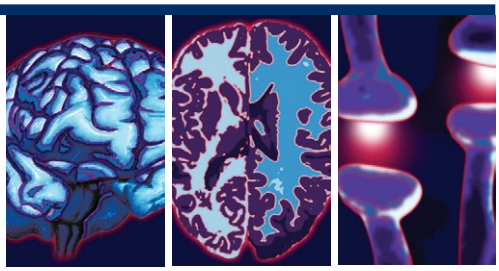

The relationships of insomnia and short and long nocturnal sleep durations with quality of life and the moderating effects of sex and age in Taiwanese adolescents

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ABSTRACT

Objective:

The aims of this study were to examine the relationships of insomnia and short and long nocturnal sleep durations with quality of life (QOL) and the moderating effects of sex and age on the relationships after controlling for the effects of depressive symptoms in Taiwanese adolescents.

Methods:

Self-reported insomnia, nocturnal sleep duration and QOL were measured in 5,590 high schools students. The associations of insomnia and nocturnal sleep duration with QOL and the moderating effects of sex and age on the associations were examined by multiple regression analysis models to control for the effects of depression.

Results:

After controlling for the effects of age, sex and depression, the severity of insomnia was negatively associated with all domains of QOL except for the social relationships dimension. Short sleepers had poorer family domain of QOL than average sleepers; however, long sleepers had better pain and psychological wellbeing domains of QOL than average sleepers. Sex and age had moderating effects on the associations of insomnia with several domains of QOL.

Conclusion:

Insomnia and nocturnal sleep duration should be taken into consideration when intervening adolescents' QOL.

Keywords

Adolescent, Insomnia, Nocturnal sleep duration, Quality of life, Depression

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Introduction

Adolescence is a developmental period marked by decreased sleep duration [1]. Research has demonstrated that insomnia and insufficient sleep duration may impair adolescents' daytime memory, reduce cognitive and behavioral functioning, be associated with poor health status, and increase the risk of motor vehicle accident, suicide, substance use, and behavior problems [2,3]. Meanwhile, insomnia is associated with several kinds of psychiatric illnesses, such as anxiety, depressive and pain disorders [4,5].

Quality of life (QOL) is defined as individuals' perceptions of their own position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns; it is a broad-ranging concept, incorporating in a complex way the persons' physical health, psychological state, level of independence, social relations, personal beliefs, and relationship to salient features of the environment [6]. There are several important issues regarding the relationships of insomnia and nocturnal sleep duration with QOL in adolescents that need further study. First, there has been no study examining the relationships of short and long nocturnal sleep duration with QOL in a community sample of adolescents at the same time. Second, previous studies have found that depression is significantly associated with insomnia [7], short nocturnal sleep duration [7] and poor QOL [8] in adolescents. However, it needs further examine whether depression confounds the relationships between insomnia and nocturnal sleep duration and QOL in adolescents. Third, there has been no study examining the moderating effects of sex and age on the relationship between insomnia and nocturnal sleep duration and QOL in adolescents. Research has found that an older age was significantly associated with short nocturnal sleep duration in adolescents [7]. Meanwhile, there are sex and age differences in the levels of QOL in adolescents [9]. Thus, whether sex and age have moderating effects on the relationships of insomnia and nocturnal sleep duration with QOL in adolescents needs further study.

The aims of this cross-sectional study were to examine the relationships of insomnia and short and long nocturnal sleep durations with QOL the moderating effects of sex and age on the relationships in a large-scale, representative population of Taiwanese adolescents. We hypothesized that insomnia and short nocturnal sleep duration are associated with poor QOL in adolescents. Because of lack of previous studies on the relationship between long nocturnal sleep duration and QOL and the moderating effects of sex and age in adolescents, we temporally hypothesized that long nocturnal sleep duration is associated with good QOL in adolescents.

