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Self-reported sleep patterns, sleep problems, and behavioral problems among school children aged 8–11 years

On average, we spend one-third of our lives sleeping. Throughout early development, children spend more time asleep than in any waking activity and by early school age a child has spent more time asleep than in social interactions, exploring the environment, eating, or any other waking activity. Thus, sleep can be argued as the primary activity of the brain during those early years of development and contemporary research is confirming the common belief that developing brains need a considerable portion of the day for sleep. There is a growing body of epidemiological studies investigating sleep disorders in children throughout their development. Depending on surveys (e.g., self- or parent-reported, retrospective) and age representation, prevalence rates of pediatric sleep disorders vary tremendously between 10 and more than 40% [1, 2, 6, 13, 19, 20, 21, 27, 29, 40, 41]. The most common reported sleep disorders are insomnia, hypersomnia, and abnormal behaviors during sleep [18]. According to a survey in 2002 [13], 76% of school children in Vienna (Austria) aged 11–15 years reported occasional sleep problems, with only 12% of the investigated cohort (332 pupils) reporting no sleep problems. The remaining 12% suffered from sleep problems almost every night with corresponding daytime symptoms, such as fatigue, necessary naps, and concentration difficulties. Sim-

ilarly, and considering both the report of problems in initiating sleep and feeling disturbed by this complaint, about 20% of German school-aged children suffer from insomnia [16, 17, 33, 42], which results in a sleep debt of up to 120 min per school day [10] as well as in daytime sleepiness, attention deficits, and cognitive impairment [32, 42]. This alarming number finds confirmation in the 2004 ‘Sleep in America Poll’ by the National Sleep Foundation, the first nationwide survey on children’s and parents’ sleep habits: according to parents or caregivers, children below the age of 10 clearly do not get enough sleep (about 2 h less than recommended by experts) and a remarkable number of children have some kind of sleep problem and appear sleepy during the day. Most worrisome, impaired school performance and attention as well as behavior problems like hyperactivity and/or emotional problems are well known to be highly correlated with difficulties in initiating and maintaining sleep in children [23].

In the present paper, we report the results of a survey investigating sleep and behavior in a healthy population of pre-adolescent children (ages 8–11 years). The aim was to evaluate typical sleep patterns, estimating the prevalence of sleep problems and analyzing whether they are related to behavioral problems in these children.

Materials and methods

Subjects

A total of 330 children (174 girls, 156 boys) aged between 8 and 11 years (9.52 ± 0.56 years) participated in our anonymous survey. The study was performed during December 2008 in Salzburg (Austria), a city with a population of 149,108, of which 1,221 are school children aged between 8 and 11 years (4th grade of elementary school). Fifteen elementary schools were selected from two districts (‘Salzburg Stadt’ and ‘Salzburg Land’). The local education authority of Salzburg, the principals of all 15 schools, as well as parents and children were informed about the study in detail. The questionnaire and our study objectives were described in an information letter to the parents and written informed consent was requested; 623 children were invited to participate in the study, with 330 (52%) finally participating, representing approximately 27% of the respective age cohort in Salzburg county. All participating classes were visited by the principal investigator to ensure that the same information was given to all children. All children completed the questionnaire within a school lesson. The study followed the ethical standards of the Helsinki Declaration.

Tab. 1 Mean bedtime, wake-up time, and sleep duration in school children aged 8–11 years ($n=330$)

	Mean	SD	Mann Whitney-U (gender; z-score)
Bedtime (school day)	8:20 p.m.	00:39	-0.523
Wake-up time (school day)	6:34 a.m.	00:26	-2.097 [♀]
Bedtime (weekend)	9:45 p.m.	00:55	-1.276
Wake-up time (weekend)	7:58 a.m.	01:09	-3.433 ^{**♀}
Sleep duration (school day)	10.23 h	0.79 h	-0.625
Sleep duration (weekend)	10.22 h	1.35 h	-4.382 ^{***♀}

* $p<0.05$; ** $p<0.01$; *** $p<0.001$; [♀]indicates that girls show a higher mean rank.

