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A new diagnostic tool for children with sleep disorders

First validation data for the Children's Sleep Comic

Introduction

Sleep disturbances occur frequently among school-aged children [1, 20]. However, the reported prevalence rates vary widely, between 5 and 40% [1, 19, 20]. This may be due to sample differences or the sleep disorders focused on, but most importantly, it could also reflect differences in the diagnostic tools used. Sleep disorders may lead to hyperactivity, irritability and aggression [6, 12, 31], as well as daytime sleepiness, a lack of concentration, memory deficits and cognitive impairment [10, 15]. Possible long-term consequences in children include a poor school performance, impaired family and social life [23, 32] and a reduced quality of life [13, 21]. Nevertheless, sleep disturbances in children are often not recognized in pediatric care [17, 22] and only 3.3% of consultations concern sleep problems [22]. Although sleep disorders are common and influence daily family life, only 13.9% of parents talk about the issue with their general practitioner [3].

To assess sleep disorders in children, the parents are usually interviewed. However, they do not always recognize all of the problems the child has with sleeping [18]. Based on parental interviews alone, one-third of sleep disorders go unrecognized; for example, parents may not be aware of awakenings during the night or early awakening in the morning [20]. Consequently, the child should also be involved in the diagnostic process. Children

are able to provide reliable information on certain aspects of their sleep, particularly concerning problems falling asleep and maintaining sleep [18, 20]. The younger the child, the better the parents' information about his or her sleep; the older the child, the better the child can provide the information him- or herself [24].

Despite the prevalence of childhood sleep disorders and the requirement for a valid diagnosis, there are few standardized diagnostic instruments [28]. Most of the existing questionnaires only assess the parents' view. The self-report questionnaires for pediatric sleep disorders that are available are designed for children of at least 8 years of age [30]. Therefore, we developed the Children's Sleep Comic as a new diagnostic tool for children aged 5–10 years [27].

Since we have previously developed a procedure for quantitative analysis and found the Children's Sleep Comic to be applicable and highly accepted in a target sample, we now present the first validation data. We assessed children with the Children's Sleep Comic and the German version of the Sleep Self Report (SSR-DE). We assessed their parents with the German version of the Children's Sleep Habits Questionnaire (CSHQ-DE) and the diagnostic interview for sleep disorders in children ("Diagnostischen Interview kindlicher Schlafstörungen", DIKS). We hypothesized that there would be a positive correlation between the presence

of a sleep disorder diagnosis according to the DIKS and the intensity of sleep problem score (ISPS) of the Children's Sleep Comic.

Materials and methods

Procedures and samples

Children were recruited from three randomly chosen German primary schools in Hesse and Bavaria. All schools were located in small towns. Prior to testing, parents received an informative letter, gave their written informed consent and provided a phone number for the interview. The study was conducted according to standard ethical guidelines as defined by the Declaration of Helsinki (World Medical Association) and certified by the Ethics Committee of the Medical Department of the University of Würzburg.

Children were tested in the classroom. A sample of 112 children aged between 5 and 11 years were interviewed with the Children's Sleep Comic. Group interviews were conducted with eight children per group. To prevent the children influencing each other during the interviews, each child sat at a separate table and provided answers in private. Each child received a copy of the comic. Additionally, an investigator read the questions aloud and questions, cartoons and answering options were all projected onto the wall. A second investigator was also present and quietly answered questions.

Children Sleep Comic



What are you doing before going to bed?



I rollick



I play computer games



I watch TV



I play with my family/brothers/sisters



I do something different

Schwertle, Kanis, Kahl, Kübler & Schlarb, 2011

Children Sleep Comic



Where do you fall asleep in the evening?



in my own bed



in my parents' bed



in the living room



in my brother's/ sister's bed



somewhere else

Schwertle, Kanis, Kahl, Kübler & Schlarb, 2011

Children Sleep Comic



Where do you sleep during the night?



I sleep in my own room

I sleep in the room of my brother or sister



I sleep in my parents' room

Schwertle, Kanis, Kahl, Kübler & Schlarb, 2011

Children Sleep Comic



Where do you sleep during the night?



I sleep in my parents' bed



I sleep in the bed of my brother or sister

Schwertle, Kanis, Kahl, Kübler & Schlarb, 2011

Fig. 1 ◀ Children's Sleep Comic example questions and response options

The children and their parents filled out further questionnaires at home: children completed the SSR-DE and parents completed the CSHQ-DE. Questionnaires were returned to the schools within 1 week. Parents provided demographic data.