Methods

■ Participants

The participants in this study were enrolled from the 2009 Project for the Health of Children and Adolescents in Southern Taiwan, a research program studying the mental health status of children and adolescents living in four counties and three metropolitan areas in southern Taiwan [10]. In 2009, there were 254,130 students in 205 junior high schools and 202,883 students in 143 senior high/vocational schools in this area. On the basis of the definitions of urban and rural districts in the Taiwan-Fukien Demographic Fact Book [11] and school and grade characteristics, a stratified random sampling strategy was used to ensure that there was proportional representation of districts, schools, and grades. Five junior high schools and five senior high/vocational schools were randomly selected from urban districts; similarly, five junior high schools and four senior high/vocational schools were randomly selected from rural districts. The classes in these schools were further stratified into three levels based on grade in primary, junior high and senior high/vocational school. Then, a total of 6,703 high school students in grades 7 through 12 were randomly selected based on the ratio of students in each grade.

The Institutional Review Board (IRB) of Kaohsiung Medical University approved the study. Before conducting the study, we prepared a leaflet explaining the purpose and procedure of this study. Students took the leaflet home for their parents or main caretakers, who could telephone the researchers, write in a communications book, or ask their children directly to refuse to join the study. The students also had the right to refuse to participate in this study by returning blank questionnaires along with those from other students.

Instruments

Athens Insomnia Scale (AIS-8). We used the Taiwanese version of the 8-item AIS-8 to assess the severity of subjective insomnia over the recent one month [12,13]. Higher total scores indicated more severe insomnia symptoms and subjective sleep-related distress. The

psychometrics of Taiwanese version of the AIS-8 have been described elsewhere [7,13]. The Cronbach's α coefficient for the AIS-8 in the present study was 72.

■ Nocturnal sleep duration

In this study, we collected the self-reported data for sleep duration at night. The participants were asked: "How many hours of sleep on average do you usually get every night on weekdays in recent one month?" and "How many hours of sleep on average do you usually get every night on weekends in recent one month?" [7]. The present study used the mean of the nocturnal sleep duration on weekdays and weekends to represent participants' habitual nocturnal sleep duration. The two-week test-retest reliability (Pearson correlation's r) was .72 and correlation between self-report and parents' report for the duration of nocturnal sleep (Pearson correlation's r) was .69 ($p < .001$) [7]. The present study defined total nocturnal sleep duration below and above one standard deviation (SD) of the mean of nocturnal sleep duration of all participants in this study as short and long nocturnal sleep duration, respectively.

■ Taiwanese Quality of Life Questionnaire for Adolescents (TQOLQA)

We used the self-reported TQOLQA to measure the levels of QOL in recent two weeks among participants [14]. The 5-point 38-item TQOLQA contains seven domains, including family (7 items, e.g., "Are you satisfied with the help and support you receive from your family?", Cronbach's α = .91), residential environment (8 items, e.g., "Do you feel safe and protected in your home?" , Cronbach's α = .88), personal competence (7 items, e.g., "Can you finish your daily affairs?" , Cronbach's α = .89), social relationships (5 items, e.g., "Are your friends reliable when you need them?" , Cronbach's α = .80), physical appearance (4 items, e.g., "Do you feel inferior because of your appearance?" , Cronbach's α = .78), psychological well-being (4 items, e.g., "Are you upset?" , Cronbach's α = .79), and pain (3 items, e.g., "Do you worry about pain or discomfort?" , Cronbach's α = .71). After the raw scores are converted for the reverse questions, higher total scores indicate better QOL over the preceding 2 weeks. Each subscale is then standardized to range from zero (lowest level of functioning) to 100 (highest level). The Cronbach's α coefficient ranges from .77 to .91 for the global scale and seven domains [14].

■ Mandarin Chinese version of the Center for Epidemiological Studies-Depression Scale (MC-CES-D)

The MC-CES-D used in this study was a 20-item self-administered questionnaire that used a 4-point evaluation scale to assess the frequency of depressive symptoms in the preceding week [15,16]. Higher MC-CES-D scores indicated more severe depression. The Cronbach's α coefficient for the MC-CES-D in the present study was .92.

■ Socio-demographic characteristics

Characteristics including sex (girls or boys) and age were collected. Because in Taiwan most adolescents younger than 15 years old are junior high school students (grade 7 to 9) and those 15 years old or older are junior high school students (grade 10 to 12), the participants were divided into those younger than 15 years old and those who were 15 years old or older (younger vs. older).

Statistical analysis

A total of 6,445 students (96.2%) agreed to join this study. Of the 258 students who refused to join this study, 68 students refused based on their parents' opinion, 128 returned blank questionnaires, and 62 were absent when the research assistants visited their classes. Each participant completed the research questionnaire anonymously under the direction of research assistants in each classroom during school hours. All students received a gift worth NT$33 (one US dollar) at the end of the assessment.

