Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 9, 3333-3351

The Impact Of Adolescents' Delayed School Start Time On Academic Achievement And Other Co-Related Factors

[1]Youming Liu, [2]Kaiyao Duan, [3]Zhipeng Fan, [4]Jiaxing Wu, [5]Yuhao Zeng

[1]Faculty, Washington University in St. Louis, Email: liuyouming34good@126.com
[2]Faculty, University of Technology of Belfort-Montbéliard, Email: roland.duan@biacademy.cn
[3]Faculty, University of International Business and Economics, Email:frank.zp@foxmail.com
[4]Faculty, University College London, Email: jackson.wu@biacademy.cn
[5]Student, Chongqing BI Academy, Email: yuhaozeng2007@163.com

Abstract – The objective of this study was to look into the impacts of a delayed school start time for high school students at Chongqing B1 Academy in Chongqing, China. The contribution of the study includes a two-way analysis based on gender and another using quasi-experimental analysis. The study was conducted in terms of student academic achievement and other co-relational factors. Perceived health, sleepiness, behavioral problems, depression, anxiety, stress, life satisfaction, sleep efficiency, sleep disturbance, medication use, and daytime dysfunction are among the factors considered. The study included 443 11th-grade students. The students were divided into groups for the experimental analysis. The control group consisted of 220 students chosen at random, while the experimental group consisted of 223 students. Students in the control group started school at 7.30 a.m., while students in the experimental group started school one hour later at 8.30 a.m. Both groups took a pre-test to determine their academic achievement level before the experiment. Data was collected over 12 weeks. Students from both groups took a post-test after 12 weeks to see if there had been any changes. The researcher noticed that both groups had grown, but the experimental group had improved significantly. The findings of the study also revealed that students in the experimental group improved their academic performance. For further analysis, the researcher employed the descriptive, one-sample t-test, and Pearson correlation matrix. They demonstrated improved health perception, life satisfaction, and sleep efficiency. There was also a significant reduction in sleepiness, behavioral problems, depression, anxiety, stress, sleep disturbance, medication use, and daytime dysfunction.

Keywords – adolescents, sleep, anxiety, delayed school start, healthy, academic performance.

1. Introduction

Clinicians recommend that adolescents between the ages of 13 and 17 get eight to ten hours of sleep per night. Failure to do so may have an impact on their academic, physical, and mental health. Drowsiness and daytime sleepiness are caused by a lack of sleep (Widome et al., 2020). This has a negative impact on students' academic performance as well as cognitive and behavioral issues (Gruber et al., 2020). Adolescents face an early sleep-wake cycle due to the early start of school. Few researchers have confirmed that this affects academic and behavioral issues. Boarding schools can create convenience while keeping the students' health and well-being in mind. The National Sleep Foundation has made the same recommendation. However, adolescent sleeplessness can lead to risks such as type 2 diabetes, hypertension, and other health problems (Genta et al., 2021). Unfortunately, most high

schools start earlier than others do. Both of these severely limit the sleep hours of adolescents (Norbury & Evans, 2019). People can be active during the day and sleep at night. Exposure to identical light and dark conditions causes changes in Chronotypes, which have a genetic basis (Goldin et al., 2020). Psychological and behavioral rhythms aid in determining Chronotypes. During the week, waking times are determined by work and school schedules (Illingworth et al., 2019). On free days, waking times are typically delayed and sleeping time is increased. Both types of conditions have health issues, which have an impact on their academic performance (Scott et al., 2019). As a result, school schedules must be better aligned. Researchers have also looked into the links between adolescent social media use and sleep timing and quality (Gariepy et al., 2020). The objective of the present study is to investigate the one-hour delayed school start time for high school students at Chongqing B1 Academy in Chongqing, China. The school day now begins at 8.30 a.m. rather than 7.30 a.m. The contribution of the study includes a two-way analysis, one based on gender and the other on quasi-experimental analysis. The study was conducted in terms of student academic achievement and other co-relational factors. Perceived health, sleepiness, behavioral problems, depression, anxiety, stress, life satisfaction, sleep efficiency, sleep disturbance, medication use, and daytime dysfunction are among the factors considered. The remainder of the paper is organized as follows: Section 2 demonstrates the literature review conducted concerning the study. Section 3 discusses the study's significance. Section 4 contains the research objectives. The research methodology is described in detail in Section 5. Section 6 contains the findings and discussion. Finally, sections 7 and 8 discuss the study's limitations and conclusion.

2. Related Research

Lown et al. (2021) compared the two types of feedback used by early childhood educators. Performance, delayed performance, and real-time visual performance is all included in the feedback. The primary objective was to evaluate academic engagement behaviour. Teachers must manage disruptive behaviours in the classroom. These may have a long-term impact on the child's academic performance. The findings show that a positive teacher-student relationship promotes students' academic engagement. However, analysing students' behaviour in the classroom under varying conditions remains a challenge.