Measures

A self-administered questionnaire with 80 questions was designed to assess sleep patterns and problems as well as behavioral strengths and difficulties [12]. We adopted our questions from various sleep and a behavioral questionnaire: 'Children's Sleep Habits Questionnaire (CSHQ – Sleep self report)' by Owens et al. [27], 'Fragebogen über Schlafprobleme 11- bis 16-jähriger Kinder und Jugendlicher' [44], 'Kinderfragebogen (7. bis 13. Lebensjahr) – Fragen zum Schlafen und Befinden am Tage' [7], 'The Strength and Difficulties Questionnaire' (SDQ; [9]). Children were asked to recall their sleep patterns and problems as well as their behavioral strengths and difficulties over the last month. There were 35 items concerning sleep patterns and sleep problems rated on a 4-point scale: 'very frequent' (score 3) if the sleep behavior occurred daily or almost daily; 'frequent' (score 2) for two to three times a week; 'sometimes' (score 1) for about two to three times a month; and 'never' (score 0) for zero to less than one time a month. The remaining 20 items requested answers regarding demographic characteristics (e.g., gender, age) and sleep habits, like bedtime on school days or weekends, morning wake up time on school days or weekends, wake-up modalities (by myself, someone else, alarm clock) on school days or weekends, sleep onset latency, awake before getting up, as well as night awakenings. Furthermore, we asked for behavioral and environmental factors (e.g., sleeping alone, sharing a room, before-bedtime activities). The questionnaire was composed of open questions, yes/no questions, as well as multiple choice questions. Questions taken from the SDQ asking about 25 attributes, some being positive and oth-

ers being negative, concluded the questionnaire. These 25 items were divided in five scales assessing emotional symptoms (e.g., 'I am often unhappy, down-hearted or tearful'), conduct problems (e.g., 'I get very angry and often lose my temper'), hyperactivity and inattention (e.g., 'I am restless, I cannot stay still for long'), peer relationship problems (e.g., 'Other children or young people pick on me or bully me') as well as prosocial behavior (e.g., 'I am helpful if someone is hurt, upset or feeling ill'). A three-point response scale was used to record children's levels of agreement: 'not true', 'somewhat true', and 'completely true'. Scores were allocated on the basis of 0 for items checked as being 'not true', 1 for items checked as being 'somewhat true', and 3 for items checked as 'completely true'. A small number of negatively worded items were reverse scored. A total difficulties score describing behavioral problems (range 0–40) was obtained by adding the scores for all but the prosocial items. In addition, each of the five subscales was computed by only using the respective items (range: 0–10).

Data analysis

The present study had primarily a descriptive focus in that it sought to investigate the prevalence of specific sleep patterns and problems as well as their association with behavioral problems. Based on the parameters 'bedtime' and 'morning wake up time', we calculated sleep duration on school days as well as weekends. For the purpose of analysis concerning associations between sleep and behavioral problems, some items were conceptually grouped into two total scores by adding the scores of the relevant items: sleep problems (17 items, cf. **Tab. 3**) as well as

daytime sleepiness (8 items, cf. **Tab. 4**). Descriptions were made by the use of mean, standard deviation, frequencies, and percentages. We used nonparametric tests (Mann Whitney-U) for comparison of independent groups in categorical variables. Spearman correlations were applied for testing associations of categorical variables. Only children with complete datasets were included. Data were analyzed using the computer software Statistical Program for Social Sciences (SPSS), Version 15.0 for Windows. Significance level was set at $p<0.05$.

Results

Sleep patterns and sleep duration

The mean bedtime, wake-up time, and sleep duration on school days and weekends are shown in **Tab. 1**. Average bedtime and wake-up time on school days were 8:20 p.m. (SD=39 min) and 6:34 a.m. (SD=26 min), respectively. Girls showed significant later wake-up times than boys (6:37 a.m. vs. 6:32 a.m.; $z=-2.097$, $p=0.036$). On weekends, children went to bed at 9:45 p.m. (SD=55 min) and woke up at 7:58 a.m. (SD=69 min). Like on school days, girls woke-up significantly later on weekends than boys (8:11 a.m. vs. 7:43 a.m.; $z=-3.433$, $p=0.001$). Average sleep duration was 10.23 h (SD=0.79 h) on school days and 10.22 h (SD=1.35 h) on weekends. There was a significant difference between girls and boys concerning sleep duration on weekends indicating that girls slept longer than boys (10.50 vs. 9.91 h; $z=-4.382$, $p<0.001$).

Regarding sleep patterns about sleep onset, 47% of the children answered watching TV 'very frequent' or 'frequent' prior to sleep. In addition, 8.8% reported playing computer games prior to sleep; this was more prevalent in boys than in girls ($z=-2.701$, $p=0.007$). The data indicate that 67.6% slept in their own bedroom. When inquiring about pets, we found that 53% owned a pet: 16.6% of the children allowed their pets to sleep in their bedrooms (but not in the bed), and 11.8% shared their beds with a pet. A significant correlation between sharing the bed with a pet and the sleep problem 'awakening during night and starting playing

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Abstract

Objectives. Investigation of sleep patterns, sleep problems, and behavioral problems in 8- to 11-year-old children.