Data analysis was performed using SPSS 17.0 statistical software (SPSS Inc., Chicago, IL, USA). First, multiple regression analyses were used to examine the associations of insomnia and short and long nocturnal sleep duration with QOL by controlling for the effects of sex, age, and depression. Participants with average nocturnal sleep duration were used as the reference group when examining the associations of short and long nocturnal sleep duration with QOL. Second, we used the standard criteria [17] to examine whether the associations of insomnia and short and long nocturnal sleep duration with QOL were different in terms of the participants' sex and age. According to the criteria, moderation occurred when the interaction term for the predictor (insomnia and nocturnal sleep duration) and the hypothesized moderator (sex and age) were significantly

associated with the dependent variable (QOL) after controlling for the main effects of both the predictors and hypothesized moderator variables. In this study, if insomnia and nocturnal sleep duration, sex, and age were significantly associated with QOL in the multiple regression analysis, the interactions (insomnia or nocturnal sleep duration x sex or age) were further selected into multiple regression analysis to examine the moderating effects. Because of three regression analysis models used in the present study, a two-tailed p value of less than .0167 (0.05/3) was considered statistically significant.

Results

A total of 5,590 participants completed the research questionnaires without omission. Those who had missing data in the questionnaires were more likely to be boys ($\chi 2 = 18.772$, $p < .001$) and younger. ($\chi 2 = 58.150$, $p < .001$). The demographic and sleep characteristics and the levels of QOL and depression symptoms among the participants are shown in Table 1. The mean and SD of nocturnal sleep duration of the all participants were 7.3 hours and 1.1 hours, respectively. According the definition of long and short nocturnal sleep duration described above, 13.0% of the participants were short nocturnal sleepers (nocturnal sleep duration shorter than 6.2 hours), and 14.5% of the participants were long nocturnal sleepers (nocturnal sleep duration longer than 8.4 hours).

The results of multiple regression analysis on the associations between insomnia and the seven domains of QOL and the moderating effects of sex and age are shown in Table 2. The results showed that the severity of insomnia was negatively associated with all domains of QOL except for the social relationships dimension. Sex had a moderating role on the associations of insomnia with the QOL domains of psychological well-being and pain. Further examination found that the associations between insomnia and the QOL domains of psychological well-being (boys: Beta = -.245, t = -14.233, p < .001; girls: Beta = -.178, t = -11.239, p < .001) and pain (boys: Beta = -.208, t = -9.801, p < .001; girls: Beta = -.170, t = -8.247, p < .001) were more significant in boys than in girls. Age had a moderating role on the associations of insomnia with the QOL domains of residential environment, personal competence, physical appearance, and psychological well-being. Further examination found that the associations between insomnia and the QOL domains of residential environment (younger: Beta = -.178, t = -7.166, p < .001; older: Beta = -.142, t = -7.392, p < .001), personal competence (younger: Beta = -.151, t = -8.314, p < .001; older: Beta = -.034, t = -1.829, p < .001), physical appearance (younger: Beta = -.093, t = -4.531, p < .001; older: Beta = -.028, t = -1.499, p < .001), and psychological well-being (younger: Beta = -.243, t = -13.724, p < .001; older: Beta = -.184, t = -12.040, p < .001) were more significant in younger adolescents than in older ones.

Table 1: Sex, age, sleep characteristics, levels of quality of life and depression symptoms (N=5590).

	n (%)	Mean (SD)
Sex		
Girls	2968 (53.1)	
Boys	2622 (46.9)	
Age		
Younger (< 15 years)	2482 (44.4)	
Older (≧15 years)	3108 (55.6)	
Severity of insomnia on the AIS-8		6.2 (3.1)
Nocturnal sleep duration		
Average sleep	4050 (72.5)	
Short sleep	727 (13.0)	
Long sleep	813 (14.5)	
Levels of QOL on the TQOLQA		
Family		65.7 (18.7)
Residential environment		62.5 (18.3)
Personal competence		56.6 (13.3)
Social relationships		66.0 (18.1)
Physical appearance		64.6 (19.2)
Psychological well-being		64.7 (18.5)
Pain		64.1 (17.0)
Severity of depression on the MC-CES-D		15.7 (9.8)

