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The Sleep Disturbance Scale for Children (SDSC) Construction and validation of an instrument to evaluate sleep disturbances in childhood and adolescence

OLIVIERO BRUNI, SALVATORE OTTAVIANO, VINCENZO GUIDETTI, MANUELA ROMOLI, MARGHERITA INNOCENZI, FLAVIA CORTESI and FLAVIA GIANNOTTI

Department of Developmental Neurology and Psychiatry, University of Rome 'La Sapienza'

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SUMMARY To attempt a categorization of sleep disorders in children, we developed a 27 item Likert-type rating scale (Sleep Disturbance Scale for Children: SDSC) and assessed the psychometric properties was developed. The scale was distributed to the mothers of 1304 children (1157 controls, mean age 9.8y; 147 sleep disorder subjects, mean age 9.2y, composed of four clinical groups: Insomnia 39 subjects, Hypersomnia 12 subjects, Respiratory disturbances during sleep 25 subjects and Parasomnias 71 subjects). The internal consistency was high in controls (0.79) and remained at a satisfactory level in sleep disorder subjects (0.71); the test/retest reliability was adequate for the total ($r=0.71$) and single item scores. The factor analysis (variance explained 44.21%) yielded six factors which represented the most common areas of sleep disorders in childhood and adolescence. Enuresis was the only item with a factor loading lower than 0.40 and with a low inter-item correlation and was therefore eliminated, resulting in a final scale of 26 items. The re-evaluation of the sample, using the factor scores, supported the validity and the discriminating capacity of the scales between controls and the four clinical groups. The correlation between factor scores corroborated the hypothesis that childhood sleep disturbances are not independent entities nor do they cluster into different groupings related to each other. The SDSC appears to be a useful tool in evaluating the sleep disturbances of school-age children in clinical and non-clinical populations.

KEYWORDS adolescents, children, parasomnias, sleep disorders, sleep questionnaire

INTRODUCTION

A growing amount of literature suggests that sleep disturbances are common among school children. Epidemiological surveys carried out in childhood and adolescence evaluated the quantitative aspects of sleep behaviour, assessing the frequency distribution of sleep disturbances through the distribution of questionnaires (Salzarulo and Chevalier 1983; Dollinger 1985; Richman 1987; Fisher *et al.* 1989). The frequency of such disorders has not been clearly established, although sleep difficulties have been found in 35–46% of school children and a 14% prevalence of 'poor sleepers' in school children is reported in different studies (Simonds and Parraga 1982; Petta *et al.* 1984; Klackenberg 1987; Kahn *et al.* 1989). However, in this age range sleep disturbances are rarely isolated, there is often an overlap of symptoms in the same subject. Therefore it could be very useful to obtain not only an evaluation of the frequency of sleep disorders, but also a 'score' that gives the clinician a global evaluation from the questionnaires of sleep disturbances for the single subject.

The structure of the paediatric sleep questionnaires for school-aged children varies widely; some of them are based on direct interviews, whereas others are based on specific questions

Correspondence: Dr Oliviero Bruni, Department of Developmental Neurology and Psychiatry, University of Rome 'La Sapienza', Via dei Sabelli 108-00185, Rome, Italy. Tel.: +39 6 4456941; fax: +39 6 4957857.

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on sleep behaviour and are difficult to compare because the questions asked or the grading of the responses are different and lack a specific sensitivity (Dollinger 1982; Simonds *et al.* 1982; Karacan *et al.* 1983; Kahn *et al.* 1989; Cook and Burd 1990). A few studies (Dollinger 1982; Fisher *et al.* 1989, 1990; Acebo *et al.* 1994) were carried out to attempt a standardization of the questionnaires on sleep behaviour in childhood and adolescence but none were formulated to give an index of sleep disturbances. A study carried out by Fisher *et al.* (1990) was the only attempt to formulate a standardized rating scale, along with the investigation of the factor structure, to determine whether the factor patterns corresponded to clinically described categories. However, this study failed to demonstrate relationships between factors and the categories of children's sleep disorders included in the diagnostic system proposed by the Association of Sleep Disorders Centres (ASDC 1979), particularly for the section of disorders of initiating and maintaining sleep. This result was explained by the authors as having been as a result of the low accuracy of the parental reports and to the incorrect interpretation of the wording of items in the questionnaire. Although the problem of exactness in the parental report (inversely related to the length of the recall period) could be taken into account, this source was needed to obtain information regarding the sleep behaviour of children in a large sample; furthermore, parental reports of disturbed sleep and objective measurement of sleep generally agree (Acebo *et al.* 1994; Pollock 1994). The bias concerning the information given by the parents could be minimized with the correct wording of the items and the exact description of specific sleep disturbances that could improve the reliability of parental rating scales.

According to these assumptions, a questionnaire in order to assess a variety of sleep-related behaviours in childhood and adolescence (Sleep Disturbance Scale for Children: SDSC) was developed. The purpose of the study was to assess the psychometric properties, to define the factor structure of the questionnaire and to evaluate if it could fit into the categories of the ASDC (1979).

METHOD

Development of the questionnaire

The development of the SDSC was made in order to: (1) provide a standardized measure of sleep disturbance in childhood and adolescence through an easy-to-use sleep index score for clinicians and researchers; (2) create a database of a large population in order to define normal values; (3) define different subsets of items that could be used as a screening test for identifying the specific areas of sleep disorders and (4) identify children with disturbed sleep.

The items were derived from clinical experience and from a review of previous sleep questionnaires reported in the literature. The items that described a typical symptom of any major sleep disorder were selected, even if of low frequency in the general population.

