Clinical and Historical Predictors of Sleep Disturbances in School-Age Children

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Several studies attempted to evaluate the predictive value or the associated risk of several factors only on generic sleep disorders and mainly night-wakings. Aim of this study was to evaluate the influence of biological and historical and clinical factors on the different aspect of sleep behavior and disturbances evaluated by the Sleep Disturbance Scale for Children. Mothers of 1157 children (583 M, 574 F) aged 6.5 to 15.3 years (mean 9.8) completed the SDSC together with a questionnaire on demographic data about family composition, parent's education and professional activities, as well as clinical data about pregnancy, delivery and medical history of the child with specific questions regarding pathologies that could affect sleep; sleep habits of parents and children were also investigated. Global sleep disturbances measured as SDSC total score were affected by co sleeping, early sleep disorders, adenotonsillitis, asthma and parents' sleep disorders. Early sleep disorders, asthma and parents' sleep disorders had a significant main effect on disorders of initiating and maintaining sleep. Sleep breathing disorders score was associated with the presence of cosleeping, adenotonsillitis, asthma, food allergy. Disorders of Arousal score was affected by early sleep disorders and parents' sleep disorders. There was a significant main effect of co-sleeping, early sleep disorder, adenotonsillitis, parents' sleep disorder on sleep-wake transition disorders score; of gender, parents' sleep disorder on Disorders of excessive somnolence score and of gender, early sleep disorder and parents' sleep disorder on Sleep hyperhydrosis score. Post-hoc comparisons showed that females vs. males have higher scores in Disorders of excessive somnolence score while males scored higher in Sleep hyperhydrosis score. A visual generalized model revealed that predictors for Total SDSC score are early sleep disorders, parents' sleep disorders, adenotonsillitis and asthma. Our results underline the role of genetic and neurobiological substrate on the development of children sleep, delineating the areas of the sleep that are involved and rising some suggestions on which factors could lead to different later sleep disturbances.
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Key words: *sleep disorders, predictors, children*

INTRODUCTION

Sleep disturbances in preschool children tend to persist, as the child grow older and the mothers perceived their child's sleep problems as stressful to them and their family life. In 84% of SD infants these problems persisted after 3 years of age (1) and were still present in 75% of 8 years-old children having presented SD at 3 years (2). Pollock (3) reported a significant increased risk of sleep problems at 10 years if the child had the problem at age 5. Further, sleep problems in older children were often associated with sleep-waking disorders in the 1st year of life (4) and, conversely, children who had early disorders of the sleep-waking rhythm often had multiple sleep problems later (5). In a study on predictive value of behaviors at 3 years, Abe et al. (6) found that sleep disturbances were of the most persistent group. These

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relationships between early waking-sleeping rhythm disturbances and later sleep problems indicated a continuity of the sleep-disturbed behavior.

Several studies attempted to evaluate the predictors of sleep disorders in school age children; a wide range of possible causes of sleep disturbance have been reported by Pollock (3) that showed that a large number of factors were significantly associated with disturbed sleep: maternal age at child's birth, West Indian and African origin, method of delivery, writing problems, and previous attendance at child guidance services. Most research identified predisposing factors for sleep disorders in infancy and children, leading often to contradictory results: no association with socio-economic status has been found in several studies (7-9) while a British study found a difference in terms of ethnic origin (10). Breast-feeding has been reported by some Authors as contributing factor to sleep disorders (11) but not confirmed by others (12). Most studies have failed to find a relationship between gender and sleeping pattern (13). Perinatal factors have been found to be more prevalent in sleep-disordered children by Bernal (8) and Moore and Ucko (9), not confirmed by Anders and Keener (13). However, the factors leading to the sleep disorders are still largely unknown; the influence of the early mother-child relationship as well as the effects of clinical, psychological and hereditary variables are still controversial (8,14). The absence of specific somatic or mental disorders in children with both early and later sleep disturbances (5) suggested that probably other variables (i.e. genetic, neurobiological substrate) could affect sleep behavior and disturbances.

Most of the previous studies evaluated the predictive value or the associated risk of several factors only on generic sleep disorders and mainly night-wakings. Aim of this study was to evaluate the influence of biological and historical and clinical factors on the different aspect of sleep behavior and disturbances evaluated by the Sleep Disturbance Scale for Children (15).

METHODS

Procedure

In an earlier study (15) we evaluated the psychometric properties of the Sleep Disturbance Scale for Children (SDSC); in this study we report on factors predictive of a series of sleep disturbances that were assessed by the instrument. The SDSC is an easy-to-fill form to collect data on sleep behavior of children and adolescents and provide a total and 6 factors scores that represent the most common areas of sleep disorders in childhood and adolescence: Disorders of initiating and maintaining sleep (DIMS), Sleep Breathing Disorders (SBD), Disorders of arousal (DA), Sleep-Wake Transition Disorders (SWTD), Disorders of excessive somnolence (DOES), Sleep Hyperhydrosis (SHY).

