

Case Study of the Relationship between Sleep Quality and Academic Performance

Leying Wang, Xinxian Lu

Guangdong Country Garden School, Foshan, China
Email: Frannylu515@gmail.com

How to cite this paper: Wang, L.Y. and Lu, X.X. (2025) Case Study of the Relationship between Sleep Quality and Academic Performance. *Journal of Behavioral and Brain Science*, 15, 1-10.

<https://doi.org/10.4236/jbbs.2025.151001>

Received: September 18, 2024

Accepted: January 23, 2025

Published: January 26, 2025

Copyright © 2025 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Background: The study's primary research suggests the relationship between high-school international students in China's sleep quality and learning efficiency which is academic performance. Considering the effect of Chinese traditional cultural background, this study mainly investigates Chinese international high school students' sleeping quality and patterns through the Pittsburgh Sleep Quality Index. **Methods:** A sample of 249 Chinese high school students in the Pearl River Region completed the questionnaire about their sleep quality using PSQI, their academic performance, and socio-demographic factors one month before the final exam in July 2023. **Results:** None of the students have good sleep quality, according to the PSQI; 40.8% of students have poor sleep quality, and 59.2% have significant sleep disturbance. The results of ordinal logistic regression show that good sleep quality is positively associated with good academic performance. **Conclusion:** Our findings highlight the association between sleep and academic performance on the unique sleep patterns of Chinese international high school students, who often follow very different sleep patterns from other conventional students enrolled in the regular curriculum. High school students suffer from severe sleep deprivation and poor sleep quality. Under great academic stress, Chinese high school students should know the importance of sleep, balance sleep, and study.

Keywords

Sleep Quality, Academic Performance, Chinese Adolescents

1. Introduction

Sleep is important for protecting people's physical and mental health and main-

taining people's normal survival and development. Studies have found that sleep is associated with obesity and malnutrition, increased blood pressure, chronic inflammation, cardiovascular disease, emotional impairment, mental health problems, and changes in brain maturity that support cognition, learning, and emotion [1]-[7]. However, people's attention to sleep needs to be more. According to the China Sleep Research Report (2023), 47.55% of respondents slept less than 8 hours per night on average, and 16.79% slept less than 7 hours per night on average, reflecting that lack of sleep is common among the public.

The research has a closer look at the relationship between sleep quality and academic performance in international high school students in China. Until now, only a few research studies have considered Chinese high-school international students' sleep quality in China. According to the China Education Organization, China had 520,000 international high school students in China in 2023, although most hold Chinese passport and their mother tongue is Chinese. Most international high school students' study in private schools, which offer an international curriculum and aim to prepare their students to pursue their bachelor's degrees in foreign countries.

Chinese high-school international students in China often face cultural challenges. Therefore, the article will examine the relationship between high-school international students in China's sleep quality and learning efficiency, which is academic performance.

This work assumes that students in international programs in China with a higher sleep quality are more likely to perform better academically at school. Specifically, since the number of international students in Guangdong province is second only to Shanghai, we decided to investigate Chinese international students in Guangdong province by using the questionnaire designed with items adapted from the Pittsburgh Sleep Quality Index (PSQI).

2. Literature Review

2.1. Background Information

According to the World Health Organization, 27% of the world's population has sleep problems, and more than a third of American adults sleep less than seven hours per night. If sleep is seriously insufficient, people will become restless, emotional instability, memory loss, poor judgment, and even delusions and hallucinations [8]-[10]. Lack of sleep increases the risk of many major diseases, among which the risk of cancer, heart disease, and diabetes increases significantly [3].

During early pubertal development, adolescents sleep and wake up late [11]. Other factors like school schedule, study pressure, work, video games, and social interaction lead to a general lack of sleep among adolescents [12]. According to the study, only 5.6 percent of Chinese college students sleep more than eight hours, 13.9 percent sleep more than seven hours, 72.6 percent sleep six to seven hours, and 13.5 percent sleep less than six hours [13]. According to a survey by

the Centers for Disease Control and Prevention (CDC) (Wheaton *et al.* 2018), 57.8% of middle school students and 72.7% of high school students in the United States sleep less than the recommended amount for their age group. Therefore, studies have shown that adolescent sleep deprivation is a significant public health problem over the past few decades [11].

