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Sleep problems and duration in school-aged children at different levels of giftedness

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ABSTRACT

Objectives: Optimal sleep is crucial for developing and maintaining gifted children's cognitive abilities. However, only a few studies have explored the sleep profiles of gifted children and overlooked their internal variations. This study aimed to investigate subjective and object sleep profiles in school-aged gifted children with different levels of giftedness.
Methods: This study included 80 school-aged children (50 % male) aged 6–11 years. Giftedness was assessed using the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV). Subjective and objective sleep were evaluated using the Children's Sleep Habits Questionnaire (CSHQ) and Actiwatch 2.
Results: The sample was divided into three groups based on their full scale intelligence quotient (IQ): 16 typically developing children (IQ < 130), 38 moderately gifted children (IQ: 130–145), and 26 highly gifted children (IQ > 145). The highly gifted children had the mildest sleep problems, particularly in sleep duration and daytime sleepiness. Moderately gifted children had the shortest subjective average sleep duration, while the three groups had no significant differences in Actiwatch-measured sleep variables. Furthermore, CSHQ total and daytime sleepiness subscale scores were negatively associated with the full scale IQ in gifted children after controlling for confounders including emotional and behavioral problems.
Conclusions: Children with higher levels of giftedness experience fewer subjective sleep problems but have similar objective sleep parameters. It is imperative to implement tailored sleep strategies for fostering intellectual development and nurturing young talents.

1. Introduction

Gifted children outperform their peers and rank in the top 10 % of natural ability [1,2]. They contribute greatly to future human resources and are a primary driving force for societal development [3]. However, studies have not fully unveil potential factors contributing to the cognitive advantage of gifted children [4,5]. It has been well recognized that sleep is one of the most important and modifiable factors for the development of children's brains and intelligence, but its characteristics and relationship with giftedness levels in school-aged children warrant investigation [6].

Substantial evidence supports that poor sleep quality and insufficient sleep are associated with compromised cognitive development and performance in children [7–10]. Studies have also linked longer sleep

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duration to higher intelligence quotient (IQ) in school-aged children [11–13]. However, inconsistent finding exists that school-aged children with higher IQ demonstrate shorter sleep duration, possibly due to their higher daytime cognitive efficiency and nighttime sleep efficiency [14]. Furthermore, these studies in general children have mixed individuals with different levels of IQ, and thus overlooked sleep characteristics and their association with IQ levels in gifted children.

Given their superior adaptability [15], gifted children may benefit from protective factors like improved nighttime efficiency [14] and heightened daytime alertness [16] to support their cognitive abilities, necessitating empirical investigation. However, some cross-sectional studies found that gifted children had more insomnia and other sleep problems as reported by parents compared to non-gifted children [17–19]. A cohort study demonstrated no significant difference in parent-reported sleep problems between gifted and non-gifted children across childhood [20]. Considering the negative impact of sleep problems on cognition, the observation that gifted children may experience similar or even more sleep problems than typically developing children underscores the necessity for further investigation. Within the group of gifted children, there is a wide range of abilities that can be further categorized as moderately, highly, and exceptionally gifted [21]. It is crucial to recognize that individuals with different levels of giftedness are distinct, much like those with average abilities differing from individuals with intellectual disabilities [22]. Existing studies treating gifted children as a homogeneous group [23] may obscure the genuine sleep characteristics of gifted children and their association with giftedness.

Only a few studies have examined sleep in gifted children using objective measures such as polysomnography and actigraphy. Polysomnography studies have identified inconsistent differences in sleep macrostructure between gifted and typically developing children [17,24,25]. As far as we know, there is only one study using actigraphy to investigate sleep characteristics of gifted children, and it demonstrated no significant difference in sleep duration from that of typically developing children [19]. Notably, existing studies have predominantly used small or selective samples in Western countries, and rarely applied both subjective and objective sleep measures, making multidimensional features of sleep health in gifted children unclear. Moreover, well-recognized cultural differences in sleep health and sleep practices also highlight further investigation into sleep profiles of gifted children in China [26–28].

Therefore, with both parent-reported questionnaire and actigraphy, the current study aimed to explore the differences in subjective and objective sleep characteristics among Chinese school-aged children with different giftedness levels (moderately gifted and highly gifted) as compared to children with typical development, and investigate associations between their sleep profiles and IQ scores, adjusting for important confounding factors, emotional and behavioral problems in particular [27,29,30].

