – dyssomnias, namely frequent waking and problems falling asleep, and parasomnias, namely somnambulism (sleepwalking), sleep terrors (also called night terrors), somniloquy (also called sleep talking), enuresis (bedwetting), bruxism (grinding the teeth), nocturnal rhythmic movement disorders (body rocking, head banging or head rolling), restless legs syndrome, and bad dreams.

Methodology

The data on children’s sleep presented in this fascicle were collected using the *Self-Administered Questionnaire for the Mother* (SAQM) administered in each annual round of the QLSCD from when the children were 5 months old to 8 years of age. They are not based on objective measurements, such as laboratory records. The characteristics of the child and his/her family environment in the analyses are derived from the various questionnaires administered to the mother or the person who best knows the child, while certain cognitive or physical measurements of development are based on tests administered to the child.

The findings presented in this fascicle are either unpublished or drawn from research that has already been published. All the unpublished data and those taken from previous publications of the ISQ are weighted, and therefore have been adjusted so that the results can be generalized to the target population of the QLSCD. Moreover, the survey’s complex sample design was taken into account in calculating the precision of the estimates and in the conducting of statistical tests. The findings taken from articles published in professional journals based on QLSCD data are the sole responsibility of the articles’ authors. They are based on unweighted data, namely data that were not adjusted to compensate for higher non-response among certain families (e.g. low-income households, single-parent households or those in which the parents speak a language other than French or English). In addition, though the findings present a portrait of the families being followed, caution is recommended in terms of generalizing the findings to the QLSCD target population. For more details on the methodology used in the survey, the reader is invited to refer to the articles and reports cited in this fascicle.

Figure 1
Mean duration of night sleep at various ages, Québec, 2000–2006



Source: Institut de la statistique du Québec, *QLSCD 1998-2010*.

Sleep profiles of Québec children

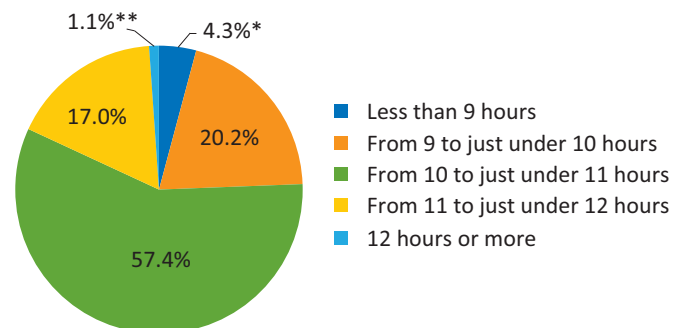
Previous research based on QLSCD data has revealed that approximately three quarters of children born in Québec at the end of the 1990s were sleeping at least six consecutive hours at night around the age of 5 months, as reported by the mother (Petit et al., 2000). At this age, half of the children were sleeping even eight or more consecutive hours, while 80% were doing so at the ages of 1½ and 2½ years. With regards to night waking, 31% of children were awakening at least three or more times around the age of 5 months, versus 16% at 1½ and 13% at 2½ years of age (Petit et al., 2002).

Figure 1 presents the mean duration of the children’s night sleep from the age of 2½ to approximately 8 years. As the figure shows, mean sleep duration was from 10 to 10.5 hours a night during this timeframe. This mean duration corresponds to the recommendations of the *Canadian Sleep Society* (2005) according to which a child 3 to 10 years of age should sleep at least 10 to 11 hours a night. There was a significant increase in the mean duration of nocturnal sleep from the age of 2½ to 3½ years. This increase of about 30 minutes, on average, coincided with a decrease in the duration of the nap, as reported by the mothers (see further in the text). Thereafter, the mean number of hours slept at night remained stable up to the age of 6 years, then decreased at 7 and 8 years, namely at the time the children were in first and second grade of elementary school.

Although the mean durations of nocturnal sleep observed at these ages seem to conform to the recommendations, there was a certain variability in the time slept at each age (Figure 2). For example, most of the children at 8 years of age (57%) were sleeping between 10 and 11 hours a night, but 24% of children at this age were sleeping less than 10 hours and 18% more than 11 hours.

Around the age of 8 years, when the children were in Grade 2 of elementary school, approximately one in four were sleeping less than the number of recommended hours.

Figure 2
Distribution of 8-year-old children by number of hours of night sleep, Québec, 2006



* Coefficient of variation between 15% and 25%; interpret with caution.

** Coefficient of variation higher than 25%; imprecise estimate provided for information purposes only.

Source: Institut de la statistique du Québec, *QLSCD 1998-2010*.

Naps

High percentages of children at the ages of 2½, 3½ and even 4 years added a daytime nap to their nocturnal sleep, namely 92%, 74% and 63% respectively. As reported by the mothers, the mean duration of the nap was 2 hours at the age of 2½ years and one to two hours at the ages of 3½ and 4 years. At 5 years, when approaching kindergarten, nearly half (49%) of the children were having a daily nap with a duration of approximately an hour (data not shown).



Sleep schedules

In kindergarten, at approximately 6 years of age,² the children went to bed on average at 7:55 p.m. (± 34 min) and woke up at 6:44 a.m. (± 29 min) on weekdays (data not shown). On weekends, the children went to bed and got up an hour later, namely at 8:50 p.m. (± 41 min) and 7:34 p.m. (± 52 min) respectively. It should be noted that children in low-income families had the same sleep schedule as other children during the week, but went to bed slightly later (8:59 p.m. vs. 8:48 p.m.) and got up later (7:55 a.m. vs. 7:28 a.m.) on weekends (data not shown).

Dyssomnia

There are mainly two types of dyssomnia in children – frequent night wakings and problems falling asleep.