Methods. A total of 330 children (age: $M=9.52$; $SD=0.56$; range=8–11 years; 47.3% girls) in the 4th grade of elementary school in Salzburg (Austria) completed a self-report questionnaire (80 items) to survey sleep patterns, sleep problems, and behavioral problems.

Results. Children aged 8–11 years slept approximately 10 h and 13 min on school days ($SD=47$ min) as well as on weekends ($SD=81$ min); girls slept significantly longer on weekends than boys. Most common self-reported sleep problems were dryness of the mouth (26.6%), sleep onset delay (21.9%),

bedtime resistance (20.3%), and restless legs (19.4%). There was a significant association between watching TV as well as playing computer games prior to sleep with frightful dreams. Daytime sleepiness indicated by difficulty waking up (33.4%) and having a hard time getting out of bed (28.5%) was also very prominent. However, children in Salzburg seemed to be less tired during school (6.6%) or when doing homework (4.8%) compared to other nationalities. Behavioral problems (e.g., emotional symptoms, hyperactivity and inattention, conduct problems, peer problems) and daytime sleepiness were both significantly associated with sleep problems: the more sleep problems reported, the worse behavioral problems and daytime sleepiness

were. Moreover, we could show that sharing the bed with a pet was also related to sleep problems.

Conclusions. Self-reported sleep problems among 8- to 11-year-old children are very common. There is a strong relationship between sleep disorders and behavioral problems. Routine screening and diagnosis as well as treatment of sleep disorders in school children should, therefore, be established in the future.

Keywords

School children · Sleep patterns · Sleep problems · Behavioral problems · Self-report questionnaire

Schlafgewohnheiten, Schlafprobleme und Verhaltensauffälligkeiten bei Schulkindern im Alter von 8–11 Jahren

Zusammenfassung

Hintergrund. Untersuchung von Schlafgewohnheiten, Schlafproblemen und Verhaltensauffälligkeiten bei Schulkindern im Alter von 8–11 Jahren.

Material und Methoden. 330 Volksschüler der 4. Klassen in Salzburg (Österreich; Alter im Mittel=9,52; Standardabweichung SD : 0,56; Spanne: 8–11 Jahre; 47,3% Mädchen) nahmen an einer Fragebogenuntersuchung (Selbstbeurteilungsfragebogen; 80 Items) zum Thema Schlafgewohnheiten, Schlafprobleme sowie Verhaltensauffälligkeiten teil.

Ergebnisse. Schul Kinder von 8–11 Jahren schlafen sowohl an Schultagen als auch am Wochenende 10 h 13 min (Schultage: $SD=47$ min; Wochenende: $SD=81$ min). Mädchen schlafen am Wochenende signifikant länger als Jungen. Am häufigsten werden folgende Schlafprobleme beschrieben: ein tro-

ckener Mund (26,6%); eine verzögerte Einschlafdauer (>20 min; 21,9%); Weigerung, ins Bett zu gehen (20,3%); unruhige Beine (19,4%). Kinder, die sich oft oder häufig im Traum fürchten, berichten, dass sie vor dem Schlafengehen Fernsehen oder Computerspielen. Hinsichtlich der Tagesmüdigkeit geben 33,4% an, morgens nur schwer wach zu werden, und 28,5% kommen nur schwer aus dem Bett. Trotzdem sind die österreichischen Kinder im Vergleich zu anderen Nationalitäten tagsüber in der Schule (6,6%) und während der Hausaufgaben (4,8%) relativ selten müde. Sowohl Verhaltensauffälligkeiten (emotionale Probleme, Verhaltensprobleme, Hyperaktivität, Probleme mit Gleichaltrigen) als auch die Tagesmüdigkeit stehen in engem Zusammenhang mit Schlafproblemen: je deutlicher die Schlafproblematik, desto stär-

ker sind sowohl die Verhaltensauffälligkeiten als auch die Tagesmüdigkeit ausgeprägt. Außerdem konnte gezeigt werden, dass Kinder, die ihr Bett mit einem Haustier teilen, schlechter schlafen.

Schlussfolgerung. Schlafprobleme werden von Salzburger Kindern im Alter von 8 bis 11 Jahren häufig beschrieben. Es besteht offensichtlich ein starker Zusammenhang zwischen Schlafproblemen und Verhaltensauffälligkeiten. Vorsorgeuntersuchungen sowie ggf. die Therapie von Schlafstörungen sollten deshalb in Zukunft für Schulkinder eingerichtet werden.

