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RESEARCH ARTICLE

Correlates of inadequate sleep health among primary school children

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Summary

The aim of the present study was to explore potential factors of inadequate sleep health (i.e. sleep duration, quality, and timing) of school-aged children. Data were collected among 382 primary school children (aged 4–13 years) and their parents. Personal characteristics (i.e. age, sex), individual lifestyle behaviours (i.e. screen use, sleep hygiene behaviour), social and community factors (i.e. parental sleep-related practices, parental barriers, perceived ethnicity), and living conditions (i.e. parental educational level, sleep environment) were assessed with a parental questionnaire. Sleep duration, quality, and timing were assessed with a sleep diary. Associations were analysed using linear mixed models and logistic regression analyses. In total, 332 children, with a mean (range) age of 7.5 (4–13) years, were included in the analyses. The mean sleep duration was 632 min/night, the mean sleep quality score was 40, on a scale from 10 to 50, and 25% had a bedtime that varied >40 min between weekdays. Factors negatively associated with children's sleep health included older age, perceived non-Dutch cultural background, lower parental pre-sleep emotional support, the parental barrier to get their child to bed on time when siblings have a later bedtime, high parental educational level, sleeping in a darkened bedroom, and being brought to bed after falling asleep. On average, children in the present study had adequate sleep health. The factors found to be associated with children's sleep health are useful for future healthy sleep research and intervention development.

KEYWORDS

associations, childhood, children, correlates, factors, sleep

1 | INTRODUCTION

Inadequate sleep health (e.g. insufficient sleep duration, poor sleep quality and irregular sleep timing [Buysse, 2014]) among children is an important public health concern (Matricciani, Olds, & Petkov, 2012; Matricciani, Paquet, Galland, Short, & Olds, 2019), as healthy sleep is essential for a wide range of physical, mental, and behavioural outcomes (Astill, Van der Heijden, Van Ijzendoorn, & Van

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Someren, 2012; Matricciani et al., 2019). Despite these benefits, the percentage of children around the world who meet the recommended amount of good quality sleep (i.e. 10–13 hr/day for children aged 3–5 years and 9–11 hr/day for children aged 6–13 years (Hirshkowitz et al., 2015)) seems to be declining (Matricciani et al., 2012). Therefore, promotion of healthy sleep among children via preventive interventions is warranted.

To develop preventative sleep interventions, it is essential to know which factors are most important when promoting healthy sleep among children. A model that has been shown to be helpful in explaining potential factors of sleep health among children is the Dahlgren and Whitehead's "determinants of health model", which is therefore also applied in the present study (Dahlgren & Whitehead, 1991; Komrij et al., 2020). In this model, the child has a set of fixed characteristics (e.g. age, sex) and is surrounded by several layers of (changeable) factors regarding (sleep) health: the individual lifestyle factors (e.g. screen use, sleep hygiene), social and community factors (e.g. parental practices), living conditions (e.g. housing, education, sleep environment) and the general socioeconomic and cultural factors (e.g. access to health care, political environment; Dahlgren & Whitehead, 1991). The factors are interrelated within and between the various layers and are all potentially related to sleep health. Therefore, it is important to consider all these factors together when examining potential factors of children's sleep health.

Prior research identified several factors related to sleep health that could be placed in the various layers of the "determinants of health model" (Dahlgren & Whitehead, 1991). Several studies show the importance of children's age in relation to children's sleep and sleep practices (Belmon, Van Stralen, Busch, Harmsen, & Chinapaw, 2019; Buxton et al., 2015). For individual lifestyle factors, numerous studies found evidence for an adverse relation between screen time behaviour and sleep duration (Belmon et al., 2019; Hale & Guan, 2015). In addition, children, parents, and sleep professionals perceived psychological factors (e.g. fear, affective state) and evening activities (e.g. playing stimulating games before sleeping) as important factors of children's sleep health (Belmon, Brasser, et al., 2020; Belmon, Busch, et al., 2020). For social and community network factors, previous research indicated that parental pre-sleep emotional support (e.g. reviewing the day), parental structure (e.g. providing a bedtime routine) and parental rule setting is positively related to children's sleep health (Adam, Snell, & Pendry, 2007; Buxton et al., 2015). Moreover, perceived barriers to go to bed on time (e.g. social norm among siblings; Belmon, Busch, et al., 2020; McDowall, Campbell, & Elder, 2016) and cultural differences in sleep practices (Anujuo, Vrijkotte, Stronks, Jean-Louis, & Agyemang, 2016) might negatively influence children's sleep. For the factors related to children's living conditions that influence children's sleep health, a low parental educational level (Doane et al., 2019; Komrij et al., 2020), the presence of screens in the bedroom (Belmon et al., 2019; Hale & Guan, 2015), the lack of a healthy sleep environment (e.g. a dark and quiet bedroom at night; Bagley, Kelly, Buckhalt, & El-Sheikh, 2015; Galland & Mitchell, 2010) and bed(room) sharing (Mindell, Meltzer, Carskadon, & Chervin, 2009; Spruyt, O'Brien, Cluydts, Verleye, & Ferri, 2005) were found to be negatively related to sleep health. However, many previous studies considered only one sleep outcome or investigated only one or a few potential factors and their relation to sleep health (Anujuo et al., 2016; Bagley et al., 2015; Belmon et al., 2019; Buxton et al., 2015), thereby ignoring the overlap in explained variance by the factors from the different layers of the "determinants of health model".

Therefore, the aim of the present study was to explore a broad range of potential factors of school-aged children's inadequate sleep health (i.e. sleep duration, sleep quality, and sleep timing) to inform future intervention development. We hypothesised that all factors are individually related to at least one of the sleep outcomes and that some associations are different between younger and older school-aged children.

2 | METHODS

2.1 | Study design, setting and participants

This correlational study was performed as part of the research project "The Amsterdam Healthy Sleep Project", which focussed on developing a preventative intervention to promote healthy sleep among primary school-aged children. The study was carried out among primary school-aged children (aged 4–13 years) and their parents from schools located in the City of Amsterdam, the Netherlands. The Medical Ethical Committee of the VU University Medical Center approved the study protocol (2018.170). Before the start of the data collection, written informed consent was obtained. No exclusion criteria were applied as we aimed to obtain a diverse study sample (including children with and without sleep problems) representative for primary schoolchildren living in the City of Amsterdam.

Data collection took place from April until July 2018. All schools were approached by a "Healthy School" advisor from the Public Health Service of Amsterdam who was associated with that school. When a school agreed to participate, researchers visited the schools to provide children with in-class oral information on the study and handed out envelopes containing the study materials to be taken home. These included an information letter, an informed consent form, a 7-day sleep diary, and a parental questionnaire. To stimulate participation enthusiasm, incentives were used in the form of a lottery among participating parents and children (i.e. for every 10th participating child and their parent, a cinema voucher of 10 euros was allotted), and a reward was provided for the classroom with the highest response rate per school (i.e. a package with all sorts of toys to play games in the schoolyard). Parents were also reminded by the schools via the app or school website to participate in the study. After parents completed the study materials, the sealed envelopes were returned to the classroom teachers and collected by the researchers (after ~2–4 weeks). Data were collected from a total of 382 children from six primary schools along with their parents.