According to Wolfson and Carskadon [14], there is a close relationship between sleep patterns and academic performance. Teenagers who do not get enough sleep have irregular sleep patterns and poor sleep quality and tend to do worse in school. Their GPA is often lower than 3.5. Teens who do not sleep well are more likely than teenagers who do not have sleep problems to have learning difficulties and to be sleepy during class more often during the day. Among sleep-deprived teens, 21 percent had failed classes or had difficulty learning [14]. Studies on how sleep affects academic performance have found that sleep deprivation, both before and after encoding, has a detrimental effect on memory. As a result, depriving participants of the first night of sleep after encoding new information results in lower performance at tests, supporting the theories of sleep-associated memory consolidation [4]. Moreover, sleep-deprived participants can encode less information than rested controls, supporting the theory that sleep restores memory encoding capacity [4]. Therefore, adolescents who aim to increase their grades and have better academic performance at school should reduce irregular sleep and sleep deprivation.

2.2. Chinese Adolescent Sleep Quality

The study of Lin Rongmao, Yan Youwei, and Tang Xiangdong reviewed studies in the last 15 years on the sleep quality of young students in China by using the Pittsburgh Sleep Quality Index. The conclusion shows that young Chinese students, especially senior high school students and college students, do not have high-quality sleep; the sleep disturbance in high school students ranged from 13.93% to 44.8%. Therefore, the most prominent problems of adolescent students' sleep quality in China are insufficient sleep time and daytime dysfunction [15]. In addition, some common significant factors influence Chinese students' sleep quality: Chinese families often put much pressure on students to improve their academic performance. Thus, it is common for children to burden themselves with tremendous academic pressure and spend more and more time on their studies, even sacrificing sleep time [16]. Therefore, under large pressure of family expectations and learning tasks, Chinese high school students' sleep quality can easily be affected by mental stress: study anxiety and depression.

2.3. Chinese International Student Sleep Quality

Compared to their counterparts in the United States, Chinese students seem to have different sleep patterns: later bedtime and earlier morning wake time, which leads to shorter sleep duration by one hour [17]. In addition, due to the earlier school start time and required evening study hours, most Chinese schools have

napping time, which is also a critical difference in sleep patterns between Americans and China [17].

Chinese high-school international students in China often face cultural challenges when adapting to new teaching schedules in Chinese classrooms due to the Confucian heritage learning background [18]. For example, some international schools do not offer napping time like public schools. Therefore, international students may have a different sleep quality than Chinese students in public schools, affecting their academic scores.

3. Study Design

3.1. Survey Questionnaire

This study collects data through an online survey. It asks survey participants for their socio-demographic information, such as their grade, gender, parent's highest education level, city of residence, school type, academic performance, and sleep patterns and quality. Academic performance is measured with a self-reported question: "How was your recent academic performance among your grades?" The question was rated on a 5-point scale from "top 20% in the grade" to "top 80% or less".

The questionnaire designed to form the Pittsburgh Sleep Quality Index (PSQI) was adapted and revised to fit the purpose of this study. The participants report their sleep patterns, including bedtime, sleep latency, wake time, nighttime sleep duration, and other questions associated with sleep in the past month (*i.e.*, one month before the summer vacation when preparing for the final exam). These items are respectively stated as "In the past month, what time have you usually gone to bed at night, how long (in minutes) does it usually take you to fall asleep each night, what time have you usually gotten up in the morning, and how many hours of actual sleep did you get at night?" Bedtime is rated from 1 (before 10:00 PM) to 8 (after 3:00 AM) with 1-hour intervals, and the wake time is rated from 1 (before 6:00 AM) to 6 (after 11:00 AM). Sleep latency is rated from 0 (5 to 10 minutes) to 3 (over 30 minutes) with 15-minute intervals. Subjective sleep quality is rated from 0 (very good) to 3 (very bad). Sleep duration is calculated as the integral amounts of hours, and habitual sleep efficiency is calculated according to sleep duration and the original responses. Trouble sleeping means having insomnia or, for over 2 hours, not falling asleep in a bed. It has seven items, rating on a 4-point scale: 0 if the problem did not occur during the past month, 1 for less than once per week, 2 for one or twice a week, and 3 for three or more times a week. Frequency of medicine use, daytime dysfunctions, and sleep disorders, which contain four items, are rated on the same scale as trouble sleeping. The questionnaire includes other factors that might affect sleep quality, such as family education, regional differences, and varying sleep habits on weekdays and weekends can affect sleep quality.