Kansagra (2020) concentrated on adolescent sleep hours. The American Academy of Sleep Medicine recommends 8 to 10 hours of sleep per night for optimal health. According to a sleep deprivation survey, 72 percent of students engage in risky behaviour because of sleep deprivation. Sleep deprivation has a variety of health consequences. It can cause mood swings, depression, self-harm, and other negative behaviours, exacerbating their anxiety and insomnia. A few studies in the literature have found that as adolescents gain weight, they sleep less. Sleep deprivation has a negative impact on cognitive performance. Sleep hygiene refers to the various factors that influence sleep. Good sleep hygiene, on the other hand, keeps a good sleeping environment and time. Various mechanisms for improving sleep have been reported by sleep scientists over the last decade. There is a lack of understanding about the advantages of getting more sleep. Many healthcare professionals recommend delaying the start of school for optimal sleep and better future initiatives for adolescents. This is what sparked the current research study.

Bruni et al. (2022) investigated the effects of home confinement on sleep patterns and sleep disturbances in Italian children and adolescents during the COVID-19 pandemic. People were

forced to stay at home due to the COVID-19 outbreak, imposing travel restrictions. Children and adolescents were also kept at home for extended periods, with schools remaining closed. This has put pressure on them with a variety of psychological issues, particularly sleep issues. Sleep disturbances are associated with increased levels of stress because of potential changes in family financial circumstances, health concerns, and uncertainty about the future. Increase the opportunity for extended daytime naps and favour the use of technology for extended periods during the day. The restrictions resulted in unrestricted sleep schedules, prolonged screen exposure, limited access to outdoor activities, decreased peer interactions, as well as increased stress and anxiety, all of which can contribute to unhealthy sleep patterns and sleep disturbances in children and adolescents. 5805 people took part in the study. The findings revealed that the lockdown had a negative impact on sleep onset and offset. Their sleep-wake schedule appears to be physiological with later bedtime and wake time.

Yeo et al. (2019) investigated the relationship between sleep duration and health measures, with a focus on student academic achievement. Participants in the study ranged in age from 13 to 19 years. According to the study, getting less sleep at night increases depression. This resulted in poor health and well-being. Few students with sleep deprivation reported absenteeism, behavioral issues, or anxiety. However, the authors emphasize that to assist adolescents in improving their sleep health and academic performance, it is necessary to identify the factors that cause negative impacts. This has prompted the researchers to conduct the current study.

Simon et al. (2019) investigated the relationship between insulin resistance and sleep in obese adolescents. Insulin resistance has been linked to insomnia. The study included 31 adolescents whose sleep was monitored for one week. A three-hour glucose tolerance test was then performed. A regression analysis was carried out. Longer sleep time and time in bed on weekends and weekdays, as well as an earlier weekday bedtime, were found to be significantly associated with better insulin sensitivity. According to Pillai et al. (2022), delaying the start of school for older adolescents compared to younger adolescents can reduce the total number of students attending school at the same time. This strategy provides a practical way to reduce school density and the potential transmission of COVID-19 in schools, while also improving the sleep health of adolescents. The following research questions are addressed in detail in the paper.

Research Questions

1. Are there any gender differences in adolescent academic achievement with delayed school start time?
2. What are the impacts of the delayed school start time among adolescents?
3. Does delayed school start time have a positive impact on adolescents' academic, mental, and physical well-being?

3. Significance of Study

Poor sleep quality leads to poor mental health and well-being. Sleep is essential for analyzing brain function and systematic physiological processes (Nahmod et al., 2019). Sleep deprivation is associated with negative outcomes. Nowadays, adolescents who are struggling with mental health issues drop out of school, attempt suicide, and engage in risky behaviour. Adolescents' emerging period is marked by increased autonomy and decreased parental supervision (Wang et al., 2019). As a result, they have trouble sleeping because they go to bed late and get up early. The majority of new research indicates that

delayed school start times have a positive impact. As a result, the current study looks into the impact of delayed school start times on adolescent academic achievement and other co-relational factors. The study includes adolescents between the ages of 15 and 17. As a result, policymakers and administrators will be better able to recognize adolescents' healthy well-being and make real policy recommendations, thereby improving their future.

4. Research Objective

- To investigate whether there exist any gender differences in adolescent academic achievement with the delayed school start time.
- To analyze the impacts of the delayed school start time among the adolescents related to their academic, mental, and physical well-being.