2. Method

2.1. Participants

This study was conducted between December 2016 and March 2017. It was designed to be observational and cross-sectional, focusing on gifted school-aged children in grades one to four. The participants were 80 children aged 6–11 years (50 % boys) from an experimental primary school. Unlike normal public schools in Shanghai, the school is purposefully designed to cater to gifted children, with a substantial portion of students falling within this category. It implements specialized teaching pilot programs specifically tailored to meet the unique needs of these gifted individuals. We used a stratified random sampling of 10 boys and 10 girls in grades one to four to study the gifted children in different grades better. All selected students and their parents consented to participate. We excluded individuals with significant physical or

Table 1
Demographic characteristics of typically developing, moderately gifted, and highly gifted children.

	TD (N = 16)		MG (N = 38)		HG (N = 26)		χ^2	*P*
	Mean	SD	Mean	SD	Mean	SD		
Age	8.90	1.44	8.64	1.29	8.41	0.19	1.20	0.548
Sex (n, %)							0.83	0.662
Male	9	56.3	17	44.7	14	53.8		
Female	7	43.8	21	55.3	12	46.2		
Father's education level (n, %)							0.27	0.873
Master's degree or above	8	50.0	20	52.6	15	57.7		
Bachelor's degree or college	8	50.0	18	47.4	11	42.3		
Mother's education level (n, %)							0.10	0.952
Master's degree or above	5	31.3	13	34.2	8	30.8		
Bachelor's degree or college	11	68.8	25	65.8	18	69.2		
Grade (n, %)							7.12	0.310
1	4	25.0	11	28.9	5	19.2		
2	3	18.8	7	18.4	10	38.5		
3	3	18.8	9	23.7	8	30.8		
4	6	37.5	11	28.9	3	11.5		
Neuropsychological characteristics								
Full Scale IQ	121.00	7.38	136.79	4.94	155.15	7.82	67.31	<0.001
Verbal Comprehension Index (VCI)	120.06	11.67	134.32	14.45	153.35	12.11	37.28	<0.001
Perceptual Reasoning Index (PRI)	121.88	9.08	128.89	8.87	137.62	9.59	23.12	<0.001
Working Memory Index (WMI)	115.00	12.16	130.55	12.03	145.62	19.92	27.12	<0.001
Processing Speed Index (PSI)	101.69	10.08	112.95	16.59	129.69	21.40	20.73	<0.001
SVPD	10.44	9.19	15.63	10.51	18.27	9.81	7.00	0.030
VCI-PRI ≥15 (n, %)	3	18.8	21	55.3	17	65.40	9.09	0.011
Behavioral characteristics								
Emotional symptoms	1.81	1.33	1.76	1.95	1.12	1.63	4.61	0.100
Conduct problems	1.56	1.32	1.16	1.13	1.77	1.48	3.20	0.202
Hyperactivity	4.00	2.03	3.32	2.67	2.50	1.99	4.88	0.087
Peer problems	1.63	0.96	2.03	1.57	1.88	1.42	0.29	0.864
Prosocial behavior	7.63	1.31	8.21	1.51	8.00	2.35	2.61	0.271
SDQ total difficulties	9.00	3.25	8.26	5.25	7.27	4.53	2.51	0.284

TD = typically developing; MG = moderately gifted; HG = highly gifted; SVPD = significant verbal performance difference.

Table 2
CSHQ scores of typically developing, moderately gifted, and highly gifted children.

	TD (N = 16)	MG (N = 37)	HG (N = 26)				Fisher LSD	Fisher LSD	Fisher LSD
	Mean ± SD	Mean ± SD	Mean ± SD	F	*P*	η2	*P* (TD/MG)	*P* (TD/HG)	*P* (MG/HG)
Bedtime resistance	7.75 ± 1.69	8.92 ± 2.71	8.08 ± 2.67	1.52	0.225	–	–	–	–
Sleep onset delay	1.38 ± 0.72	1.32 ± 0.58	1.27 ± 0.53	0.16	0.851	–	–	–	–
Sleep duration	4.94 ± 1.24	4.59 ± 1.34	3.92 ± 1.23	3.56	0.033	0.086	0.376	0.015	0.045
Parasomnias	8.56 ± 1.41	8.16 ± 1.28	7.96 ± 1.11	1.14	0.326	–	–	–	–
Night waking	3.69 ± 0.70	3.51 ± 0.93	3.65 ± 1.09	0.26	0.770	–	–	–	–
Sleep anxiety	5.94 ± 1.57	6.51 ± 2.29	5.58 ± 2.02	1.60	0.208	–	–	–	–
Sleep disordered breathing	3.50 ± 0.63	3.32 ± 0.71	3.42 ± 0.76	0.38	0.687	–	–	–	–
Daytime sleepiness	12.69 ± 3.20	12.03 ± 2.85	10.38 ± 2.89	3.72	0.029	0.089	0.454	0.016	0.032
Total score	45.38 ± 6.12	44.86 ± 7.81	41.19 ± 6.85	2.50	0.089	0.062	0.813	0.071	0.050

TD = typically developing; MG = moderately gifted; HG = highly gifted; CSHQ=Children's Sleep Habit Questionnaire.