As part of the questionnaire, mothers were asked to fill out also a section on demographic data about family composition, parent's education and professional activities, as well as clinical data about pregnancy, delivery and medical history of the child with specific questions regarding pathologies that could affect sleep; sleep habits of parents and children were also investigated.

As dependent variables (continuous) we considered the SDSC total score and the SDSC 6 factor scores. The following independent variables were included in the analysis: child's age, sex, birth weight, length of gestation, pregnancy, delivery, condition at birth, feeding method, co sleeping, birth order, report of sleep problems in infancy, cow's milk allergy, colic during the first months, recurrent adenotonsillitis, asthma or allergic rhinitis or bronchitis, food allergy, sleep disorders in parents, father's and mother's level of education.

Subjects

The SDSC and the aforementioned section were distributed during a 12 months study period to a sample of normal healthy control subjects, composed of Caucasian children mostly from families with a working and middle class background, randomly selected in four public schools of Rome, two in the city center, one on the Southern and one on the Northern outskirts of the city. The return rates from the schools were 78%, 86%, 81% and 89%. Questionnaires were completed for 1157 children (583 M, 574 F) aged 6.5 to 15.3 years (mean 9.8).

Statistical Analysis

A univariate analysis with Main effect ANOVA was used to evaluate, the effects of clinical, historical and biological factors on global sleep disturbances (measured as SDSC total score) and of single factor scores. A visual generalized model for Total SDSC score was used to evaluate the best predictors of global sleep disturbances in our sample.

All statistical analyses were performed on a personal computer using the commercially available package program Statistica (TM) v. 5.5 (Statsoft Inc., Tulsa, OK).

RESULTS

The characteristics of the sample were summarized in Table 1. We therefore analyzed the effects of these variables on the scores derived from the SDSC scale. The univariate analysis (Table 2) showed that there was a main effect of co sleeping (F=4,85; p < 0.05), early sleep disorders (F=19,58; p < 0.001), adenotonsillitis (F=15,01; p < 0.01), asthma (F=6,86; p < 0.01) and parents' sleep disorders (F=30,94; p < 0.001) on Total score. DIMS score was affected by early sleep disorders (F=7,20; p < 0.01) asthma (F=4,24; p < 0.05) and parents' sleep disorders (F=15,23; p < 0.001). Significant main effects on SBD score were found for co sleeping (F= 14,79; p < 0.01), adenotonsillitis (F=54,73; p < 0.001), asthma (F=20,05 ; p < 0.001), food allergy (F=7,21 ; p < 0.01). Early sleep disorders (F=12,82; p < 0.01), and parents' sleep disorders (F=5,96; p < 0.05) showed a significant main effect on DA score. There was a significant main effect on SWTD score of co-sleeping (F=14,05;p<0,01), early sleep disorder (F=29,92;p<0,001), adenotonsillitis (F=17,22; p<0,01), parents' sleep disorder (F=14,89;p<0,01); there was a main effect of gender (F=5,06;p<0,05), parents' sleep disorder (F=12,35;p<0,01) on DOES score and of gender (F=22,66;p<0,001), early sleep disorder (F=11,55;p<0,01) and parents' sleep disorder (F=17,64;p<0,001) on SHY score. Post-hoc comparisons showed that females vs. males have higher scores (7,27 vs. 6,95) in DOES while males scored higher in SHY (3,11 vs. 2,62).

Table 1. Characteristics of the sample

	N	%
Problems during pregnancy	142	12.27
Prematurity	64	5.53
Perinatal problems	72	6.23
Breast feeding	695	60.07
Early sleep disorders	138	11.93
Colics	323	27.92
Cow's milk allergy	88	7.61
Food allergy	56	4.84
Adeno-tonsillitis	358	30.94
Asthma	113	9.76
Sleep disorders in parents	104	8.99
Cosleeping	33	2.85

Based on the results of the univariate analysis the variables that showed statistical significance were selected for entering on a visual generalized model for Total SDSC score. This analysis revealed that the Total SDSC score can be determined using as baseline predictors early sleep disorders, parents' sleep disorders, adenotonsillitis and asthma (R=,34, R2=,11, F=9,79, df 15, p < 0.001).

DISCUSSION

The findings of this study allowed us to determine the effects of some biological and clinical variables on sleep disorders in school age children. Global sleep disturbances were best predicted by early sleep disorders, parents' sleep disorders, adenotonsillitis and asthma.

The presence of early sleep-wake rhythm disorders and of familiarity for sleep disorders seemed to be the most significant factors influencing the persistence and/or the appearance of sleep disorders in school age children indicating that a continuity of sleep disorders exists and emphasizing the importance of the genetic substrate. These findings confirmed the several reports on the continuity of sleep disorders through different ages.