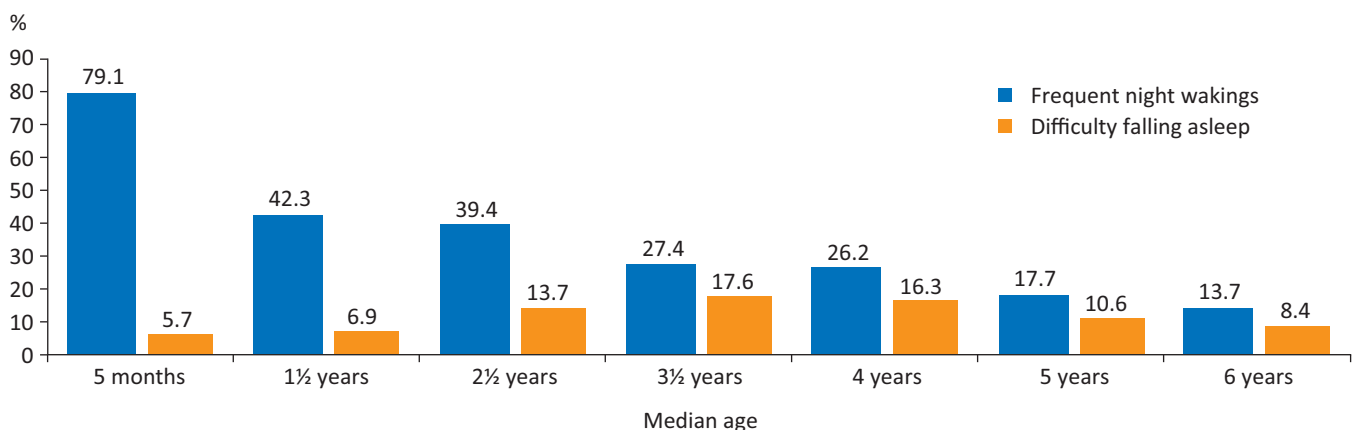
Repetitive nocturnal waking constitutes one of the most common topics of discussion among parents of young children, not without reason, because it is very common before the age of 2 years. Indeed, a study conducted by Minde et al. (1993) using video recordings showed that children 1 to 3 years of age awoken on average three times a night. The fact of being a good sleeper or a bad sleeper corresponds to the ability or inability of a child to fall back asleep after waking. A child incapable of falling back asleep by him/herself will therefore signal his/her parents by crying and as a result will take more time to fall back asleep.

The children's nocturnal wakings were reported by the mothers from the age of 5 months to the age of 6 years. As seen in Figure 3, at the age of 5 months and 1½ years, 79% and 42% of children respectively had signaled their wakings at least once a night in the month preceding the survey. This problem continued to decrease. At the age of 6 years,³ the proportion of children who had done this decreased to 14%.

With regards to problems falling asleep, these include not only resistance to going to bed, but also taking 30 or more minutes to fall asleep at night. These problems appeared at a slightly higher age than frequent night wakings, namely between 2½ and 4 years of age; they then decreased in frequency at the age of 5 years. As reported by the mothers, 6% of children 5 months and 1½ years of age had difficulty falling asleep. This proportion significantly increased from the age of 2½ years to the age of 4 years (14% to 18%), then decreased at the age of 5 years (11%) (Figure 3).

Figure 3

Prevalence of frequent¹ night wakings and difficulty falling asleep at various ages, Québec, 1998–2004



1. At least once a night during the past month.

Source: Institut de la statistique du Québec, *QLSCD 1998-2010*.



Parasomnias

Parasomnias are defined as “undesirable physical events or experiences that occur during entry into sleep, within sleep or during arousals from sleep” (American Academy of Sleep Medicine, 2005). Adult parasomnias have been the subject of many studies, but little is known about childhood parasomnias. The few studies conducted among children reveal that parasomnias in general do not have serious

impacts. However, in some cases, this sleep disorder can regularly disturb the sleep of a child or that of a family, and can lead to injury (in cases of rhythmic movement disorders, somnambulism or sleep terrors) or psychological distress (particularly in cases of enuresis) (Owens, France and Wiggs, 1999; Sheldon, Ferber and Kryger, 2005).

Somnambulism, sleep terrors, somniloquy, enuresis, bruxism, rhythmic movement disorders, restless legs syndrome⁴ and bad dreams were assessed annually in the QLSCD from the age of 2½ to 8 years (see Box 1). Data collected from the mothers provided a means of determining whether children had experienced one or another of these disorders, at least occasionally during this period of childhood. The data revealed that only very few children, namely 3%, had not experienced any of the disorders, even excluding bad dreams (data not shown). In other words, nearly all of the children in the survey had experienced one of these problems at least once between the ages of 2½ and 8 years. The most common parasomnias reported by the mothers were bad dreams (95%) and somniloquy (89%) (Figure 4). These were followed by bruxism (54%), sleep terrors (44%), restless legs syndrome (35%), enuresis (30%), somnambulism (22%) and rhythmic movement disorders (13%). As we can see in Figure 4, the prevalence of somnambulism, enuresis and rhythmic movement disorders was higher in boys than in girls.

Box 1

Assessing parasomnias in the QLSCD

Parasomnias among the children were assessed by certain questions in the *Self-Administered Questionnaire for the Mother*. The mother had to indicate the frequency of each parasomnia: 1) Never, 2) Sometimes, 3) Often, 4) Always.

Somnambulism

Does your child walk in his/her sleep?

Sleep terrors

Does your child have night terrors (wakes up suddenly, crying, sometimes drenched in sweat and confused)?

Somniloquy

Does your child talk in his/her sleep?

Enuresis

Does your child pee in his/her bed (or wet his/her diaper)* at night?

Bruxism

Does your child grind his/her teeth during the night?

Rhythmic movement disorders

Does your child rock himself/herself or bang his/her head against his/her pillow, his/her bed or the wall in a repetitive fashion either while falling asleep or during sleep?

Restless legs syndrome

(from the age of 3½ years to 8 years)

Does your child have unpleasant sensations in his/her legs at bedtime that force him/her to move?