The initial questionnaire, composed of a larger number of items (45), was tested on a randomly chosen pilot sample in two elementary schools in Rome during a period in which epidemiological data were collected (Bruni *et al.* 1994). The answers to the preliminary questionnaire are not included in the present report. Because some of the questions were not understood clearly by the mothers, we omitted or clarified some of them. As part of previous studies (Bruni *et al.* 1994, 1995), we performed repeated measures of item reliability, consistency and discrimination that allowed us to eliminate those with low item-total correlation without significantly changing the internal consistency.

The SDSC assesses sleep behaviour and disturbances during the previous 6 mo. We chose a 6-mo period because of the low frequency in the population of some sleep disorders and in order to discriminate between transient and persistent disturbances. The questionnaire consisted of two sections: the first one was used to obtain demographic, behavioural and clinical data, information about previous illnesses and present medical status with specific questions regarding pathology that could affect sleep; the second was made up of 27 items in a Likert-type scale with values 1–5 with the wording arranged so that higher numerical values reflected a greater clinical severity of symptoms.

Subjects

The SDSC was distributed during a 12 mo study period to: (a) normal healthy control subjects (C), 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 centre, 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%. Based on the first part of the questionnaire, 95 subjects (7.6%), with medical/developmental problems or with chronic illnesses or taking drugs affecting sleep, were excluded. After this selection, questionnaires were completed for 1157 children (583 Male, 574 Female) aged 6.5–15.3 y (mean 9.8). Joint letters from the director of the schools and from the investigators describing the study design and requesting the co-operation of the parents, were distributed with the questionnaire. The forms were handed out and collected by the teachers.

(b) consecutive sleep disorder children (SD) (85 Male, 62 Female, mean age 9.2 y; range 5.8–15.2) referred to the Sleep Disorders Centre of this Department during the period September 1994–September 1995. Of the 147 subjects, 39 (26.53%) were referred for problems in initiating and maintaining sleep (Insomnia), 12 (8.16%) for excessive somnolence (Hypersomnia), 25 (17%) for respiratory disturbances during sleep (RDS) and 71 (48.29%) for parasomnias (PAR). Evaluation for all subjects included a complete medical history and physical examination as well as evaluation of cognitive development and personality profile. The presence of known central nervous system diseases when suspected, was assessed with neurophysiological and

neuroradiological examinations. The diagnosis of the sleep disorder, when necessary, was confirmed by a polysomnographic study.

The two groups were comparable by age and sex. Analysis of variance failed to show significant differences in age between groups. The sex ratio among SD and C subjects was comparable ($\chi^2 = 3.18$, d.f. = 1, not significant).

The entire questionnaire took the mothers 10 min to complete and 5 min were required to enter data on the computer and to score.

To evaluate test/retest reliability, 100 subjects were randomly selected from the control group to complete the SDSC once again.

Statistical analysis

Reliability analysis was used to calculate Cronbach's alpha, which gives a measure of the internal consistency, and to construct the item-total correlation coefficients.

Paired Student's *t*-tests and Spearman rank order correlation were used to assess test/retest reliability at time 1 (T1) and time 2 (T2).

The factor analysis of SDSC item scores was performed using the principal component method of extraction and rotated by using the varimax method.

Sensitivity and specificity were assessed using the ROC technique (Fletcher *et al.* 1988) to set the 'cut-off point'. Sensitivity is the extent to which a scale detects patients with the target illness, whereas specificity is the extent to which it identifies normal subjects as not having the illness.

The degree to which the questionnaire detected differences between controls and the SD group (validity) was assessed using the ANOVA test for the total and the single factor scores.

All statistical analyses were performed on a personal computer using the commercially available package program Statistica (TM) vs. 4.5 (Statsoft Inc., Tulsa, OK).

RESULTS

Internal reliability

The reliability analysis was performed on item scores from the C and the SD subjects. Cronbach's alpha was 0.79 for the C group and 0.71 for the SD group (Table 1). This indicates a good level of internal consistency among the 27 items of the SDSC questionnaire for both groups considered. Item-total correlation matrix showed coefficients ranging from 0.46 (item 4) to 0.17 (item 19) for the control group and ranging from 0.48 (item 4) to 0.08 (item 19) for the SD group. The alpha value did not increase after deleting any one of the items, except for the sleep disorder group (items 8, 14, 19); however, the aforementioned deletion did not significantly change the alpha value.

Test/retest reliability

The average length of the test/retest interval (T1–T2) was 35 d (range: 28–46 d).

Table 1 Cronbach's alpha and item-total correlations between the groups

		Control	*Sleep disorder*
		1157	*147*
Cronbach's alpha		*0.79*	*0.71*
	Items	*r*	*r*
	1	0.28	0.12
	2	0.37	0.24
	3	0.38	0.29
	4	0.46	0.48
	5	0.44	0.40
	6	0.30	0.24
	7	0.21	0.13
	8	0.20	0.10
	9	0.26	0.28
	10	0.32	0.34
	11	0.36	0.40
	12	0.34	0.30
	13	0.26	0.15
	14	0.22	0.10
	15	0.27	0.28
	16	0.40	0.29
	17	0.25	0.26
	18	0.32	0.29
	19	0.17	0.08
	20	0.21	0.17
	21	0.27	0.17
	22	0.31	0.19
	23	0.38	0.25
	24	0.45	0.39
	25	0.31	0.21
	26	0.33	0.23
	27	0.21	0.10

Completion rate was 94% and there were 94 subjects (38 Male, 56 Female, mean age 9.4 y; range 6.11–10.10 y). Spearman rank order correlation demonstrates temporal stability in total ($r = 0.71$) and single item scores that ranged from 0.66 (item 17) to 0.21 (item 14), all significant at $P < 0.05$. Paired Student's *t*-tests for the single items showed no significant differences between T1 and T2.

Factor analysis

Factor analysis was performed for the C and the SD groups.