2.2 | Measures

The parental questionnaire was created specifically for this research project. As, to our knowledge, no instrument with high-quality evidence for the psychometric properties of reliability and validity is available that comprehensively measures child sleep health in a general population of healthy children, the best available questionnaires and sleep diary were selected and used as a basis for our study (Carney et al., 2012; Gradisar et al., 2013; Harsh, Easley, & LeBourgeois, 2002; McDowall et al., 2016; Musher-Eizenman & Holub, 2007). Both the questionnaire and sleep diary were pre-tested among six parents representative of the study population. The comprehensibility of the study materials was pre-tested using the "think aloud method" (Charters, 2003) and necessary changes were made accordingly. The pre-test showed that the materials were well-understood by parents. To focus on the factors that were most relevant for child public health practices, all decisions regarding the selection, conceptualisation, and prioritisation of the variables were made in close collaboration with two child health experts: a paediatrician at the Child Public Health department and the head of prevention at the Parenting Advice Center in Amsterdam.

2.2.1 | Children's sleep health

Data on children's sleep health were collected with a sleep diary. Parents were asked to complete the diary together with their child each morning for 7 consecutive days. Items in the diary included a question about bedtime, sleep time (i.e. time of trying to go to sleep), sleep offset time, and sleep quality. *Sleep duration* was defined as the time, in minutes, between sleep time and wake time. Napping was not considered, because most children stop napping when they start primary school (Kocevska et al., 2020) and in the Netherlands children start primary school at the age of 4 years. *Sleep quality* was defined as the rating of the child's sleep, on a 5-point Likert scale ranging from (1) "very bad" to (5) "very good". To facilitate interpretation due to small regression coefficients, the sleep quality scores were multiplied by 10 and therefore ranged from 10 to 50. *Sleep timing* was defined as the variability of the bedtime of the corresponding week. This was determined by the standard deviation (*SD*) of the bedtimes of each child, with a minimum of two reported bedtimes. As there is no evidence-based recommendation for bedtime variability (Allen, Howlett, Coulombe, & Corkum, 2016), the corresponding values were dichotomised based on the value of the third quartile (i.e. 40 min): (1) "a regular bedtime" (i.e. SD <40 min) and (2) "an irregular bedtime" (i.e. SD ≥40 min). In this way, children with the largest variability in bedtimes (i.e. the fourth quartile) were compared to the participating children with a lower variability in bedtimes (i.e. SD <40 min). For descriptive purposes, mean sleep duration and sleep quality scores were calculated for each child with at least two reported sleep duration and sleep quality values.

2.2.2 | Personal characteristics

The personal characteristics of the child included age (continuous in years) and a dichotomous variable for age, which was categorised into 4–8 and 9–13 years. Also, the child's sex (female/male) was included.

2.2.3 | Individual lifestyle factors

The individual lifestyle behaviours of the child included sleep hygiene behaviours, e.g. screen use, drinking, physical activity, and worrying before bedtime. The questions to measure screen use were based on the National Sleep Foundation's 2011 Sleep in America Poll (Gradisar et al., 2013). It was assessed whether the child was accustomed to using (1) mobile devices (smartphone and/or tablet), (2) a computer or game console, and (3) a television in the hour before bedtime. The questions regarding sleep-related behaviours were based on the Children's Sleep Hygiene Scale (CSHS; Harsh et al., 2002). It assessed whether the child was accustomed to (1) drinking one or more glasses before bedtime, (2) playing around before bedtime (e.g. running, jumping), (3) using his/her bed for other things besides sleeping (e.g. playing or watching television), and (4) going to bed with worries. Parents answered the questions on a 5-point Likert scale: "never", "almost never", "sometimes", "almost every evening", and "every evening". Due to low variability, the answers to each question were dichotomised into "no" (i.e. [almost] never) and "yes" (i.e. sometimes or [almost] every evening).

2.2.4 | Social and community factors

The social and community factors we included were parental sleep-related practices, parental barriers, and perceived cultural group. The parental sleep-related practices that were assessed were based on the domains of the Comprehensive Feeding Practices Questionnaire (CFPQ) (Musher-Eizenman & Holub, 2007): (1) emotional support, (2) routine, and (3) rules. Other domains of the CFPQ were not included as these were less relevant to the purpose of this study. The items of the domains of the original questionnaire were adapted and translated into sleep practices, based on findings in the scientific literature (Adam et al., 2007; Belmon, Brasser, et al., 2020; Belmon, Busch, et al., 2020; Gruber et al., 2014). Parents answered the questions on a 5-point Likert scale, ranging from (1) "never" to (5) "always". For each domain, a mean score was calculated, ranging from 1 (indicating that the parent did not engage in this sleep-related practice) to 5 (indicating that the parent fully engaged in this sleep-related practice). As the number of items of each domain was low, Cronbach's alpha was acceptable if >0.5 (Bowling, 2014). The domain "parental pre-sleep emotional support" consisted of two items (i.e. "I make sure that going to bed is a pleasant and fun time for my child" and "When my child goes to bed, I review the day with him/her"): Cronbach's alpha 0.53. The domain "routine" consisted of five items (e.g. “My child has a bedtime routine”): Cronbach’s alpha 0.62. The domain “rules” consisted of four items (e.g. “Within our family, there are rules about bedtimes, and these are carried out”); Cronbach’s alpha of 0.71. Table S1 provides an overview of the included items per domain.

Three parental barriers were assessed, based on the results of previous research (Belmon, Busch, et al., 2020; McDowall et al., 2016). Parents were asked to what extent they perceived a barrier to get their child to bed in time when (1) the parents are busy themselves, (2) the parents experience stress, and (3) siblings have a later bedtime. Answers could be given on a 5-point Likert scale ranging from (1) “I never succeed” to (5) “I always succeed”. Due to low variability, the answers were dichotomised into “Parent succeeds in getting his/her child to bed on time” (i.e. “I [almost] always or sometimes succeed”) and “Parent does not succeed in getting his/her child in bed on time” (i.e. I [almost] never succeed”). For the question about siblings, parents could also answer “not applicable”.

Finally, the child’s perceived cultural background was assessed according to the following question: “Which cultural group do you feel your child belongs to?”. Parents could indicate multiple pre-specified cultural backgrounds: Dutch, Moroccan, Turkish, Surinamese, or other. The answers were dichotomised into “a perceived Dutch cultural background” and “a perceived non-Dutch cultural background” (including a mixed [Dutch] perceived cultural background).

2.2.5 | Living conditions

The living conditions included parental educational level, the presence of screens in the house, and the physical sleep environment. Parental educational level was categorised into a low educational level (primary school or prevocational secondary education), a medium educational level (senior general secondary education, pre-university education or vocational secondary education), or a high educational level (higher professional education or university), based on the highest level of education completed by the parent and his/her partner.