Subsequently, the telephone interviews were conducted. Each interview was performed according to a defined procedure to reduce interviewer bias. The introduction, the interview itself and all additional questions were thus consistent. The duration of telephone interviews varied between 20 and 45 min.

Instruments

Children's Sleep Comic

The Children's Sleep Comic consists of 37 items relating to general information (e.g. age, gender, family, daytime activities, somatic complaints) and sleep problems including sleep hygiene, quality of

sleep, nightmares, dreaming, awakening in the morning, daytime napping, nighttime sweating, nighttime bruxism and chronotype. Items were generated based on the 2005 International Classification of Sleep Disorders-Second Edition (ICSD-2) from the American Academy of Sleep Medicine. Each item is associated with a cartoon for each possible response (see **Fig. 1** for examples). This enables young children to answer the questionnaire, together with an interviewer, without the need to be able to read and write.

The items concerning sleep hygiene generate information relating to activities prior to sleeping; where the child falls asleep, where the child sleeps during the night, activities in bed prior to sleeping, sleep-onset associations, behavior during nighttime disturbances and awakenings during the night. The items concerning quality of sleep address sleep quality during the week and at the weekend, as well as sleep quality in general. Furthermore, children state if they like going to bed. The questions relating to nighttime fears assess fear of particular objects, intensity of fear and whether children are concerned about the fears.

Some of the answering options had been previously classified as supporting sleep, negatively affecting sleep or as being neutral. The items classified as interfering with sleep are summed up to generate the ISPS, which allows for quantitative analysis. The highest possible ISPS is 26; the higher the score, the more severe the sleep problem.

The Children's Sleep Comic is of high value due to its child-orientated format. Previous results indicated its appropriateness for interviewing children with regards to their sleep behavior and sleep problems [27].

Parental interview for sleep disorders in children

The DIKS parental interview for sleep disorders in children [26] is a structured parental interview for the diagnosis of sleep disorders in children aged 5–10 years. It comprises all sleep disorder diagnoses and isolated symptoms of the ICSD-2 that are relevant for sleep disorders in children. Only tentative diagnoses can be given for narcolepsy and sleep-related breathing

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A new diagnostic tool for children with sleep disorders. First validation data for the Children's Sleep Comic

Abstract

Background. In addition to a parental evaluation, the diagnosis of childhood sleep disorders should include a child's own assessment of sleep behavior. In order to address the lack of self-rating instruments for the assessment of sleep in young children, a new self-assessment tool was developed: the Children's Sleep Comic. Here we present the first validation data.

Materials and methods. A sample of 112 children aged between 5 and 10 years was assessed with the Children's Sleep Comic and the German version of the Sleep Self Report (SSR-DE). Parents completed the German version of the Children's Sleep Habits Questionnaire (CSHQ-DE) and participated in a telephone interview based on the diagnostic interview for sleep disorders in children (DIKS). The diagnosed sleep disorders were compared to the children's ratings in the Children's Sleep Comic.

Results. Kuder–Richardson analysis demonstrated good internal consistency ($\alpha=0.86$). Initially, no correlation was found between

the intensity of sleep problem score (ISPS) of the Children's Sleep Comic and the presence of a diagnosis. Based on theoretical considerations and discriminatory power analysis, different subscores were then calculated for the symptoms of general insomnia and those of childhood behavioral insomnia addressed by the Children's Sleep Comic. Comparisons with the corresponding diagnoses according to the DIKS now yielded significant correlations. Comparisons between the Children's Sleep Comic and the SSR-DE, as well as the CSHQ-DE, also indicated significant moderate correlations.

Conclusion. The Children's Sleep Comic can be used as a reliable self-rating instrument for children with insomnia. The adapted procedure for quantitative analysis of the Children's Sleep Comic encourages further validation of the Children's Sleep Comic.

Keywords

Children · Sleep · Sleep disorders · Self-assessment · Validation

Ein neues diagnostisches Instrument für Kinder mit Schlafstörungen. Erste Validierungsdaten zum Kinderschlafocomic

Zusammenfassung

Hintergrund. Zur Diagnostik kindlicher Schlafstörungen sollte das Schlafverhalten des Kindes sowohl aus elterlicher als auch aus kindlicher Sicht beurteilt werden. Um dem Mangel an Selbstbeurteilungsinstrumenten zum Schlaf bei jungen Kindern zu begegnen, wurde ein neues Instrument entwickelt, der Kinderschlafocomic. Erste Validierungsdaten werden hier vorgestellt.