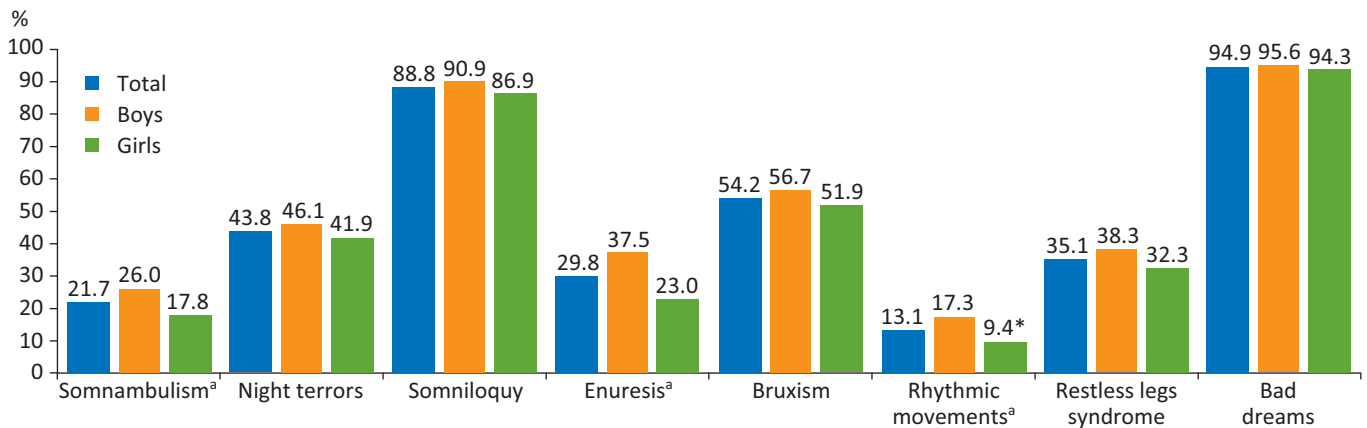
Bad dreams

Does your child have nightmares?⁵

* Asked at 2½ years only.

Figure 4

Proportion of children having manifested various parasomnias at one time or another between the ages of 2½ and 8 years, by sex, Québec, 2000–2006



Note : The proportions of children who wet their beds were calculated for the period between the ages of 5 and 8 years.

* Coefficient of variation between 15% and 25%; interpret with caution.

a. Difference between the sexes at the threshold of 0.05.

Source: Institut de la statistique du Québec, QLSCD 1998-2010.

Many parasomnias appear in early childhood. This is the case for sleep terrors in the QLSCD – their prevalence decreased with age (Figure 5b).⁶ With regards to wetting the bed or diaper, it is obviously normal at a very young age; it was much less common after the age of 2½ years (Figure 5d). However, if a child is still wetting the bed at 5 years, this then can be defined as enuresis. Approximately 25% of boys and 16% of girls in the target population of the QLSCD were reported by the mothers to manifest this problem at the age of 5 years (data not shown). Rhythmic movement disorders, relatively uncommon irrespective of age, were also more often observed at a very young age (Figure 5f).

In contrast, the prevalence of somnambulism and bruxism increased with age (Figures 5a and 5e). The prevalence of somniloquy, already fairly high at a young age (46% at 2½ years), increased at 3½ years, then attaining around 60% at 7 and 8 years of age (Figure 5c).

As for restless legs syndrome, it seems it was slightly more common between 4 and 6 years of age (affecting 15% of children) and its prevalence decreased to 9% at 7 and 8 years (Figure 5g). The latter proportion is close to that observed among Québec adults (Lavigne and Montplaisir, 1994). On this topic, it is possible that the phenomenon of “growing pains” contributed to artificially inflating the prevalence of restless legs syndrome among children 4 to 6 years of age, since the symptoms can be similar. Finally, irrespective of their age, approximately two in three children had bad dreams on an occasional basis (Figure 5h). A much smaller proportion of the children had bad dreams frequently (Figure 5h) (Simard et al., 2008a).

Environmental factors associated with sleep disorders among children in kindergarten