The presence of screens at home was assessed with three questions (Gradisar et al., 2013). Firstly, whether the child had access to a mobile device (smartphone/tablet): (1) the child does not own nor has access to a mobile device, (2) the child does not own, but has access to a mobile device, or (3) the child owns a mobile device. Secondly, whether the child has (a) screen(s) (television/computer/game console) in his/her own bedroom (no/yes). Thirdly, whether the child was accustomed to bringing a mobile device into his/her bedroom at night. This third question was measured on a 5-point Likert scale and dichotomised into “no” (i.e. [almost] never) and “yes” (i.e. sometimes or [almost] every evening).

The physical sleep environment was assessed (Harsh et al., 2002) by asking if the child (1) sleeps in a darkened bedroom, (2) is brought to bed after falling asleep, (3) shares his/her bedroom (e.g. with siblings or parents), and (4) sleeps in a quiet sleep environment. These answers were also measured on a 5-point Likert scale and dichotomised (no/yes).

2.3 | Statistical analyses

Data entering, cleaning, and transformation of variables was executed in IBM Statistical Package for the Social Sciences (SPSS), version 26. The data were checked on possible data-entry errors and extreme values. When parents reported their child’s sleep times being consistently earlier than their child’s bedtime, the times were swapped. When this was done inconsistently, both times were changed to missing. When it was only a single error, the time was changed to the other corresponding days in the diary. Similar procedures were followed for wake-up times and the time of getting out of bed. Outliers on all of the continuous variables were reduced or increased to a maximum of three times the value of the *SD* above or below the mean.

To investigate how many days of the diary had to be completed for reliable estimation of sleep duration and sleep quality, reliability analyses were performed by comparing mean sleep duration and sleep quality of 7 completed diary days with the means of less completed diary days. The analyses showed that, for each child, a minimum of 2 completed sleep diary days (either week or weekend days) needed to be included. The 2 completed weekdays compared to 7 completed diary days showed good reliability for both sleep duration and sleep quality with an intraclass correlation coefficient (ICC) of 0.84 and 0.81, respectively. The 2 completed weekend days compared to 7 completed diary days also showed good reliability with an ICC of 0.78 for both sleep duration and sleep quality (Koo & Li, 2016). Table S2 presents the results of the reliability analyses. In addition, sensitivity analyses were performed by running all the following analyses only for the children whose parents completed all 7 diary days and comparing these results with the results of the analyses including children whose parents completed a minimum of 2 diary days.

Descriptive statistics were performed to describe the characteristics of the study sample. As the age range was rather large and sleep and its potential related factors may differ with age, these analyses were stratified for children’s age (i.e. 4–8 and 9–13 years). Independent-samples *t* tests for the continuous factors and chi-square tests for the categorical factors were conducted to analyse whether the means of the two groups differed. Children with missing data on sleep timing and with <2 complete days for both sleep duration and sleep quality were excluded. A logistic regression analysis was performed to assess whether the excluded children differed significantly in age, sex, and parental educational level. The number of missing values was $<10\%$ of the study population for each of the independent variables, with exception of the variable “using a television before bedtime” (11.4% missing). This was considered as inconsequential for the results (Bennett, 2001).

Repeated-measures analyses were performed using linear mixed models to assess the associations between the independent variables and (1) sleep duration and (2) sleep quality. For sleep timing, logistic regression analyses were performed. The mixed models and logistic regression analyses were executed in STATA standard edition, version 14. All assumptions to perform the analyses were met. To assess the associations with sleep duration and sleep quality, an intercept-only model was run first. In this model, (1) sleep duration and (2) sleep quality were the dependent variables and a random intercept for the child was added on a second level. Subsequently, it was assessed whether it was necessary to add a random intercept for schools on a third level, using the likelihood-ratio test. As the models did not significantly improve, the random intercept for schools was excluded.

First, analyses were performed for each of the independent variables, which were adjusted for the child's age and sex, as these factors have been reported to be associated with children's sleep, thus possibly introducing confounding effects (Komrij et al., 2020; Spilsbury et al., 2004). Second, all variables that were significantly associated with (1) sleep duration or (2) sleep quality were subsequently added as a random slope to the intercept-only models. According to the likelihood-ratio test, none of the variables improved the model when added as a random slope. Hence, no random slope was added in the final models. Third, potential effect modification by children's age (i.e. dichotomous; 4–8 and 9–13 years) was explored by adding an interaction term to the model. Age was considered to be an effect modifier if the p value of the interaction term was <0.1. Lastly, multivariable mixed model analyses were performed for children aged 4–8 and 9–13 years separately with the variables that were significantly associated with the sleep outcomes to investigate which of the variables were correlated to (1) sleep duration and (2) sleep quality, adjusted for the influences of other relevant factors, and the dependency of the repeated measures of the sleep outcome within the individuals. For sleep timing, a multivariable logistic regression analysis was performed. Regression coefficients (B), odds ratios (ORs) and confidence intervals (CIs) were reported ($\alpha = 0.05$; two-sided).

3 | RESULTS

3.1 | Characteristics of the study participants

Of the 35 invited schools, six agreed to participate (17% response rate). The schools were located in socioeconomically diverse areas of Amsterdam. For these six participating schools, the response rates ranged from 5% to 27%. A total of 382 children and their parents participated in the study. The percentage of children with sleep diary data for a minimum of 2 completed diary days was 82% for sleep duration, 86% for sleep quality, and 75% for sleep timing. The percentage of children with complete 7 diary days was 59%, 70%, and 63%, respectively. After exclusion of 50 children with missing data for sleep timing and <2 reported values for both sleep duration and sleep quality, data from 332 children and their parents (92%) were used in the present study. The logistic regression analysis showed that the excluded children did not differ from the included children in terms of age, sex, and parental educational level. The characteristics of the study sample are shown in Table 1.

3.2 | Associations with children's sleep health

Table 2 presents the results from the univariable linear mixed model and logistic regression analyses. Most factors were only marginally associated with children's sleep health. Children's age was associated with all three sleep domains (i.e. sleep duration, sleep quality, and sleep timing). This means that for every year older the children are, they sleep on average 8.8 (95% CI −10.8 to −6.9) min less, have a 0.3 (95% CI −0.6 to 0.0) points lower rated sleep quality score, and have 1.3 (95% CI 1.1 to 1.3) higher odds of an irregular bedtime. None of the individual lifestyle factors were associated with the sleep outcomes. Regarding the social and community factors, lower parental pre-sleep emotional support was associated with an irregular bedtime (B 0.6; 95% CI 0.5 to 0.9). Moreover, the parental barrier to get their child to bed on time when siblings have a later bedtime was associated with a lower sleep quality score (B −2.0; 95% CI −3.9 to −0.1). Regarding living conditions, a high parental educational level (B −14.1 min; 95% CI −27.7 to −0.5) and being brought to bed after falling asleep (B −15.1 min; 95% CI −26.6 to −3.7) were negatively associated with sleep duration and sleeping in a darkened bedroom was associated with a lower sleep quality score (B −1.9; 95% CI −3.3 to −0.5). The sensitivity analyses showed that there were no relevant differences between the children whose parents completed a minimum of 2 diary days and the children whose parents completed all 7 diary days.