Table 3
Subjective sleep duration of typically developing, moderately gifted, and highly gifted children.

	TD (N = 16)	MG (N = 38)	HG (N = 26)				Fisher LSD	Fisher LSD	Fisher LSD
	Mean ± SD	Mean ± SD	Mean ± SD	F	*P*	η2	*P* (TD/MG)	*P* (TD/HG)	*P* (MG/HG)
Sleep duration (h)									
School days	9.08 ± 0.61	8.86 ± 0.52	9.13 ± 0.44	2.43	0.094	0.059	0.148	0.784	0.043
Weekends	9.94 ± 0.72	9.53 ± 0.63	9.92 ± 0.52	4.29	0.017	0.100	0.026	0.921	0.014
Average	9.33 ± 0.59	9.05 ± 0.50	9.36 ± 0.39	3.71	0.029	0.088	0.057	0.866	0.016
Time in bed (h)									
School days	9.19 ± 0.58	9.13 ± 0.39	9.30 ± 0.36	1.28	0.284	0.032	0.646	0.400	0.115
Weekends	10.22 ± 0.86	9.76 ± 0.57	10.09 ± 0.63	3.52	0.035	0.084	0.022	0.547	0.051
Average	9.48 ± 0.57	9.31 ± 0.35	9.53 ± 0.38	2.45	0.093	0.060	0.163	0.728	0.040

TD = typically developing; MG = moderately gifted; HG = highly gifted.

neurodevelopmental disorders, and those requiring ongoing medical treatment or medication. The researchers asked parents to answer validated questionnaires to assess their children's sleep disturbances, emotional and behavioral problems, and demographic details. The study was approved by the Institutional Review Board of Shanghai Children's Medical Center (SCMCIRB-K2017057) and adhered to the guidelines outlined in the Declaration of Helsinki.

2.2. Measures

Certified and proficient assessors assessed giftedness using the Chinese version of the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV) [31]. The WISC-IV is internationally recognized as one of the most authoritative and widely used diagnostic intelligence test. The test results were expressed in terms of deviation IQ on full scale and subtests including Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), Processing Speed Index (PSI). We also calculated the performance of the three groups regarding IQ heterogeneity. An absolute difference of ≥15 between VCI and PRI is referred to as a significant verbal performance difference (SVPD), and represents the heterogeneity of cognitive traits [32,33].

According to previous studies [21,22,34], the participants were divided into three groups based on full-scale IQ: < 130 as the typical developing (TD) group, 130–145 (two standard deviations above average) as the moderately gifted (MG) group, and > 145 (three standard deviations above average) as the highly gifted (HG) group.

Sleep was evaluated subjectively with the Chinese version of the Children's Sleep Habit Questionnaire (CSHQ) [35]. The CSHQ was originally developed by Owens et al. to assess sleep problems in children [36]. The Chinese version of CSHQ has good reliability and internal consistency (Cronbach's α was 0.80 for the full scale and 0.49 to 0.72 for the subscale) [28]. Higher scores indicate more disturbed sleep, and a total score above 41 is considered poor sleep quality [27]. In addition to assessing children's sleep problems, the questionnaire included items on children's bedtime, wake-up time and sleep duration on school days and weekends. Weekday and weekend sleep parameters were weighted by the number of days and then averaged to obtain the weekly average. The time in bed was then calculated by wake-up time minus bedtime.

Sleep was also objectively measured using an Actiwatch 2 (Philips Respironics, Inc.), which looks like a watch with a built-in accelerometer that continuously records movement to assess sleep unobtrusively from motor activity. Movement data below a predetermined activity threshold is converted to sleep; movement data above a predetermined activity threshold is converted to wakefulness [37]. Children underwent 7-day actigraphy monitoring and completed sleep diary. Trained researchers used the manufacturer's algorithm set at the medium sensitivity threshold (wake threshold value was 40) to tag and parameterize all activity data based on sleep diaries. The sleep variables were as follows: (1) sleep duration, (2) time in bed calculated by sleep onset and offset, (3) sleep onset latency (SOL), (4) wake after sleep onset (WASO), and (5) sleep efficiency (SE).