Sleep quality is measured by calculating the data obtained from respondents using the methods provided by the PSQI, and the calculation of the global PSQI

score has seven components, with a range of 0 - 21 points. According to PSQI, an overall score of 0 - 5 indicates good sleep quality, a range of 6 - 10 indicates poor sleep quality and a score greater than 10 represents suffering from significant disturbance.

3.2. Procedure

The survey was distributed online at the end of the semester in July 2023, considering preparation for the exam. Participation in the online survey was entirely voluntary. A total of 249 questionnaires were returned, and 228 returned questionnaires were valid. Questionnaires were distributed, completed, and returned within the summer of 2023.

3.3. Data Analysis

We analyzed the data from the questionnaires with SPSS Statistics (Version 26). Descriptive statistics (means, standard deviations, frequencies, and percentages) analyzed participants' socio-demographic information. Pearson's correlation and χ^2 test determined the relationships between variables. We use an ordinal logistic regression model to examine the association between sleep quality and academic performance.

4. Results and Discussions

4.1. Participants

A total of 228 high school students from China Guangdong Province who were in an international program participated in the online survey. Of the sample, 53.1% (N = 121) are female, and 46.9% (N = 107) are male. Almost all participants are from boarding schools with similar daily school schedules. The formal school schedule starts at 7:40 AM and ends at 11:40 AM. Afternoon classes resume at 1:30 PM and end at 6:00 PM. Three self-study periods start at 7:20 PM and end by 9:50 PM. By the way, it is not uncommon to find out that evening self-study time has been occupied by teaching lessons.

The socio-demographic characteristics are summarized in **Table 1**. 53.1% of the adolescents were female, and 46.9% were male. Almost half (47.8%) of the students were from grade 9, 22.4% were from grade 10, 23.2% were from grade 11, and 6.6% were from grade 12. Regarding parents' highest education, 22.2% completed graduate school, 43.7% completed college or university, 20% completed high school, and 3.5% completed primary school or below. For city of residence, more than two-thirds (69.7%) of participants reported living in Foshan, 17.1% live in Guangzhou, 7.0% live in Shenzhen, and 6.1% live in other cities in Guangdong Province. More than half (59.6%) of these adolescents from international programs were from bilingual private schools, 4.4% were from foreign discipline schools, 9.2% were from ordinary private schools, and 18.4% were from other types of schools.

Table 1. Socio-demographic characteristics of the participants.

Category	N (%)
Gender	
Female	121 (53.10)
Male	107 (46.90)
Grade	
9	9 (3.90)
10	51 (22.40)
11	12 (5.20)
12	65 (28.30)
Parent's highest education level	
College or University	100 (43.90)
Graduate school	19 (8.30)
High school	60 (26.30)
Primary school or below	61 (26.30)
City	
Foshan	159 (69.60)
Guangzhou	31 (13.20)
Shenzhen	16 (7.00)
Other	14 (6.10)
School type	
Bilingual private school	136 (59.60)
Foreign discipline school	20 (8.70)
Ordinary private school	30 (13.00)
Public school	42 (18.40)

4.2. Characteristics of Academic Performance

In terms of academic performance, 28.5% of the adolescents were top 20% in the grade, 32.0% were top 20% - 40%, 21.9% were top 40% - 60%, 8.8% were top 60%-80%, and 8.8% were top 80% or less (**Figure 1**).

Academic Performance Distribution of Adolescents

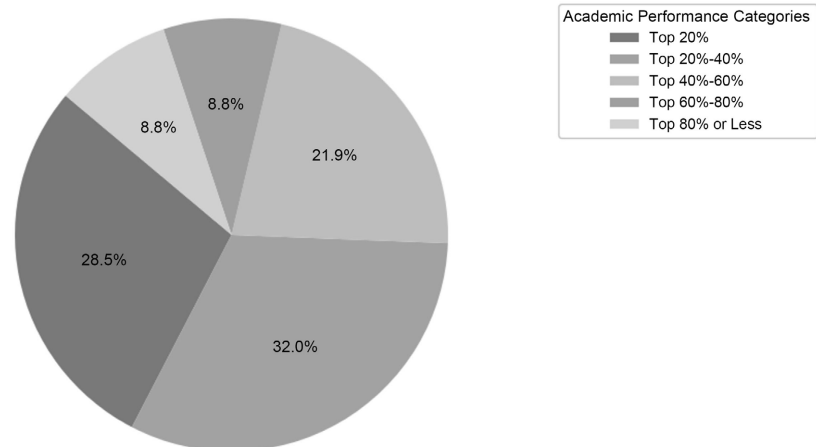


Figure 1. Academic performance distribution of adolescents.