5. Research Methodology

5.1 Participants and Procedure

The study enlisted the participation of 443 adolescents (219 (49.43%) male and 224 (50.56%) female, ages 15 to 17). The participants were chosen using a random selection procedure from Chongqing B1 Academy School in China of students studying in the 11th class. The data was collected by delivering a self-reported questionnaire to students from March 2022 to May 2022. The students were chosen randomly for participation, and the pupils were made aware of the importance of completing the questionnaire. The objective of the study and the information that participation is optional were explained to the participants. The institutional administrators gave their ethical approval. A descriptive-quantitative research design was used in this study. The primary goal of the current study was to measure the students' academic achievement and other co-relational factors such as perceived health, sleepiness, behaviour problems, depression, anxiety, and stress; life satisfaction; sleep efficiency; sleep disturbance; use of medication; and daytime dysfunction. For this quasi-experimental study, the students were divided into groups for the experimental analysis. The control group consisted of 220 students chosen at random, while the experimental group consisted of 223 students. Students in the control group started school at 7.30 a.m., while students in the experimental group started school one hour later at 8.30 a.m. Both groups took a pre-test to determine their academic achievement level prior to the experiment. Data was collected over 12 weeks. Students from both groups took a post-test after 12 weeks to see if there had been any changes. Table 1 below illustrates the descriptions of the participants in the study.

Table 1: Distribution of the Participants of the Study

Group	School Time	Number
Control	7.30 a.m.	220
Experimental	8.30 a.m.	223
Total		443

5.2 Measures

The following survey items were used to determine the dependent variable: (a) what is the perceived health level. (a) How many hours do they sleep each night? What was their daily routine during the school activities? Likert's 5-point measurement scale was used in the study, ranging from 1 (Never/Strongly Disagree) to 5 (Always/Strongly Agree). The delayed school

start time was assessed using Academic achievement and other co-relational factors such as perceived health, sleepiness, behaviour problems, depression, anxiety, and stress, life satisfaction, sleep efficiency, sleep disturbance, medication use, and daytime dysfunction were used to determine the severity level. Table 1 contains more information about our analysis variables and results. Academic achievement and co-relational factors were independent variables.

5.3 Survey Instrument

Gender, academic achievement, time to sleep, level of perceived health, sleepiness, behavioral problems, depression, anxiety, and stress, life satisfaction, sleep efficiency, sleep disturbance, use of medication, and daytime dysfunction were all questioned in the survey. To ensure the items' validity and reliability, we chose items that had been evaluated in earlier research wherever possible (Buysse et al., 1989), Cheung & Lucas, 2014), Ginneken & Groenewold, 2012), Wolfson & Carskadon, 1998), and we changed a few of the items as needed for the current study area. The student's academic achievements were graded on a five-point scale ranging from one to five, as presented in Table 2. Following the completion of data collection and processing, reliability testing was carried out to check that the constructions had appropriate internal consistency. The scales were confirmed to be credible because all Cronbach alphas were 1.00. SPSS 22.0 was used to conduct all data analyses.

Table 2: Academic Achievement Range Score

Range of Score	Classification
5	Excellent
4	Very Good
3	Good
2	Average
1	Poor

6. Results and Discussion

A quasi-experimental design was used to compare the pre-test and post-test results of both the control and experimental group students' academic achievement. Tables 3-11 show the results and discussions. For analysis, the researcher used the descriptiveness, one-sample t-test, and Pearson correlation matrix.

