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Research Article

Daytime Sleepiness And Time Monitoring Were Served Play A Chain-Like Intermediary Role Between The Influence Between Junior High School Students' Chronotype On Anxiety

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Abstract: Discussing the mechanism of anxiety is particularly important for preventing and reducing anxiety. In this study, 520 junior high school students were selected as subjects to explore the mechanism of daytime sleepiness and time monitoring between chronotype and anxiety. The results show that: the type of chronotype significantly predicts anxiety, the students who go to bed early and get up early have lower anxiety levels; the students who go to bed late and get up late have higher anxiety levels. After controlling the sleep time, daytime sleepiness and time monitoring were served as mediators between the influence from chronotype on anxiety in the chain-mediation model. Conclusion: Improve the chronotype and the level of time monitoring to reduce the anxiety of junior high school students.

Keywords: junior high school students，chronotype, daytime sleepiness, time monitoring，anxiety,

1.Research purpose

To prevent anxiety requires understanding the path of anxiety. Chronotype are one of the factors that affect anxiety[1], and empirical studies on the chronotype of college students [2] and teacher groups [3] have been confirmed. For adolescents, how the situation urgently needs to be confirmed, because adolescents are susceptible to anxiety. If adolescent anxiety develops into an anxiety disorder, the course of the disease will become protracted. We urgently need to understand the path of influence of adolescents' anxiety. According to existing researches, the students who go to bed late and get up late are related to anxiety. Individuals with night chronotype may cause insufficient night sleep and daytime sleepiness problems due to daily time requirements, while daytime sleepiness has been proven to be related to anxiety. Increased, chronotype may affect the individual's anxiety level [4.5] by affecting daytime sleepiness. Based on this inference, daytime sleepiness may be an intermediary between chronotype and anxiety. In addition, studies have confirmed that the time monitoring is related to anxiety. The higher the individual's time monitoring, the lower the level of anxiety[6]. According to previous studies, we found that: chronotype, daytime sleepiness, and time monitoring are all paths that affect anxiety. There is a close relationship between them. The main purpose of this research is to explore the relationship and influence mechanism of the above four variables.

2. Research background

In recent years, researchers have found that chronotype are significantly correlated with anxiety [7.8.9.10], which tends to go to bed late and get up late，The higher the level of form anxiety[11]. This study believes that for adolescents, chronotype will also affect the level of anxiety. Therefore, we propose hypothesis one: the adolescents' chronotype can have a direct impact on anxiety, and the more they tend to go to bed late and get up late, the higher their anxiety level. As shown in Figure 1:

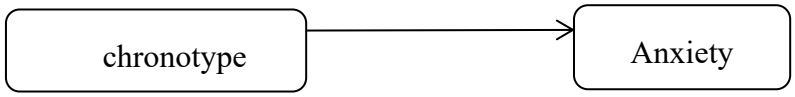


Figure 1：the theoretical model of chronotype act on anxiety

The research of scholars Martin[12], Shimura[13] and others (2018) found that the two variables of chronotype and daytime sleepiness are related. Individuals who tend to be night-type will cause daytime sleepiness when they are forced to wake up in the morning according to the schedule set by work or school. So logically speaking, the influence of chronotype comes first, and the phenomenon of daytime sleepiness comes second. At the same time, scholars Lou[14], Yang[15] and others (2017) have paid attention to the correlation between daytime sleepiness and anxiety. Therefore, we can propose hypothesis 2：Chronotype can affect anxiety, and can also affect anxiety through daytime sleepiness. Daytime sleepiness is the intermediary of them. as shown in Figure 2.

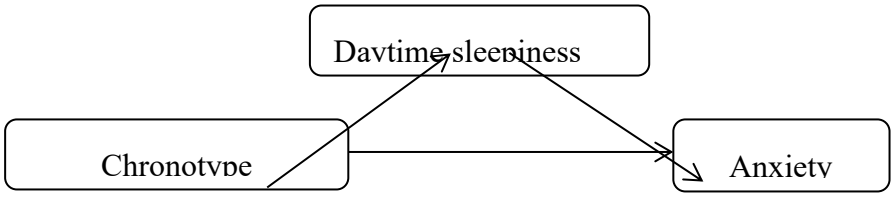


Figure 2：Intermediary model of chronotype, daytime sleepiness, and anxiety

In addition, Scholars as Cheng Ke[16] and Wang Yanfang[17] found that Time monitoring and sub-dimensions are significantly negatively correlated with anxiety. Students who are better at managing time have lower anxiety levels; and those with high time management tendencies have significantly lower anxiety scores. Chronotype is related to anxiety, and it is significantly related to time monitoring (Yang Jingfan et al., 2018), so we can put forward hypothesis three: Time monitoring is the mediator of work rest and anxiety. As shown in Figure 3:

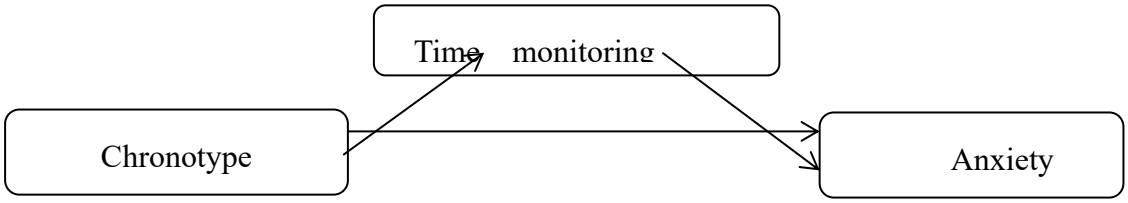
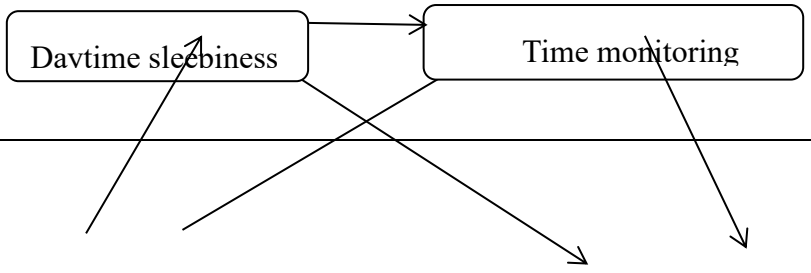


Figure 3：Mediation model of chronotype, time monitoring, and anxiety

Researches by Kelly[18] and Yang[15] have shown that daytime sleepiness or time monitoring is closely related to adolescents' anxiety. Most previous studies have investigated the influence of sleep patterns or daytime sleepiness and time monitoring on anxiety in isolation. Few studies have compared the above the first three variables are combined to examine the path that affects anxiety. Therefore, on the basis of previous research, this study takes daytime sleepiness as behavioral observations, and the concept of work and rest and time monitoring as psychological factors, and integrates these three to investigate their impact on the level of individual anxiety, and explores the type of work and rest. How to influence anxiety by acting on daytime sleepiness and time monitoring in turn, in order to more effectively reveal the inner mechanism of youth anxiety. Therefore, this research attempts to construct a chain mediation model: chronotype affect anxiety by sequentially acting on daytime sleepiness and time monitoring. Demographic background variables may affect the model variables [19.20.21], so this study takes demographic background variables with statistically significant differences in mean values as the control variables in the model. The hypothetical model 1 constructed in this study is shown in Figure 4.



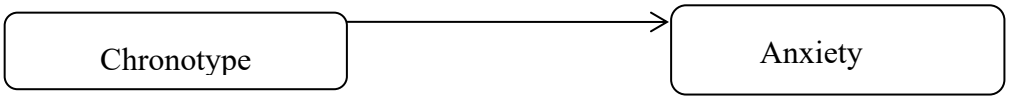


Figure 4： Chained intermediary hypothesis model 1 (this model incorporates control variables)

It should not be overlooked that since the creation of the model is based on the study of the relationship between variables in the literature review and logical reasoning, the position of the variable in the structural equation model will affect the fit of the model, and the change of the position of the variable will also affect the explanation of the entire model, so in order to confirm the best model of the relationship between the four variables of chronotype, daytime sleepiness, time monitoring, and anxiety, this study is based on the model 1 shown in Figure 4 and also based on other possible logics of the four variables. The relationship constructs the corresponding structural equation model.

Previous studies have shown that chronotype can affect anxiety through daytime sleepiness and anxiety through the of time monitoring. They both affect anxiety. Therefore, in addition to the logical relationship shown in Model 1, we also consider the of time monitoring as a reflection of the individual The variables of personality traits are relatively stable, and daytime sleepiness is a relatively unstable behavior that is easily affected. In addition, previous studies on the relationship between them have not proved the exact prediction [22.23], so we think that Chronotype→time monitoring→daytime sleepiness→anxiety is the independent variable . The time monitoring predicts the phenomenon of daytime sleepiness in the first place. It also conforms to a certain logic. Individual daytime sleepiness may will be affected by its time monitoring, so we propose another chained mediation hypothesis model: Chronotype first affects anxiety through the time monitoring and then through daytime sleepiness (Model 2, Figure 5).