4.3. Characteristics of Sleep Quality

Table 2 presents the characteristics of sleep patterns. According to the Pittsburgh Sleep Quality Index, a global PSQI score of 0 to 5 represents good sleep quality, 6 to 10 represents poor sleep quality, and a total score above 10 indicates a significant sleep disturbance. According to the data, of the 228 participants, none had good sleep quality, 40.8% had poor sleep quality, and almost two-thirds (59.2%) had significant disturbance with their sleep, indicating that high schools generally suffer from poor sleep quality. It has long been the case that Asian adolescents receive relatively large amounts of homework and spend more extended periods learning than their American and European peer [19]. Gradisar, Gardner & Dohnt claimed that Chinese high school students usually go to bed later than North American adolescents, and Wang stated that Chinese adolescents obtain less sleep than European samples [20] [21]. However, the quality of sleep of Chinese high school students is still worse than that of other countries in Asia. For instance, Park surveyed Korean adolescents' sleep quality using PSQI; the average global PSQI score was 4.21, indicating good sleep quality [22]. The sleep quality of Chinese teenagers is unhealthy and lower than the world average. Improving adolescents' sleep quality should become a public concern.

Table 2. Characteristics of sleep quality.

Level of sleep quality	N (%)
Good (PSQI score: 0 - 5)	0 (0.00)
Poor (PSQI score: 6 - 10)	93 (40.8)
Significant disturbance (PSQI score: >10)	135 (59.2)

4.4. Association between Sleep Quality and Academic Performance

Table 3 summarizes the ordinal logistic regression analysis results about the relationship between sleep quality and academic performance. In the analysis, socio-demographic factors, such as gender and grade, do not account for the variance in academic performance ($p > 0.05$). The analysis shows that there is a positive association between sleep quality and academic performance ($R = 0.178$, $p < 0.05$). According to the analysis, compared to those students who suffer from significant disturbance with their sleep, the probability for the students who have poor sleep quality to rank in the top 80% or less will decrease significantly ($\beta = -0.427$). For the students who increase their sleep quality by 1 level, the probability of increasing their academic performance by 1 level increases by 49% ($OR = 0.49$). The result of this study indicates that sleep quality is positively associated with academic performance. Chinese High school adolescents suffer from high academic pressure from both school and their families, sacrificing bedtime for study. Sleep patterns and sleep quality in high school students are not even up to the standard for the development of adolescents at this stage. This phenomenon reflects that adolescents may have wrong cognition about sleep. For students who want to achieve

good academic performance, obtaining enough sleep and ensuring sleep quality is necessary.

Table 3. Ordinal logistic regression analysis between sleep quality and academic performance.

	β	OR	p	OR 95% CI
Academic performance = top20%	-1.447	0.0499313	0.067	0.05~1.109
Academic performance = top20% - 40%	-0.410	0.14233502	0.601	0.142~3.091
Academic performance = top40% - 60%	0.240	0.273585647	0.760	0.274~5.905
Academic performance = top60% - 80%	0.592	0.389039475	0.450	0.389~8.395
Grade	0.035	0.894580317	0.641	0.895~1.198
Gender	-0.140	0.652610041	0.337	0.653~1.157
Parents' highest education level	-0.072	0.802338005	0.340	0.802~1.079
Level of sleep quality = poor	-0.427	0.490068489	0.003	0.49~0.869
Level of sleep quality = significant disturbance	—	—	—	—

5. Limitations

This study has several limitations. First, the sample size is relatively small and clusters in the Guangdong area, potentially affecting the study's generalizability. Second, we assumed that some socio-demographic factors, such as location and different school types, may account for the variance in academic performance due to the difference in schedule and academic stress. However, the data we obtain is invalid for data analysis in these terms. As shown in **Table 1**, the participants are mainly from Bilingual schools and live in the Foshan area. Therefore, we do not consider the items "City" and "School type" as factors in the data analysis. Third, the analysis findings may underestimate sleep quality due to response bias, as Students with sleep issues might be more willing to participate. Finally, the participants are only required to report their sleep quality within one month, so this study may be inaccurate in the long term because we do not include some long-term factors that potentially affect academic performance.

