ACTA PÆDIATRICA
NURTURING THE CHILD

Acta Pædiatrica ISSN 0803–5253

REGULAR ARTICLE

Sleep problems in children with cerebral palsy and their relationship with maternal sleep and depression

Sarah Wayte[1], Elizabeth McCaughey[2], Simone Holley[1], Dagmara Annaz[3], Catherine M Hill (cmh2@soton.ac.uk)[1]

1.Division of Clinical Experimental Sciences, Faculty of Medicine, University of Southampton, Southampton, UK
2.Department of Community Child Health, Solent NHS Trust, Southampton, UK
3.Department of Psychology and Human Development, Institute of Education, London, UK

Keywords
Cerebral palsy, Maternal depression, Maternal mood, Maternal sleep, Sleep

Correspondence
Catherine M Hill, Division of Clinical Experimental Sciences, Faculty of Medicine, University of Southampton, Mail point 803 CB, University of Southampton Foundation NHS Trust, Tremona Road, Southampton, Hampshire SO16 6YD, UK.
Tel: +4423 80796091 |
Fax: +4423 80796420 |
Email: cmh2@soton.ac.uk

Received
13 November 2011; revised 10 January 2012; accepted 11 January 2012.

DOI:10.1111/j.1651-2227.2012.02603.x

ABSTRACT

Aim: To compare sleep problems in children with cerebral palsy to typically developing children. To study the relationship between sleep problems in children with cerebral palsy and maternal sleep quality and depression.

Methods: Fifty-seven children with cerebral palsy aged 4–12 years were identified from a UK disability database. Maternal sleep disturbance and mood were assessed using the Pittsburgh Sleep Quality Index and the Major Depression Inventory. Child sleep problems, assessed with the Children's Sleep Habits Questionnaire, but not maternal variables, were compared to 102 typically developing children.

Results: Forty children (70%) were recruited with a mean age of 7.8 (SD 2.4). Sleep anxiety, night wakings, parasomnias and sleep-disordered breathing sub-scales indicated significantly more difficulties than in typically developing children. 40% of mothers of children with cerebral palsy had poor sleep quality of whom 44% had depressed mood. Child and maternal sleep disturbance were significantly correlated. Maternal sleep quality predicted 50% of the variance in maternal depression.

Conclusions: Children with cerebral palsy have more sleep problems than typically developing peers. Their mothers also have disturbed sleep that correlates with maternal depression. Childhood sleep problems can be treated and should be identified in routine clinical practice.

INTRODUCTION

Cerebral palsy (CP) affects between 2 and 3% of live born infants in the developed world (1). These children have multiple risk factors for sleep disturbance because of the nature of their primary brain injury and resultant morbidity. Firstly, to consider factors that may impair a child's ability to fall asleep. General intellectual impairment is associated with sleep disturbance in childhood, as these children take longer to learn the art of self-soothing to sleep (2). In children with significant visual impairment, sleep onset may also be impaired because of altered light perception and reduced natural melatonin secretion (3). Additional factors may disrupt the integrity of sleep. Children with CP have a number of reasons to wake including pain because of gastro-oesophageal reflux disease, muscle spasms or local skin pressure because of restricted movement (4). Furthermore, they are vulnerable to upper airway obstruction (5) that can cause repeated arousal from sleep. Finally, epilepsy, a common complication of CP, is associated with sleep disturbance in childhood (6). In concert, these factors may not only disturb the child's sleep but may lead to increased parental anxiety and night-time monitoring which in turn can promote behavioural insomnia in any child (7).

Sleep promotes healthy neuropsychological function (8) and learning (9) in childhood. Conversely, sleep disturbance is associated with challenging behaviour in learning disabled children (10). While there are no experimental studies of sleep restriction in children with CP, their reduced

Key notes

- Children with cerebral palsy have more sleep problems than typically developing peers.
- Mothers of children with cerebral palsy have high rates of sleep disturbance, comparable to rates previously reported in mothers of young infants.
- Maternal sleep quality significantly correlated with maternal depression.
- Sleep problems in children with cerebral palsy should be actively addressed with the potential to benefit both the child and main carer.

cognitive reserve (11) in comparison with typically developing[1] (TD) peers would predict a greater impact of sleep deprivation on their daytime function. This is supported by a study of 41 children with CP which reported that insomnia symptoms contributed unique variance to psychosocial quality of life measures (12).