Gender-based Analysis

Table 3: Result of Pre-test Student's Gender-based Analysis

Gender	N	Mean	Std. Error Mean	SD
Male	219	2.39	0.0729	1.08

Female	224	2.39	0.0740	1.11

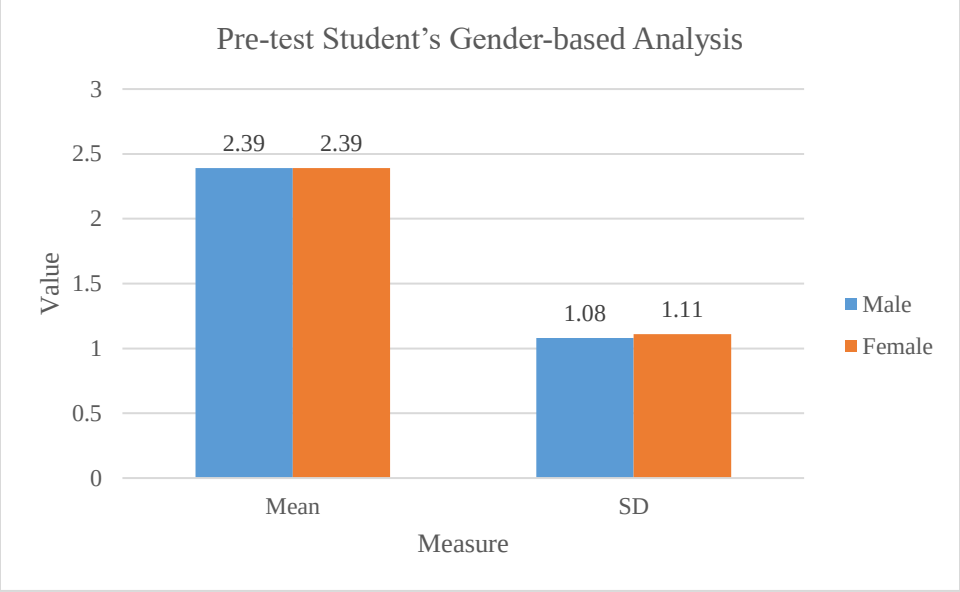

Figure 1 Pre-test Student's Gender-based Analysis

The pre-test results of the gender-based analysis are presented in Table 3 and Figure 1. The male mean score is 2.39, which is similar to the female mean score of 2.39. Males and females have SD scores of 1.08 and 1.11, respectively. This indicates that there is no significant difference in academic achievement between male and female students during their pre-test.

Table 4: Result of Post-test Student's Gender-based Analysis

Gender	N	Mean	Std. Error Mean	SD
Male	219	3.27	0.0973	1.44
Female	224	3.29	0.0938	1.40

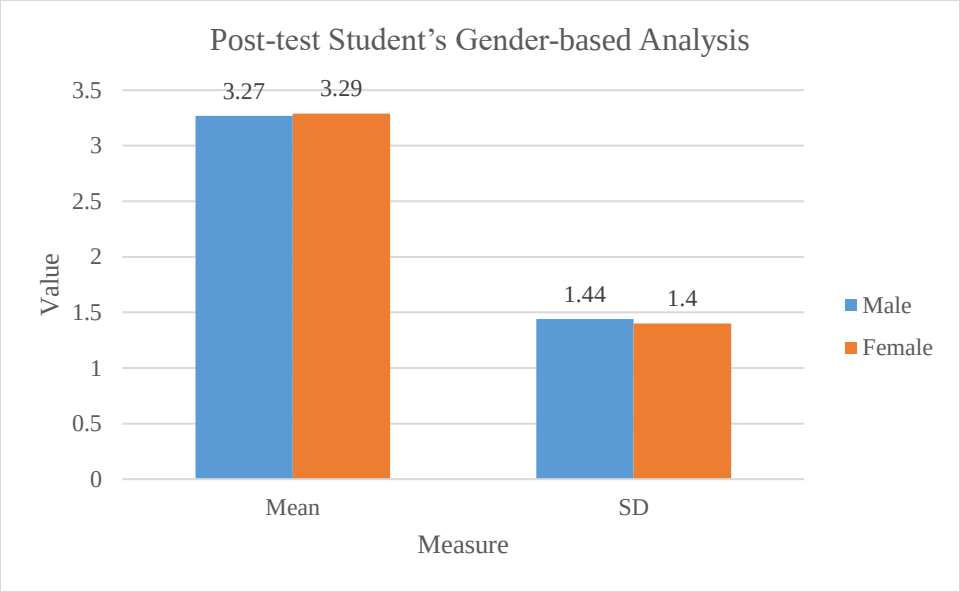

Figure 2 Post-test Student's Gender-based Analysis

The post-test results of the gender-based analysis are presented in Table 4 and Figure 2. The male mean score is 3.27, which is similar to the female mean score of 3.29. Males and females have SD scores of 1.44 and 1.40, respectively. This indicates that there is no significant difference in academic achievement between male and female students during their post-test.

Table 5: Result of Pre-test Student's Achievement Analysis

Range of Score	Classification	Pre-test Student Achievement	
		S	%
5	Excellent	38	8.57%
4	Very Good	40	9.02%
3	Good	35	7.9%
2	Average	273	61.62%
1	Poor	57	12.86%
Total		443	100%

Table 5 shows the results of the student's performance on the pre-test. Only 8.57 % demonstrated excellent achievement. 61.62 % were only average, while 12.86 percent were poor. This demonstrates that the student's academic performance during the pre-test was mostly average.

Table 6: Result of Post-test Student's Achievement Analysis

Range of Score	Classification	Post-test Student Achievement	
		S	%
5	Excellent	143	32.27%
4	Very Good	78	17.60%
3	Good	44	9.93%
2	Average	140	31.6%
1	Poor	38	8.57%
Total		443	100%

Table 6 shows the results of the student's performance on the Post-test. The post-test reveals a statistically significant difference. Approximately 32.27% demonstrated exceptional achievement. 17.60 % were excellent. Whereas only 8.57 % were poor, there was a significant drop in average academic achievement to 31.6 %. This demonstrates that the student's academic performance differed significantly during their post-test. Table 7 summarises the investigation's findings, as well as the gender-based descriptiveness results. Several factors' mean, SD, and standard error mean scores are shown for both male and female adolescents.