To determine the number of factors to extract, scree plots and eigenvalues were examined. Using the eigenvalues of one criterion, eight factors were extracted, accounting for 52% of the variance. Inspection of the scree plot suggested a six-factor solution. Analyses of all the possible solutions between six and eight factors indicated that the six-factor solution, which accounted for 44.21% of the variance, was the most interpretative and the one that appeared to best fit the data. The factor solution is presented in Table 2.

Twenty-six out of 27 items loaded above 0.40 on the extracted factors; item 19 (bed-wetting) showed a loading of 0.15 on factor five. Since this item showed the lowest factor loading and also the lowest inter-item correlation, it was eliminated

Table 2 Factor for the Sleep Disturbance Scale for Children

	Variance explained	*Factor loading*
Factor 1: Disorders of initiating and maintaining sleep (DIMS)	16.58%	
1 Sleep duration		0.55
2 Sleep latency		0.64
3 Going to bed reluctantly		0.55
4 Difficulty in falling asleep		0.68
5 Falling asleep anxiety		0.46
10 Night awakenings		0.47
11 Difficulty in falling asleep after awakenings		0.45
Factor 2: Sleep breathing disorders (SBD)	6.29%	
13 Breathing problems		0.74
14 Sleep apnoea		0.67
15 Snoring		0.63
Factor 3: Disorders of arousal/nightmares (DA)	5.91%	
17 Sleepwalking		0.46
21 Sleep terrors		0.77
22 Nightmares		0.72
Factor 4: Sleep wake transition disorders (SWTD)	5.53%	
6 Hypnic jerks		0.60
7 Rhythmic movement disorders		0.40
8 Hypnagogic hallucinations		0.42
12 Nocturnal hyperkinesia		0.43
18 Sleeptalking		0.46
20 Bruxism		0.49
Factor 5: Disorders of excessive somnolence (DOES)	5.10%	
23 Difficulty in waking up		0.67
24 Tired when waking up		0.71
25 Sleep paralysis		0.53
26 Daytime somnolence		0.52
27 Sleep attacks		0.41
19 Bed-wetting		0.15
Factor 6: Sleep hyperhydrosis (SHY)	4.80%	
9 Falling asleep sweating		0.85
16 Night sweating		0.79
Total variance explained	**44.21%**	

from further analysis. The 26 item scale is reported in Appendix A.

Factor one was defined by seven items related to sleep duration and latency, problems in falling asleep and night awakenings; therefore this factor could be generically labelled as the difficulty in initiating and maintaining sleep factor (DIMS). Factor two is entirely composed of sleep disorder breathing items. Factor three was defined by three items related to arousal disorders (DA: sleepwalking, sleep terrors) and nightmares. Factor four reflected the sleep/wake transition disorders (SWTD). Factor five was described entirely by the items related to daytime somnolence and restless sleep and could therefore be defined as the disorders of excessive somnolence factor (DOES). The items with the highest factor loading were those referred to falling asleep and night sweating that identified the sixth factor as sleep hyperhydrosis (SHY).

Forcing the factor analysis of the SD group into six factors (variance explained 47.82%), it was observed that four out of six corresponded, with minimal variation, to the factor structure of the control sample (Table 3). The SD group showed differences in factors three and four, three being composed of items related to arousal and sleep/wake transition disorders (items 6, 12, 17, 18, 20, 21 and 22) while factor four was defined by hypnagogic hallucinations and sleep attacks plus bed-wetting and rhythmic movement disorders.

Distribution of SDSC score and validity

The factor scores were obtained by summing the score of the items which loaded on the single factor. The total score is the sum of the 26 items retained with a possible range from 26 to 130. The total score (ranging from 26 to 87) showed different distributions for C and SD subjects (Fig. 1) and achieved normal distribution in SD patients (Wilk's $W = 0.97$), while it had a skewed distribution in the C group; the score was therefore logarithmically converted for statistical analysis (Wilk's $W = 0.93$).

The ROC analysis showed that the SDSC had good

Table 3 Correspondence of the two factor solutions

*Factor**	*Control group*		*Sleep Disorder Group*	
	Items	*Variance explained*	*Items*	*Variance explained*
1. DIMS	1, 2, 3, 4, 5, 10, 11	16.58%	1, 2, 3, 4, 5, 10, 11	12.46%
2. SBD	13, 14, 15	6.29%	13, 14, 15	7.12%
3. DA	17, 21, 22	5.91%	**6, 12,** 17, **18, 20,** 21, 22	9.93%
4. SWTD	6, 7, 8, 12, 18, 20	5.53%	7, 8, **19, 27**	5.61%
5. DOES	23, 24, 25, 26, 27, 19	5.10%	23, 24, 25, 26	6.96%
6. SHY	9, 16	4.80%	9, 16	5.74%

* See Table 2 for abbreviations and for the numbers and the wording of the items; non-corresponding items are in bold.