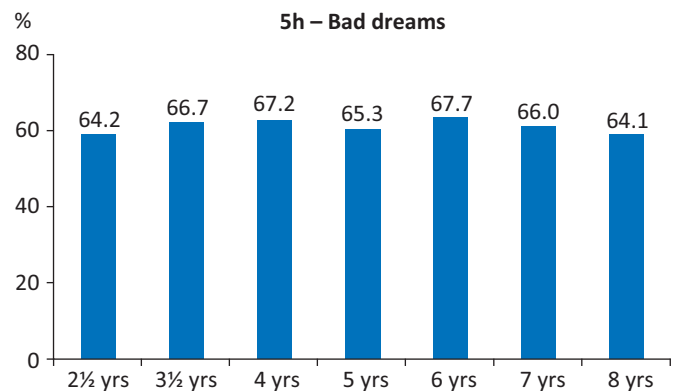
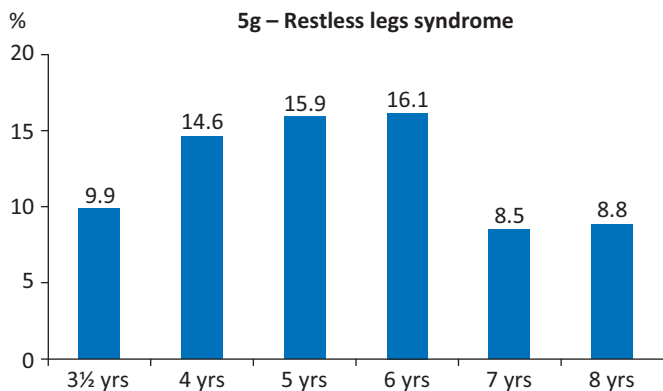
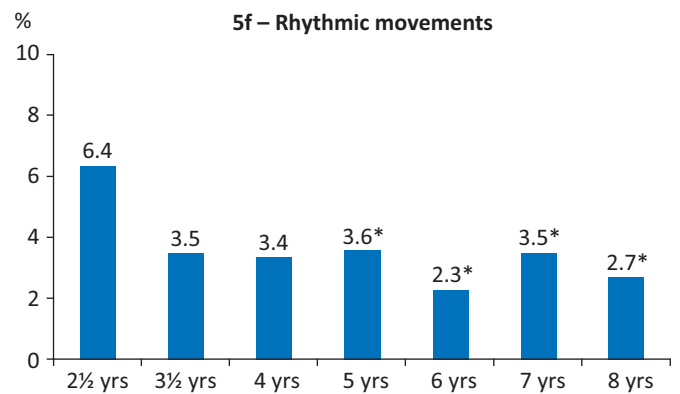
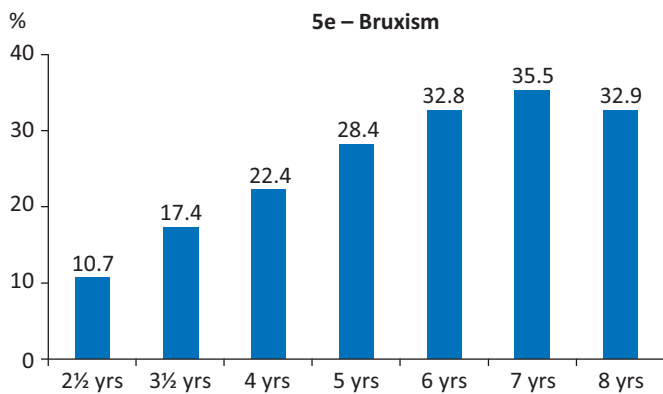
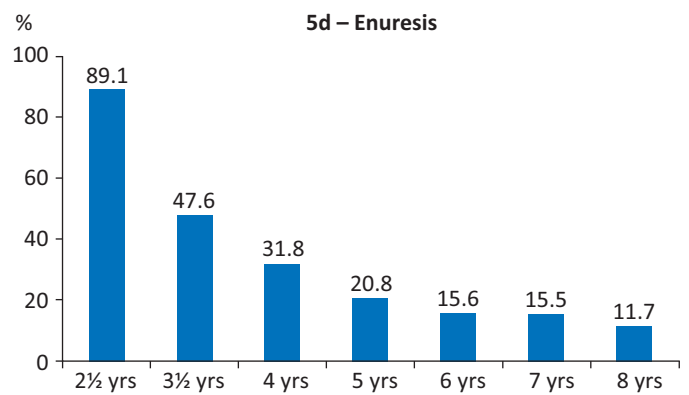
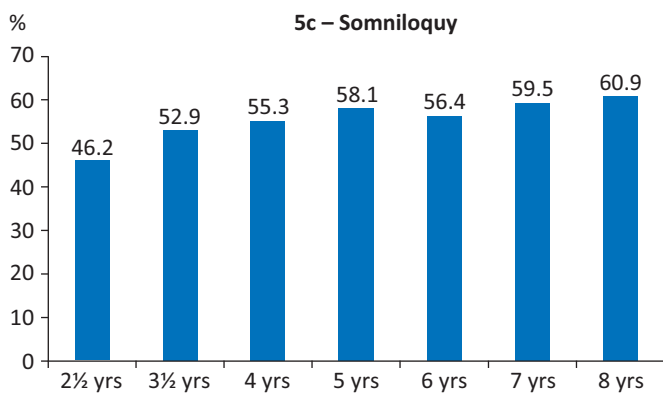
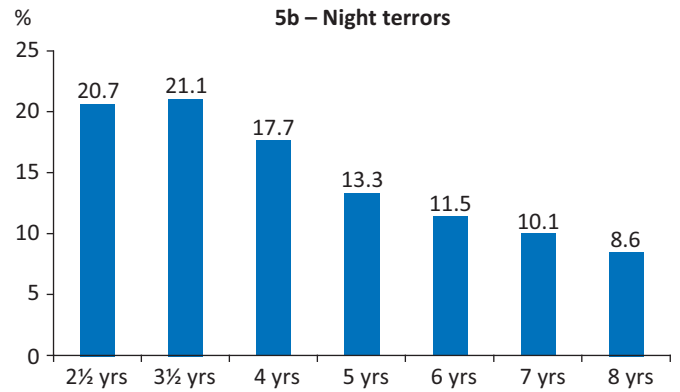
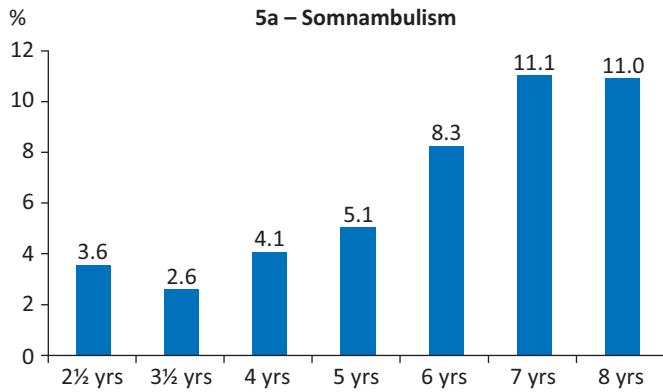
The frequency of sleep disorders, dyssomnias and parasomnias in young children justifies the quest for more knowledge of the factors associated with these phenomena. This is even more important since we know that children with frequent night wakings or problems falling asleep around the age of 6 years have a shorter sleep duration (Petit et al., 2007). Shortened sleep may have negative effects on the disposition to learn, as we will see later in this fascicle.

Previous analyses of QLSCD data have shed light on the main characteristics associated with children not sleeping through the night at 5, 17 and 29 months of age (Petit et al., 2000, 2002; Touchette et al., 2005a). These factors comprise certain parental behaviours regarding the sleep period of the child, such as the presence of a parent while falling asleep, bringing the child to the parents’ bed after wakings (at the three aforementioned ages), the fact of being a boy (at 5 months) or being breastfed (at 5 months).⁷ Children who were not sleeping through the night, as reported by their mother, were also more likely to be perceived as having a more difficult temperament (at 5 and 17 months) or not being in very good health (at 29 months). In addition, mothers of children who were not sleeping through the night at 2½ years of age were likely to feel less effective as a parent.

What about children in kindergarten?

Figures 5a to 5h

Prevalence of various parasomnias at various ages, Québec, 2000–2006



* Coefficient of variation between 15% and 25%; interpret with caution.

Source: Institut de la statistique du Québec, QLSCD 1998-2010.