Despite the importance of sleep to healthy daytime function and the risk factors for poor sleep in children with CP, there have been few studies examining sleep problems in these children. A questionnaire study of 173 children with CP in Ireland aged 6–11 years reported a pathological sleep score in 23% compared to 5% of TD children (13). These children had difficulties with initiation and maintenance of sleep, sleep–wake transition, sleep-disordered breathing and excessive daytime sleepiness. The authors suggested that further research might consider the consequences of such difficulties for both the child and family. A Swedish questionnaire-based study including 216 children with CP aged 1–16 years reported sleep problems in 50.5%, with the commonest difficulties including 'problems relaxing', 'nightmares', medical reasons and breathing difficulties. Importantly, 39.8% of the children required parental attention on at least one occasion every night, and 74% of parents felt that the child's sleep difficulties impacted on their own daytime functioning (4).

Parenting a child with CP is associated with increased risk of psychological stress and poor physical health in the primary caregiver, who is usually the mother (14). Maternal sleep quality is a potential mediator of these effects. Sleep disturbance in TD children has been shown to predict maternal sleep quality which in turn predicts maternal mood (15). This study aimed to examine the relationship between child's sleep, maternal sleep and maternal mood in a CP population.

METHODS

Ethical approval was obtained from the Isle of Wight, Portsmouth & South East Hampshire Research Ethics Committee; reference 08/H0501/8.

Mothers of children with CP completed the following questionnaires at a home visit:

Demographic questionnaire: maternal ethnicity, employment status (full-time carer/mother, part-time or full-time employment) and relationships status (single, cohabiting, married) were recorded.

Pittsburgh Sleep Quality Index (*PSQI*): The PSQI assesses sleep quality and sleep disturbances over the past month in adults (16). It has been validated in healthy controls, patients with a major depressive disorder and a clinical sample of patients with sleep complaints and is reported to have a sensitivity of 0.90 and specificity of 0.87 in the detection of sleep disturbance. It generates a maximum difficulty score of 21, and a score above 5 indicates poor sleep quality.

Major Depression Inventory (*MDI*): The MDI measures severity of depression and acts as a clinical diagnostic instrument based on an ICD-10 diagnosis of depression (17). It has been shown to have a sensitivity of 0.86–0.92 and specificity of 0.82–0.86 in the diagnosis of clinical depression. Total scores equate to clinical symptoms as follows: 'mild depression' (20–24), 'moderate' (25–29) or 'severe' (30+).

Parents of both TD children and mothers of children with CP completed the *Child Sleep Habits Questionnaire* (*CSHQ*), a screening instrument for school-aged children based on clinical symptom presentations of common sleep disorders (18). Test–retest reliability is acceptable (range 0.62–0.79). A cut-off total CSHQ score of 41 identifies children with a clinical sleep problem with a sensitivity of 0.80 and specificity of 0.72. Eight sub-scales, including (bedtime resistance, sleep-onset delay, sleep duration, sleep anxiety, night waking, parasomnias, sleep-disordered breathing and daytime sleepiness) together, generate a total sleep disturbance score.

Medical and developmental data relevant to sleep disturbance were sourced from the medical records of children with CP. These included pattern and severity of CP, history of prematurity, presence or absence of epilepsy, visual impairment, eczema, respiratory disease and gastro-oesophageal reflux. Cognitive impairment and severity of motor disability were defined by standard UK criteria (19) as profound where ability was <25% of expected, severe if <50% of expected and moderate if <66% of expected.