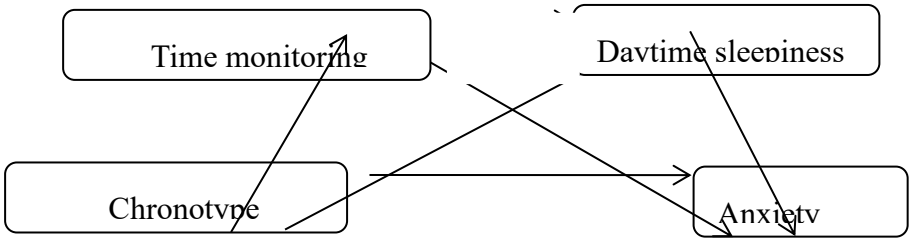


Figure 5. Chained intermediary hypothesis model 2 (this model incorporates control variables)

In addition, since the chronotype and the time monitoring belong to the category of psychology and are both related to sleep[24], the time monitoring may affect the individual's daytime sleepiness, which in turn affects the individual chronotype and causes anxiety. We take the time monitoring as the independent variable, and construct the structural equation by influencing daytime sleepiness and thus the anxiety logic relationship in turn: time monitoring→day sleepiness→work and rest pattern→anxiety model (model 3, Figure 6)

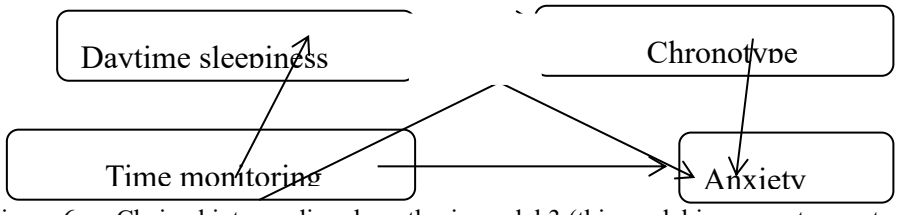


Figure 6： Chained intermediary hypothesis model 3 (this model incorporates control variables)

3. Research methods

3.1 Research objects

This research takes junior high school students as the research object. The M middle school in S province was randomly selected. M middle school is a local prestigious school with rigorous learning school , strict discipline, strict management of teaching , and a high rate of enrollment. The school officially starts classes at 8:00 in the morning. Before 8:00, the students decide whether to study in the morning at school or not. At noon and evening, students will arrange their own work and rest at home.

We adopted a cluster sampling method to select 520 students from two classes (a total of 6 classes) from the first, second, and third grades as the subjects. This questionnaire was distributed with the assistance of the teacher in charge of each class. After the instruction of confidentiality and voluntary participation was informed, students began to answer the question. 509 questionnaires were returned on site, with a recovery rate of 97.9%. After deleting invalid questionnaires such as incomplete answers, there are 487 valid questionnaires remaining, with an effective rate of 93.7%. The basic situation of the subjects is shown in Table 1.

Table 1： Basic situation of subjects

Variable	Category	Number of people	Percentage (%)
SEX	male	242	49.7
	female	245	50.3
grade	First grade	156	32.0
	Second grade	174	35.7
	Third grade	157	32.2
study in the morning	Yes	426	87.5
	No	61	12.5
Lunch rest	Yes	362	74.3
	No	125	25.7

3.2 Research tools

This study used the method of stratified cluster sampling.

Regarding **Chronotype** , we choose the Chinese version of Morning-evening Questionnaire introduced （MEQ） by Zhang Bin [25] . MEQ estimates the activity preference in the circadian rhythm based on the participant's self-description. The higher the score, the more the early morning type, and the more the night type. There are 19 items in MEQ. In this study, the Cronbach alpha coefficient of the scale is 0.72.

Regarding the time monitoring scale, we used subscale of the Youth Time Managemen" compiled by Huang Xiting and Zhang Zhijie [26], with a total of 24 items, using Richter's self-rating 5-point scale for scoring. High indicates that the individual's of time monitoring is better. In this study, the Cronbach alpha coefficient of the scale is 0.882.