The Strengths and Difficulties Questionnaire (SDQ), was used to measure child emotional and behavioral problems. The questionnaire comprises 25 questions divided into five subscales: Emotional symptoms, Conduct problems, Hyperactivity or Inattention, Peer Problems, and Prosocial Behavior [38]. Parents rated each item on a 3-point Likert scale to measure how often certain behaviors or emotions were observed in the child. A total difficulty score adds up four-difficulty subscales of Emotional symptoms, Conduct problems, Hyperactivity or Inattention, and Peer Problems. The Chinese version of SDQ has acceptable reliability and internal consistency (Cronbach's α was 0.59 for the entire scale and 0.30 to 0.68 for the subscale) [39].

2.3. Statistics

For characterizing the participants, chi-square analyses were used for categorical variables, and Kruskal-Wallis tests were used for non-normality continuous variables. MANOVAs for relevant dependent variables were performed to explore sleep differences among three groups wherever appropriate. ANOVAs for univariate analyses were used to further explored individual variables, considering their

Table 4
Actiwatch sleep parameters of typically developing, moderately gifted, and highly gifted children.

	TD (N = 14)	MG (N = 33)	HG (N = 25)		
	Mean ± SD	Mean ± SD	Mean ± SD	F	*P*
Sleep duration (min)					
School days	448.53 ± 34.89	452.69 ± 28.97	461.40 ± 25.37	1.06	0.352
Weekends	487.54 ± 48.26	487.45 ± 38.74	487.98 ± 26.62	<0.01	0.998
Average	465.19 ± 36.19	465.39 ± 26.49	470.31 ± 22.26	0.27	0.762
Time in bed (min)					
School days	487.47 ± 38.67	493.92 ± 28.12	501.11 ± 23.07	1.06	0.353
Weekends	535.59 ± 46.27	532.31 ± 42.96	529.93 ± 31.97	0.09	0.914
Average	505.51 ± 37.15	507.18 ± 27.58	510.36 ± 21.73	0.16	0.853
SOL (min)	31.33 ± 17.66	26.69 ± 11.79	28.29 ± 13.63	0.57	0.571
WASO (min)	41.07 ± 10.04	42.39 ± 13.25	40.23 ± 13.21	0.21	0.810
SE (%)	83.50 ± 5.58	84.22 ± 4.84	83.96 ± 3.48	0.12	0.884

TD = typically developing; MG = moderately gifted; HG = highly gifted; SOL = sleep onset latency; WASO = wake after sleep onset; SE = sleep efficiency.

resilience to deviations from normal distribution [40]. Post-hoc tests with Fisher's Least Significant Difference (LSD) analyses were conducted to identify specific group differences. Subsequently, hierarchical regression analyses were carried out to examine the association between sleep and giftedness in gifted children. The dependent variable was CSHQ score or sleep duration in children, whereas the independent variable was their full scale IQ, adjusting for potential confounders including SDQ total difficulties and sociodemographic factors (age, sex, and mother's education level). The significance level was set at $p < 0.05$. SPSS (version 24.0) was used for data analysis.

3. Results

3.1. Demographic characteristics

The TD, MG, and HG groups included 16, 38, and 26 children. Table 1 shows no significant differences among the three groups regarding age, sex, parental education, grade level, or SDQ scores. The differences among the three groups were significant for all four WISC-IV subtest scores ($p < 0.001$). The HG group showed the highest SVPD among the three groups ($p = 0.030$).

3.2. CSHQ - measured sleep problems

One participant did not have data for one of the questions on the CSHQ sleep anxiety subscale and was therefore excluded from the analysis of the CSHQ score. MANOVA conducted on CSHQ subscales showed a marginally significant difference among 3 groups, $F = 1.534$, $p = 0.096$, $\eta 2 = 0.149$. As demonstrated in Table 2, further univariate ANOVA with LSD showed significant differences among three groups in CSHQ subscales of sleep duration ($p = 0.033$) and daytime sleepiness ($p = 0.029$), with the HG group having lowest scores. The univariate ANOVA with LSD showed marginally significant difference in CSHQ total score among the three groups ($p = 0.089$), with the HG group having a lowest mean score. The prevalence rates of sleep disturbances based on CSHQ cut-off of 41 were 68.8 % in the TD group, 67.6 % in the MG group, and 38.5 % in the HG group, showing a significant difference ($p = 0.044$).