Material und Methoden. Eine Stichprobe von 112 Kindern im Alter von 5–10 Jahren bearbeitete den Kinderschlafocomic und die deutsche Version des Sleep Self Report (SSR-DE). Die Eltern beantworteten zusätzlich die deutsche Version des Children's Sleep Habits Questionnaire (CSHQ-DE) und nahmen an einem Telefoninterview teil, das auf dem diagnostischen Interview Kindlicher Schlafstörungen (DIKS) basierte. Die so diagnostizierten kindlichen Schlafstörungen wurden mit den Antworten der Kinder im Kinderschlafocomic verglichen.

Ergebnisse. Die interne Konsistenz war mit $\alpha=0,86$ hoch. Zunächst wurden keine Korrelationen zwischen dem Intensity-of-Sleep

Problem Score (ISPS) des Kinderschlafocomics und einer Diagnose nach DIKS gefunden. Folglich wurden unterschiedliche Teilscores für die Diagnosen allgemeine Insomnie und behaviorale Insomnie des Kindesalters gebildet, die sich aufgrund theoretischer Überlegungen und Trennschärfeanalysen ergaben. Die anschließenden Vergleiche mit den entsprechenden Diagnosen nach DIKS erbrachten signifikante Korrelationen. Auch die Vergleiche zwischen dem Kinderschlafocomic und dem SSR-DE sowie dem CSHQ-DE ergaben signifikante moderate Korrelationen.

Schlussfolgerung. Der Kinderschlafocomic kann zur Erfassung kindlicher Insomnien als reliables Selbstbeurteilungsinstrument eingesetzt werden. Die angepasste quantitative Auswertungsmethode für den Kinderschlafocomic ermutigt zu dessen Einsatz in weiteren Analysen.

Schlüsselwörter

Kinder · Schlaf · Schlafstörungen · Selbstbeurteilung · Validierung

Tab. 1 Differential diagnoses according to DIKS

Diagnosis	Frequency ^b (%)
Inadequate sleep hygiene	21.4
Insomnia	17.9
Behavioral insomnia of childhood	13.4
– Sleep-onset association type	8.9
– Limit-setting type	6.3
Psychophysiological insomnia	2.7
Sleep-related breathing disorder ^a	2.7
Sleep enuresis	2.7
Nightmare disorder	2.7
Sleep bruxism	1.8
Sleepwalking	0.9
Pavor nocturnus	0.9

^aTentative diagnosis, ^bfrequencies include the possibility of more than one diagnosis.

disorders. The criteria for all other sleep disorders are adequately covered by the DIKS and thus can be diagnosed. In addition to the ICSD-2 diagnoses, the interview allows for a determination of sleep-related anxieties and a differential diagnosis of comorbid anxiety disorders. The rules allow questions to be skipped if there are no indications for the specific sleep disturbance. Consequently, the duration of the interview varies between 20 and 45 min. The answers are evaluated by the interviewer in terms of the following four alternatives: “?” (no or insufficient information), “1” (criterion not met), “2” (criterion not fully met) and “3” (criterion fully met). Validation of the DIKS showed test–retest and inter-rater reliability values of $\kappa > 0.80$ [26].

Children's Sleep Habits Questionnaire

The CSHQ-DE [18, 25] was used to relate the Children's Sleep Comic score to parental proxy ratings. It consists of 52 items, which are assessed using a three-point descriptive rating scale (1= rarely, 2= sometimes, 3= usually). Eight aspects of sleep behavior are assessed: bedtime resistance, sleep-onset delay, sleep duration, sleep anxiety, nightwakings, parasomnia, sleep-disordered breathing and daytime sleepiness. The psychometric properties of the CSHQ-DE are good (Cronbach's $\alpha = 0.71$; retest–reliability, $r = 0.82$) [25]. The subscale scores and the total score differentiate between clinical and control samples

on individual items, which supports construct validity [18, 25]. A wide range of studies using the CSHQ confirm the high acceptance of this instrument [9, 16].

Sleep Self Report

To relate the comic score to another self-rating instrument, we used the SSR-DE [19, 28]. The SSR was constructed according to the CSHQ to permit comparison of the children's and the parents' ratings [19]. Children rate their sleep on a three-point rating scale (1= rarely, 2= sometimes, 3= usually) for 29 items, which are then summed up to give a total score. The high reliability (Cronbach's $\alpha = 0.73$) and test–retest reliability ($r = 0.51$) of the SSR-DE render it a good instrument for assessing sleep behavior in children [28]. It is also highly accepted and well understood by children [2, 11, 19].