Frequent wakings and difficulty falling asleep

Table 1 shows the results of analyses linking certain characteristics of the child or family and dyssomnias around the age of 6 years, namely frequent night wakings and difficulty falling asleep. More specifically, we compared children presenting these sleep problems at the age of 6 years with those who had never had these problems (Petit et al., 2007).

As we can see in Table 1, separation anxiety in the child reported by the mother when the child was 6 years of age is the only characteristic examined that was associated with both frequent night wakings (at least once a night in the previous month) and difficulty falling asleep. Certain parental behaviours regarding the child's sleep period at the age of 2½ years were also significantly associated with sleep problems at the age of 6, namely the presence of the parent at bedtime in the case of frequent night wakings, and bringing the child to the parents' bed in response to a night waking in the case of difficulty falling asleep. Finally, two other factors were associated with difficulty falling asleep in children 6 years of age: 1) a moderate or severe level of depression in the mother when the child was 5 months, and 2) insufficient family income when the child was 6 years of age.

However, the analyses that were conducted do not provide a means of establishing the contribution of each of these factors nor the direction of the influence between the characteristics examined and the sleep problems. On the one hand, some of these factors could be interrelated or be the result of another factor. For example, separation anxiety in the child may in part be the result of a parent's overprotectiveness (Benoit et al., 1992; Scher and Blumberg, 1999). In this regard, the QLSCD data reveal that compared to other mothers, those who manifested certain behaviours at bedtime (presence until the child falls asleep) and at night wakings (bringing the child to the parents' bed) had a higher score on the maternal overprotectiveness scale. Moreover, such parental behaviours regarding sleep were more frequent among depressed mothers or in low-income families (data not shown). It would be interesting to be able to disaggregate the roles of these various factors. On the other hand, the findings of other studies based on QLSCD data do provide a means of establishing the direction of the relationship between parental behaviours regarding sleep and the children's dyssomnias. According to a study conducted by Simard et al. (2008b), certain parental behaviours regarding the sleep period (e.g. parental presence at bedtime, giving drink or food to the child at night wakings) may often indicate a reaction that is not

Table 1
Characteristics associated with dyssomnias at 6 years of age, Québec, 1998–2004

	Frequent night wakings	Difficulty falling asleep
	Threshold ¹	
Low birth weight (under de 2,500 g)	Not significant	Not significant
Mother's characteristics (5 months)		
Immigrant status	Not significant	Not significant
Symptoms of depression (> 90 th percentile)	Not significant	< 0.05
Parental behaviours regarding the child's sleep (29 months)		
Parent present at bedtime	< 0.05	Not significant
Brings the child to the parents' bed in response to night wakings	Not significant	< 0.05
Family's characteristics (6 years)		
Low income	Not significant	< 0.05
Biological parents separated or divorced	Not significant	Not significant
Child's characteristics (6 years)		
Separation anxiety (> 90 th percentile)	< 0.05	< 0.05

1. Results of chi-square tests comparing children presenting with one or another dyssomnias at the age of 6 years and those who had never manifested any of these problems.

Not significant: a result that was not significant at the threshold of 0.05 after weighting and taking into account the sample design.

Sources: Adapted from PETIT et al., 2007. Table 4: "Factors That Were Assessed in Relation to Persistent Dyssomnias at 6 Years of Age".
Institut de la statistique du Québec, QLSCD 1998-2010.

adapted to sleep problems the child already has. This study also revealed that sleep problems at a very young age were more predictive of certain sleep problems observed at the age of 6 years than parental behaviours. Such findings suggest that it may be important to intervene early with parents whose children have sleep problems in order to prevent the creation of a vicious circle.

Bad dreams and other parasomnias

The QLSCD data reveal that, in contrast to dyssomnias, parasomnias at the age of 6 years did not generally lead to a reduction in the duration of sleep (Petit et al., 2007). However, as with dyssomnias, many parasomnias such as somnambulism, sleep terrors, bruxism, and somniloquy, may be associated with separation anxiety at 6 years of age. Other factors have been identified as being associated with certain parasomnias at the age of 6, namely separation or divorce on the part of the parents since the birth of the child in the case of sleep terrors and maternal depression when the child was 5, or low family income with regards to rhythmic movement disorders (Petit et al., 2007). Finally, an analysis of QLSCD data, taking into account a wide range of factors, revealed that bad dreams at the age of 6 years was associated with a more difficult temperament in the child as reported by the mother when he/she was 5 months old, with symptoms of general anxiety in the child reported by the mother at 17 months, and the presence of the parent at the child's bedtime at the age of 2½ years. On the other hand, sharing the parent's bed in response to night wakings at a young age (3½ years) has been associated with a lower risk of bad dreams at the age of 6 years (Simard et al., 2008a). This behaviour on the part of the parents may be a concrete expression of the importance to them of comforting their children in certain circumstances. As indicated by the authors, the influence of parental behaviours on children's sleep may differ according to the age of the child and the sleep problem at hand (Simard et al., 2008b). Most of the research conducted on this topic shows how important it is for parents to have behaviours that are adapted to the sleep problem or developmental stage of the child, the goal being to foster the child's autonomy during the sleep period.

During childhood, many sleep problems are associated with separation anxiety, wherein lies the importance of the parents establishing early on a reassuring relationship with the child that fosters autonomy, which over time means the child falling or falling back asleep alone.

Biological components of sleep problems

Although many environmental factors (parent present at bedtime, parents have separated, etc.) can be associated with sleep problems in children, the biological component should not be neglected. Even if a child benefits from an environment that should be favourable for establishing his/her wake/sleep rhythm, factors proper to the child and his/her metabolism can hinder the process of sleep consolidation.