Participants

Children with CP aged 4–12 years were identified from the Solent West Healthcare NHS disability database. Of 57 children identified as potential participants, five were deemed unsuitable to participate by their clinician because of family stress or child ill health; three families could not be contacted, four families were willing to participate but subsequently cancelled scheduled appointments, and five declined to take part. The final sample consisted of 40 participants aged 4–11 years.

Control group data including age, gender, ethnicity and CSHQ responses were available from 102 (52 male) TD children of White European background aged from 4 to 11 years old who had participated in local studies of neurocognition and sleep (20,21). These children had been recruited as healthy siblings or friends of children with sleep-disordered breathing or via local schools and nurseries.

Sample descriptive characteristics

Children were classified into five motor patterns of CP: quadriplegic (35%), hemiplegic (27%), diplegic (22%), ataxic (8%) and athetoid (8%). Thirty-eight were classified as White European and 2 were as Asian.

There were no differences in age between the children with CP and TD group ($t_{144} = 1.46$, $p > 0.05$). There

[1]For the purpose of this study typically developing 'TD' implies healthy children whose development is considered to be within the normal range.

Table 1 Characteristics of children with cerebral palsy and characteristic-specific differences in maternal and child sleep scores

Child characteristics (N = 40)	%	CSHQ total score	PSQI total score
Sex, M/F	67/33	ns	ns
Gestation		ns	ns
37–42 weeks	50		
Preterm	50		
Severity of motor impairment		ns	ns
Mild to moderate	52.5		
Severe to profound	47.5		
Visual loss		$p < 0.05$	$p < 0.05$
None	65		
Mild	22.5		
Severe and Profound	12.5		
Cognitive impairment		ns	ns
Normal	37.5		
Mild and Moderate	32.5		
Severe and Profound	30		
Epilepsy	25	ns	ns
Maternal characteristics (n = 40)	**%**	**CSHQ total score**	**PSQI**
Employment Status		$p < 0.01$	ns
Full-time mother	37.5		
Paid employment (all)	62.5		
Relationship status		ns	ns
Single	35%		
Cohabiting	65%		

Only four children had established respiratory disease, none had eczema, and two had established gastro-oesphageal reflux disease; therefore, these data were not further analysed. There were no differences in maternal depression inventory by child or maternal characteristics, and therefore, these data are not presented.

was a higher proportion of boys in the CP group (67.5%) compared to the TD group (49.1%) ($\chi^2_1 = 3.98$, $p < 0.05$).

Amongst the mothers of the children with CP, 37.5% did not have paid employment outside of the home, 50% worked part-time and 12.5% worked full time in paid employment. Twenty-six (65%) were cohabiting and 14 (35%) were single parents. There was no relationship between maternal employment or cohabitation status and the severity of the child's CP. Further details of the population of children with CP and maternal characteristics are illustrated in Table 1.

Analysis

Data were analysed in SPSS v 18 (IBM, New York, NY, USA). As none of the main outcomes measures were normally distributed, group differences were assessed using the Mann–Whitney U and Kruskal–Wallis tests, and correlations were studied using Spearman's correlation coefficients. Pearson's chi-squared test was used for categorical variables. Forced entry linear regression was used to analyse predictors of child sleep and maternal depression.

Table 2 Cerebral palsy and typical developing control child CSHQ scores controlling for age and gender

	Typically developing (n = 102)		Cerebral palsy (n = 40)			
	Mean	SD	Mean	SD	F	p
Total Score	42.15	8.05	48.50	8.71	7.50	**<0.001**
Bedtime resistance	7.18	2.04	7.48	2.54	0.86	0.463
Sleep onset delay	1.61	0.77	1.73	0.85	2.28	0.082
Sleep duration	4.30	1.68	4.32	1.64	2.56	0.058
Sleep anxiety	4.83	1.39	6.00	1.83	6.27	**0.001**
Night waking	3.58	1.03	5.25	1.79	16.60	**<0.001**
Parasomnias	9.12	2.03	10.45	1.89	4.94	**0.003**
Sleep disordered breathing	3.47	0.89	4.20	1.42	4.81	**0.003**
Daytime sleepiness	10.33	3.10	11.55	3.78	2.32	0.078

Bold Values indicates statistically significance.