Analysis

The Statistical Package for the Social Sciences 18.0 for Windows (SPSS Inc., Chicago, IL, USA) was used for analysis. Tests were two-tailed and the α -level was 5%.

Validation

First, we used the Kuder–Richardson Formula 20 to measure the internal consistency for the items and the answers which generate the ISPS. To test for convergent validity of the Children's Sleep Comic, the discriminatory power was identified by calculating correlations between single answer alternatives and an external criterion [5]. As an external criterion, the presence vs. absence of a diagnosis according to the DIKS was used and point-biserial correlation coefficients were calculated. To test for significance, χ -squared tests were conducted. The relationship between the presence of a diagnosis and the ISPS was investigated by point-biserial correlations [4]. In order to compare the ISPS and the total scores of the SSR-DE and the CSHQ-DE, Pearson correlation coefficients were calculated.

Results

All questionnaires were answered completely and therefore eligible for analysis. The mean age of the children was

8.69 \pm 1.11 years; 48 girls (43%) and 64 boys (57%) took part in the interviews. Parents reported physical illness in 5.4, mental illness in 5.4 and medication use in 8.0% of the children. None of the groups differed significantly and all were included in the analyses. Mean age of the mothers and fathers were 40.79 \pm 5.24 and 43.52 \pm 5.13 years, respectively. All families lived in small towns (40.2%) or villages (54.5%). German was the mother tongue of 90.2% of the families; 5.4% reported a different first language, but were able to answer the interview questions without any problems. Some information pertaining to native language was missing.

In total, 21.4% of the children were diagnosed with a sleep disorder according to parental assessment by the DIKS. For differential diagnoses see **Tab. 1**.

The age of the children was significantly associated with the ISPS ($r = -0.23$, $p < 0.05$), with younger children having higher ISPS than older children. This was taken into account for further analyses and all tests were conducted for two different age groups (children aged 6–8 years and children aged 9–11 years).

A mean ISPS of 8.19 \pm 3.81 (min. = 2, max. = 22) was found for this sample.

Validation

Using the Kuder–Richardson Formula 20, the internal consistency of the items and their answers included in the ISPS was measured to be $\alpha = 0.86$.

To determine the discriminatory power, correlations between the response alternatives of the Children's Sleep Comic and the outcome of the DIKS (diagnosis vs. no diagnosis) were assessed by calculating ϕ -coefficients. The question–response combination that correlated significantly with the DIKS ($\phi = 0.28$, $p < 0.01$) was: “Do you wake up at night?”–“I wake up without a specific reason.” No further significant correlations were found.

The correlation between the ISPS and the presence of at least one vs. no diagnosis was $r = -0.03$ ($p < 0.05$). Results were stable for the different age groups (children aged 9–11 years: $r = 0.05$, $p < 0.05$; children 6–8 years: $r = -0.10$, $p < 0.05$). As such, there was no correlation between the results of the Children's Sleep Comic and those of the DIKS. The correlation between the

presence of at least one vs. no diagnosis and the total score of the SSR-DE ($r=0.20$, $p<0.05$) was also low.

Additionally, the correlations between the CSHQ-DE, SSR-DE, DIKS and the ISPS were calculated. The correlation between the total score of the SSR-DE and the ISPS was low to moderate ($r=0.25$, $p<0.05$). Results differed between the two age groups (children aged 9–11 years: $r=0.58$, $p<0.01$; children 6–8 years: $r=0.02$, $p<0.05$). The correlation between the total score of the CSHQ-DE and the ISPS was low ($r=0.16$, $p<0.05$). The results here did not significantly differ between the two age groups (children aged 9–11 years: $r=0.20$, $p<0.05$; children 6–8 years: $r=0.15$, $p<0.05$). Comparison of the total scores of the SSR-DE and the CSHQ-DE revealed a moderate correlation ($r=0.33$, $p<0.01$). The correlation between the presence of at least one vs. no diagnosis and the total scores of the CSHQ-DE and the SSR-DE were moderate ($r=0.50$, $p<0.05$) and low ($r=0.20$, $p<0.10$), respectively.

Exploratory analysis

Due to the low correlations with the overall ISPS, subscores for general insomnia and behavioral insomnia of childhood were generated according to the ICSD-2 criteria for differential diagnosis.