6. Conclusions and Suggestions

This study examines the sleep quality of Chinese high school students and the association between their sleep quality and academic performance. The findings demonstrate that poor sleep quality and problems are typical in Chinese high school students. None of the students have good sleep quality. According to the PSQI, 40.8% of students have poor sleep quality, and 59.2% have significant sleep disturbance. The sleep quality of Chinese teenagers is unhealthy and lower than the world average. Improving adolescents' sleep quality should become a public concern. Furthermore, poor sleep quality is negatively associated with academic performance, and there is no significant association between socio-demographic

variances and academic performance. Although there are some limitations of this study, the conclusion of this study has achieved consensus with similar previous studies.

Improving sleep quality and alleviating sleep problems of adolescents shall be considered among parents, school leaders, and other care providers to maintain physical and mental health and a decent academic performance of the youth. Here are some suggestions for care providers. School leaders should concern students with their sleep quality and sleep pattern, reasonably arrange school schedules, and appropriately reduce students' pressure. Adolescents and their parents should be educated about the importance of sleep. Parents must supervise high school students to go to bed on time and care about their sleep status to ensure adolescents' physical and mental health.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Liu, J., Joshi, D., Hay, J., Cairney, J. and Faight, B. (2010) Sleep Difficulties and Pre-adolescent Obesity. *Journal of Adolescent Health*, **46**, S15. <https://doi.org/10.1016/j.jadohealth.2009.11.035>
- [2] Javaheri, S., Storfer-Isser, A., Rosen, C.L. and Redline, S. (2008) Sleep Quality and Elevated Blood Pressure in Adolescents. *Circulation*, **118**, 1034-1040. <https://doi.org/10.1161/circulationaha.108.766410>
- [3] Tobaldini, E., Costantino, G., Solbiati, M., Cogliati, C., Kara, T., Nobili, L., *et al.* (2017) Sleep, Sleep Deprivation, Autonomic Nervous System and Cardiovascular Diseases. *Neuroscience & Biobehavioral Reviews*, **74**, 321-329. <https://doi.org/10.1016/j.neubiorev.2016.07.004>
- [4] Newbury, C.R., Crowley, R., Rastle, K. and Tamminen, J. (2021) Sleep Deprivation and Memory: Meta-Analytic Reviews of Studies on Sleep Deprivation before and after Learning. *Psychological Bulletin*, **147**, 1215-1240. <https://doi.org/10.1037/bul0000348>
- [5] Brand, S., Kirov, R., Kalak, N., Gerber, M., Schmidt, N.B., Lemola, S., *et al.* (2015) Poor Sleep Is Related to Lower Emotional Competence among Adolescents. *Behavioral Sleep Medicine*, **14**, 602-614. <https://doi.org/10.1080/15402002.2015.1048450>
- [6] Matamura, M., Tochigi, M., Usami, S., Yonehara, H., Fukushima, M., Nishida, A., *et al.* (2014) Associations between Sleep Habits and Mental Health Status and Suicidality in a Longitudinal Survey of Monozygotic Twin Adolescents. *Journal of Sleep Research*, **23**, 292-296. <https://doi.org/10.1111/jsr.12127>
- [7] Gunnell, D., Chang, S., Tsai, M.K., Tsao, C.K. and Wen, C.P. (2013) *Social Psychiatry and Psychiatric Epidemiology*, **48**, 1457-1465. <https://doi.org/10.1007/s00127-013-0675-1>
- [8] Chappel-Farley, M.G., Goldstein, M.R. and Benca, R.M. (2023) Changes in Affect. In: Kushida, C.A., Ed., *Encyclopedia of Sleep and Circadian Rhythms*, Elsevier, 353-360. <https://doi.org/10.1016/b978-0-12-822963-7.00085-2>
- [9] Killgore, W.D.S. (2010) Effects of Sleep Deprivation on Cognition. *Progress in Brain Research*, **185**, 105-129. <https://doi.org/10.1016/b978-0-444-53702-7.00007-5>