3.3. Basic sleep parameters

MANOVA conducted on subjective sleep duration variables showed marginally significant differences among 3 groups: Sleep duration (school days and weekends), $F = 2.185$, $p = 0.073$, $\eta 2 = 0.054$, and Time in bed (school days and weekends), $F = 1.942$, $p = 0.085$, $\eta 2 = 0.051$. As demonstrated in Table 3, further univariate ANOVA showed significant differences among three groups in weekend sleep duration ($p = 0.017$) and time in bed ($p = 0.035$), with the MG group sleeping for the least amount of time on the weekend. The univariate ANOVA showed the difference in average sleep duration among the three groups was significant ($p = 0.029$), with the MG group having the shortest average sleep duration.

Eight individuals having incomplete Actiwatch data and one outlier were excluded for the analysis. MANOVAs showed no significant differences in either objective sleep duration or objective time in bed (school days and weekends). See Table 4 for univariate F scores.

3.4. Hierarchical regression analysis

The hierarchical regression analyses were conducted in gifted children, showing that the full scale IQ was negatively associated with CSHQ total score ($\beta = -0.21$, $p = 0.057$) and daytime sleepiness ($\beta = -0.26$, p

Table 5
Association of full scale IQ and sleep in moderately gifted and highly children according to hierarchical regression analyses.

Predictor	CSHQ- Daytime Sleepiness		CSHQ- Sleep Duration		CSHQ- Total Score		Subjective Average Sleep Duration (h)	
	R^2 change	β	R^2 change	β	R^2 change	β	R^2 change	β
Univariate model	0.099*		0.059#		0.100*		0.015	
Full Scale IQ		−0.32*		−0.24#		−0.32*		0.12
Model 1	0.063*		0.049#		0.134*		0.004	
Full Scale IQ		−0.29*		−0.22#		−0.27*		0.11
SDQ total difficulties		0.25*		0.22#		0.37*		−0.07
Model 2	0.077		0.035		0.162*		0.07	
Full Scale IQ		−0.26*		−0.20		−0.21 #		0.11
SDQ total difficulties		0.29*		0.25#		0.46*		−.04
Age		−0.15		−0.10		−0.09		−0.24#
Sex		0.20		0.15		0.39*		0.06
Mother's education level		0.09		0.03		0.01		0.05

CSHQ=Children's Sleep Habit Questionnaire; SDQ= Strengths and Difficulties Questionnaire.
#$p < 0.10$.
*$p < 0.05$.

= 0.035), adjusting for confounders (see Table 5). Moreover, the association of the full scale IQ with either the CSHQ subscale of sleep duration or subjective average sleep duration did not reach statistical significance after adjusting for confounding factors.

4. Discussion

The current study provided novel evidence in subjective and objective sleep characteristics in moderately and highly gifted school-aged children compared to TD children, along with their association with giftedness levels. We noted that HG children had less sleep problems, particularly with regard to insufficient/irregular sleep and excessive daytime sleepiness. Whilst MG children had the shortest parent-reported average sleep duration compared with TD and HG children. Moreover, our study found negative associations between sleep problems, specifically daytime sleepiness, and IQ scores in gifted children. Taken together, our findings highlight the heterogeneity and complexity of the associations, and gifted children seem to have similar objective nighttime sleep duration but higher daytime alertness.

Our study demonstrated that gifted children with higher levels of giftedness had less sleep problems, in particular daytime sleepiness, which is potentially due to their superior adaptability [15]. As gifted children have advanced cognitive skills and adaptive coping strategies [41], they may experience lower academic load and stress that are linked to sleep problems [42,43]. However, some studies have found no differences between typically developing children and gifted children on parent-reported sleep quality [20,33,44]. Contradictory results have even showed that children with high IQ had increased sleep problems such as insomnia [17–19]. The divergent findings in existing studies may be attributed to heterogeneity in the definition of giftedness (e.g., 120 versus 130 for IQ cutoff). Based on our findings, when gifted children were mixed together, it became challenging to discern differences in sleep problems.