RESULTS

Sleep disturbance in children with cerebral palsy

Children with CP had significantly higher total CSHQ scores compared to TD children (implying worse symptoms), as well as higher sleep anxiety, night waking, parasomnias and sleep-disordered breathing sub-scale scores (Table 2). Daytime sleepiness, sleep duration and sleep-onset delay were higher in children with CP compared to TD children but failed to reach statistical significance. Correlates of child sleep disturbance included maternal employment status (where unemployed status was associated with higher CSHQ scores), the extent of the child's visual and cognitive impairment as well as the presence of epilepsy (see Table 3). A series of hierarchical multiple regression analyses were used to examine predictors of child sleep disturbance using these significant correlates.

The following variables were entered simultaneously into the model: mother's employment status (unemployed, part-time or full-time employment), severity of visual disturbance (none, mild, severe or profound), presence or absence of epilepsy, and cognitive ability (normal, mild, severe or profound). There was no correlation between total CSHQ scores and age ($r = -0.073$, $p > 0.05$) and no significant difference between gender and total CSHQ scores ($t = -0.249$, $p > 0.05$), so these variables were not controlled for in the model. Inspection of the regression weights showed that mothers' employment status was the only variable adding unique variance to the prediction of the model ($t_{35} = -2.66$, $p < 0.05$), and visual disturbance approached significance ($t_{35} = 1.89$, $p = 0.067$). Owing to the sample size, only these two predictors were retained for further analysis. In the next model, mother's employment status was entered in the first step and visual disturbance in the second step. As shown in Table 4, in the final model, mothers employment status accounted for 19% of the variance in total CSHQ scores ($F_{1,38} = 9.11$, $p < 0.05$). Visual disturbance accounted for a further 17% of the variance ($F_{2,37} = 9.97$, $p < 0.01$).

Table 3 Correlations between total CSHQ scores for children with cerebral palsy and child and maternal characteristics

	1	2	3	4	5	6	7	8
1. CSHQ Total								
2. Mothers employment	−0.460**							
3. Severity of motor disability	0.264	−0.131						
4. Cognitive level	0.369*	−0.120	0.677**					
5. Epilepsy	0.338*	−0.207	0.344*	0.551**				
6. Visual disturbance	0.474**	−0.203	0.462**	0.683**	0.791**			
7. Relationship status	−0.030	−0.376*	−0.063	0.002	−0.182	−0.210		
8. PSQI	0.378*	−0.152	−0.043	0.107	0.212	0.241	0.002	
9. MDI	0.392*	−0.210	−0.073	0.134	0.251	0.317*	0.021	0.791**

*$p < 0.05$.
**$p < 0.001$.

Table 4 Regression models showing significant predictors of child sleep and maternal depression

Dependent variable	B	SE B	β	R^2	ΔR^2	F	p
Child sleep disturbance							
Mothers employment	−4.80	1.73	−0.369	0.19		9.11	0.005
Visual disturbance	3.39	1.07	0.420	0.36	0.17	9.97	0.003
Maternal depression							
Maternal sleep	2.35	0.38	0.72	0.51		39.01	<0.001

Relationship between child sleep, maternal sleep and maternal depression

Sleep disturbance scores in children were significantly correlated with sleep disturbance scores in their mothers ($r = 0.38$, $p = 0.016$). Similarly, maternal sleep disturbance scores were highly correlated with major depression inventory scores ($r = 0.79$, $p < 0.001$). All 24 mothers with PSQI scores within the normal range also had normal MDI scores. In contrast, 7/16 (44%) of mothers with PSQI scores >5, indicating sleep disturbance, had MDI scores indicative of depression.