AIS-8: Athens Insomnia Scale; MC-CES-D: Mandarin Chinese version of the Center for Epidemiological Studies-Depression Scale; TQOLQA: Taiwanese Quality of Life Questionnaire for Adolescents

The results of multiple regression analysis on the associations between short nocturnal sleep duration and the seven domains of QOL and the moderating effects of sex and age are shown in Table 3. The results showed that the adolescents with short nocturnal sleep duration reported a lower level of QOL on the family dimension. Sex and age did not moderate the association between short sleep duration and QOL.

The results of multiple regression analysis on the associations between long nocturnal sleep duration and the seven domains of QOL and the moderating effects of sex and age are shown in Table 4. The results showed that the adolescents with long nocturnal sleep duration reported a higher level of QOL on the psychological well-being and pain domains than those with average sleep duration. Sex and age did not moderate the association between long sleep duration and QOL.

Table 2: The associations of insomnia with quality of life and the moderating effects of sex and age.

	Family		Residential environment		Personal competence		Social relationships		Physical appearance		Psychological well-being		Pain	
	Beta	***t***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***
Model I														
Insomnia	-.106	-7.303***	-.160	-11.151***	-.087	-6.253***	.004	.298	-.059	-4.313***	-.211	-18.282***	-.189	-12.952***
Sex (0: girls; 1: boys)	-.058	-4.741***	.035	2.926**	-.035	-3.018**	-.132	-10.658***	.130	11.434***	.082	8.543***	.110	9.040***
Age (0: young; 1: old)	-.011	-.871	-.065	-5.413***	-.051	-4.423***	.021	1.678	-.075	-6.524***	-.089	-9.291***	-.078	-6.397***
Depression	-.367	-25.183***	-.342	-23.868***	-.448	-32.080***	-.382	-25.568***	-.454	-33.076***	-.533	-46.195***	-.252	-17.269***
Model II														
Insomnia	-.088	-4.539***	-.179	-7.665***	-.117	-5.140***			-.106	-4.742***	-.221	-11.754***	-.172	-7.205***
Sex (0: girls; 1: boys)	-.022	-.799	.086	3.234**	.000	-.012			.148	5.796***	.145	6.754***	.173	6.352***
Age (0: young; 1: old)	-.010	-.846	-.148	-5.567***	-.138	-5.328***			-.177	-6.927***	-.167	-7.790***	-.106	-3.887***
Depression	-.369	-25.228***	-.344	-23.997***	-.449	-32.154***			-.454	-33.115***	-.536	-46.426***	-.255	-17.415***
Insomnia x Sex	-.043	-1.468	-.063	-2.198	-.043	-1.536			-.023	-.830	-.078	-3.334**	-.077	-2.610**
Insomnia x Age			.110	3.533***	.114	3.756***			.133	4.485***	.102	4.082***	.037	1.168

**p<.01; ***p<.001

Discussion

The present study found that the severity of insomnia was negatively associated with most of dimensions of QOL, which is in line with the results of previous studies [18,19]. It is interesting to find that sex and age had moderating effects on the associations of insomnia with several domains of QOL. The results indicated that mental health professionals need to take sex and age into consideration when developing strategies for improving QOL among adolescents with insomnia.

Research found that short nocturnal sleep duration is significantly associated with increased risk for suicidality [20]. The results of the present study also found that compared with average sleepers, short sleepers had poorer family domain of QOL. The present study is one of the first studies to investigate the association of long nocturnal sleep duration pattern with QOL in adolescent. The results of this study found that compared with average sleepers, long sleepers had better pain and psychological wellbeing domains of QOL. Research has found that long sleep duration is associated with an increased risk for adult mortality [21] and coronary heart disease and type 2 diabetes [22]. The present study focused on adolescents, and it is possible that long sleep duration plays a different role for health in adolescents compared with that in adults. However, it warrants further study to examine how long sleep duration works for relieving pain and improving psychological wellbeing in adolescents.