Table 7: Gender-based Descriptiveness

Variables	N		Mean		Std. Error Mean		SD	
	Male	Female	Male	Female	Male	Female	Male	Female
Perceived Health	219	224	3.51	3.53	0.0852	0.0839	1.26	1.26
Sleepiness	219	224	2.72	2.56	0.110	0.101	1.63	1.51
Behavior Problems	219	223	2.28	2.30	0.0984	0.0998	1.46	1.49
Depression	219	224	2.89	2.84	0.0890	0.0881	1.32	1.32
Anxiety and stress	219	224	2.89	2.93	0.0898	0.0882	1.33	1.32
Life satisfaction	219	224	3.38	3.36	0.0684	0.0772	1.01	1.15

Sleep Efficiency	219	224	3.51	3.51	0.0832	0.0780	1.23	1.17
Sleep Disturbance	219	224	2.60	3.61	0.0775	0.0782	1.15	1.17
Use of Medication	219	224	2.12	1.94	0.0893	0.0840	1.32	1.26
Daytime dis-functioning	219	224	2.11	2.23	0.0927	0.0957	1.37	1.43

Table 7 shows that there are no significant differences in the various factors between male and female adolescents.

Quasi-Experimental-based Analysis

Table 8: Result of Pre-test –Experimental Analysis

Group	N	Mean	Std. Error Mean	SD
Control	220	2.43	0.0759	1.13
Experimental	223	2.35	0.0709	1.06

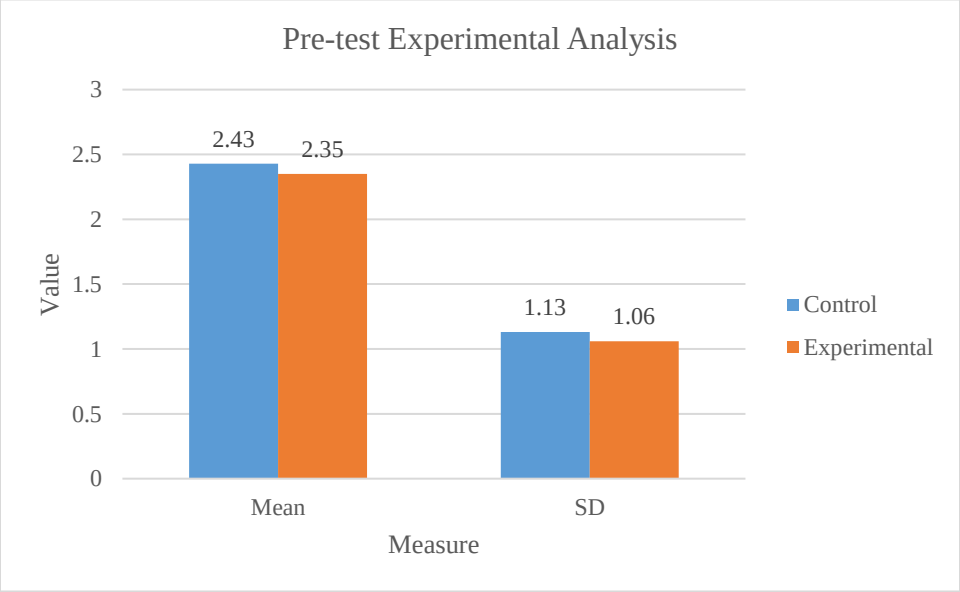

Figure 3 Pre-test Experimental Analysis

The pre-test results are shown in Table 8 and Figure 3. The control group's mean score is 2.43, which is similar to the experimental group's mean score of 2.35. The standard deviations are 1.13 and 1.06, respectively. This means that there was no significant difference between the control and experimental groups of students during the pre-test.

Table 9: Result of Post-test –-Experimental Analysis

Group	N	Mean	Std. Error Mean	SD
Control	220	2.48	0.0780	1.16
Experimental	223	4.18	0.0750	1.12