Effect modification by age was found for 11 associations in total, i.e., six factors related to sleep duration, two related to sleep quality, and three related to sleep timing. Table 3 presents the results of the stratified analyses for these factors. The parental barrier to get the child to bed on time when siblings have a later bedtime was associated with sleep duration, but only for children aged 4–8 years (B −17.6; 95% CI −33.3 to −1.9). Parental pre-sleep emotional support was related to sleep quality, but only for children aged 4–8 years (B 1.2; 95% CI 0.1 to 2.2). For sleep duration and sleep quality, the association of eight factors showed different directions for the two age groups, although most associations were non-significant in these stratified analyses. Gender was associated with sleep timing, where boys aged 6–13 years had 0.4 lower odds of an irregular bedtime than girls in that age group (95% CI 0.2 to 0.9). Furthermore, children aged 4–8 years with a perceived non-Dutch cultural background (OR 3.0; 95% CI 1.4 to 6.6) and those who shared a bedroom (OR 2.1; 95% CI 1.0 to 4.3) had higher odds of an irregular bedtime than those with a Dutch cultural background and who did not share a bedroom.

Table 4 shows the results of the multivariable analyses for children aged 4–8 years. As in the univariable analyses, these analyses also showed that older age of the children (B −7.8; 95% CI −11.4 to −4.2), the parental barrier to get the child to bed on time when siblings have a later bedtime (B −15.3; 95% CI −30.5

TABLE 1 Characteristics of the study sample

Characteristic	Total $n = 332$	Age 4–8 years $n = 211$	Age 9–13 years $n = 106$
Sleep health			
Sleep duration, min, mean (*SD*)	631.8 (41.3)***	644.2 (35.8)	608.7 (41.9)
Sleep quality score, mean (*SD*)	40.2 (5.6)***	40.6 (5.6)	39.4 (5.1)
Irregular bedtime, %	25	19	36
Individual characteristics			
Age, years, mean (*SD*)	7.5 (2.2)	-	-
Boys, %	46	49	42
Individual lifestyle factors, %			
Mobile device use before bedtime	55	52	62
Television use before bedtime	52	50	56
Computer/game console use before bedtime	36	32	42
Drinks one or more glasses before bedtime	73	74	70
Active play before bedtime	44**	51	31
Bed also used for other purposes beside sleeping	46	44	48
Goes to bed with worries	12	10	17
Social and community factors			
Pre-sleep emotional support score, mean (*SD*)	3.9 (0.8)	3.9 (0.7)	3.8 (0.8)
Routine score, mean (*SD*)	4.1 (0.6)**	4.2 (0.6)	4.0 (0.6)
Rules score, mean (*SD*)	4.4 (0.6)**	4.4 (0.6)	4.2 (0.7)
Parental barrier to get their child to bed on time when the parent is busy, %	26	26	28
Parental barrier to get their child to bed on time when the parent experiences stress, %	21	19	24
Parental barrier to get their child to bed on time when siblings have a later bedtime, %			
Parent succeeds to get the child to bed on time	48	45	52
Parent does not succeed to get the child in bed on time	13	12	15
Not applicable	39	43	32
Perceived non-Dutch cultural background, %	54	55	53
Living conditions			
Parental educational level, %			
Low	12	11	14
Medium	22	20	25
High	66	69	61
Having access to mobile devices, %	***		
Does not have access to a mobile device	6	6	6
Has access to a mobile device, but does not own one	43	54	21
Owns a mobile device and thus has access	51	40	33
Mobile devices in the bedroom at night, %	17*	87	77
Screen(s) in the bedroom, %	30	27	37
Darkened bedroom, %	76	78	72
Brought to bed after falling asleep, %	15	16	14
Bedroom sharing, %	34*	38	27
Quiet sleep environment, %	84	82	89

Differences in means with independent sample *t* test for continuous variables and differences in proportions for categorical variables. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 2 Univariable associations between child characteristics, lifestyle factors, social and community factors, living conditions and sleep health

	Sleep duration (*n* = 314)	Sleep quality (*n* = 329)	Sleep timing (*n* = 330)
	B (95% CI)	B (95% CI)	OR (95% CI)
Individual characteristics			
Age in years	−8.8 (−10.8 to −6.9)***	−0.3 (−0.6 to −0.03)*	1.3 (1.1 to 1.4)*
Boys	−4.3 (−12.7 to 4.1)	−0.5 (−1.7 to 0.7)	0.7 (0.4 to 1.2)
Individual lifestyle factors			
Mobile device use before bedtime	1.9 (−6.8 to 10.5)	0.8 (−0.4 to 2.0)	1.1 (0.7 to 2.0)
Television use before bedtime	0.9 (−8.1 to 9.9)	0.9 (−0.3 to 2.2)	1.7 (0.9 to 2.9)
Computer/game console use before bedtime	−0.5 (−9.8 to 8.8)	0.3 (−1.0 to 1.6)	0.9 (0.5 to 1.5)
Drinks one or more glasses before bedtime	3.9 (−5.5 to 13.4)	1.0 (−0.4 to 2.3)	0.7 (0.4 to 1.2)
Active play before bedtime	−1.6 (−10.1 to 7.0)	0.1 (−1.1 to 1.3)	0.7 (0.4 to 1.2)
Bed also used for other purposes besides sleeping	5.4 (−3.1 to 13.9)	−0.7 (−1.9 to 0.5)	0.6 (0.4 to 1.1)
Goes to bed with worries	−9.9 (−22.9 to 3.3)	−1.4 (−3.2 to 0.5)	0.7 (0.3 to 1.7)
Social and community factors			
Perceived non-Dutch cultural background	6.0 (−2.4 to 14.4)	−0.5 (−1.7 to 0.7)	1.5 (0.9 to 2.6)
Parental pre-sleep emotional support	−0.1 (−5.7 to 5.6)	0.6 (−0.2 to 1.4)	0.6 (0.5 to 0.9)**
Rules	6.6 (−0.7 to 14.0)	−0.1 (−1.1 to 1.0)	1.2 (0.8 to 1.9)
Routine	2.7 (−4.3 to 9.7)	0.0 (−1.0 to 1.0)	1.2 (0.8 to 1.9)
Parental barrier to get the child to bed on time when the parent is busy	−7.5 (−16.8 to 1.9)	−1.1 (−2.4 to 0.3)	0.8 (0.4 to 1.4)
Parental barrier to get the child to bed on time when the parent experiences stress	−9.2 (−19.6 to 1.2)	−1.2 (−2.7 to 0.3)	1.0 (0.5 to 1.9)
Parental barrier to get the child to bed on time when siblings have a later bedtime	−5.2 (−18.3 to 7.9)	−2.0 (−3.9 to −0.1)*	1.0 (0.4 to 2.3)
Living conditions			
Parental educational level [reference category = low]			
Medium	−4.1 (−19.5 to 11.3)	−0.5 (2.7 to 1.7)	1.4 (0.6 to 3.7)
High	−14.1 (−27.7 to −0.5)*	−0.9 (2.7 −1.0)	1.0 (0.4 to 2.4)
Access to mobile devices [reference category = has no access to mobile devices]			
Has access to a mobile device, but does not own one	10.1 (−8.1 to 28.2)	0.6 (−2.1 to 3.3)	1.0 (0.3 to 3.7)
Owns a mobile device and thus has access	3.6 (−14.8 to 21.9)	0.5 (−2.2 to 3.1)	1.9 (0.5 to 7.1)
Mobile devices in the bedroom at night	−3.6 (−15.4 to 8.3)	0.0 (−1.7 to 1.6)	1.1 (0.6 to 2.2)
Screen(s) in the bedroom	5.8 (−3.6 to 15.2)	0.5 (−0.8 to 1.9)	1.0 (0.5 to 1.7)
Darkened bedroom	0.9 (−9.3 to 11.1)	−1.9 (−3.3 to −0.5)**	1.0 (0.5 to 1.8)
Brought to bed after falling asleep	−15.1 (−26.6 to −3.7)*	0.0 (−1.7 to 1.7)	0.6 (0.3 to 1.5)
Bedroom sharing	−2.0 (−11.0 to 7.1)	−0.7 (−2.0 to 0.6)	1.3 (0.8 to 2.3)
Quiet sleep environment	3.7 (−7.9 to 15.2)	0.3 (−1.4 to 1.9)	1.2 (0.5 to 2.5)