Regarding the daily sleepiness scale, we use the Chinese version of the Pediatric Daytime Sleepiness Scale (PDSS-C) compiled by Hu Na, Meng Lingdi, and Liu Kun (2018). PDSS is designed to evaluate the occurrence of EDS, and the subject group is for children and adolescents aged 11-15. There are 8 multiple-choice questions on the scale, using Richter's 5-point scale. The higher the score, the more serious the daytime sleepiness. In this study, Cronbach's coefficient α is 0.773.

Regarding the anxiety scale, we use the Chinese version of the State-Trait Anxiety Inventory (STAI) revised by Mingyuan Zhang (1993). A total of 20 multiple-choice questions, using the Likert 4-point scale, the higher the score, the higher the level of anxiety. In this study, Cronbach's coefficient α is 0.899.

3.3 Data analysis

The data analysis included descriptive analysis,independent sample t-test, paired sample t-test, ANOVA, Pearson correlation, regression analysis, and mediation analysis conducted by the process plug-in SPSS20.0.

Besides, AMOS17.0 was used to proceed the structural equation model to test the model fitting of the mediation model. The conclusions were obtained：

4. Results and discussion

4.1 Descriptive statistics of chronotype, daytime sleepiness, time monitoring and anxiety.

The overall status of the junior high school students' chronotype, daytime sleepiness, time monitoring and anxiety are shown in Table 3.

Table 3 Overall descriptive statistical results of variables (N=487)

Variable	Min	Max	M	SD	p	
chronotype	34.000	53.000	52.802	6.097		
daytime sleepiness	0.000	32.000	11.741	5.853	0.005	
time monitoring	32.000	117.000	79.082	16.164	0.911	
anxiety	20.000	73.000	39.768	11.745	0.150	

Note: p is obtained from single sample t test

It can be seen from Table 3 above that the average score of the total score of chronotype is 52.80±6.10 (M±SD). Most of the chronotype of the tested junior high school students are in the middle type, and the number of the two extreme types is small; the tested junior high school students In the daytime sleepiness variable total score average is 11.741±5.853 (M±SD), which is higher than the theoretical median of 11. The single-sample t-test shows that the average daily sleepiness score is significantly different from the theoretical median (p=0.005), so The level of sleepiness of junior high school students in this school is at a high level; the average total score of junior high school students in the time monitoring variable is 79.082±16.146 (M±SD), which is close to the theoretical median value of 79. The median difference did not reach a significant level (p=0.910), indicating that the school's junior high school students' time monitoring concept level is at a medium level. In addition, there is a big difference between the maximum value and the minimum value, which shows that the individual differences in adolescents' time monitoring concept are worthy of attention. The average total score of the anxiety variable of junior high school students is 39.768±11.745 (M±SD). The single-sample t-test shows that the average total score of anxiety is not significantly different from the theoretical median (p=0.150), which is slightly higher than the theoretical median of 39. The anxiety of junior high school students is at a moderate level, but it still needs attention.

4.2 Correlation analysis of chronotype, daytime sleepiness, time monitoring and anxiety

Correlation analysis of chronotype, daytime sleepiness, time monitoring concept and anxiety is carried out, and the results are shown in Table 3. The content in the table shows that there is a significant correlation between chronotype, daytime sleepiness, time monitoring concept and anxiety. $p<0.001$). The work-rest pattern score was negatively correlated with daytime sleepiness and anxiety (correlation coefficient between -0.586 ~ -0.334, $p<0.001$), and positively correlated with time monitoring ($r=0.317$, $p<0.001$). In addition, daytime sleepiness was positively correlated with anxiety ($r=0.362$, $p<0.001$), and negatively correlated with time monitoring ($r=-0.369$, $p<0.001$). The of time monitoring was negatively correlated with anxiety ($r=-0.304$, $p<0.001$)

Table 3 Table 8 Correlation analysis between variables

	1	2	3	4
1 chronotype	1			
2.daytime sleepiness	-0.586**	1		
3.time monitoring	0.317**	-0.369**	1	
4. anxiety	-0.334**	0.362**	-0.304**	1

Note: * <0.05, ** <0.01, *** <0.001

4.2 Regression analysis

There are significant correlations among the junior high school students' chronotype, daytime sleepiness, time monitoring, and anxiety variables. Therefore, regression analysis is required for the predictive relationship between the variables. We took the length of sleep, gender, age, grade, whether to study in the morning , whether have lunch rest , and length of sleep as control variables, and performed multiple regression analysis. The results are shown in Table 4.