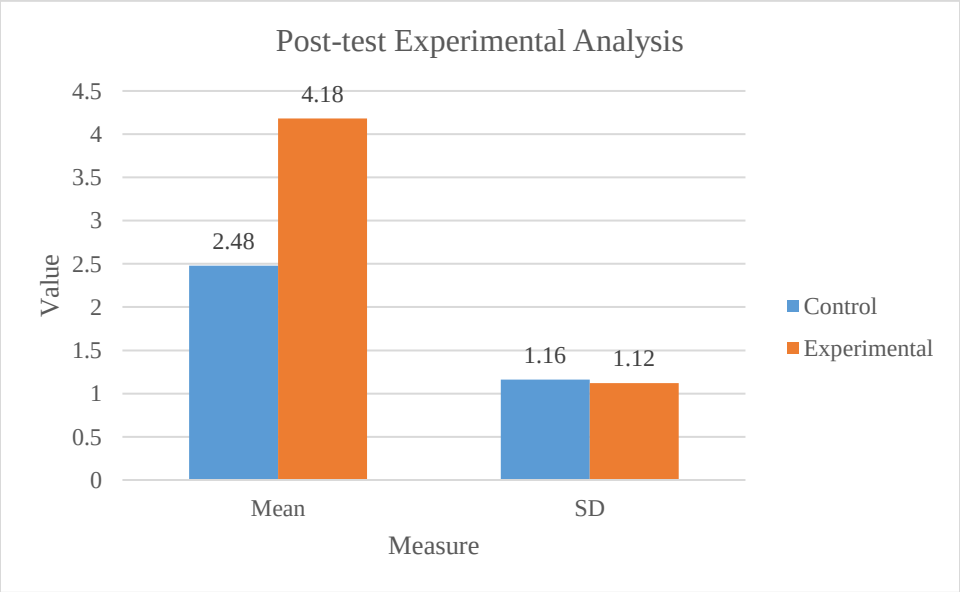

Figure 4 Post-test Experimental Analysis

The post-test results are shown in Table 9 and Figure 4. The control group's mean score is 2.48, which is lower than the experimental group's mean score of 4.18. The standard deviations are 1.16 and 1.12, respectively. This means that there exists a significant difference between the control and experimental groups of students after the practice of the delayed school start time. The students in experimental group outperformed. The comparative analysis is presented in Table 10 and Figure 5.

Table 10: Result of Student's Achievement Analysis

	Classification	Control Group	Experimental Group

Range of Score		Pre-test	Post-test	Pre-test	Post-test
5	Excellent	9.09	9.54	8.07	54.70
4	Very Good	10	11.81	8.07	23.31
3	Good	9.09	9.09	6.72	10.76
2	Average	58.18	55.90	65.02	7.62
1	Poor	13.63	13.63	12.10	3.58
Total (%)		100%	100%	100%	100%

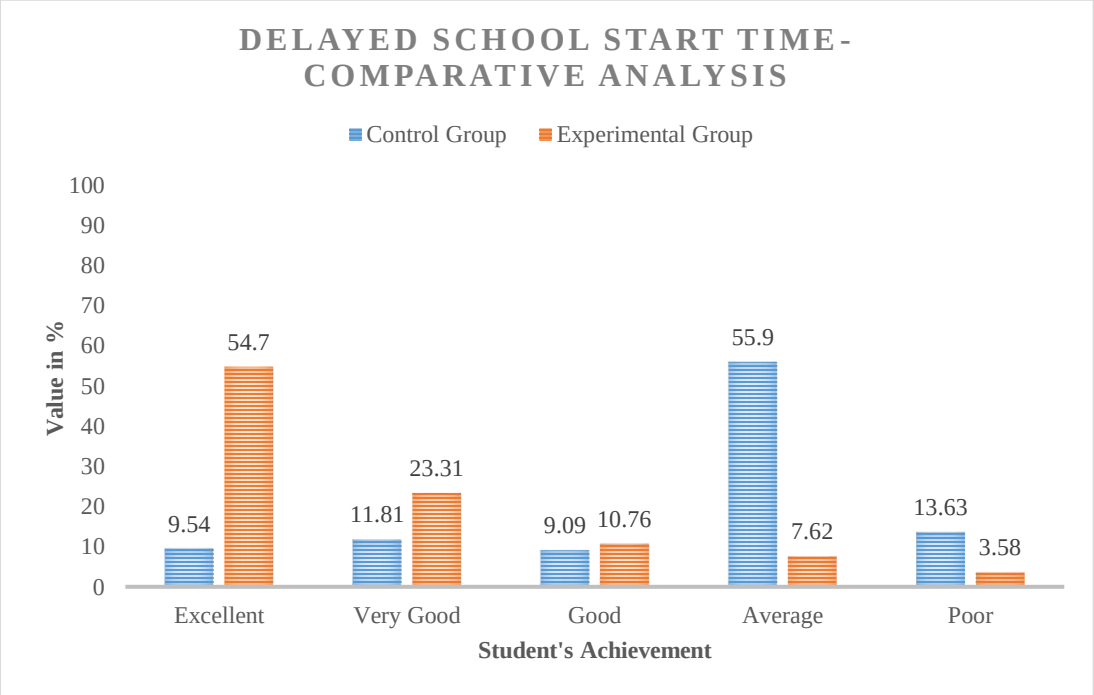

Figure 5 Delayed School Start Time Comparative Analysis

Table 11 summarises the investigation's findings. The mean, SD, and standard error mean scores of several factors are shown in comparison to the students in the control and experimental groups.