B, regression coefficient; CI, confidence interval; OR, odds ratio. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
All univariable analyses were adjusted for age and sex.

to −0.1), and being brought to bed after falling asleep (−26.5; 95% CI −39.8 to −13.2) were associated with shorter sleep duration; parental pre-sleep emotional support (B 1.4; 95% CI 0.3 to 2.5), and sleeping in a darkened bedroom (B −2.3; 95% CI −4.1 to −0.5) were associated with a lower sleep quality, and a perceived non-Dutch cultural background was associated with irregular sleep timing (OR 2.8; 95% CI 1.3 to 6.3). Table 5 shows the results of the multivariable mixed model analyses for children aged 9–13 years. No multivariable analyses could be performed for sleep timing, as solely pre-sleep emotional support, children's sex and age were univariably associated with sleep timing for children aged 9–13 years. The multivariable mixed model analyses showed that

TABLE 3 Univariable associations between child characteristics, lifestyle factors, social and community factors, living conditions and sleep health stratified by age

	Age 4–8 years	Age 9–13 years
	B (95% CI)	B (95% CI)
Sleep duration		
Mobile device use before bedtime	7.6 (−2.3 to 17.4)	−10.6 (−27.2 to 6.1)
Television use before bedtime	8.1 (−2.3 to 18.4)	−12.2 (−29.2 to 4.8)
Parental barrier to get the child to bed on time when siblings have a later bedtime	−17.6 (−33.3 to −1.9)*	14.2 (−8.9 to 37.4)
Darkened bedroom	8.0 (−4.3 to 20.3)	−9.8 (−27.6 to 8.0)
Brought to bed after falling asleep	−23.7 (−36.5 to 11.0)	3.7 (−19.1 to 26.5)
Bedroom sharing	−8.6 (−18.9 to 1.6)	12.6 (−5.1 to 30.3)
	B (95% CI)	B (95% CI)
Sleep quality		
Parental pre-sleep emotional support	1.2 (0.1 to 2.2)*	−0.3 (−1.5 to 0.9)
Quiet sleep environment	1.2 (−0.8 to 3.12)	−2.0 (−5.0 to 1.0)
	OR (95% CI)	OR (95% CI)
Sleep timing		
Boys	1.0 (0.5 to 2.1)	0.4 (0.2 to 0.9)*
Perceived non-Dutch cultural background	3.0 (1.4 to 6.6)**	0.6 (0.3 to 1.4)
Bedroom sharing	2.1 (1.0 to 4.3)*	0.6 (0.2 to 1.5)

B, regression coefficient; CI, confidence interval; OR, odds ratio. *$p < 0.05$, **$p < 0.01$.
All univariable analyses were adjusted for age and sex.

TABLE 4 Multivariable associations between child characteristics, social and community factors, living conditions and sleep health for children aged 4–8 years

	Sleep duration (*n* = 183)	Sleep quality (*n* = 198)	Sleep timing (*n* = 205)
	B (95% CI)	B (95% CI)	OR (95% CI)
Age in years	−7.8 (−11.4 to −4.2)***	−0.1 (−0.7 to 0.5)	1.3 (1.0 to 1.7)
Boys	−3.0 (−12.5 to 6.4)	−0.5 (−2.0 to 1.1)	1.0 (0.5 to 2.0)
Perceived non-Dutch cultural background	-	-	2.8 (1.3 to 6.3)*
Parental pre-sleep emotional support	-	1.4 (0.3 to 2.5)*	0.7 (0.4 1.1)
Parental barrier to get their child to bed on time when siblings have a later bedtime	−15.3 (−30.5 to −0.1)*	−2.4 (−4.8 – 0.1)	-
Parental educational level [reference category = low]			
Medium	−0.7 (−19.7 to 18.2)	-	-
High	−9.2 (−26.2 to 7.5)	-	-
Darkened bedroom	-	−2.3 (−4.1 to −0.5)**	-
Brought to bed after falling asleep	−26.5 (−39.8 to −13.2)***	-	-
Bedroom sharing	-	-	2.0 (1.0 to 4.3)

B, regression coefficient; CI, confidence interval; OR, odds ratio.* $p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

older age of the children was associated with both shorter sleep duration (B −11.5; 95% CI −19.3 to −3.7) and a lower sleep quality (B −1.1; −2.1 to −0.1), and that a high parental educational level was associated with shorter sleep duration (B −30.8; 95% CI −55.1 to −6.5).

Although some effects were small (e.g. sleep duration in minutes), the variation of the means of the sleep outcomes were also small. Some of the associations comprised up to almost half a *SD* and could therefore be considered as meaningful. For example, the factor "parental barrier to get the child to bed on time when siblings

TABLE 5 Multivariable associations between child characteristics, social and community factors, living conditions and sleep duration and sleep quality for children aged 9–13 years

	Sleep duration (n = 98)	Sleep quality (n = 101)
	B (95% CI)	B (95% CI)
Age in years	−11.5 (−19.3 to −3.7)**	−1.1 (−2.1 to −0.1)*
Boys	−2.0 (−17.0 to 13.1)	−0.6 (−2.6 to 1.4)
Parental barrier to get their child to bed on time when siblings have a later bedtime	-	−1.7 (−4.5 to 1.2)
Parental educational level [reference category = low]		
Medium	−9.6 (−36.1 to 16.8)	-
High	−30.8 (−55.1 to −6.5)**	-
Darkened bedroom	-	−1.4 (−3.7 to 0.8)
Brought to bed after falling asleep	−7.7 (−31.3 to 16.0)	-

B, regression coefficient; CI, confidence interval.*$p < 0.05$, **$p < 0.01$.

have a later bedtime" was associated with sleeping 15.3 min less on average with the total sleep duration variable having a standard error of the mean of 35.8 min. An association that entails such a large part of the variation could be seen as meaningful in practice. Similarly, this also applies to the other found associations, except for the factor "children's age" in relation to sleep quality for older children (B −1.1; 95% CI −2.1 to −0.1), which was considered rather small and therefore less meaningful.