Schlüsselwörter

Schulkinder · Schlafgewohnheiten · Schlafprobleme · Verhaltensauffälligkeiten · Selbstbeurteilungsfragebogen

Tab. 2 Frequencies of dreaming and dream contents among school children aged 8–11 years ($n=330$)

	Frequency (%)				Mann Whitney-U (gender; z-score)
	Very frequent	Frequent	Sometimes	Never	
Dreaming	33.3	24.8	37.0	4.8	-1.197
Dreaming: funny content	21.5	23.0	39.1	16.4	-1.708
Dreaming: sad content	3.3	12.1	38.8	45.8	-3.672***♀
Dreaming: frightful content	4.8	8.5	33.0	53.6	-2.400♀

* $p<0.05$; *** $p<0.001$; ♀ indicate that girls show a higher mean rank.

Tab. 3 Frequencies of sleep problems in school children aged 8–11 years ($n=330$)

	Frequency (%)				Mann Whitney-U (gender; z-score)
	Very frequent	Frequent	Sometimes	Never	
Struggles at bedtime	5.8	14.5	37.6	42.1	-0.788
Falls asleep in another's bed	7.9	6.1	5.8	80.3	-0.610
Needs a parent in room to sleep	3.6	2.4	10.0	83.9	-0.348
Bed time anxiety	5.5	2.1	20.3	72.1	-1.870
Restless legs	7.3	12.1	23.3	57.3	-1.142
Sweating	3.0	3.6	20.3	73.0	-1.897
Enuresis	0.6	0.3	3.9	95.2	-1.277
Nocturnia	4.2	7.3	42.1	46.4	-1.306
Dryness of the mouth	11.8	14.8	33.6	39.7	-0.463
Moving to parents' bed during the night	2.7	2.7	15.5	79.1	-0.308
Awakening during night and starting playing or watching TV thereafter	1.8	3.9	7.0	87.3	-2.404♂
Awakening because of a dream	4.5	7.3	39.1	49.1	-0.987
Awakening because of a pet	2.4	0.6	7.6	89.4	-1.979♀
Awakening because of too much light	1.5	3.9	19.4	94.5	-0.379
Awakening because of feeling too warm	4.2	4.8	30.3	60.6	-0.168
Awakening because of feeling too cold	0.9	4.2	19.1	75.8	-3.545***♀
Awakening because of too much noise	2.4	3.3	27.0	67.3	-0.435

* $p<0.05$; *** $p<0.001$; ♀, ♂ indicate that girls, respective boys show a higher mean rank.

or watching TV thereafter' was identified ($r_{328}=0.265$, $p<0.001$).

Dreaming

An overview about dreaming in Austrian children, with 58.1% of the children reporting dreaming 'very frequent' or 'frequent', is given in **Tab. 2**. Concerning dream content, 44.5% had funny dreams, 15.4% sad dreams, and 13.3% frightful dreams. Interestingly, girls were significantly more often confronted with sad ($z=-3.672$, $p<0.001$) and frightful ($z=-2.400$, $p=0.016$) dream content.

Our data indicate that watching TV as well as playing computer games prior to sleep influence the content of children's

dreaming: there was a significant correlation between watching TV ($r_{328}=0.145$, $p=0.008$) as well as playing computer games ($r_{328}=0.119$, $p=0.031$) prior to sleep and frightful dream contents.

Sleep problems

The frequencies of individual sleep problems are shown in **Tab. 3**. Dryness of the mouth (26.6%), struggling at bedtime (20.3%), and restless legs (19.4%) were the most prevalent problems. Falling asleep in another's bed (14%), nocturnia (11.5%), and awakening because of a dream (11.8%) were also common. Mann Whitney-U tests showed significant differences between boys and girls in the following vari-

ables: awakening during night and starting playing or watching TV thereafter ($z=-2.404$, $p=0.016$), awakening because of a pet ($z=-1.979$, $p=0.048$), and awakening because of feeling too cold ($z=-3.545$, $p<0.001$). Whereas boys significantly woke up more often during the night and started playing or watching TV thereafter, girls woke up more often because of a pet or because of feeling too cold.

Concerning sleep initiating and maintenance problems, 21.9% of the children reported a sleep onset latency longer than 20 min, 9.1% complained about frequent awakenings (three or more per night) and 13.3% were awake at least 15 min before getting up. Regarding these items, we found no significant gender differences.

Daytime sleepiness

The prevalence rates of daytime sleepiness are shown in **Tab. 4**; 65.8% of the children needed to be awakened by others in the morning. Difficulty waking up (33.4% very frequent or frequent) and hard time getting out of bed (28.5% very frequent or frequent) were the most prominent problems. No gender differences were observed.

Associations of sleep problems and daytime sleepiness with behavioral problems

The strengths (prosocial behavior) as well as difficulties (emotional symptoms, hyperactivity and inattention, conduct problems, peer relationship problems) in school children measured by the SDQ [9] are demonstrated in **Tab. 5**. Girls reported more prosocial behavior ($z=-4.769$, $p<0.001$), whereas boys were more hyperactive and inattentive ($z=-3.040$, $p=0.002$).