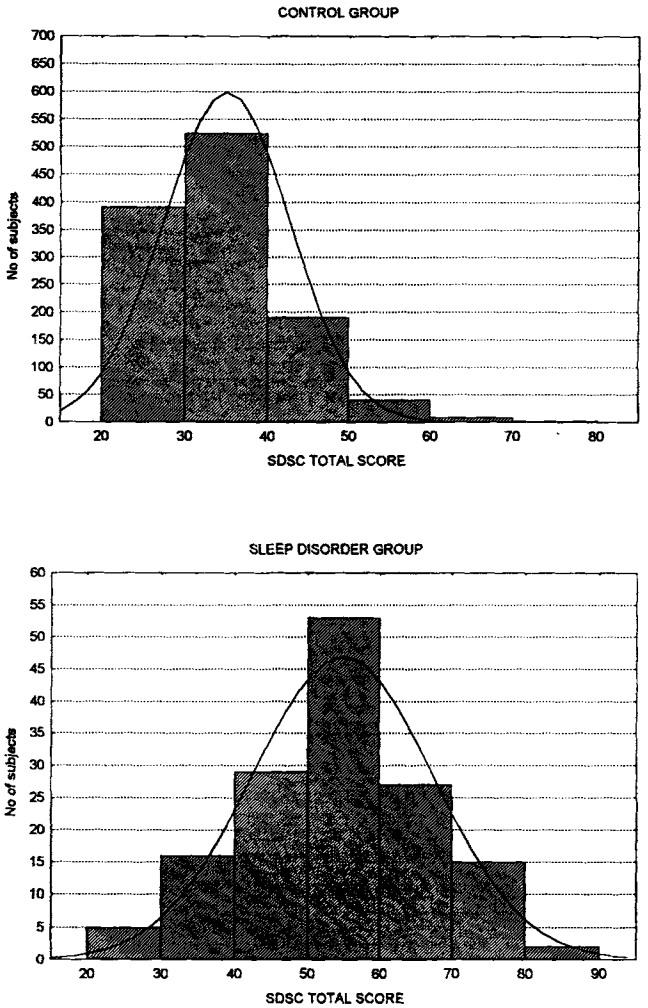

Figure 1. Histograms of the distribution of the SDSC total score for the control and sleep disorder subjects.

diagnostic accuracy (AUC=0.91) and that the cut-off score with the best diagnostic confidence, as determined by the intersect point of sensitivity and specificity, was 39 (which corresponded to the upper quartile of the control group's SDSC total score); this cut-off point gave a sensitivity of 0.89 and a specificity of 0.74. This score correctly identified 73.4% of the C group (849/1157) and 89.1% of the SD subjects (131/147) and could be used as a rough limit to identify children with disturbed sleep.

The comparisons of the mean total and factor scores between the groups and the statistical differences analysed by the ANOVA test, after the log-transformation, showed significant differences between groups (Table 4).

The covariation for age and sex showed non-significant effects on the total score (age: $F=1.53$, $P=0.22$; sex: $F=0.15$, $P=0.69$). Regarding factor scores, there were significant effects only for DOES (age: $F=33.08$, $P<0.01$; sex: $F=5.61$, $P<0.05$) and SHY factors (age: $F=10.48$, $P<0.01$; sex: $F=23.96$, $P<0.01$). Older children and females were more prone to somnolence while younger children and males to hyperhydrosis.

The post-hoc analysis (Student–Newman–Keuls procedure; Hays 1988) demonstrated that control subjects differed from all patient groups on total and factor scores except for the SBD factor, where no difference was found between C vs. PAR and C vs. INS. For the total PAR subjects scored lower than the other three clinical groups and showed statistical differences vs. INS patients. All factor scores distinguished the corresponding group from the others except for the SWTD and SHY factors, which differentiated only the control subjects from the other clinical groups.

A recording sheet based on the T-score permitted the comparison between the child's total and factor scores with normal values (Appendix B).

The factor-total correlation matrix for the two groups (Table 6 and 7) showed that DIMS, SWTD and DOES factors exhibited the highest r-values (respectively $r=0.77,67,69$ for the C group and $r=0.69,61,53$ for the SD group). C group interfactor correlations were all lower than 0.30 except for three ($r=0.30$ between DA and SWTD, $r=0.32$ between the DIMS and SWTD and $r=0.41$ between DIMS and DOES factors); in the SD group, no correlations higher than 0.30 were found between factors. It is interesting to note that a very low correlation ($r=0.09$) was found between DIMS and DOES factors in the SD group.

DISCUSSION

This study represents an attempt at a categorization of sleep disturbances in normal and sleep disordered children's groups

Table 4 Between group comparisons of the SDSC factor scores

*Factor**	*Control*		*Sleep disorder*		*P*
	Mean	*SD*	*Mean*	*SD*	
1. DIMS	9.9	3.11	17.96	6.89	<0.001
2. SBD	3.77	1.45	4.84	2.60	<0.001
3. DA	3.29	0.84	5.07	2.47	<0.001
4. SWTD	8.11	2.41	12.6	4.12	<0.001
5. DOES	7.11	2.57	9.61	4.23	<0.001
6. SHY	2.87	1.69	4.77	2.90	<0.001
SDSC total score	35.05	7.70	54.87	12.49	<0.001

* See Table 2 for abbreviations.

Table 5 SDSC scores. Comparisons between diagnostic groups

	Mean score ± SD					*ANCOVA*		*Significant Student–Newman–Keuls' comparisons*
	C (n=1157)	*INS (n=39)*	*HYPERS (n=12)*	*RDS (n=25)*	*PAR (n=71)*	*F*	*P*	
DIMS	9.90±3.11	24±5.57	14±6.83	16.32±4.98	15.90±6.16	152.50	<0.001	C vs. INS, HYPERS, RDS, PAR INS vs. HYPERS, RDS, PAR
SBD	3.77±1.45	4.31±1.86	5.5±2.90	8.44±2.96	3.76±1.36	47.61	<0.001	C vs. RDS, HYPERS RDS vs. INS, HYPERS, PAR
DA	3.29±0.84	4.53±2.66	4.33±2.57	4.28±1.59	5.77±2.44	90.21	<0.001	C vs. INS, HYPERS, RDS, PAR PAR vs. INS, HYPERS, RDS
SWTD	8.11±2.41	11.89±4.49	13.25±3.76	12.20±3.89	13.03±4.06	83.13	<0.001	C vs. INS, HYPERS, RDS, PAR
DOES	7.11±2.57	10.26±3.93	14.91±5.09	9.24±3.62	9.11±3.74	41.06*	<0.001	C vs. INS, HYPERS, RDS, PAR HYPERS vs. INS, RDS, PAR
SHY	2.87±1.69	4.76±2.90	5.25±3.07	5.32±3.11	4.49±2.82	24.89*	<0.001	C vs. INS, HYPERS, RDS, PAR
Total score	35.05±7.7	59.77±11.88	57.25±9.71	55.80±11.73	51.45±12.66	132.26	<0.001	C vs. INS, HYPERS, RDS, PAR PAR vs. INS

* Significant effect of age and sex as covariates.
Legend: C = Controls; INS = Insomnia; HYPERS = Hypersomnia; RDS = Respiratory disturbances during sleep; PAR = Parasomnias.