The role of genetics in sleep is becoming increasingly apparent. Indeed, studies in genetic epidemiology and those conducted on twins indicate that genetic factors play a major role in the appearance of parasomnias (for a review, see Hublin and Kaprio, 2003) as well as certain sleep disorders (for a review, see Taheri and Mignot, 2002). Because of studies conducted mainly among adults (Abe et al., 1993; Desautels et al., 2001; Hublin et al., 1997, 1998; Von Gontard et al., 2001), we now know genetics is in part responsible for somnambulism, sleep terrors, bruxism, enuresis and restless legs syndrome. An analysis of data from the *Étude longitudinale des jumeaux du Québec* (Québec Longitudinal Study of Twins) has provided a means of disaggregating the relative contributions of environment and genetics in the occurrence of sleep terrors in very young children (Nguyen et al., 2008). The analysis showed that the concordance of the presence of sleep terrors was higher among identical twins (who shared 100% of their genes) than among fraternal twins (who share 50% of their genes). This indicates that this parasomnia has a genetic component. In this study, the contribution of genetics to the appearance of this sleep problem was estimated at 44% and that of the environment 56%, in children 18 months of age; these proportions were respectively 42% and 59% in children 30 months of age (Nguyen et al., 2008).

Serious or recurrent health problems such as gastric reflux, colic, otitis, neurodevelopmental problems, or a lag in the maturing of a child's nervous system, can impede or delay the establishment of good sleep patterns (Ghaem et al., 1998; Hoban, 2000; Owens, 2005; Savino et al., 2005). For example, the QLSCD data revealed that children who continued to wet their bed at 4 years of age presented less-advanced motor development (boys) and language development (girls and boys), and more symptoms of hyperactivity and inattention (girls) (Touchette et al., 2005b) compared to children of the same age who already had control of their bladder at night. These various delays may have a common biological component.



Lack of sleep and its impact at school entry

According to the *Canadian Sleep Society* (2005), a child 3 to 6 years of age should sleep at least 10 to 11 hours a night to benefit from optimal cognitive, socio-emotional and physical development. What happens when children do not have the required amount of sleep?

In order to study the effects of lack of sleep on child development, various analyses have been conducted on QLSCD data to examine possible associations between the sleep profiles of children 2½ to 6 years of age and the results of various measurements of cognitive, socio-emotional and physical development (Touchette et al., 2007, 2008).

Trajectory analyses were used to categorize the target children of the QLSCD into groups based on their distinct sleep patterns between the ages of 2½ and 6 years. Nearly 90% of children were more likely to be in the groups of average and long sleepers, namely those who were consistently sleeping about 10 to 11 hours a night between the ages of 2½ and 6 years. The remaining 10% of children were sleeping well under 10 hours, namely 9 hours or less at any of the ages under study (Touchette et al., 2007, 2008).⁸ Among these children was a particular group, progressive sleepers, for whom the duration of sleep, short at the beginning, increased with age to arrive at approximately 10 hours around the age of 6 years, namely when they were in kindergarten. As we will see, it is this group of children presenting a short sleep duration at a young age among whom was found the greatest number of undesirable effects on development.

Sleep and cognitive development

According to a meta-analysis of 56 studies on sleep deprivation (Pilcher and Huffcutt, 1996), lack of sleep affects cognitive function in adults. As far as children are concerned, only a few studies have examined the impact of short-term (generally over a period of just a few nights) and partial sleep deprivation on their cognitive functioning (Carskadon, Harvey and Dement, 1981; Fallone et al., 2001; Randazzo et al., 1998). The effects of partial but chronic sleep deprivation in early childhood had never been studied before the QLSCD.

Data from the QLSCD fill this gap. They demonstrate that sleep deprivation in early childhood can have a significant impact on cognitive abilities as assessed at the age of 6 years. Indeed, it was observed that compared to average or long sleepers, children who were sleeping a fewer number of hours at a young age were more likely to score lower on the Peabody Picture Vocabulary Test (PPVT) or the Weschler Block Design test which measures non-verbal cognitive abilities (Wechsler, 1991).⁹ These associations persisted even when many characteristics potentially associated with the cognitive performance of the children were entered into the model, such as the mother having smoked during pregnancy, low birth weight, breastfeeding, mother's age at the birth of the child, mother's immigrant status, parents' educational level, family income, etc. (Touchette et al., 2007).

Sleep and behaviour

Short sleep duration leads to drowsiness. In children of preschool age, manifestations of sleepiness can take diverse forms – irritability, hyperactivity, inattention and a low threshold of tolerance, in addition to the classical signs such as yawning, lethargy or apathy (Dahl, 1996). It is also known that sleep problems are often associated with behavioural problems in children during the day (Jenkins et al., 1984; Minde, Faucon and Falkner, 1994; Simonds and Paraga, 1982; Zuckerman, Stevenson and Bailey, 1987).

QLSCD data have revealed that, compared to average and long sleepers, the group of progressive sleepers (children who sleep 9 or fewer hours at the age of 2½ years only), were more likely to have a higher score on the hyperactivity-impulsivity scale at 6 years of age, independent of many other characteristics¹⁰ (Touchette et al., 2007). Therefore, even if these children were prolonging their sleep duration as they were growing, they presented a higher risk than other children of more symptoms of hyperactivity-impulsivity, as reported by the mother, at 6 years of age.

In addition, other analyses based on QLSCD data have revealed that the children who had difficulty falling asleep at the age of 6 years had a higher score on the overall aggression scale at this age, as reported by their mother (Petit et al., 2007). All of these results seem to support the thesis that young children manifest, at least in part, their lack of sleep through externalized behaviours (e.g. agitation, irritability, impulsivity). In this regard, it has been observed in some cases that hyperactivity behaviours disappear when the sleep problem has been treated (Chervin et al., 1997).

A significant lack of sleep at a very young age, even transitory, can have negative impacts on cognitive, socio-emotional and physical development of school-aged children.

Sufficient sleep, a key factor in a healthy weight?

Childhood obesity is a public health problem that is growing in epidemic fashion everywhere in the world, but especially in industrialized countries (Ebbeling, Pawlak and Ludwig, 2002). Parallel with the increase in obesity rates, a decrease in sleep time has been observed in children. A comparison of the data from three cohorts (1974, 1979 and 1986) of Swiss children, followed from birth to 16 years of age, revealed a decrease in the duration of night sleep, mainly attributed to going to bed at a later time (Iglowstein et al., 2003).

Recent studies suggest that these two phenomena may be associated. Indeed, it has been observed that short sleep duration is associated with a higher risk of overweight or obesity in school-aged children (Chaput, Brunet and Tremblay, 2006; Desrosiers, Dumitru and Dubois, 2009; Reilly et al., 2005) and in adolescents (Gupta et al., 2002). However, these studies examined the duration of sleep only when measurements of weight were conducted.