We found a significant correlation between behavioral problems (total SDQ score) and the total score of sleep problems ($r_{328}=0.466$; $p<0.001$). In addition, we could show that more behavioral problems were associated with a higher total score of daytime sleepiness ($r_{328}=0.481$, $p<0.001$). The scores of each subscale (i.e., emotional symptoms, hyperactivity and inattention, conduct problems, peer relationship problems, prosocial be-

havior) were significantly associated with sleep problems and daytime sleepiness (■ **Tab. 6**).

Regarding sleep duration and behavioral problems, we found that children who reported more behavioral problems slept less on weekends (weekend: $r_{328} = -0.148$; $p = 0.007$).

International comparison of sleep patterns and sleep problems in school-aged children

To provide insight into international similarities and differences concerning sleep patterns and sleep problems of children aged between 8–11 years, the main results of a variety of international studies concerning sleep in school-aged children are presented in ■ **Tab. 7**.

Discussion

We investigated sleep patterns, sleep problems, as well as behavioral problems using a self-report questionnaire in Austrian (Salzburg) school children aged 8–11 years. Results confirm earlier findings indicating that sleep problems are quite frequent in childhood (e.g., [21, 29, 40]) and that they are significantly related to behavioral problems (e.g., [35, 41, 42]). Taking into account that different measurement instruments were used, our prevalence rates are comparable to those of other international studies (e.g., [1, 7, 13, 22, 42]).

The major findings of the present study are (1) children aged between 8–11 years sleep approximately 10 h 13 min during school and weekends; girls sleep significantly longer on weekends than boys (cf. ■ **Tab. 1**), (2) dryness of the mouth (26.6%), sleep onset delay (21.9%), bedtime resistance (20.3%), and restless legs (19.4%) were the most common self-reported sleep problems (cf. ■ **Tab. 3**), (3) 47% of the children watch TV prior to sleep; and watching TV or playing computer games prior to sleep was associated with frightful dreams, (4) the prevalence of daytime sleepiness (e.g., difficulty waking up: 33.4%, hard time getting out of bed: 28.5%) was prominent (cf. ■ **Tab. 4**), (5) sleep problems and daytime sleepiness were both associated with behavioral problems (cf. ■ **Tab. 6**), and (6) shar-

Tab. 4 Daytime sleepiness among school children aged 8–11 years ($n=330$)

	Frequency (%)				Mann Whitney-U (gender; z-score)
	Very frequent	Frequent	Sometimes	Never	
Difficulty waking up	17.0	16.4	32.1	34.5	-1.012
Hard time getting out of bed	13.3	15.2	33.0	38.5	-1.300
Falling asleep after woken up	3.0	6.7	17.6	72.7	-0.503
Tired at school	4.2	2.4	15.5	77.9	-0.354
Tired during homework	2.7	2.1	13.6	81.5	-0.430
Tired during playing	0.9	1.5	8.5	89.1	-0.597
Feeling exhausted	2.4	3.0	33.3	61.2	-0.227
Daytime nap	0.6	1.8	13.9	83.6	-1.841

Tab. 5 SDQ scores in school children aged 8–11 years ($n=330$)

	Mean	SD	Mann Whitney-U (gender; z-score)
Emotional symptoms	2.14	1.97	-1.610
Hyperactivity and inattention	3.42	2.05	-3.040**♂
Conduct problems	1.86	1.48	-0.763
Peer relationship problems	2.46	1.55	-0.880
Prosocial behavior	7.87	1.89	-4.769***♀
Total SDQ score	9.87	4.79	-1.024

** $p < 0.01$; *** $p < 0.001$; ♀, ♂ indicate that girls, respective boys show a higher mean rank.

Tab. 6 Correlations of sleep problems score and daytime sleepiness score with behavioral problems scores

	Emotional symptoms	Hyperactivity/inattention	Conduct problems	Peer problems	Prosocial behavior	Total SDQ score
Sleep Problems	0.402**	0.308**	0.330**	0.227**	-0.119*	0.466**
Daytime Sleepiness	0.356**	0.324**	0.358**	0.253*	-0.152*	0.481**

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

ing the bed with a pet was related to sleep problems in a negative manner.

According to Iglowstein et al. [11], sleep duration in children at the age of 9 years is 10.2 h ($SD=0.6$) and declines to 9.9 h ($SD=0.6$) at the age of 10 years. As our subjects were approximately 9.52 years ($SD=0.56$) and slept about 10 h 13 min (cf. ■ **Tab. 1**), they were well in line with the percentile curves by Iglowstein et al. [11].