The problem of genetic predisposition has been raised from other studies in which preadolescents had similar prevalence of sleep disturbances as their parents and had had problems in initiating and

Table 2. Main effects of independent variables on SDSC scores.

	df	TOTAL F	DIMS F	SBD F	DA F	SWTD F	DOES F	SHY F
Gender	1	,56	,39	2,56	,081	,040	5,06*	22,66***
Pregnancy	1	2,65	2,50	,51	,55	2,59	,84	,194
Delivery	2	,14	,90	1,20	,89	,47	,14	2,02
Birth condition	1	,37	1,16	,85	,01	,01	,13	,28
Feeding	2	1,69	,03	,01	2,54	1,87	2,77	2,33
Cosleeping	1	4,85*	,64	14,79**	,05	14,05**	,12	,30
Birth order	3	1,44	1,64	2,95	1,03	2,15	1,03	,45
Early SD	1	19,58***	7,20**	,02	12,82**	29,92***	1,38	11,55**
Milk allergy	1	,43	3,55	1,84	,16	,26	,71	,033
Colics	1	,83	1,22	,51	,16	,44	,06	,10
Adenotonsillitis	1	15,01**	,48	54,73***	,18	17,22**	2,89	2,62
Asthma	1	6,86**	4,24*	20,05***	1,72	2,41	,30	3,16
Food allergy	1	,17	,30	7,21**	,38	,11	,01	,24
Parent SD	1	30,94***	15,23***	2,73	5,96*	14,89**	12,35**	17,64***
Father education level	3	,55	,88	,26	,55	,33	2,42	,19
Mother education level	3	,25	1,26	,38	,82	,59	1,54	,97

* p < 0.05; ** p < 0.01; *** p < 0.001

maintaining sleep since infancy (14). Furthermore, Salzarulo and Chevalier (5) pointed out that several types of sleep problems are present in children with previous waking-sleeping rhythm disorders, showing that the latter can be followed not just by a single sleep problem but also by an impressive and global disturbance of sleep.

Recurrent adenotonsillitis and asthma also account for a percentage of variance in Total SDSC score. A recent report showed that sleep disturbances was associated with persistent wheezing, compared to non-wheezing children (10) supporting the fact that respiratory illness are important risk factors for sleeping disorders in childhood. In a previous study (16) was not found an increased prevalence of sleep disturbances in young children (4-48 months) with asthma but the Authors indicates a possible age and long term factors effect in explaining the increase in sleep disturbances reported in adults with asthma.

Analyzing the SDSC subscales, early sleep disorders, parents' sleep disorders and asthma had significant main effects on DIMS; these data agreed with the report that night waking and bedtime struggles persisted after 3 years in 84% of cases (1) and in 75% of 8 years-old children having SD at 3 years (2).

As expected, SBD score was influenced by the presence of asthma and adenotonsillitis; it is interesting to note that food allergy also have statistically significant effect, providing an indirect confirmation of an "allergic diathesis" in this group of children. Main effect of co-sleeping on this factor could be explained by the direct observation of the respiratory problems during sleep by the parents.

Recent report highlighted the correlation between sleep disordered breathing children and the comorbidity with behavioral sleep disorders (17); since adenotonsillitis is the main causative factor of OSAS in children, we can hypothesize that this pathology could determine global sleep disorder (as SDSC Total score) through the sleep disruption caused by sleep apnea. Adenotonsillitis is also involved with main effect on SWTD factor; again, it is possible that this disease could directly alter breathing during sleep, determine sleep fragmentation and therefore influence the appearance of sleep-wake transition disorders, confirming data reported in literature (17).

SDSC factors representing parasomnias (SWTD and DA) had influenced by the presence of early sleep disorders and of familiarity for sleep disorders; these findings enforce the common knowledge that parasomnias have a strong genetic predisposition.

The Somnolence factor had influenced by female gender and parents' sleep disorders; we can explain this result with the physiological pubertal increase of daytime sleepiness (18) and to the more advanced stage of pubertal maturation in girls (19).

The main effect of males gender on sleep hyperhydrosis factor is more difficult to explain; it could be linked a different electro-dermal reactivity in males, that have a higher electro-dermal resting levels than females (20).

Some limitations of the study should be noted. It could be taken into account the problem of the reliability of parental report, although it was demonstrated that parental reports of disturbed sleep and objective measurement of sleep generally agree (3). The ANOVA analysis allow us to evaluate the effects of independent variables on SDSC scores but it does not provide inference on predictive value. The visual generalized model on SDSC scores allowed us to enter only few variables in the model and therefore the variance explained was not high.

Notwithstanding these limitations, our results underline the role of genetic and neurobiological substrate on the development of sleep patterns and disturbances of children and confirm the clinical evidence that the presence of disturbed sleep in parents and the early sleep disturbances lead to different and multiple sleep problems, delineating the areas of the sleep that are involved and rising some suggestions on which factors could lead to different later sleep disturbances.

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