It is very interesting that the current study noted milder daytime sleepiness in children with higher giftedness level, indicating their greater daytime alertness [16]. Higher levels of alertness may in turn be beneficial to children's daytime functioning and cognitive abilities, considering substantial evidence that daytime sleepiness has been linked to academic difficulties and cognitive deficits [45,46]. According to Genç et al.'s theory, the brains of individuals with high IQs work more efficiently [47]. Therefore, it is possible that highly gifted children may display higher nocturnal efficiency, characterized by more efficient neuronal recovery and the effective elimination of sleep stress within the same amount of sleep time [14].

Our study showed that the average sleep duration reported by parents in MG children was shorter than HG children and TD children. The finding is important to indicate significant differences in subjective sleep duration between gifted children and typically developing children that would have been missed if gifted children were simply lumped together [44]. However, no significant differences were found in objective sleep parameters among the groups in our study. This may be partly due to the short recording time of Actiwatch may not reflect children's long-term sleep habits as better as parental reports [48]. Another potential reason is reporting bias of subjective sleep measurement, while it can reflect certain aspects of children's sleep status and sleep needs [49,50]. Notably, consistent to the current study, polysomnography studies also showed no significant differences in objective sleep duration outcomes between gifted children and typically developing children [17]. This highlights the importance of evaluating subjective and objective sleep health aspects.

Our study confirmed the negative association between sleep problems, daytime sleepiness in particular, and IQ in moderately and highly gifted school-aged children, after adjusting for important confounders including emotional and behavioral problems. This finding emphasizes the importance of considering giftedness levels when examining their sleep patterns and duration. Considering the large interindividual variability in sleep duration [51], the observation that highly gifted children have fewer sleep issues could suggest their better adaptability in terms of sleep. It's possible that the amount of sleep they require meets the cognitive developmental needs [14]. Therefore, tailoring sleep patterns to address specific cognitive needs is crucial for nurturing gifted school-aged children.

4.1. Strengths and limitations

To our best knowledge, this study is the first to further classify gifted children in terms of giftedness levels, expanding our understanding of sleep behaviors in gifted school-aged children. This study ensured the validity of the definition of giftedness by uniformly testing the participants' IQ using trained assessors rather than collecting data from existing databases.

The limitations of this study lie first in the small number of participants, which limits the choice of methods for complex multivariate analysis. However, it's important to emphasize that this is a valuable sample as it requires conducting numerous on-site tests, surveys completed by parents and children, and the wearing of Actiwatch. These factors ultimately contributed to the small sample size. Second, the sample of this study originated from a school with a special educational approach. The availability of gifted students to participate in our research may differ from that of typically developing children. This difference inherently limits the generalizability of our findings to the broader population of gifted children who may not attend such specialized schools. Nonetheless, this study represents a valuable attempt. Future studies should consider alternative recruitment strategies to minimize the effects of selection bias and improve the representativeness of the sample. Additionally, while the reliability and validity of the Chinese version of CSHQ have been studied, further research on its cutoff value is still required. The commonly used cutoff of 41 might overestimate sleep issues in Chinese gifted school-aged children. Nevertheless, our study adopted this standard for facilitating cross-cultural comparisons. Finally, although this study used well-standardized sleep questionnaire and actigraphy to assess sleep, this combined approach still cannot fully capture all sleep features. Future research should also incorporate tools such as polysomnography to study the sleep of children with different levels of giftedness.

4.2. Conclusions

This study provides new evidence on sleep characteristics among Chinese school-aged children with different giftedness levels. Differences in parent-reported sleep problems and sleep duration were found between children with different levels of giftedness, with the HG reporting the least severe sleep problems in terms of sleep duration and daytime sleepiness. MG children had the shortest subjective sleep duration. However, no differences in objective sleep parameters were found among children with different levels of giftedness. The second finding suggests that total IQ negatively correlates with the severity of sleep problems in gifted children after controlling for the significant effect of emotional-behavioral problems. Given the heterogeneity of sleep performance among children with high IQs, it is essential to implement tailored promotion, prevention, and intervention measures to support intellectual development and overall well-being of gifted children.

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CRediT authorship contribution statement

Jiumo Sun: Writing – original draft, Methodology, Formal analysis, Data curation. **Ruping Lu:** Resources, Investigation. **Wanqi Sun:** Validation, Formal analysis, Data curation. **Yujiao Deng:** Methodology. **Jieqiong Liu:** Methodology. **Yanrui Jiang:** Investigation. **Qi Zhu:** Project administration, Investigation, Data curation. **Hong Xu:** Writing – review & editing, Resources. **Guanghai Wang:** Writing – review & editing, Writing – original draft, Funding acquisition, Conceptualization. **Fan Jiang:** Writing – review & editing, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2024.07.030.

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