Table 11: Results of the current study

Variables	N	Mean	Std. Error Mean	SD

	Control	Experi-mental	Control	Experi-mental	Control	Experi-mental	Control	Experi-mental
Perceived Health	220	223	3.12	3.91	0.0950	0.0626	1.14	0.935
Sleepiness	220	223	3.34	1.95	0.0999	0.0899	1.48	1.34
Behavior Problems	219	223	3.09	1.52	0.0979	0.0675	1.45	1.01
Depression	220	223	3.49	2.25	0.0894	0.0654	1.33	0.977
Anxiety and stress	220	223	3.62	2.21	0.0869	0.0618	1.29	0.923
Life satisfaction	220	223	3.07	3.66	0.0722	0.0685	1.07	1.02
Sleep Efficiency	220	223	3.32	3.69	0.0867	0.0721	1.29	1.08
Sleep Disturbance	220	223	3.15	2.08	0.0856	0.0475	1.27	0.709
Use of Medication	220	223	2.36	1.70	0.0865	0.0813	1.28	1.21
Daytime dis-functioning	220	223	2.67	1.67	0.102	0.0727	1.51	1.09

Table 11 compares the results of the control and experimental groups. In all variables, there is a significant difference between the mean scores of the control and experimental groups. In terms of perceived health, life satisfaction, and sleep efficiency, students in the experimental group had higher mean scores of 3.91, 3.66, and 3.69, respectively. They also had lower mean scores of 1.95, 1.52, 2.25, 2.21, 2.08, 1.70, and 1.67 for sleepiness, behavior problems, depression, anxiety, stress, sleep disturbance, medication use, and daytime dysfunctioning. This demonstrates that delaying the start of school has a positive impact on adolescents' psychological and physical well-being. The results of the one-

sample t-test are shown in Table 12. Followed by the Pearson correlation matrix in Table 13.

Table 12: one Sample t-tests

		Statistic	df	p	Mean difference
Perceived Health	Student's t	58.9	442	< .001	3.52
Sleepiness		35.3	442	< .001	2.64
Behavior Problems		32.8	441	< .001	2.29
Depression		45.8	442	< .001	2.86
Anxiety and stress		46.3	442	< .001	2.91
Life satisfaction		65.3	442	< .001	3.37
Sleep Efficiency		61.6	442	< .001	3.51
Sleep Disturbance		47.4	442	< .001	2.61
Use of Medication		33.1	442	< .001	2.03
Daytime dis-functioning		32.5	442	< .001	2.17

Table 13 Pearson Correlation Matrix

E	G	I	K	M	O	Q	S	U	W
Perceived Health	**Sleepiness**	**Behavior Problems**	**Depression**	**Anxiety and stress**	**Life satisfaction**	**Sleep Efficiency**	**Sleep Disturbance**	**Use of Medication**	**Daytime dis-functioning**

		E		G		I		K		M	O	Q	S	U	W
E	Pearson's r	—													
	p-value	—													
G	Pearson's r	-0.156	***	—											
	p-value	< .001		—											
I	Pearson's r	-0.098	*	0.228	***	—									
	p-value	0.040		< .001		—									
K	Pearson's r	-0.126	**	0.231	***	0.240	***	—							
	p-value	0.008		< .001		< .001		—							
M	Pearson's r	-0.178	***	0.243	***	0.302	***	0.236	***	—					
	p-value	< .001		< .001		< .001		< .001		—					

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O	Pearson's r	0.160	***	-0.085		-0.141	**	-0.144	**	-0.111	*	—								
	p-value	< .001		0.074		0.003		0.002		0.019		—								
Q	Pearson's r	-0.029		-0.025		-0.053		-0.067		-0.032		-0.038		—						
	p-value	0.543		0.601		0.263		0.161		0.506		0.426		—						
S	Pearson's r	-0.109	*	0.207	***	0.174	***	0.195	***	0.209	***	-0.166	***	-0.042		—				
	p-value	0.022		< .001		< .001		< .001		< .001		< .001		0.380		—				
U	Pearson's r	-0.043		0.153	**	0.209	***	0.158	***	0.090		-0.100	*	-0.144	**	0.058		—		
	p-value	0.369		0.001		< .001		< .001		0.058		0.036		0.002		0.225		—		
W	Pearson's r	-0.131	**	0.110	*	0.217	***	0.153	**	0.213	***	0.020		-0.113	*	0.131	**	0.002		—
	p-value	0.006		0.020		< .001		0.001		< .001		0.668		0.018		0.006		0.962		—