4 | DISCUSSION

The aim of the present study was to explore factors related to children's sleep health. The results showed that children slept on average ~10.5 hr/night, had a mean sleep quality score of 40 on a scale of 10–50, and 25% of children had a bedtime variability of ≥40 min. Although most factors were only marginally associated with children's sleep health, we found that older children, children with a perceived non-Dutch cultural background, lower parental pre-sleep emotional support, the parental barrier of getting their child to bed on time when siblings have a later bedtime, high parental education level, sleeping in a darkened bedroom, and being brought to bed after having fallen asleep, were negatively associated with children's sleep. In addition, we found that children's age modified some of the associations and that the direction of these associations were different between age groups.

For all three sleep domains (i.e. sleep duration, quality, and timing) we found two or more associated factors. Only children's age was associated with all three domains. Although older children do need fewer hours of sleep, our findings indicate that they also, more often than younger children, have inadequate sleep, which is consistent with previous research (Belmon et al., 2019). In addition, our present finding that being brought to bed after falling asleep was associated with shorter sleep was in accordance with an earlier study among pre-schoolers (Mindell et al., 2009). An explanation for this finding is that independence when falling asleep (i.e. children settling to sleep in their own bed without parental presence) could be important for children's sleep health (Allen et al., 2016). Another explanation for this association could be that the time children slept before they were brought to bed was not included in the sleep diary. However, due to the cross-sectional nature of our present study, reverse causation cannot be excluded as a possibility. When children already have shorter sleep, they might be more tired and fall asleep before they are being brought to bed. A high parental educational level was also associated with shorter sleep among older children. The findings from previous research for this association are inconsistent (Belmon et al., 2019; Komrij et al., 2020; Labree et al., 2015). In addition, the present study aimed to include an as heterogeneous sample as possible by specifically selecting schools from varied neighbourhoods in terms of their socioeconomic position and the cultural backgrounds of its residents. Although this indeed resulted in a rather culturally diverse sample with 54% of the parents categorising their child as part of a perceived cultural group other than native Dutch, the parents in our sample did have a slightly higher education level than would be representative for Amsterdam as a whole, i.e. 66% high, 22% medium and 12% low versus respectively 46%, 31%, and 23% in Amsterdam in general (Statistics Netherlands, 2018). Therefore, we cannot be certain that our findings are generalisable to low-educated parents, as they were less well-represented in our present study. The present study supports evidence for the association between perceived cultural background and sleep timing, which is in accordance with the literature, where children's sleep is found to be influenced by their cultural environment and family context (Jenni & Werner, 2011). Having parental pre-sleep emotional support was associated with better sleep quality among younger children. This finding is supported by previous research (Allen et al., 2016). Parental psychosocial functioning can positively contribute to children's emotional well-being and relaxation before bedtime, which may impact their sleep health. Also, in general, younger children need more parental support than older children. Still, as mentioned above, reverse causation might also be possible, meaning that when children sleep better, they might require less pre-emotional support from their parents. Furthermore, sleeping in a darkened bedroom was negatively associated with younger children's sleep quality. Although a more darkened bedroom is seen as a good sleep hygiene practice (Galland & Mitchell, 2010), it could also lead to difficulties with getting up in the morning due to the lack of natural morning light. In addition, fear of the dark is common among (especially younger) children, which is found to be associated with sleep problems (Galland & Mitchell, 2010). Again, reverse causation might be an explanation, as parents could have darkened the bedroom because of pre-existing sleep problems. The finding that the parental barrier to get their child to bed on time when siblings have a later bedtime was related to younger children's sleep duration could be explained by the fact that younger children usually go to bed earlier and greater parental involvement is needed to get children to bed on time. In addition, some factors were only related to the children's sleep for either the younger or older children and the direction of these associations differed per age group. This finding is supported by the literature, as it is well-known that sleep itself and sleep-related practices change with the child's age (Belmon et al., 2019; Buxton et al., 2015). No other associations with children's sleep health were found. However, the rather small effect sizes found in the present study may indicate that there are other important factors, outside those carefully selected for inclusion in our research, that might play a part in explaining children's inadequate sleep health.

Results from the present study may inform future sleep research. First, there is a lack of validated questionnaires to assess sleep and its potentially related factors. As validated questionnaires are important to produce reliable and valid results, future research could focus on adapting, validating, and translating existing questionnaires. It is important to create questionnaires that include different sleep domains and sleep concepts (e.g. sleep onset latency [SOL], wake after sleep onset [WASO]) and that make a distinction between sleep (related) behaviours on week and weekend days (Adam et al., 2007; Bartholomew Elredge et al., 2016). Additionally, it is important to create questionnaires with good content validity, i.e. that measure what they intend to (De Vet, Terwee, Mokkink, & Knol, 2011), and that they are easy to use in practice. Therefore, when creating such questionnaires, specific attention should be paid to creating them in co-creation with the intended users. Secondly, the rather low response rates in the present study might have occurred due to the length of the questionnaire and the workload. In contrast to earlier research (Borba et al., 2020; Short, Arora, Gradisar, Taheri, & Carskadon, 2017), our present study showed good reliability for both mean sleep duration and sleep quality for 2 completed diary days compared to 7 days. This indicates that, instead of using a 7-day diary, it could be explored whether a shortened diary may be possible to lower the burden for participants and potentially increase participation rates. In addition, ecological momentary assessment could be considered for future research, as this method enables the investigation of short-term relationships between certain factors and children's sleep (Buysse et al., 2007). Furthermore, digital questionnaires could be of interest to improve the usability for parents and researchers.