Children with general insomnia according to DIKS showed significantly higher ISPS ($t=3.21$, $p<0.01$). The correlation between the ISPS for general insomnia and the presence of at least one vs. no diagnosis was moderate ($r=0.29$, $p<0.01$). In addition, correlations between the ISPS for general insomnia and the SSR-DE total score ($r=0.29$, $p<0.05$) and the CSHQ-DE total score ($r=0.29$, $p<0.01$) were also moderate. Children with behavioral insomnia of childhood according to DIKS had a significantly higher ISPS for behavioral insomnia of childhood ($t=2.51$, $p<0.05$). The correlation between the ISPS for behavioral insomnia of childhood and the presence of at least one vs. no diagnosis was moderate ($r=0.23$, $p<0.01$). However, correlations between the ISPS for behavioral insomnia of childhood and the SSR-DE total score ($r=0.10$, $p>0.05$) and the CSHQ-DE total score ($r=0.10$, $p>0.05$) were low. The age of the children was not associated with the ISPS in these analyses.

Discussion

The aim of this study was to present validation data for the Children's Sleep Comic, a new diagnostic tool for assessing sleep behavior and sleep problems in children. The internal consistency of the items and their answers that generate the ISPS was high, indicating that the Children's Sleep Comic is reliable. The results of the Children's Sleep Comic, the SSR-DE and the CSHQ-DE were compared to the DIKS, the parental interview for sleep disorders. The frequency distribution of the differential diagnoses was comparable to previous epidemiological studies [8, 14, 15, 29].

Contrary to the initial hypothesis, no correlation was found between the ISPS and the presence or absence of a diagnosis according to the DIKS. It was expected that the ISPS would be significantly higher in the case of a diagnosed sleep disorder and thus correlate with the DIKS. Additionally, the discriminatory power of the response options in the Children's Sleep Comic was low. This could be because the items for the ISPS were selected based on theoretical considerations alone and individual response options were not weighted [27].

Regarding the different age groups, the correlation between the SSR-DE total score and the ISPS was lower for the group of younger children (aged 6–8 years). The age effect could be due to the characteristics of the group assessment. Furthermore, developmental characteristics have to be taken into account when interviewing young children [7]. Young children may benefit from individual assessment, as opposed to group interviews. More research is clearly required for the younger age group. For instance, individual face-to-face assessment should be applied to allow for, for example, more time and the possibility of individualized breaks for each child.

The correlation between the parental rating and that of the children did not differ between the age groups, but was low overall. We had expected a moderate correlation; although parents are not fully informed about their children's sleep, they should be aware of observable sleep habits. The ISPS did not differentiate between children who had a diagnosis and those

who did not; hence we performed an alternative analysis. The items of the Children's Sleep Comic are associated with specific sleep disorder diagnoses according to the ICSD-2 criteria. Subscores for general insomnia and behavioral insomnia of childhood were calculated. Altogether, moderate correlations with the corresponding diagnoses were found and both subscores differed significantly between children with versus without a diagnosis. Thus, the Children's Sleep Comics seems to be a reliable instrument to assess childhood insomnia. This encourages further research on the ISPS. Items and answering options have to be revised and weighted according to their importance for specific sleep disorders. Furthermore, more specific items for childhood insomnia, e.g. sleep-onset latency, should be included.

Conclusion

The Children's Sleep Comic can be used as a self-rating tool to explore sleep and sleep-associated behavior in children. The high internal consistency demonstrates that it is a reliable instrument. At the current stage of development, the Children's Sleep Comic can be used to establish a good therapeutic relationship with children and gain relevant clinical information concerning sleep habits from young children. Furthermore, the approach of holding a diagnostic conversation with children has the advantage of minimizing the risk of suggestive questioning as compared to a free interview. Moreover, for older children the ISPS of the Children's Sleep Comic can even provide preliminary information pertaining to the diagnosis of general and behavioral sleep disorders, which then has to be confirmed in an individual examination. Further research on the Children's Sleep Comic will aim at optimizing its application in young children and consolidating the procedure for quantitative analysis.

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Compliance with ethical guidelines

Conflict of interest. B. Schwerdtle, J. Kanis, L. Kahl, A. Kübler and A. Schlarb state that there are no conflicts of interest.

All studies on humans described in the present manuscript were carried out with the approval of the responsible ethics committee and in accordance with national law and the Helsinki Declaration of 1975 (in its current, revised form). Informed consent was obtained from all patients included in studies.

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