Note. * p < .05, ** p < .01, *** p < .001

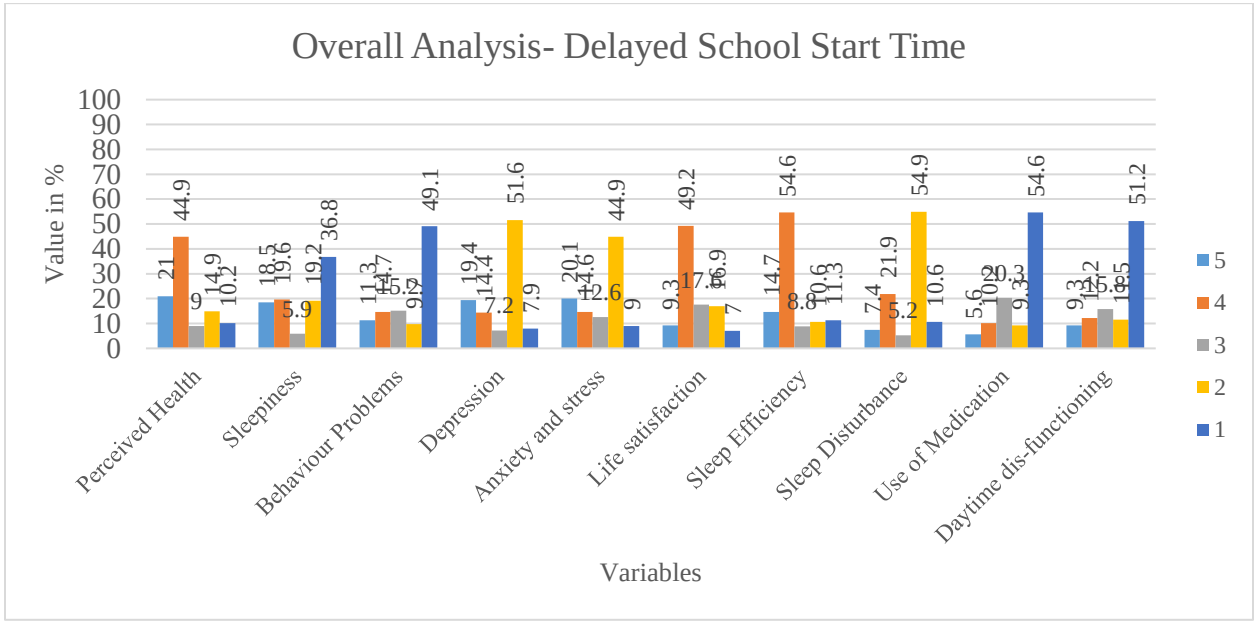

Figure 6 Overall Analysis Delayed School Start Time

Figure 6 depicts the overall analysis of the school start time delay. It was discovered that 21% and 44.9 % had excellent and very good perceived health, respectively. 36.8% reported no sleepiness, and 49.1 % reported no behavioral issues. 51.6 % had depression on rare occasions, 44.9 % had anxiety and stress on rare occasions, 49.2 % had very good life satisfaction, and 54.6 % had better sleep efficiency. Whereas 54.9 %, 54.6 %, and 51.2 % had rare sleep disruption, medication use, and daytime dysfunction, respectively. This demonstrated that the later school start time aided the adolescents' well-being in a variety of ways.

7. Limitations

The proposed research is being conducted in China. The study only includes 443 students from Grade 11 at the Chongqing BI Academy school in China.

8. Conclusion

We believe that determining how school start times may relate to health and academic outcomes is an important area for future research. The current study's findings suggest that delaying the start of school could be a long-term and transformative strategy for addressing the epidemic of sleep inadequacy among adolescents. There is a significant difference between the mean scores of the control and experimental groups in all variables. Students in the experimental group scored higher on perceived health, life satisfaction, and sleep efficiency, with mean scores of 3.91, 3.66, and 3.69, respectively. They also had lower mean scores for sleepiness, behavior problems, depression, anxiety, stress, sleep disturbance, medication use, and daytime dysfunction of 1.95, 1.52, 2.25, 2.21, 2.08, 1.70, and 1.67. This demonstrates that delaying the start of school has a positive effect on the psychological and physical well-being of adolescents. It was also discovered that 21% and 44.9 % had excellent and very good perceived health, respectively. 36.8 % said they were not sleepy, and 49.1 % said they had no behavioral issues. On rare occasions, 51.6 % experienced depression, 44.9 % experienced anxiety and stress, 49.2 % experienced very good life satisfaction, and 54.6 % experienced improved sleep efficiency. Whereas 54.9 %, 54.6 %, and 51.2 %, respectively, had rare sleep disruption, medication use, and daytime dysfunction. Future research should look into how the COVID-19 crisis and associated physical segregation affect child and adolescent sleep over time. It is thus critical that sleep considerations in children and adolescents have serious consequences that, if not addressed, could have even more serious consequences.

Conflicts of Interest

There are no conflicts of interest declared by the authors.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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