The present study has several strengths. One is that we included multiple sleep domains and a wide range of factors related to children's sleep health, and we included a study population with a diverse perceived cultural background. In addition, data on sleep health were collected through a sleep diary, which is more reliable tool to measure sleep health than a questionnaire (Werner, Molinari, Guyer, & Jenni, 2008). Although previous research showed that measurement with a sleep diary reached satisfactory agreement with actigraphy measurement (i.e. differences were <30 min; Werner et al., 2008), an objective measurement of sleep might have produced different results. Also, our collaboration with members of the Child Public Health Service and the Parenting Advice Center enabled us to match the research objectives with the needs of relevant organisations in the practical field. Involving these relevant stakeholders enables researchers to incorporate practical knowledge and produce research results that are relevant for application in practice. This collaboration helped us in the selection of factors and outcome measures, as we included only those that were indicated as most relevant by practice. For example, we included the dichotomous outcome variable for sleep timing based on the discussion with the practice professionals about a relevant cut-off value for an irregular bedtime. Finally, our present study provided insights for future sleep research and intervention design. Specifically, to provide parents with tailored support according to their children's age and thereby create custom materials to promote healthy sleep practices. Another insight was that the factors found in the present study could be included when designing healthy sleep interventions for children. When designing interventions, it is important to take a holistic approach and consider all important factors related to children's sleep health and their potential interrelatedness, e.g. with the use of systematic intervention design methods (e.g. Intervention Mapping, Bartholomew Elredge et al., 2016). Finally, the present study provided insight into which factors could be relevant to further investigate with other study designs (e.g. ecological momentary assessment). Our present study also had limitations. The response rate was rather low, it varied from 5% to 27% across schools. This might have resulted in some selection bias of good sleepers, which indeed seems likely when looking at the relatively good reported sleep health of the sample. However, our present results for mean sleep duration were comparable to the results of a recent meta-analysis which found that the mean sleep duration of Dutch children aged 6–13 years was 636 min/night (Kocevska et al., 2020). Furthermore, our present study population was rather diverse based on perceived cultural group, as 54% of parents categorised their child as part of a cultural group other than native Dutch. So, if selection bias towards good sleepers occurred, it seems to have been modest. Another limitation is that socially desirable responding might have occurred, as the variability in answers was low for many factors and was skewed towards better sleep hygiene. Finally, we eventually did not consider SOL and WASO in the calculation of sleep duration, as previous research found that SOL and WASO are difficult to measure accurately via self-report (Mazza, Bastuji, & Rey, 2020). This previous study showed that measuring bedtime and wake-up time with a sleep diary do correspond to the measurement of these constructs with actigraphy. Therefore, we used the bedtime and wake-up time as a basis for sleep duration. Unfortunately, this most likely resulted in overestimating sleep duration.

To conclude, the children in the present study had on average good sleep health. Being an older child, having a perceived non-Dutch cultural background, lower parental pre-sleep emotional support, the parental barrier to get their child to bed on time when siblings have a later bedtime, high parental education level, sleeping in a darkened bedroom, and being brought to bed after the child has fallen asleep were factors associated with children's less adequate sleep health. The present study provides valuable insights for future sleep research and intervention development.

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CONFLICT OF INTEREST

The authors declare no conflict of interest. This was not an industry supported study. This research was funded by the Amsterdam Healthy Weight Approach, the City of Amsterdam, and the scientific research institute "Sarphati Amsterdam, research for healthy living".

AUTHOR CONTRIBUTION

The conception and design of the research was done by LSB, VB, EOG, DMH, EdB, MJMC, and MMvS; the data were collected by LSB, NLK, EOG, and DMH; the data were cleaned by LSB; the data were analysed by LSB and NLK; the data were interpreted by LSB, NLK, VB MJMC, and MMvS; LSB and NLK drafted the article; all authors critically revised the article and approved the final version to be published.

DATA AVAILABILITY STATEMENT

Data available on request.

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REFERENCES

Adam, E. K., Snell, E. K., & Pendry, P. (2007). Sleep timing and quantity in ecological and family context: a nationally representative time-diary study. *Journal of Family Psychology*, *21*(1), 4–19. https://doi.org/10.1037/0893-3200.21.1.4

Allen, S. L., Howlett, M. D., Coulombe, J. A., & Corkum, P. V. (2016). ABCs of SLEEPING: A review of the evidence behind pediatric sleep practice recommendations. *Sleep Medicine Reviews*, *29*, 1–14. https://doi.org/10.1016/j.smrv.2015.08.006

Anujuo, K. O., Vrijkotte, T. G. M., Stronks, K., Jean-Louis, G., & Agyemang, C. O. (2016). Ethnic differences in sleep duration at 5 years, and its relationship with overweight and blood pressure. *The European Journal of Public Health*, *26*(6), 1001–1006. https://doi.org/10.1093/eurpub/ckw084

Astill, R. G., Van der Heijden, K. B., Van Ijzendoorn, M. H., & Van Someren, E. J. W. (2012). Sleep, cognition, and behavioral problems in school-age children: A century of research meta-analyzed. *Psychological Bulletin*, *138*(6), 1109–1138. https://doi.org/10.1037/a0028204

Bagley, E. J., Kelly, R. J., Buckhalt, J. A., & El-Sheikh, M. (2015). What keeps low-SES children from sleeping well: the role of presleep worries and sleep environment. *Sleep Medicine*, *16*(4), 496–502. https://doi.org/10.1016/j.sleep.2014.10.008

Bartholomew Elredge, L. K., Markham, C. M., Ruiter, R. A. C., Fernández, M. E., Kok, G., & Parcel, G. S. (2016). *Planning Health Promotion Programs: An Intervention Mapping Approach*, 4th ed. Jossey-Bass.

Belmon, L. S., Brasser, F. B., Busch, V., van Stralen, M. M., Harmsen, I. A., & Chinapaw, M. J. M. (2020). Perceived determinants of children's inadequate sleep health. A concept mapping study among professionals. *International Journal of Environmental Research and Public Health*, *17*(19), 7315. https://doi.org/10.3390/ijerph17197315

Belmon, L. S., Busch, V., van Stralen, M. M., Stijnman, D. P. M., Hidding, L. M., Harmsen, I. A., & Chinapaw, M. J. M. (2020). Child and parent perceived determinants of children's inadequate sleep health. A concept mapping study. *International Journal of Environmental Research and Public Health*, *17*(5), 1583. https://doi.org/10.3390/ijerph17051583

Belmon, L. S., Van Stralen, M. M., Busch, V., Harmsen, I. A., & Chinapaw, M. J. M. (2019). What are the determinants of children's sleep behavior? A systematic review of longitudinal studies. *Sleep Medicine Reviews*, *43*, 60–70. https://doi.org/10.1016/j.smrv.2018.09.007

Bennett, D. A. (2001). How can I deal with missing data in my study? *Australian and New Zealand Journal of Public Health*, *25*(5), 464–469. https://doi.org/10.1111/j.1467-842X.2001.tb00294.x

Borba, D. A., Reis, R. S., Lima, P., Facundo, L. A., Narciso, F. V., Silva, A., & de Mello, M. T. (2020). How many days are needed for a reliable assessment by the Sleep Diary? *Sleep Science*, *13*(1), 49–53. https://doi.org/10.5935/1984-0063.20190131

Bowling, A. (2014). *Research Methods in Health: Investigating Health and Health Services*, 4th ed. Open University Press.

Buxton, O. M., Chang, A. M., Spilsbury, J. C., Bos, T., Emsellem, H., & Knutson, K. L. (2015). Sleep in the modern family: protective family routines for child and adolescent sleep. *Sleep Health*, *1*(1), 15–27. https://doi.org/10.1016/j.sleh.2014.12.002

Buysse, D. J. (2014). Sleep health: Can we define it? Does it matter? *Sleep*, *37*(1), 9–17. https://doi.org/10.5665/sleep.3298

Buysse, D. J., Thompson, W., Scott, J., Franzen, P. L., Germain, A., Hall, M., … Kupfer, D. J. (2007). Daytime symptoms in primary insomnia: a prospective analysis using ecological momentary assessment. *Sleep Medicine*, *8*(3), 198–208. https://doi.org/10.1016/j.sleep.2006.10.006

Carney, C. E., Buysse, D. J., Ancoli-Israel, S., Edinger, J. D., Krystal, A. D., Lichstein, K. L., & Morin, C. M. (2012). The consensus sleep diary: standardizing prospective sleep self-monitoring. *Sleep*, *35*(2), 287–302. https://doi.org/10.5665/sleep.1642

Charters, E. (2003). The use of think-aloud methods in qualitative research an introduction to think-aloud methods. *Brock Education Journal*, *12*(2). https://doi.org/10.26522/BROCKED.V12I2.38

Dahlgren, G., & Whitehead, M. (1991). *Policies and Strategies to Promote Social Equity in Health*. Institute for Futures Studies.