Similar to a survey by Liu et al. [22] who compared sleep patterns and sleep problems among children from the United States (5–11 years) and China (7–13 years), we could show that girls slept significantly longer than boys. However, this effect in our data was only significant on weekends, whereas Liu et al. [22] did not differentiate between school days and weekends. This gender difference was also found by Spruyt et al. [40] in a sample of Belgian children. Regarding bedtime, Austrian children showed comparable sleep patterns to children in the US, whereas Chi-

nese children went to bed about half an hour later [22]. The mean wake-up time in Austrian children was 21 min earlier than in the US, but about 10 min later than in China. In contrast to Austrian children, Belgian children aged 9 years [40] showed a later bedtime (20 min) as well as a later wake-up time (29 min). According to Randler [31], German children aged 10–11 years rise at 6:28 a.m. and go to bed at 8:48 p.m., further indicating a slight difference compared to the other nationalities. As hypothesized by Liu et al. [22], those obvious differences concerning bedtime, wake-up time and sleep duration between different nationalities could be contributed to varying school schedules, homework load, and sleep practices.

A total of 21.9% of the Austrian children reported a sleep onset delay of more than 20 min, which is identical to the prevalence rates shown by Liu et al. [22] concerning US children (21%) and Chinese children (20.2%). In a study by Wiater et

Tab. 7 Overview about international similarities and differences in sleep patterns and sleep problems

	Austria	Germany	Finland	Belgium	China	USA
Sleep duration (mean ± SD)	school days: 10.23 ± 0.79 h, weekend: 10.22 ± 1.35 h ¹	9.65±0.82 h ²	#	school days: 9.90±0.78 h, week- end: 10.30±0.95 h ³	9.13±00.47 h ⁴	10.64±0.67 h ⁴
Bedtime (mean ± SD)	school days: 8:20 ± 00:39 p.m., weekend: 9:45 ± 00:55 pm ¹	8:48±00:51 pm ²	#	school days: 8:40±0:34 p.m., weekend: 9:51±0:44 p.m. ³	9:06±00:44 p.m. ⁴	8:27±00:31 p.m. ⁴
Wake-up time (mean ± SD)	school days: 6:34 ± 00:26 a.m., weekend: 7:58 ± 01:09 a.m. ¹	6:28±00:20 a.m. ²	#	school days: 7:03±0:26 a.m., weekend: 8:47±0:50 a.m. ³	6:24±00:20 a.m. ⁴	6:55±00:26 a.m. ⁴
Room sharing	32.4% ¹	#	#	31.4% ³	48% ⁴	#
Sleep onset delay	21.9% ≥2x/week (>20 min) ¹	10% often, 40% sometimes ⁵ 10% often, 35% sometimes ⁶	11.1% many/every night(s) ⁷	#	20.2% ≥2x/ week (>20 min) ⁴	21% ≥2x/week (>20 min) ⁴ 11.3% >3x / week ⁸ 21.2% ≥1x/week (>30 min) ⁹
Restless legs	19.4% ≥2x/week ¹	2% often, 10% sometimes ⁵	#	#	36.3% ≥2x/ week ⁴	35.1% ≥2x/week ⁴
Bedtime re- sistance	20.3% ≥2x/week ¹	#	#	#	6.8% ≥2x/ week ⁴	8.9% ≥2x/week ⁴ 27% >3x/week ⁸
Dryness of the mouth	8.1% very often, 41% occasi- onally ¹⁰ 26.6% ≥2x/week ¹	#	#	#	#	#
Night awakenings	9.1% ≥2x/week ¹	#	#	#	11.3% ≥2x/ week ⁴	2.5% ≥2x/week ⁴ 6.5% >3x/week ⁸ 13.6% ≥1x/week ⁹
Waking too early	13.3% ≥2x/week ¹	#	#	#	#	#
Waking up diffi- culties	33.4% ≥2x/week ¹	15% often, 28% sometimes ⁵	#	#	43.5% ≥2x/ week ⁴	38.7% ≥2x/week ⁴
Daytime sleepi- ness	6.6% ≥2x/week (at school), 4.8% ≥2x/week (during home- work) ¹	3% often, 22% sometimes ⁵	#	#	20.9% ≥2x/ week ⁴	24% ≥2x/week ⁴
TV prior bedtime	47% ≥2x/week ¹	35% often, 46% sometimes ⁵	#	#		76.5% usually ¹¹
Nightmares	13.3% ≥2x/week ¹	4% often, 40% sometimes ⁵ 3.5% often, 40% sometimes ²	5.4% many/every night(s) ⁷	#	9.9% ≥2x/ week ⁴	9.8% ≥2x/week ⁴ 8.1% ≥1x/week ⁹
Pets in bed	11.8% ≥2x/week ¹	#	#	#	#	#