Table 4 Multiple regression coefficient table of each variable

Predictor Variable	Dependent variable	β	R^2	t	p
chronotype	anxiety	-0.334	0.112	-7.811***	<0.001
chronotype	daytime sleepiness	-0.563	0.344	-15.931***	<0.001
chronotype	time monitoring	0.840	0.101	7.365***	<0.001
daytime sleepiness	time monitoring	-0.134	0.136	-8.733***	<0.001
daytime sleepiness	anxiety	0.181	0.131	8.562***	<0.001
time monitoring	anxiety	-0.418	0.092	-7.024***	<0.001

Note: * <0.05, ** <0.01, *** <0.001

4.3 Daytime sleepiness and time monitoring: a chain mediation effect test

In order to test the mediating effect between the variables, anxiety is used as the dependent variable, daytime sleepiness and time monitoring are used as the mediating variable, and chronotype is the independent variable. Sleep duration, gender, age, grade, whether reading in the morning, whether A mediation model is established with lunch rest and sleep duration as the control variables, and the SPSS plug-in process is used to estimate the direct and indirect effects of the multiple mediation model based on the framework of logistic regression. The results are shown in Table 5 .

Table 5 Bootstrap analysis of the mediation effect test

effect	Standardized indirect effect estimates	95% confidence interval	Standard error
(Direct effect)1→4	-0.294	[-0.526，-0.062]	0.118
(Indirect effect 1)1→2→4	-0.183	[-0.308，-0.070]	0.063
(Indirect effect 2)1→2→3→4	-0.059	[-0.105，-0.026]	0.020
(Indirect effect 3)1→3→4	-0.057	[-0.125，-0.015]	0.067

1= chronotype，2= daytime sleepiness，3= time monitoring , 4= anxiety

Direct path: 1 (chronotype)→4 (anxiety) The confidence interval does not contain 0, indicating that the direct path effect of work and rest pattern on anxiety is significant, which verifies hypothesis 1: work and rest pattern has a predictive effect on anxiety.

Indirect path 1: 1 (chronotype) → 2 (daytime sleepiness) → 4 (anxiety) The confidence interval does not contain 0, indicating that the work and rest pattern-day sleepiness-anxiety mediation model is established, and daytime sleepiness plays a part of the mediating role. It accounts for 61.2% of the total indirect effects, which validates the second hypothesis: chronotype can affect anxiety, and can also affect anxiety through daytime sleepiness. Daytime sleepiness is the mediator of the two.

Indirect path 2: 1 (chronotype) → 2 (daytime sleepiness) → 3 (time monitoring) → 4 (anxiety) The confidence interval does not contain 0, indicating that chronotype go through daytime sleepiness, time monitoring, and anxiety in turn The intermediary effect of the chain is significant, accounting for 19.7% of the total indirect effects, verifying Hypothesis 4: chronotype in turn affect anxiety through daytime sleepiness and time monitoring.

Indirect path 3: the confidence interval of 1 (chronotype) → 3 (time monitoring) → 4 (anxiety) does not contain 0, indicating thatchronotype-time monitoring-anxiety mediation model is established. Time monitoring is part of the mediation, accounting for 19.1% of the total indirect effect verified Hypothesis 3: The chronotype can affect anxiety, and can also affect anxiety through the time monitoring, which is the mediator between the two， The chain intermediary model diagram is shown in Figure 6.

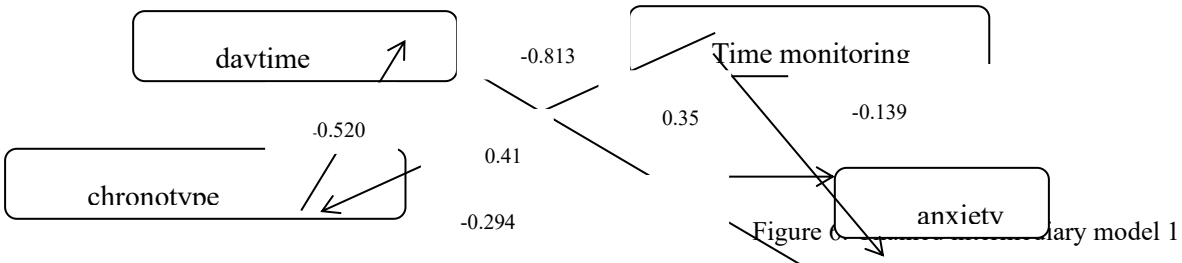


Figure 6 iary model 1

In order to determine the degree of fit of the model, AMOS 17.0 was used to construct the structural equation model. The model fit values are shown in Table 6 below.