Predictors of maternal depression

In the group of children with CP, 40% of mothers were classified as having poor sleep quality using the PSQI. The rate of maternal depression, according to the MDI, was as follows: no depression (82.5%); mild depression (5%); moderate depression (2.5%); and severe depression (10%). Hierarchical linear regression was used to analyse predictors of maternal depression.

Maternal depression

Significant correlates of maternal depression were entered simultaneously as predictor variables into a linear regression model: child sleep (CSHQ total score), maternal sleep quality (PSQI score) and visual disturbance in the child. An inspection of the regression weights showed that only maternal sleep quality explained a unique amount of variance in maternal depression scores, so this variable was retained for further analyses. In the final model (Table 4), maternal sleep quality accounted for 50% of the variance in maternal depression scores ($F = 39.01$, $p < 0.001$).

DISCUSSION

In support of previous work (4,13), we have demonstrated high rates of sleep disturbance amongst children with CP compared to TD controls. In common with these reports, children with CP had more problems with sleep-disordered breathing. Certainly, this is a concern for parents; in one study, 8.3% of children with CP were checked by their parents at night specifically because of breathing problems (4). Furthermore, obstructive sleep apnoea can lead to increased night waking which was also reported as a problem in CP children in this study. Other factors that may wake children include positioning needs, pain from muscle cramps, gastro-oesophageal reflux and toileting needs (4). In contrast to the Irish community-based study (13), children in our study did not have more problems settling to sleep. However, only 10% of the Irish sample had quadriplegia, in contrast to 35% of children in this study. Children with whole body involvement are restricted in their ability to get out of bed and may, therefore, be perceived by parents as less 'resistant'.

Visual impairment was also found to predict child sleep problems, concurring with previous reports (13). Light is a powerful synchronizer of biological rhythms, and visual stimuli help the child understand the behavioural expectations of night and day (7). Certainly, our findings lend further support to the importance of visual impairment in sleep difficulties in children with CP.

Sleep difficulties in children with CP in this study were predicted by maternal employment status. We hypothesize that mothers who are in employment are less likely to be socially isolated. Social support has been shown to moderate the association between severity of functional impairment in childhood CP and maternal depression (22). Thus, mothers who are depressed because of social isolation may struggle to manage behavioural sleep problems in their children resulting in higher child sleep problem scores.

An important finding of this study was that almost one in five mothers of children with CP had depressed mood. Maternal sleep quality explained 50% of the variance found in maternal depression. Importantly, factors such as the severity and type of their child's CP did not predict maternal depression.

Caring for a child with CP places an additional burden of care on parents. A higher incidence of depression has previously been reported in mothers of children with CP (23). It could be reasonably assumed that the greater the child's disability, the greater the burden of care and risk of parental mental health difficulties. As in previous studies (23) however, we failed to demonstrate an association between maternal depression and the severity of the child's motor disability, highlighting the complex interacting factors that determine mental health outcomes. In a large study of the determinants of well-being of adults (mostly mothers) caring for children with CP, key predictors of poor outcomes included child behavioural problems, higher care-giving demands and reduced family function (14). We are not aware of any studies that have considered maternal sleep in this context.

This cross-sectional study was not designed to understand causation, and some caution needs to be exercised in interpreting our data as there is bidirectional relationship between sleep and depression. Sleep disturbance is a key symptom of depression. It is possible that depressed mothers with concomitant sleep problems were also more anxious and sensitized to their child's sleep difficulties which they then overreported. However, experimental sleep deprivation studies in adults consistently show a negative impact on mood (24). In mothers of children with atopic eczema, only 39 min of sleep loss while caring for their child was related to measures of anxiety and depression (25). Given the significant correlation between child and maternal sleep in this study, we postulate that disrupted child sleep may be causatively associated with maternal sleep problems which in turn may contribute to maternal depression.

LIMITATIONS OF THIS STUDY

Reliance on parent report increases the potential for reporter bias. Studies comparing subjective measures, such as sleep diaries and questionnaires, to objective sleep measures such as actigraphy (motion sensors that differentiate sleep and wake), have indicated that parents may overreport sleep difficulties in their children (26). However, parents of children with CP in this study did not report problems across all sleep sub-scales suggesting genuine differences between these children and TD peers. Further studies using objective measures such as actigraphy would be of value.