Table 6 Pearson correlation coefficients among the factors for control group

	Total	*DIMS*	*SBD*	*DA*	*SWTD*	*DOES*
DIMS	0.77					
SBD	0.45	0.21				
DA	0.45	0.29	0.11			
SWTD	0.67	0.32	0.26	0.30		
DOES	0.69	0.41	0.17	0.22	0.29	
SHY	0.51	0.26	0.13	0.17	0.23	0.22

See Table 2 for abbreviations.

Table 7 Pearson correlation coefficients among the factors for sleep disorder group

	Total	*DIMS*	*SBD*	*DA*	*SWTD*	*DOES*
DIMS	0.69					
SBD	0.34	0.01				
DA	0.31	0.10	0.09			
SWTD	0.61	0.18	0.11	0.23		
DOES	0.53	0.09	0.13	0.01	0.24	
SHY	0.45	0.12	0.21	0.01	0.13	0.21

See Table 2 for abbreviations.

based on the parental reports. The internal consistency, the factor analysis and the validity in discriminating clinical groups support the use of the SDSC score as a sum scale of the 26 items both for the total score and the single six factor ones.

Some of the limitations concerning this study should be noted. The data were cross-sectional, based on a retrospective classification of the subjects, and the collection of information was limited to the parents. However, in studying a large cohort we were obliged to use the retrospective method and to use parents as a source of clinical information. Although valuable data could have been directly obtained from the children, the collection of information was limited to the parents since the questionnaires analyse some sleep disorders and behaviours which the child could not be aware of (i.e. sleepwalking, sleeptalking, sleep terrors, etc.). Furthermore, it was demonstrated that parental information is an effective method for the detection of behavioural and developmental problems (Glascoe and Dworkin 1995) and sleep disturbances (Acebo *et al.* 1994; Pollock 1994). We should also consider that a percentage of the control subjects might possibly have sleep disturbances, as in the general population. Confirming this assumption, this instrument correctly identified 73.4% of controls and was consistent with literature reports (Kahn *et al.* 1989) that $\approx 30\%$ of a normal sample of children could have sleep problems.

Notwithstanding these limitations and the lack of a verification of the parental reports through independent measures such as a polysomnographic study of a representative sample, the questionnaire appears to be useful in evaluating the sleep disturbances of school age children, both in large surveys and in research applications in clinical and non-clinical population. It may be used as a simple screening measure and could also be helpful in analysing the relationship between overall sleep disturbance and other variables, such as age, health status, medical diseases, psychological conditions and cognitive performances.

In this study, the factor analysis seems to group items in a logical and comprehensive fashion and these findings are in agreement with those of other adult sleep questionnaires that yielded 7–8 factors (Webb *et al.* 1976; Beutler *et al.* 1978; Domino *et al.* 1984; Buysse *et al.* 1989). A review of the factor analytic literature in childhood and adolescence (Dollinger 1985) showed that the majority of the studies are primarily based on assessing psychopathology or other behaviours associated with sleep. In these studies, sleep disturbances are considered as a contributing factor or a consequence of psychopathology. We are aware that psychological links (such as parent/child interaction) could play an important role in determining sleep disturbances, but it is beyond the aims of this study to discuss if and why the psychological substrate could interfere with sleep behaviour.

The only two reports which are based on assessing primarily the sleep disorders from a statistical point of view are the factor analytic study of the Children Sleep Behaviour Scale (CSBS; Fisher *et al.* 1990) and Dollinger's (1982) study based on the cluster analysis of 20 items. This latter study identified four clusters of children composed of a group with various immature bedtime behaviours, two clinically sleep-disturbed groups (one defined by fear of sleeping and the other one by severe anxiety during sleep) and a non-sleep-disturbed group. This investigation was the first attempt to classify children with sleep problems not only based on clinical intuition, but statistical analysis. It also highlights the clinical utility of clustering children on the basis of sleep-related symptomatology.

The factor analysis of the CSBS (Fisher *et al.* 1990) yielded five factors: the first factor was related to behaviours characteristic of parasomnias, the second reflected bedtime resistance, the third concerned positive affect, the fourth motor activity during sleep and the fifth sleep anxiety. The results did not support the hypothesis that the five factor patterns corresponded to clinically described categories (derived from the ASDC nosology). The CSBS is based on items exploring primarily sleep behaviours other than sleep disorders. This approach, and the wording of the items, could guide the parents towards a description of 'normal behaviour' and could lead to an underestimation of the sleep disorders by the mothers; this could explain the absence of concordance with the ASDC categories.

The SDSC factor analysis could be considered closer to the ASDC categories, since the wording and the items are primarily based on sleep disturbances. We prefer to use the old classification system (ASDC 1979) rather than the new one (ICSD, 1990) because in our view it seems to be more adaptable to childhood, more clinical in its nature and best suited for the purpose of the study.