Based on QLSCD data, we conducted analyses designed to establish whether there was an association between the children's sleep profiles from 2½ to 6 years of age and excess weight, namely overweight and obesity, using direct measures of height and weight taken when the children were 6 (Touchette et al., 2008). In these analyses, overweight and obesity were assessed using international criteria as defined by Cole et al. (2000) taking into account the sex and age of the child.

The findings revealed that, compared to long sleepers, children who were sleeping fewer than 10 hours (about 9 hours or less) at a young age were more likely to present excess weight at 6 years of age. Even when a myriad of

variables were statistically taken into account, ones that could potentially be associated with excess weight, such as birth weight, level of physical activity, sweets intake and parents' socioeconomic status, short sleep duration during childhood continued to be associated with the risk of presenting excess weight at the age of 6 years (Touchette et al., 2008).

This same study also revealed that children who were sleeping fewer than 9 hours at 2½ years of age were already more likely to present excess weight at this age. Even when weight at 2½ years was taken into account, the association between sleep profiles and excess weight at 6 years of age remained significant. Therefore, these results lead us to believe that the impact of short sleep duration was already present at the age of 2½ years, and it was probably cumulative (Touchette et al., 2008). Finally, an American longitudinal study recently supported the importance of sleep in the early years of life by demonstrating that short sleep duration at a young age (mean durations at 6 months, 1 year and 2 years) constitutes a risk factor for excess weight at the age of 3 (Taveras et al., 2008).

Findings to retain

Dyssomnias such as frequent night wakings and difficulty falling asleep in young children are not only disturbing for parents, but also affect the sleep duration of a child. We have demonstrated that short sleep duration is associated with various aspects of child development in the years around school entry. Indeed, short sleep duration seems to be associated with lower cognitive performance, more symptoms of hyperactivity-impulsivity and increased risk of overweight or obesity. Taken as a whole, research conducted on associations between sleep and various facets of child development suggests that there is a sensitive period at a young age during which lack of sleep can be prejudicial to development, even if sleep duration increases later.

Parasomnias are common in childhood and in general are considered benign. Moreover, parasomnias do not seem to reduce sleep duration – they therefore do not present the same risks for development. In contrast, regular bedwetting after the age of 4 years¹¹ may be an indicator of a delay in certain aspects of development, notably motor and language, or of behavioural problems such as hyperactivity and inattention (Touchette et al., 2005b). Thus additional assessments of development may prove necessary in children beset with this problem.

Bedtime may be perceived as a form of separation for both the child and parents. This time of day also seems to activate manifestations of separation anxiety in children. The child may cry and demand the parents be present. An association was observed between symptoms of anxiety in the child and persistent parasomnias, such as bruxism, sleepwalking and sleep terrors. However, this anxiety in the child may be associated with the difficulty the parent has in separating from his/her child. Thus anxious parents may interfere with the development of children's ability to soothe and calm themselves (Scher and Blumberg, 1999) through their overprotective behaviours at their child's bedtime and at night wakings. Anders had already observed in 1979 that infant sleep problems seemed to be associated with parental behaviours at bedtime.

However, it is important to note that certain sleep problems and parental behaviours at bedtime may be circular in nature. Some sleep problems are likely to result in overprotective behaviours on the part of parents which in turn foster the persistence of these problems in the child (Simard et al., 2008b). This clearly suggests the importance of further analyses to gain a better understanding of the processes at work here.

Prevention and solutions

The findings presented in this fascicle combined with the current state of knowledge in the field underline the importance of parents adopting behaviours that foster the autonomy of young children with regards to sleep. Indeed, it has now been established that dyssomnias are often, but not always, the result of the difficulty a child has in calming and soothing him/herself. In this regard, it would be very productive to educate parents on this topic at the time of the birth of their child or during the first few months of life. Prospective and current parents should have information at their disposal on the normal evolution of sleep in children and ways of intervening in case sleep problems arise in their child that are not medical or neurodevelopmental in origin. They could then structure their interactions with their infant/child at bedtime and during nocturnal wakings so that the behaviour that interfered with sleep is not reinforced.

Appendix 1 presents a number of suggestions to foster children having a good sleep from the first few months of life,

and proven methods to alleviate certain sleep problems. If unfortunately a child has not "learned" how to fall asleep or fall back asleep by him/herself and the habit of clamouring for his/her parents has been well established, solutions do exist. A recommended practice is the 5-10-15 or Ferber method as suggested by Dr. Ferber, a pediatric sleep specialist (Ferber, 1985). Used correctly, this method produces results quickly, in only a few nights, and its efficacy is enduring (see Appendix 1). It should be noted that the American Association of Sleep Medicine has published a review paper on the behavioural treatment of dyssomnias in infants and young children (Mindell et al., 2006).

Parasomnias in children are often benign and in general do not require any treatment. However, in the case of somnambulism (sleepwalking) or sleep terrors that happen frequently or pose a danger to a child, the most commonly used therapeutic intervention is the method of scheduled awakenings (Frank et al., 1997; see Appendix 1). It has been reported that episodes cease quite rapidly at the beginning of treatment and the method has long-lasting benefits (for a review of the literature, see Owens, France and Wiggs, 1999).

With regards to frequent bedwetting after the age of 5 years, it can be treated in various ways depending on its origin – inability to wake up, a hyperreactive bladder, or a low-volume bladder (for a review of treatments, see Butler and Holland, 2000). The wearing down of teeth and temporal mandibular joint pain caused by severe bruxism can be prevented by wearing an occlusal guard (Dubé et al., 2004).

Finally, given the prevalence of sleep problems in children and the possible consequences, it is important that other behavioural interventions be made and evaluated.

Conclusion

The duration of sleep, not just its quality, is of primary importance for various aspects of child development from a very young age. Indeed, from the age of 2½ to about 6 years, the majority of children seem to need at least 10 hours of sleep for optimal development. However, because of individual variations, it is possible that the amount of sleep needed for healthy development differs from one child to another.