¹Hoedlmoser et al., the present study; ²Randler, 2009; ³Spruyt et al., 2005; ⁴Liu et al., 2005; ⁵Wiater et al., 2005; ⁶Fricke-Oeckermann, Plücker, et al., 2007; ⁷Paavonen et al., 2000; ⁸Blader et al., 1997; ⁹Stein et al., 2001; ¹⁰Psiroglu et al., 2002; ¹¹Owens et al., 1999; ¹²Schredl et al., 2009; # indicates not specified.

al. [42], who investigated German children aged 8–11 years, sleep onset delay was even higher with 10% of the children describing 'often' and 35% 'sometimes' a sleep onset delay. Fricke-Oeckermann and colleagues [6] focused on sleep difficulties in initiating and maintaining sleep in childhood and found that 40% of German children reported 'sometimes' and 10% 'often' sleep onset problems. Paavonen et al. [29] provide data about sleep problems of school children in Finland, where 11.1% had difficulties with sleep onset 'many nights' or 'every night'. According to a study by

Stein et al. [41], for 13.1% of US children, it takes more than 30 min to fall asleep at least once a week and for 8.1% sleep onset delay is an every night problem. Blader et al. [1] found a sleep onset delay in 11.3% of the US children.

Restless legs at sleep onset, which is a characteristic symptom of restless legs syndrome, was described by 19.4% of the Austrian children [30], while, in comparison, the prevalence of this sleep problem was 12% in a German survey [42]. For US and Chinese children, Liu et al. [22] even reported a prevalence of 35.1% and 36.3%,

respectively. However, this study did not specifically ask for restless legs, but generally whether children are restless and move a lot.

Bedtime resistance with a prevalence of 20.3% was comparable with a US study by Blader et al. [1], who reported struggling at bedtime in 27% of the children. These high prevalence rates are, however, not confirmed by Liu et al. [22], where only 8.9% of the US children and 6.8% of the Chinese children show bedtime resistance.

According to Ipsiroglu et al. [13], the symptom 'dryness of the mouth' is characteristic for obstructive sleep apnea (OSA); 26.6% of the Austrian sample described this problem. Ipsiroglu et al. [13] investigated the frequency of self-reported OSA symptoms of children aged between 11 and 15 years in Austria and found that 8.1% of the children report this symptom 'very often' and 41% 'occasionally'. Ipsiroglu and colleagues could show that sleep disorders like OSA may be more common in school children than is estimated and that parasomnia/insomnia events (e.g., nightmares, night terrors, sleep walking, waking up at night) can be a clinical manifestation of OSA.

Night awakenings with a prevalence of 9.1% were similar to data surveyed in Finland by Paavonen et al. [29], who reported a prevalence of 7.1%. Results by Liu et al. [22] indicate night awakenings in 2.5% of US children and in 11.3% of the Chinese children. Blader et al. [1] found night waking in 6.5% of their US children sample, whereas a further US population investigated by Stein et al. [41] reported prevalence rates of 13.6%.

Waking too early was quite common in the Austrian sample (13.3%), while children in Finland do not complain that much about this problem (2.3%; [29]).

Comparable to Liu et al. [22], who reported quite high prevalence rates for waking up difficulties in US (38.7%) and Chinese (43.5%) children, we found that 33.4% of the Austrian sample had difficulties waking up and 28.5% described a hard time getting out of bed. Similarly 25% of a German population [42] complained about that kind of waking up problems. However, concerning daytime sleepiness, 24% of the US, 20.9% of the Chinese, and 22% of the German children [42] reported tiredness during the day, whereas only very few Austrian children described being tired during school (6.6%) or during homework (4.8%). Therefore, it seems that Austrian children are less tired during the day compared to other nationalities.

Data revealed that both sleep problems and daytime sleepiness were associated with emotional problems, hyperactivity and inattention, conduct problems, as well as peer relationship problems. These associations were also described by Wiater

et al. [42] in a German population. There is already profound knowledge about the relationship between attention deficit and hyperactivity disorder (ADHD) and sleep problems (for review, e.g., [3, 26]). In addition, we found that there is a significant relationship between behavioral problems and sleep duration on weekends, indicating that children with sleep problems slept less on weekends. Yet, it has to be mentioned that the direction of these relationships are unclear. However, we favor the interpretation that insufficient or not restful sleep per se is causing behavioral problems, like inattention or emotional problems, rather than the other way round, as it is well known that sleep is not only important for physical growth, but also affects behavior and emotional development as well as cognitive functioning, learning, and attention in children (cf. [5, 8, 15, 23, 35, 36]).