While a recruitment rate of 70% is acceptable for a population sampled from a community setting, sampling bias is a possible confounder in our data. Sampling bias could have resulted in recruitment of a disproportionate number of children with severe cerebral palsy. Against this is the fact that the distribution of motor disorder in our sample was very similar to that reported in a community sample of over 400 children with CP in the US (1). Equally, we could have selectively sampled children with greater sleep difficulties than non-participants. Sampling of mothers with greater depressive symptoms would perhaps be less likely as such mothers would be predicted to be more likely to decline study participation (27).

Finally, our control group data were limited to child sleep measures and did not include maternal sleep and depression measures. It is not possible to conclusively know whether the mothers in this sample were more depressed or more sleep disturbed than their peers caring for healthy TD children. However, a large UK childhood cohort study has reported maternal depression rates of 9.9% compared to 17.5% in this sample (28). Furthermore, a study of 2830 Norwegian mothers caring for infants aged 6–20 weeks reported mean PSQI scores of 6.3 (29). This did not differ statistically from the mean PSQI scores of 5.5 in our study ($p = 0.07$, one way *t*-test), suggesting that levels of sleep disturbance in mothers of children with CP are similar to those experienced by mothers caring for young infants. Future studies should include a matched control group of families with TD healthy children.

Finally, a larger study may have provided sufficient power to examine a broader range of potential predictors of child sleep problems and maternal depression.

CONCLUSION

This study supports previous data indicating that children with CP have significantly greater sleep problems than their TD peers. Maternal sleep disturbance was similar to that previously reported in mothers of young infants although our study group was school age. In turn, a high proportion of mothers with disturbed sleep were depressed. This study was not designed to answer whether maternal sleep disturbance preceded maternal depression or *vice versa*. Either way it is feasible that mothers' sleep may be disrupted by their children's sleep problems. Importantly, child sleep problems are amenable to behavioural management approaches (7). Clinicians must prioritise the treatment of sleep problems in children with CP with the potential to improve not only the well-being of the child but importantly the well-being of the child's main carer.

ACKNOWLEDGEMENTS

We are grateful to community paediatric colleagues in Solent NHS Trust for their assistance in recruiting to this study and to the mothers who gave generously of their time to participate.

References

1. Winter S, Autry A, Boyle C, Yeargin-Allsopp M. Trends in the prevalence of CP in a population-based study. *Pediatrics* 2002; 110: 1220–5.