De Vet, H. C., Terwee, C. B., Mokkink, L. B., & Knol, D. L. (2011). *Measurement in medicine: a practical guide*. Cambridge University Press.

Doane, L. D., Breitenstein, R. S., Beekman, C., Clifford, S., Smith, T. J., & Lemery-Chalfant, K. (2019). Early life socioeconomic disparities in children's sleep: The mediating role of the current home environment. *Journal of Youth and Adolescence*, *48*(1), 56–70. https://doi.org/10.1007/s10964-018-0917-3

Galland, B. C., & Mitchell, E. A. (2010). Helping children sleep. *Archives of Disease in Childhood*, *95*(10), 850–853. https://doi.org/10.1136/adc.2009.162974

Gradisar, M., Wolfson, A. R., Harvey, A. G., Hale, L., Rosenberg, R., & Czeisler, C. A. (2013). The sleep and technology use of Americans: Findings from the National Sleep Foundation's 2011 sleep in America poll. *Journal of Clinical Sleep Medicine*, *9*(12), 1291–1299. https://doi.org/10.5664/jcsm.3272

Gruber, R., Carrey, N., Weiss, S. K., Frappier, J. Y., Rourke, L., Brouillette, R. T., & Wise, M. S. (2014). Position statement on pediatric sleep for psychiatrists. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, *23*(3), 174–195.

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep Medicine Reviews*, *21*, 50–58. https://doi.org/10.1016/j.smrv.2014.07.007

Harsh, J., Easley, A., & LeBourgeois, M. K. (2002). An instrument to measure children's sleep hygiene. *Sleep*, *26*, A316.

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., … Adams Hillard, P. J. (2015). National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep Health*, *1*(1), 40–43. https://doi.org/10.1016/j.sleh.2014.12.010

Jenni, O. G., & Werner, H. (2011). Cultural issues in children's sleep: a model for clinical practice. *Pediatric Clinics of North America*, *58*(3), 755–763. https://doi.org/10.1016/j.pcl.2011.03.008

Kocevska, D., Lysen, T. S., Dotinga, A., Koopman-Verhoeff, M. E., Luijk, M., Antypa, N., & Tiemeier, H. (2020). Sleep characteristics across the lifespan in 1.1 million people from the Netherlands, United Kingdom and United States: A systematic review and meta-analysis. *Nature Human Behaviour*, *5*, 113–122. https://doi.org/10.1038/s41562-020-00965-x

Komrij, N. L., van Stralen, M. M., Busch, V., Inhulsen, M. M. R., Koning, M., de Jong, E., & Renders, C. M. (2020). Predictors of Changes in Sleep Duration in Dutch Primary Schoolchildren: the ChecKid Study. *International Journal of Behavioral Medicine*, *28*(2), 189–199. https://doi.org/10.1007/s12529-020-09876-7

Koo, T. K., & Li, M. Y. (2016). A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. *Journal of Chiropractic Medicine*, *15*(2), 155–163. https://doi.org/10.1016/j.jcm.2016.02.012

Labree, L. J. W., Van de Mheen, H., Rutten, F. F. H., Rodenburg, G., Koopmans, G. T., & Foets, M. (2015). Sleep duration differences between children of migrant and native origins. *Zeitschrift Fur Gesundheitswissenschaften*, *23*(3), 149–156. https://doi.org/10.1007/s10389-015-0665-8

Matricciani, L., Olds, T. S., & Petkov, J. (2012). In search of lost sleep: Secular trends in the sleep time of school-aged children and adolescents. *Sleep Medicine Reviews*, *16*(3), 203–211. https://doi.org/10.1016/j.smrv.2011.03.005

Matricciani, L., Paquet, C., Galland, B., Short, M., & Olds, T. (2019). Children's sleep and health: A meta-review. *Sleep Medicine Reviews*, *46*, 136–150. https://doi.org/10.1016/j.smrv.2019.04.011

Mazza, S., Bastuji, H., & Rey, A.E. (2020). Objective and subjective assessments of sleep in children: comparison of actigraphy, sleep diary completed by children and parents' estimation. *Frontiers in Psychiatry*, *11*, 495. https://doi.org/10.3389/fpsyt.2020.00495

McDowall, P. S., Campbell, A. C., & Elder, D. E. (2016). Parent knowledge of child sleep: a pilot study in a children's hospital cohort. *Sleep Medicine*, *21*, 57–62. https://doi.org/10.1016/j.sleep.2016.01.014

Mindell, J. A., Meltzer, L. J., Carskadon, M. A., & Chervin, R. D. (2009). Developmental aspects of sleep hygiene: findings from the 2004 National Sleep Foundation Sleep in America Poll. *Sleep Medicine*, *10*(7), 771–779. https://doi.org/10.1016/j.sleep.2008.07.016

Musher-Eizenman, D., & Holub, S. (2007). Comprehensive Feeding Practices Questionnaire: validation of a new measure of parental feeding practices. *Journal of Pediatric Psychology*, *32*(8), 960–972. https://doi.org/10.1093/jpepsy/jsm037

Short, M. A., Arora, T., Gradisar, M., Taheri, S., & Carskadon, M. A. (2017). How many sleep diary entries are needed to reliably estimate adolescent sleep? *Sleep*, *40*(3), zsx006. https://doi.org/10.1093/sleep/zsx006

Spilsbury, J. C., Storfer-Isser, A., Drotar, D., Rosen, C. L., Kirchner, L. H., Benham, H., & Redline, S. (2004). Sleep behavior in an urban US sample of school-aged children. *Archives of Pediatrics and Adolescent Medicine*, *158*(10), 988–994. https://doi.org/10.1001/archpedi.158.10.988

Spruyt, K., O'Brien, L. M., Cluydts, R., Verleye, G. B., & Ferri, R. (2005). Odds, prevalence and predictors of sleep problems in school-age normal children. *Journal of Sleep Research*, *14*(2), 163–176. https://doi.org/10.1111/j.1365-2869.2005.00458.x

Statistics Netherlands (2018). *Education level*. Retrieved from https://www.cbs.nl/nl-nl/maatwerk/2020/17/opleidingsniveau-naar-gemeenten-wijken-en-buurten

Werner, H., Molinari, L., Guyer, C., & Jenni, O. G. (2008). Agreement rates between actigraphy, diary, and questionnaire for children's sleep patterns. *Archives of Pediatrics and Adolescent Medicine*, *162*(4), 350–358. https://doi.org/10.1001/archpedi.162.4.350

SUPPORTING INFORMATION

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