Given the importance of sleep, people working in pediatrics and/or family medical settings should be given extensive training in prevention, screening and treatment of dyssomnias. Early screening for sleep problems in children requires the implementation of screening and monitoring procedures adapted to pediatric populations.

With regards to research, it would be important to better document dyssomnias related to biological maturation and those due to chronic disease or a handicap. QLSCD data collected to the end of elementary school should provide more

in-depth knowledge on the evolution of sleep problems in children and their impact on development. More specifically, it will be interesting to examine changes in the sleep patterns of children as they enter adolescence. Indeed, we know that this is when sleep phase delay occurs in the biological clock, which affects both the timing of the secretion of certain hormones such as melatonin (which regulates the sleep-wake rhythm), and the sleep schedule itself (Jenni, Achermann and Carskadon, 2005; Loberge et al., 2001). In other words, teenagers generally go to bed later and wake up later.



Appendix 1

Practical advice to foster a good night's sleep in the first few years of life

Establish a bedtime routine.

Provide a good environment for sleeping.

- Have the child go to sleep in the dark at night (but not during the day).
- The bedroom should be cool at night.
- Avoid a noisy environment.

Do not let the child fall asleep before putting him/her to bed (from 4-5 months of age on).

Let the child fall asleep by him/herself (don't stay with him/her until he/she falls asleep).

Don't bring the child to the parents' bed after night wakings (from 4-5 months of age on).

For a baby being breastfed at night, wait a short interval of time between the baby's request to be fed and the mother's response (from 4-5 months of age on).

Maintain the same sleep schedule on weekends.

Give the child an article that can calm him/her down (e.g. a small blanket, a teddy bear or other stuffed animal).

For more details, read the "Sleep" section in the comprehensive guide entitled *From Tiny Tot to Toddler: a practical guide for parents from pregnancy to age two*, which in Québec is given free to future parents by medical staff at the beginning of pregnancy (Doré and Le Hénaff, 2009).

The 5-10-15 Method or Ferber Method to Help the Child Fall Asleep or Fall Back Asleep Alone

This is a method that can be used after the age of 6 months. It is even more effective if the child has already demonstrated he/she is capable of sleeping through the night.

- First examine the sleep environment of the baby to ensure there are no external causes for wakings.
- Establish a pre-bedtime routine for the child and maintain it night after night.
- After the bedtime routine, put the child to bed...awake.
- The parent may see that as soon as the baby is put to bed, he/she begins to cry. The parent should leave the room, wait 5 minutes, then return. She can then try to quietly comfort the baby by caressing his/her back, but not by talking to him/her or picking him/her up in her arms. After a few moments, the child should calm down a little bit. It is then time to leave the room.
- The second time, wait 10 minutes before going to see the baby and comfort him/her in his/her bed. The third time, wait 15 minutes. The baby will learn that crying will only result in a quick check on him/her by the parents.

The goal of this method is not to torture the child but to teach him/her to comfort him/herself, thereby developing the habit to fall back asleep alone after night wakings.

For further details, see Ferber (1985).

Scheduled Awakenings Method to Treat Sleepwalking or Sleep Terrors

- Keep a journal of sleepwalking or sleep terror events for approximately two weeks (or for a shorter or longer period depending on the frequency of episodes).
- Calculate the average time of night when these episodes occur.
- Wake the child every night 15 to 30 minutes before the usual time of the episode for a period of about a month.
- Ensure that he/she is completely awake for about 5 minutes and let him/her fall back asleep.

For more details, see Frank et al. (1997).

Notes

1. Dominique Petit and Jean Paquet are researchers at the Centre for the Study of Sleep and Biological Rhythms at Hôpital du Sacré-Cœur de Montréal. The director of the Centre is Jacques Y. Montplaisir, clinician, researcher and Professor in the Department of Psychiatry at the Université de Montréal. Évelyne Touchette is a researcher at the International Laboratory for Child and Adolescent Mental Health Development, INSERM U669, Université Paris-Sud and Université Paris-Descartes in France, and is a member of the Groupe de recherche sur l'inadaptation psychosociale (GRIP) (Research Group on Psychosocial Maladjustment) at the Université de Montréal.
2. It should be noted that the question on bedtime was not asked after the children were 6 years of age.
3. To determine whether the prevalences presented in Figure 3 varied with age, 95% confidence intervals of the estimates were compared. All differences reported in the text are significant at the threshold of 0.05.
4. "Restless Legs Syndrome ... is a neurological disorder that causes an irresistible urge to move the legs. This urge arises from discomfort in the lower limbs – sensations such as tingling, prickling, "pins and needles," burning – the intensity of which greatly varies from one person to another. Since the symptoms tend to worsen in the evening and night, falling asleep is more difficult." This syndrome can also result in having a light sleep or engender insomnia, leading to fatigue and drowsiness during the day (for more details [in French], see: www.passeportsante.net/fr/Maux/Problemes/Fiche.aspx?doc=syndrome_jambes_sans_repos_pm; page accessed August 3, 2009).
5. Note: The term used in the English version of the questionnaire should have been "bad dreams." As a consequence, the responses to this question are not equivalent to those of the French version.
6. To determine whether the prevalences shown in Figures 5a to 5h varied by age, confidence intervals of the estimates at 95% were compared. All the differences reported are significant at the threshold of 0.05.
7. It should be noted that the delay between the request and the response could be the main reason for this effect rather than the feeding method itself (Keener, Zeanah and Anders, 1988; Pinilla and Birch, 1993). Indeed, it is generally recognized that there are many advantages to breastfeeding, both for the mother and the infant, as well as the mother-child relationship.
8. Based on a probabilistic method, the proportions indicated here should not be considered as the proportions of children who followed each of the trajectories.
9. It should be emphasized that the results of these two tests were associated with academic performance in Grade 1 of elementary school (Lemelin and Boivin, 2007).
10. A higher score was defined as being at least one standard deviation above the mean.
11. Approximately 13% of the QLSCD children were wetting their bed at both 5 and 6 years of age, while 7% were doing so at each age between 5 and 8 years.

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