2. Clements J, Wing L, Dunn G. Sleep problems in handicapped children: a preliminary study. *J Child Psychol Psyc* 1986; 27: 399–407.
3. Lockley SW, Skene DJ, Arendt J, Tabandeh H, Bird AC, Defrance R. Relationship between melatonin rhythms and visual loss in the blind. *J Clin Endocrin* 1997; 82: 3763–70.
4. Hemmingsson H, Stenhammer AM, Paulsson K. Sleep problems and the need for parental night-time attention in children with physical disabilities. *Child Care Health Dev* 2008; 35: 89–95.
5. Kotagal S, Gibbons VP, Stith JA. Sleep abnormalities in patients with severe cerebral palsy. *Dev Med Child Neurol* 1994; 36: 304–11.
6. Wirrell E, Blackman M, Barlow K, Mah J, Hamiwka L. Sleep disturbances in children with epilepsy compared with their nearest-aged siblings. *Dev Med Child Neurol* 2005; 47: 754–9.
7. Hill CM. Effective treatment of behavioural insomnia in children. *J Child Psychol Psychiatry* 2011; 52: 731–40.
8. O'Brien LM, Gozal D. Neurocognitive dysfunction and sleep in children: from human to rodent. *Pediatr Clin North Am* 2004; 51: 187–202.
9. Hill CM, Hogan AM, Karmiloff-Smith A. To sleep, perchance to enrich learning? *Arch Dis Child* 2007; 92: 637–43.
10. Wiggs L, Stores G. Severe sleep disturbance and daytime challenging behaviour in children with severe learning disabilities. *J Intellect Disabil Res* 1996; 40: 518–28.
11. Stern Y. Cognitive reserve. *Neuropsychologia* 2009; 47: 2015–28.
12. Sandella DE, O'Brien LM, Shank LK, Warschausky SA. Sleep and quality of life in children with cerebral palsy. *Sleep Med* 2011; 12: 252–6.
13. Newman CJ, O'Regan M, Hensey O. Sleep disorders in children with cerebral palsy. *Dev Med Child Neurol* 2006; 48: 564–8.
14. Raina P, O'Donnell M, Rosenbaum P, Brehaut J, Walter SD, Russell D, et al. The health and well-being of caregivers of children with cerebral palsy. *Pediatrics* 2005; 115: e626–36.
15. Meltzer LJ, Mindell JA. Relationship between child sleep disturbances and maternal sleep, mood, and parenting stress: a pilot study. *J Fam Psychol* 2007; 21: 67–73.
16. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res* 1988; 28: 193–213.
17. Bech P. The sensitivity and specificity of the Major Depression Inventory, using the present state examination as the index of diagnostic validity. *J Affect Disord* 2001; 66: 159–64.
18. Owens JA, Spirito A, McGuinn M. The Children's Sleep Habits Questionnaire (CSHQ): psychometric properties of a survey instrument for school-aged children. *Sleep* 2000; 23: 1043–51.
19. Disability in Childhood: towards Nationally Useful Definitions – Report of working group in definitions of Disability in Childhood. British Association for Community Child Health and Department of Health, UK, 1994.
20. Hill CM, Harrison D, Hogan AM. Sleep habits and neurobehavioural correlates in young children who snore. *J Sleep Res* 2008; 17(Suppl 1): 483.
21. Holley S, Hill CM, Stevenson J. Deficits in executive function are associated with shorter sleep duration in normally developing children aged 6–12 years. *J Sleep Res* 2008; 17(Suppl 1): 357.
22. Manuel J, Naughton MJ, Balkrishnan R, Paterson Smith B, Koman LA. Stress and adaptation in mothers of children with cerebral palsy. *J Pediatr Psychol* 2003; 28: 197–201.
23. Unsal-Delialioglu S, Kaya K, Ozel S, Gorgulu G. Depression in mothers of children with cerebral palsy and related factors in Turkey: a controlled study. *Int J Rehabil Res* 2009; 32: 199–204.
24. Banks S, Dinges DF. Behavioral and physiological consequences of sleep restriction. *J Clin Sleep Med* 2007; 3: 519–28.
25. Moore K, David TJ, Murray CS, Child F, Arkwright PD. Effect of childhood eczema and asthma on parental sleep and well-being: a prospective comparative study. *Br J Dermatol* 2006; 154: 514–18.
26. Wiggs L, Montgomery P, Stores G. Actigraphic and parent reports of sleep patterns and sleep disorders in children with subtypes of attention-deficit hyperactivity disorder. *Sleep* 2005; 28: 1437–45.
27. Almeida L, Kashdan TB, Nunes T, Coelho R, Albino-Teixeira A, Soares-da-Silva P. Who volunteers for phase I clinical trials? Influences of anxiety, social anxiety and depressive symptoms on self-selection and the reporting of adverse events. *Eur J Clin Pharmacol* 2008; 64: 575–82.
28. Hanington L, Ramchandani R, Stein A. Parental depression and child temperament: assessing child to parent effects in a longitudinal population study. *Infant Behav Dev* 2010; 33: 88–95.
29. Dørheim SK, Bondevik GT, Eberhard-Gran M, Bjorvatn B. Sleep and depression in postpartum women: a population-based study. *Sleep* 2009; 32: 847–55.