Watching TV prior to sleep appears to be very common in children aged 8–11 years, not only in Austria (47%), but also in Germany (34%; [42]). Owens et al. [28] even found that 76.5% of US children aged between 4.8 and 11 years are watching TV throughout their usual bedtime routine. Furthermore, 8.8% of Austrian children were playing computer games prior to sleep, which was more common in boys than girls. Both watching TV and playing computer games prior to sleep affected the content of children's dreams in a negative fashion (more frightful dreams). Earlier reported associations [28] of watching TV with bedtime resistance, sleep onset delay, anxiety around sleep, and shortened sleep duration were not confirmed.

Comparable to other populations (e.g., [40, 43]) about one-third of the Austrian sample (32.4%) had to share their bedroom with their siblings or parents. However, as noted by Blader et al. [1] and Liu et al. [43], room sharing does not seem to be associated with more sleep problems or enhanced daytime sleepiness.

An interesting and new aspect included in our survey was the investigation of sleep habits associated with pets. In our study, 53% of the Austrian children reported having a pet at home: 16.6% reported that the pet stays in their bedroom during the night, and 11.8% even shared their bed with the pet. Awakening because of

a pet appeared to be rare in our sample (4%). However, we found that girls woke up significantly more often because of a pet and that there was a significant association between sharing the bed with a pet and the sleep problem 'awakening during night and starting playing or watching TV thereafter' in both girls and boys. Additional research is needed to investigate the impact of bed sharing with a pet on sleep patterns and sleep problems in children. Former studies [4] indicated that a child's sleep can also be influenced by sleep patterns of co-sleeping parents or siblings and that there is a significant relationship between bed sharing and night awakenings [14]. As every child has individual needs depending on developmental level, individual characteristics, and attachment behavior, it is not recommended to fundamentally condemn the practice of bed sharing with parents or siblings by professional advice. However, regarding bed sharing with pets, it is recommended to carefully assess whether benefits are not outweighed by negative consequences, such as snoring or 'night active' pets or simply hygiene aspects.

Concerning nightmares 13.3% of Austrian children reported having 'very frequent' or 'frequent' frightful dreams and 11.8% even wake up because of a dream. Schredl et al. [38] investigated nightmares in a German population and found that 43.5% of the children stated having nightmares 'sometimes' to 'often'. Similarly Wiater et al. [42] reported a nightmare prevalence of about 44% in German children. Liu et al. [22] results indicate regular nightmares in about 10% of US and Chinese children. According to Paavonen et al. [29], only 5.4% of Finnish children complained about nightmares. Interestingly, Austrian girls were more often confronted with sad and frightful dream content than boys. Schredl and Pallmer [37] as well as Nielson et al. [25] reported similar results in adolescent girls, who described more nightmares than boys. It could be speculated that boys might be more affected by social desirability and, thus, underestimate the occurrence of sad and frightful dream contents. Furthermore—as hypothesized by Nielsen et al. [25]—this gender difference could reflect the female vulnerability to stress and depression.

As one hardly can think about robust factors explaining some of the huge international differences described above (cf., **Tab. 7**; e.g., nightmares: >40% in Germany, 10% in US and China, 13% in Austria, 5% in Finland; bedtime resistance: 20.3% in Austria, 8.9% in US, 6.8% in China), it is important to generally treat this type of questionnaire data with caution. In our opinion, small differences in the various study designs might be potent factors biasing outcomes. One might think of study sampling (newspaper, school selection, city or rural), selection and phrasing of questions, asking children or parents, administration of questionnaire at home or school (present or absent peers, or parents), time of questioning, social norms, etc., to mention just a few. In addition, we have to keep in mind that only 53% of the invited children participated in this survey. It may be plausible to assume that children with more behavioral and sleep problems are less motivated to take part in the survey, which would result in an underestimation of actual sleep problems in young school children. However, compared to other similar studies, these dropout rates appear to be common (e.g., [42] 53%; [22] 46.9%; [40] 67.3%).

In conclusion, our Austrian (Salzburg) survey study confirms the high prevalence of sleep problems as well as the associations between sleep problems and daytime sleepiness with behavioral problems in 8- to 11-year-old children. However, school children in Salzburg appear to sleep more sufficiently and do not suffer from tiredness at school or during homework compared to other nationalities. A new aspect raised by our investigation is the association between keeping a pet and sleep habits.

Taken together, maladaptive sleep patterns and sleep disorders already emerge in these early years and should, therefore, be effectively screened, diagnosed, and—if necessary—treated before becoming chronic and affecting school performance and quality of life in general.

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