Factor one (DIMS) of the SDSC was defined by items related to bedtime resistance and by those related to night awakenings, sleep duration and latency and could therefore fit the definition of the ASDC. Factors two and five were clearly unequivocal groupings represented by sleep breathing disorders and disorders of excessive somnolence. The reason why the bed-wetting item loaded on the DOES factor, could be related to the fact that most parents believe that depth of sleep is a major reason why their child wets the bed. Despite this fact, three decades of research indicate that bed-wetting children do not have abnormal sleep patterns and, although depth of sleep may be an important factor in some children, enuretic episodes are not associated with deep sleep, transition between sleep stages, or arousal. In the sense that a sleep disorder is defined by some abnormal sleep pattern, nocturnal enuresis is not strictly speaking a sleep disorder. (Sheldon *et al.* 1992; Barclay and Houts 1995). These data are in agreement with other questionnaire-based studies (Dollinger 1982; Fisher *et al.* 1987, 1990) which stated that enuresis should be considered independent from a wide range of sleep-related behaviours, and should not be included in any category of the child's sleep problems.

Factor three (sleepwalking, sleep terrors, nightmares) and four (sleep-wake transition disorders) reflected the parasomnias. Sleep terror, nightmares and sleepwalking loaded into the same factor because it could be difficult for the parents

to discriminate between these events on the basis of the clinical presentation. Nocturnal hyperkinesia that loaded on factor four could be considered a marker of sleep instability in childhood by the parents.

Sleep hyperhydrosis (factor six) was associated with sleep apnoea (Brouillette *et al.* 1984; Guilleminault 1987) and sudden infant death syndrome (Kahn *et al.* 1987). Although an association between sleep apnoea and excessive sweating has been reported, these results showed that the correlation between the SBD and SHY factor was low ($r=0.13$), indicating that based on parents' ratings the two conditions are not related to each other. Since few studies have been carried out on this disorder, the prevalence and correlates of excessive sweating in sleep in children remains unknown. However, we think that it should be considered as a characteristic childhood sleep disorder and deserves further investigation also because it was included in the International Classification of Sleep Disorders (ICSD 1990) as a proposed sleep disorder.

Regarding the factor analysis of the SD group, the grouping of several items in factor three could be as a result of the fact that the parents tended to bring all the paroxysmal events together because of the high frequency and of the possible overlapping of sleep problems in sleep disordered subjects. In factor four, the loading of hypnagogic hallucinations and sleep attacks are probably related to cases of hypersomnolence or suspected narcolepsy in the SD group. Furthermore, the association of bed-wetting and rhythmic movement disorders could be linked to the presence of children with brain damage or mental retardation in the hypersomnia group. This association is often reported in children with brain dysfunction (Thorpy 1990).

When analysing the differences between groups it was noted that each factor significantly differentiated the corresponding clinical group from the others, except for the SWTD and SHY factors. The latter is the only one that did not have a corresponding 'clinical group'. The SWTD factor did not differentiate the PAR group from the others, probably because the parasomnias represent a heterogeneous group of disorders and because of the low prevalence of some particular disorders that clustered on the SWTD factor.

Moreover, the lowest SDSC total score (achieved by the parasomnias group) could be explained assuming that parasomnias represent the less disrupting events for children's sleep, in the sense that they are dysfunctions associated with sleep but do not alter the sleep pattern.

The mean effect of age and sex as covariates on the DOES factor, with older subjects and females being more somnolent, could be related to the physiologic pubertal increase of daytime sleepiness and to the more advanced stage of pubertal maturation in girls (Carskadon *et al.* 1980; Carskadon *et al.* 1993). The differences in the SHY factor are more difficult to explain; the direct relation with a younger age could be linked to the maturation of the autonomic nervous system, but it is more complex to clarify the higher level of hyperhydrosis in males. Therefore this finding deserves further investigation.

The factor analysis and the correlation between the sub-scales supported the hypothesis that childhood sleep disturbances do not belong to a unitary dimension, but tend to form subgroups more or less related to each other, confirming the clinical evidence of the overlapping of pediatric sleep disorders (Dollinger 1985; Fisher and Wilson 1987; Sheldon *et al.* 1992). There is a low inter-factor correlation in SD subjects which shows that, in this group, sleep disturbances are clustered into groupings which are not interconnected. It is interesting to note that, while DIMS and DOES factors are inter-related in the C subjects, in the SD groups there is no correlation; we could explain this result assuming that the lack of sleep in SD subjects could lead to hyperactivity and behaviour disturbances instead of sleepiness.

CONCLUSIONS

The results appear to demonstrate that: (1) the SDSC is an easy-to-fill form to collect data on sleep behaviour of children and adolescents; (2) the internal consistency is good in spite of the relative heterogeneity of the items; (3) both item and total scores do not change significantly when tested and re-tested; (4) the six factors extracted, representing the most common areas of sleep disorders in childhood and adolescence, could be used to design a 'child's sleep disturbance profile' and would be useful for directing the clinician toward specific areas of dysfunction that require further investigation; (5) the evaluation of the clinical groups using factor scores confirms the discriminating capacity of the scales derived from factor analysis.

However, we have to consider that the SDSC is primarily intended to assess the sleep-related disorders in childhood and adolescence and not to provide an accurate clinical diagnosis.

Further studies are needed to assess the replicability of the present study, to verify the parental sleep reports and the validity of the SDSC through sleep laboratory measures and to analyse different clinical samples. Moreover, it could be very useful to study the differences in the same clinical sample by grouping the hereditary and anamnestic variables (i.e. presence of sleep disturbances in the parents, presence of sleep problems in infancy, etc.), or to repeat and extend this study by combining the sleep disturbance scale data with other neurobehavioural variables.

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REFERENCES

Acebo, C., Sadeh A., Seifer R., Tzischinsky O., Dickstein S., Aytur S., Brown C., Shimada S., Yoder E., Hafer A. and Carskadon M. A. Mother's assessment of sleep behaviours in young children: scale

reliability and validation vs. actigraphy. *Sleep Research*, 1994, 23: 130.

Association of Sleep Disorders Centers and the Association for the Psychophysiological Study of Sleep. Diagnostic classification of sleep and arousal disorders. *Sleep*, 1979, 2: 1–137.