- [10] Luby, E.D., Grisell, J.L., Frohman, C.E., Lees, H., Cohen, B.D. and Gottlieb, J.S. (1962) Biochemical, Psychological, and Behavioral Responses to Sleep Deprivation. *Annals of the New York Academy of Sciences*, **96**, 71-79. <https://doi.org/10.1111/j.1749-6632.1962.tb50102.x>
- [11] Louzada, F. (2019) Adolescent Sleep: A Major Public Health Issue. *Sleep Science*, **12**, 1. <https://doi.org/10.5935/1984-0063.20190047>
- [12] Liu, Z., Wang, G., Geng, L., Luo, J., Li, N. and Owens, J. (2014) Sleep Patterns, Sleep Disturbances, and Associated Factors among Chinese Urban Kindergarten Children. *Behavioral Sleep Medicine*, **14**, 100-117. <https://doi.org/10.1080/15402002.2014.963581>
- [13] Li, L., Wang, Y., Wang, S., Li, L., Lu, L., Ng, C.H., *et al.* (2017) Sleep Duration and Sleep Patterns in Chinese University Students: A Comprehensive Meta-Analysis. *Journal of Clinical Sleep Medicine*, **13**, 1153-1162. <https://doi.org/10.5664/jcsm.6760>
- [14] Wolfson, A.R. and Carskadon, M.A. (1998) Sleep Schedules and Daytime Functioning in Adolescents. *Child Development*, **69**, 875-887. <https://doi.org/10.1111/j.1467-8624.1998.tb06149.x>
- [15] Yan, Y., Lin, R., Tang, X., He, F., Cai, W. and Su, Y. (2013) The Relationship between Worry Tendency and Sleep Quality in Chinese Adolescents and Young Adults: The Mediating Role of State-Trait Anxiety. *Journal of Health Psychology*, **19**, 778-788. <https://doi.org/10.1177/1359105313479628>
- [16] Li, S., Arguelles, L., Jiang, F., Chen, W., Jin, X., Yan, C., *et al.* (2013) Sleep, School Performance, and a School-Based Intervention among School-Aged Children: A Sleep Series Study in China. *PLOS ONE*, **8**, e67928. <https://doi.org/10.1371/journal.pone.0067928>
- [17] Liu, X., Liu, L., Owens, J.A. and Kaplan, D.L. (2005) Sleep Patterns and Sleep Problems among Schoolchildren in the United States and China. *Pediatrics*, **115**, 241-249. <https://doi.org/10.1542/peds.2004-0815f>
- [18] Wang, J. and Lin, J. (2018) Traditional Chinese Views on Education as Perceived by International Students in China: International Student Attitudes and Understandings. *Journal of Studies in International Education*, **23**, 195-216. <https://doi.org/10.1177/1028315318797356>
- [19] Liu, B., Gao, F., Zhang, J., Zhou, H., Sun, N., Li, L., *et al.* (2020) Sleep Quality of Students from Elementary School to University: A Cross-Sectional Study. *Nature and Science of Sleep*, **12**, 855-864. <https://doi.org/10.2147/nss.s266493>
- [20] Gradisar, M., Gardner, G. and Dohnt, H. (2011) Recent Worldwide Sleep Patterns and Problems during Adolescence: A Review and Meta-Analysis of Age, Region, and Sleep. *Sleep Medicine*, **12**, 110-118. <https://doi.org/10.1016/j.sleep.2010.11.008>
- [21] Wang, N., He, J., Wang, Z., Miao, R., Leslie, E. and Xu, F. (2018) The Prevalence of Sufficient Physical Activity among Primary and High School Students in Mainland China: A Systematic Review and Meta-Analysis. *Public Health*, **163**, 67-75. <https://doi.org/10.1016/j.puhe.2018.06.019>
- [22] Park, B.K. (2020) The Pittsburg Sleep Quality Index (PSQI) and Associated Factors in Middle-School Students: A Cross-Sectional Study. *Child Health Nursing Research*, **26**, 55-63. <https://doi.org/10.4094/chnr.2020.26.1.55>