There were some limitations of this study. In the first, the cross-sectional research design limited our ability to draw conclusions regarding the causal relationships between insomnia, sleep duration and QOL. Further longitudinal studies are needed to determine the causal relationships between sleep patterns and QOL. Second, study data were exclusively self-reported. The use of one data source could have influenced our findings and may have resulted in shared-method variance. Third, this study recruited adolescent students as the research population; however, adolescents who had dropped out of school and were attending night schools were not recruited into this study. Fourth, the present study did not measure nocturnal sleep duration on weekdays and weekends separately. Fifth, the experiences of bullying involvement and mental health problems were measured in different periods. For example, while participants' insomnia and nocturnal sleep duration were inquired in the period of past one month, QOL and depression were just measured in the periods of two and one weeks, respectively. Whether this different temporal reference is a bias affecting the results warrants further study. Sixth, significant differences in sex and age between participants who had and had no missing data in the questionnaires may reduce the representativeness of the final sample. Despite such limitations, this study contributes to the literature and may help parents and health professionals to understand adolescents' health and establish policy to promote their health.

Table 3: The associations of short nocturnal sleep duration with quality of life and the moderating effects of sex and age[a].

	Family		Residential environment		Personal competence		Social relationships		Physical appearance		Psychological well-being		Pain	
	Beta	***t***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***
Model III														
Short sleep duration	-.036	-2.679**	-.017	-1.300	-.012	-.928	.020	1.440	.009	.736	-.006	-.530	.028	2.080
Sex (0: girls; 1: boys)	-.058	-4.365***	.037	2.831**	-.033	-2.651**	-.129	-9.593***	.128	10.268***	.075	7.049***	.099	7.413***
Age (0: young; 1: old)	-.015	-1.102	-.082	-6.271***	-.062	-4.933***	.011	.848	-.077	-6.193***	-.098	-9.172***	-.085	-6.387***
Depression	-.415	-31.046***	-.427	-32.384***	-.496	-38.877***	-.375	-27.463***	-.482	-38.238***	-.658	-61.197***	-.373	-27.646***
Model IV														
Short sleep duration	-.028	-1.581											.050	1.800
Sex (0: girls; 1: boys)	-.054	-3.765***											.097	6.706***
Age (0: young; 1: old)	-.015	-1.096											-.079	-5.552***
Depression	-.415	-31.024***											-.373	-27.643***
Short sleep duration x Sex	-.012	-.660											.006	.349
Short sleep duration x Age													-.032	-1.218

[a]: Average nocturnal sleep as reference; **p<.01; ***p<.001

Table 4: The associations of long nocturnal sleep duration with quality of life and the moderating effects of sex and age[a].

	Family		Residential environment		Personal competence		Social relationships		Physical appearance		Psychological well-being		Pain	
	Beta	***t***	**Beta**	***t***	**Beta**	***z***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***	**Beta**	***t***
Model V														
long sleep duration	-.006	-.455	-.018	-1.353	-.006	-.461	-.006	-.468	.016	1.290	.050	4.588***	.039	2.873**
Sex (0: girls; 1: boys)	-.059	-4.524***	.033	2.577	-.040	-3.197**	-.136	-10.228***	.126	10.316***	.085	7.928***	.106	7.996***
Age (0: young; 1: old)	-.027	-2.006	-.083	-6.350***	-.063	-4.982***	.013	.978	-.079	-6.361***	-.097	-8.909***	-.087	-6.440***
Depression	-.427	-32.604***	-.430	-33.206***	-.494	-39.306***	-.383	-28.727***	-.487	-39.589***	-.638	-59.513***	-.354	-26.689***
Model VI														
Long sleep duration											.044	2.526	.030	1.396
Sex (0: girls; 1: boys)											.082	7.027***	.098	6.735***
Age (0: young; 1: old)											-.097	-8.215***	-.081	-5.553***
Depression											-.638	-59.502***	-.354	-26.711***
Long sleep duration x Sex											.008	.506	.026	1.303
Long sleep duration x Age											.000	.000	-.016	-.935

[a]: Average nocturnal sleep as reference; **p<.01; ***p<.001

Acknowledgements

This study was supported by grants NSC 98-2410-H-037-005-MY3 and 99-2314-B-037-028-MY2 awarded by the National Science Council, Taiwan (ROC) and grant KMUH 100-0R48 awarded by Kaohsiung Medical University Hospital.

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