Barclay D. R. and Houts A. C. Childhood enuresis. In: Schaefer C. E. (Ed.) *Handbook of Sleep Disorders in Children*. Aronson Inc., Northvale, 1995: 223–252.

Beutler, L. E., Thornby, J. I. and Karacan I. Psychological variables in the diagnosis of insomnia. In: R.L. Williams and I. Karacan (Eds) *Sleep Disorders: Diagnosis and Treatment*. John Wiley & Sons, New York, 1978: 61–100.

Brouillette R., Hanson D., David R. *et al.* A diagnostic approach to suspected obstructive sleep apnea in children. *J. Pediatr.*, 1984, 105: 10.

Bruni, O., Cortesi, F., Giannotti, F. and Romoli M. Preliminary report on a sleep disturbance questionnaire for school-age children (SDQC). *J. Sleep Res.*, 1994, 3 (Suppl. 1): 33.

Bruni, O., Ottaviano, S., Guidetti, V., Romoli, M. and Innocenzi M. The Sleep Disturbance Index for Children (SDIC): Construction and validation of an instrument to evaluate sleep disturbances in childhood and adolescence. Abstract Book. *Vth European Pediatric Sleep Club Meeting*, Messina February 10–11, 1995: 10–12.

Bruni, O., Romoli, M., Innocenzi, M., Giannotti, F., Cortesi, F. and Ottaviano S. Prevalenza dei disturbi del sonno in età scolare. In: Di Perri R., Raffaele M., Silvestri R. and Smirne S. (Eds) *Il Sonno in Italia 1994*. Poletto Ed., Milano, 1994: 163–171.

Buysse, D. J., Reynolds III C. F., Monk, T. H., Berman, S. R. and Kupfer D. J. The Pittsburg Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Res.*, 1989, 28: 193–213.

Carskadon, M. A., Harvey, K., Duke, P., Anders, T. F., Litt, I. F. and Dement W. C. Pubertal changes in daytime sleepiness. *Sleep*, 1980, 2: 453–460.

Carskadon, M. A., Vieira, C. and Acebo C. Association between puberty and delayed phase preference. *Sleep*, 1993, 16 (3): 258–262.

Cook, J. and Burd L. Preliminary report on construction and validation of a pediatric sleep disturbance questionnaire. *Percept. Motor Skills*, 1990, 70: 259–267.

Dollinger S. J. On the varieties of childhood sleep disturbance. *J. Clin. Child Psychol.*, 1982, 11: 107–115.

Dollinger S. J. Childhood sleep disturbances. *Adv. Clin. Child Psychol.*, 1985, 9: 279–332.

Domino, G., Blair, G. and Bridges A. Subjective assessment of sleep by sleep questionnaire. *Percept. Motor Skills*, 1984, 59: 163–170.

Fisher, B. E. and McGuire K. Children Sleep Behavior Scale: Normative data on 870 children in grades 1–6. *Percept. Motor Skills*, 1989, 68: 227–236.

Fisher, B. E., Pauley, C. and McGuire K. Do diagnostic pattern exist in the sleep behaviors of normal children? *J. Abnorm. Child Psychol.*, 1990, 18 (2): 179–186.

Fisher, B. E. and Wilson A. E. Selected sleep disturbances in school children reported by parents: prevalence, interrelationships, behavioral correlates and parental attributions. *Percept. Motor Skills*, 1987, 64: 1147–1157.

Fletcher R. H., Fletcher S. W. and Wagner E. H. *Clinical Epidemiology, the Essentials*. Williams and Wilkins, Baltimore, 1988 (second edition).

Glascoe F. P. and Dworkin P.H. The role of parents in the detection of developmental and behavioral problems. *Pediatrics*, 1995, 95 (6): 829–836.

Guilleminault C. Obstructive sleep apnea syndrome in children. In: C. Guilleminault (Ed) *Sleep and its Disorders in Children*. Raven Press, New York, 1987: 213–224.

Hays W. L. *Statistics*. C.B.S. College Publishing, New York, 1988 (fourth edition).

I.C.S.D. *International Classification of Sleep Disorders. Diagnostic and Coding Manual. Diagnostic Classification Steering Committee*. Thorpy M. J., Chairman. Rochester, Minnesota: American Sleep Disorder Association, 1990.

Kahn, A., Van de Merckt, C., Dramaix, M., Magrez, P., Blum, D., Rebuffat, E. and Montauk L. Transepidermal water loss during sleep in infants at risk for sudden death. *Pediatrics*, 1987, 80 (2): 245–250.

Kahn, A., Van de Merckt, C., Rebuffat, E., Mozin, M. J., Sottiaux, M., Blum, D. and Hennart P. Sleep problems in healthy preadolescents. *Pediatrics*, 1989, 84 (3): 542–546.

Karacan, I., Thornby, J. and Williams R. L. Sleep disturbance: a community survey. In: C. Guilleminault and E. Lugaresi (Eds) *Sleep/Wake Disorders: Natural History, Epidemiology and Long-term Evolution*. Raven Press, New York, 1983: 37–60.

Klackenberg G. Incidence of parasomnias in children in a general population. In: C. Guilleminault (Ed) *Sleep and its Disorders in Children*. Raven Press, New York, 1987: 99–113.

Petta, D., Carskadon, M. A. and Dement W. Sleep habits in children aged 7–13 years. *Sleep Res.*, 1984, 13: 86.

Pollock J. I. Night-waking at five years of age: predictors and prognosis. *J. Child Psychol. Psychiat.*, 1994, 35: 699–704.

Richman N. Surveys of sleep disorders in children in a general population. In C. Guilleminault (Ed) *Sleep and its Disorders in Children*. Raven Press, New York, 1987: 115–127.

Salzarulo, P. and Chevalier A. Sleep problems and their relationship with early disturbances of the waking sleeping rhythms. *Sleep*, 1983, 6: 47–51.