Table 6 Fitting value table of model 1

Model 1	CFI	NFI	RMSEA	CMIN	NPAR	RMR
value	0.94	0.930	0.070	3.212	36	0.060

The results in Table 6 show that CFI=0.95, NFI=0.93, RMSEA=0.07, RMR=0.06, and the structural equation fits well. In addition to the model 1 shown in Figure 8, this study also constructed a corresponding structural equation model based on the other possible logical relationships of the four variables, and compared each set of models through the model fitting data presented by Amos, so that the model's Simplicity and goodness of fit strike the best balance. The newly constructed models in this study are: taking chronotype as the independent variable, anxiety as the dependent variable, time monitoring and daytime sleepiness as the mediation of the chain mediation model (Figure 7, Model 2); taking the time monitoring as the mediator The independent variable, anxiety as the dependent variable, chronotype, daytime sleepiness are the mediators of the chain mediation model (Figure 8, Model 3).

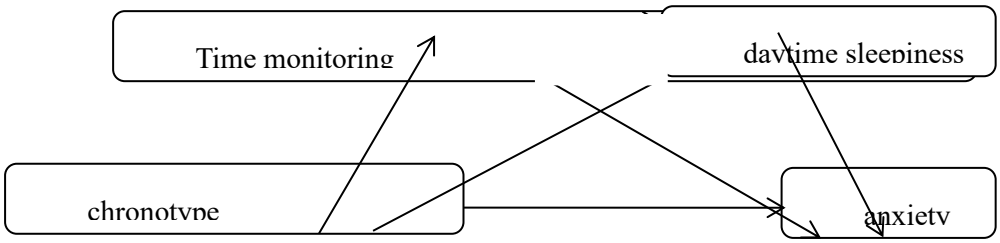


Figure 7, Model 2

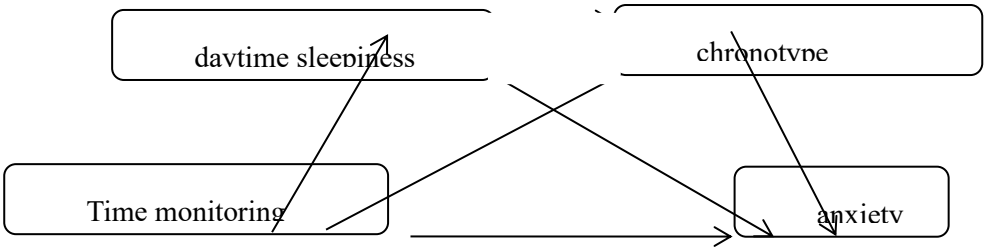


Figure 8, Model 3

The model fitting values of the three structural equation models are compared, as shown in Table 6 :

Table 6 Model 1 fitting value table

	CFI	NFI	RMSEA	RMR	AIC
model1	0.949	0.930	0.070	0.060	286.95
model2	0.949	0.932	0.070	0.040	335
model3	0.949	0.932	0.075	0.042	312

model1：chronotype→ daytime sleepiness→ time monitoring→ anxiety；

model2：chronotype→ time monitoring→ daytime sleepiness→ anxiety

model3：time monitoring→ daytime sleepiness→ chronotype→ anxiety

According to the statistical test standard, the AIC value is used to test the model fit value. The smaller the value, the better. The smaller the value indicates the higher the fit of the model and the simpler the model. When comparing several models, you should Comparing the AIC values, when the AIC values of the two models differ by more than 10, the difference has reached a significant level. It can be seen from Table 11 that the numerical differences between Model 1 and Model 2 and Model 3 have reached a significant level, and the AIC value of Model 1 is the smallest, which confirms that Model 1 is the optimal model of the relationship between the four variables.

5. Research conclusion

1. The chronotype significantly predicts anxiety, the students who go to bed early and get up early have lower anxiety levels; the students who go to bed late and get up late have higher anxiety levels.
2. After controlling the sleep time, daytime sleepiness and time monitoring were served as mediators between the influence from chronotype on anxiety in the chain-mediation model.
3. Improve the chronotype and the level of time monitoring to reduce the anxiety of junior high school students.
4. This research provides empirical data of psychological research for the requirement of go to bed and get up early my country has long advocated.

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