Sheldon, S. H., Spire, J. P. and Levy H. B. *Pediatric Sleep Medicine*. W.B. Saunders, Philadelphia, 1992: 186.

Simonds J. F. and Parraga H. Prevalence of sleep disorders and sleep behaviors in children and adolescents. *J. Am. Acad. Child Psychiatr.*, 1982, 21 (4): 383–388.

Thorpy M. J. Rhythmic movement disorders. In: Thorpy M. J. (Ed.) *Handbook of Sleep Disorders*. Marcel Dekker, New York, 1990: 609–629.

Webb, W. B., Bonnet, M. and Blume G. A post-sleep inventory. *Percept. Motor Skills*, 1976, 43: 987–993.

Appendix A. SLEEP DISTURBANCES SCALE FOR CHILDREN

INSTRUCTIONS: *This questionnaire will allow to your doctor to have a better understanding of the sleep-wake rhythm of your child and of any problems in his/her sleep behaviour. Try to answer every question; in answering, consider each question as pertaining to the* ***past 6 months*** *of the child's life. Please answer the questions by circling or striking the number ① to ⑤.* Thank you very much for your help.

Name:_____ Age:_____ Date:_____

1. How many hours of sleep does your child get on most nights.	① *9-11 hours*	② *8-9 hours*	③ *7-8 hours*	④ *5-7 hours*	⑤ *less than 5 hours*
2. How long after going to bed does your child usually fall asleep	① *less than 15'*	② *15-30'*	③ *30-45'*	④ *45-60'*	⑤ *more than 60'*

					⑤ **Always (daily)**
				④ **Often (3 or 5 times per week)**	
			③ **Sometimes (once or twice per week)**		
		② **Occasionally (once or twice per month or less)**			
	① **Never**				
3. The child goes to bed reluctantly	①	②	③	④	⑤
4. The child has difficulty getting to sleep at night	①	②	③	④	⑤
5. The child feels anxious or afraid when falling asleep	①	②	③	④	⑤
6. The child startles or jerks parts of the body while falling asleep	①	②	③	④	⑤
7. The child shows repetitive actions such as rocking or head banging while falling asleep	①	②	③	④	⑤
8. The child experiences vivid dream-like scenes while falling asleep	①	②	③	④	⑤
9. The child sweats excessively while falling asleep	①	②	③	④	⑤
10. The child wakes up more than twice per night	①	②	③	④	⑤
11. After waking up in the night, the child has difficulty to fall asleep again	①	②	③	④	⑤
12. The child has frequent twitching or jerking of legs while asleep or often changes position during the night or kicks the covers off the bed.	①	②	③	④	⑤
13. The child has difficulty in breathing during the night	①	②	③	④	⑤
14. The child gasps for breath or is unable to breathe during sleep	①	②	③	④	⑤
15. The child snores	①	②	③	④	⑤
16. The child sweats excessively during the night	①	②	③	④	⑤
17. You have observed the child sleepwalking	①	②	③	④	⑤
18. You have observed the child talking in his/her sleep	①	②	③	④	⑤
19. The child grinds teeth during sleep	①	②	③	④	⑤
20. The child wakes from sleep screaming or confused so that you cannot seem to get through to him/her, but has no memory of these events the next morning	①	②	③	④	⑤
21. The child has nightmares which he/she doesn't remember the next day	①	②	③	④	⑤
22. The child is unusually difficult to wake up in the morning	①	②	③	④	⑤
23. The child awakes in the morning feeling tired	①	②	③	④	⑤
24. The child feels unable to move when waking up in the morning	①	②	③	④	⑤
25. The child experiences daytime somnolence	①	②	③	④	⑤
26. The child falls asleep suddenly in inappropriate situations	①	②	③	④	⑤

Disorders of initiating and maintaining sleep (sum the score of the items 1,2,3,4,5,10,11)	
Sleep Breathing Disorders (sum the score of the items 13,14,15)	
Disorders of arousal (sum the score of the items 17,20,21)	
Sleep-Wake Transition Disorders (sum the score of the items 6,7,8,12,18,19)	
Disorders of excessive somnolence (sum the score of the items 22,23,24,25,26)	
Sleep Hyperhydrosis (sum the score of the items 9,16)	
Total score (sum 6 factors' scores)	

Appendix B. SDSC Scoring Sheet

Name:_____ Age:_____

	TOTAL	DIMS	SBD	DA	SWTD	DOES	SHY	
T								T
100+	74+	26+	11+	8+	21+	20+		100+
99	73	25			20			99
98	72							98
97	71							97
96						19		96
95	70	24			19			95
94	69			7				94
93	68		10					93
92		23				18	10	92
91	67				18			91
90	66							90
89	65	22						89
88	64					17		88
87					17			87
86	63	21	9				9	86
85	62					16		85
84	61							84
83					16			83
82	60	20		6				82
81	59					15		81
80	58						8	80
79	57	19	8		15			79
78								78
77	56					14		77
76	55	18						76
75	54							75
74					14		7	74
73	53	17				13		73
72	52		7					72
71	51							71
70		16		5	13			70
69	50					12	6	69
68	49							68
67	48							67
66	47	15			12			66
65			6			11		65
64	46							64
63	45	14					5	63
62	44				11			62
61						10		61
60	43	13						60
59	42							59
58	41		5	4	10			58
57		12				9	4	57
56	40							56
55	39							55
54	38	11			9			54
53	37					8		53
52			4					52
51	36						3	51
50	35	10			8	7		50
49	34							49
48								48
47	33	9		3				47
46	32					6		46
45	31		3		7		2	45
44		8						44
43	30							43
42	29					5		42
41	28	7			6			41
40	27							40
39							1	39
38	26		2			4		38
37					5			37
36								36
35				2				35
34								34