Screen time and risky sexual behavior: the mediating role of adverse psychological effect among adolescents

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Abstract

Background
In the age of digitalization and information technology, the widespread availability of digital media facilities has led to a scenario where most adolescents are exceeding the recommended screen time limits, a trend that is on the rise. Excessive screen time could potentially have detrimental effects on the physical and mental well-being of adolescents. While the association between screen time and psychological health as well as risky behaviors has been explored, the mediating influence of screen time on psychological health and risky behaviors remains unconfirmed.

Methods
The data analysis involved 4054 participants, with mean age of 17.64 years (standard deviation 0.95 years). This study relied on self-reported data regarding screen time and mental health over the past 30 days. Logistic regression and structural equation modeling were employed to examine the relationship between risky sexual behavior, screen time, and the mental well-being of the participants.

Results
During the study, the regression analysis showed that the increase of screen time was significantly positively associated with risky sexual behavior, the \( OR \) and 95% \( CI \) was 2.566(1.073-6.138) after adjusted the confounders. Otherwise, the screen time was positive associated with adverse psychological effect and risky sexual behavior (\( \beta=0.01 \) and 0.03, \( P \leq 0.05 \)), and the psychological effect was positive associated with risky sexual behavior (\( \beta=0.04 , P \leq 0.05 \)).

Conclusions
The results of the mediation analysis demonstrate that the adverse psychological effects serve as a mediating variable between screen time and risky sexual behaviors among adolescents, providing evidence for their role. In order to effectively minimize the prevalence of risky sexual behaviors among adolescents and effectively prevent short-term and long-term psychological and physical harm, restricting screen time may be crucial.

Introduction
Adolescent health forms a crucial cornerstone for the entire lifespan, and which plays a crucial role in determining the well-being of future generations\(^1\). According to the World Health Organization, adolescence spans from ages 10 to 19, encompassing a period of growth and maturation marked by physical, cognitive, behavioral, and psychological transformations. Risky behaviors among children and adolescents represent a pressing global public health concern\(^2\). The normalization of sexual concepts in mass media has led to a rise in risky sexual behaviors among adolescents, posing significant risks to their physical and mental health. Engaging in risky sexual behaviors not only heightens the likelihood of sexually transmitted
diseases and unintended pregnancies but also impacts their psychological well-being, potentially causing lasting harm to their overall health. A report from the National Health and Family Planning Commission indicates that the average age of adolescents engaging in their first sexual intercourse is 15.9 years old, with an incidence rate of 15–17%. These findings emphasize the need for greater attention to the health of adolescents.

Research indicates that multiple factors are associated with the occurrence of risky sexual behaviors among adolescents. In recent years, due to the widespread use of the internet and social media, the mode of communication has undergone a transformation, and online socialization has emerged as a new form of communication. Increasing evidence suggests a positive correlation between internet use and risky sexual behavior. While several studies have attempted to investigate the link between electronic equipment use and the initiation of adolescent sexual behavior, previous findings have been inconsistent. Most studies have found that prolonged screen time increases the risk of adolescent sexual behavior. However, surprisingly, some studies have also suggested that internet use may decrease the risk of adolescent sexual behavior. Furthermore, research on the relationship between adolescent sexual behavior and psychological well-being is limited. Currently, some studies suggest that excessive internet use may lead to detrimental psychological health. Several studies have found a connection between excessive internet use and the onset of anxiety and depression. Another study has also found similar results. However, while previous research primarily focused on investigate the separate links between screen time and depression, anxiety, and risky behavior, there is limited research exploring psychological well-being as a mediating variable in the relationship between screen time and risky behavior.

Against this backdrop, the aim of this study is to be an investigation of the occurrence of risky behaviors among adolescents and the relationship between screen time and adverse psychological effects and risky behavior. The findings of this study may contribute to policy-making and intervention measures and provide a background for future research aimed at identifying relevant factors or risk factors for the increasing trend of risky behavior.

**Methods**

**Design and participants**

At each selected school, students were sampled from three or more majors using a complete cohort sampling method, ensuring equal proportions of gender and grade levels. A complete of 6000 individuals have participated in this research. The inclusion criteria were (1) students in schools; (2) informed consent to participate in this study; (3) age ranged from 10 to 19 years old. After excluding duplicate or incorrect records, a final analysis was conducted on 4084 participants. Parental consent forms were distributed to parents and collected through teachers. Adolescent consent was obtained prior to data on the collected data. Data were collected through an anonymized, self-completion questionnaire via an online electronic survey platform. Two trained statisticians were present to introduce the survey, distribute the questionnaire link, and explain and clarify any questions that participants may have. It took about 40 to 60 minutes to complete the survey. At the time of the program, each student received a small gift valued at 20-30 RMB.
Students were organized to complete the electronic questionnaire during lunch breaks or other free time or in their psychology classes. During the survey process, communication or discussion was not encouraged, but students were allowed to raise their hands to ask questions to the survey staff. A self-designed questionnaire was used to investigate general characteristics, screen time, psychological status, and risky behaviors among middle school adolescents. With the consent and full cooperation of three schools, students selected class time to independently complete the anonymous self-administered questionnaire survey. The survey was completed independently by students and submitted online with informed consent.

**Ethical approval**

All research procedures were approved and ethically monitored by the Ethics Committee of the First Affiliated Hospital of Xi’an Jiaotong University, with project number (No. XJTU1AF2023LSK-272).

**Measures**

**Individual characteristics.**

Age was obtained from the respondents’ birth year in the survey questionnaire. Gender, grade level, whether they were only child, and whether they consumed alcohol or smoked were also investigated. Additionally, we collected family information such as parents’ education level and economic status.

**Screen time.**

By asking the study participants about the total amount of screen time spent watching TV, playing computers, cell phones, iPads, and other electronic devices added up to the total amount of video screen exposure per day (except for time spent on online courses or learning materials). (0: ≤ 1 hours, 1: 1 and ≤ 2 hours, 2: 2 and ≤ 3 hours, 3: 3 hours).

**Patient Health Questionnaire-2 (PHQ-2).**

The Patient Health Questionnaire-2 (PHQ-2) consists of the first two items of the PHQ-9, which is based on symptoms of depression or anhedonia. The diagnosis of depression is of paramount significance, and the PHQ-2 has proven to be an excellent screening instrument for detecting depression in various settings. The PHQ-2 asks for the presence of depressed mood and anhedonia in the past month and includes the two most relevant DSM-IV criteria for depression. The two questions are: "In the past two weeks, have you been frequently bothered by low mood, depression, or despair?" and "In the past two weeks, have you often struggled with a lack of interest or pleasure in doing things?" For each of these items, it measures the frequency of their self-reported anxiety symptoms (not at all = 0, a number of days = 1, more than half the days = 2, nearly every day = 3), and overall score of the PHQ-2 varies from 0 to 6.

**Generalized Anxiety Disorder 2-item (GAD-2).**

The Generalized Anxiety Disorder-2 (GAD-2) scale was originally constructed in 2007 by Kroenke, Spitzer, and their colleagues as a unique "ultra-brief initial screening tool". Over the past decade, the GAD-2 has
been widely used in primary care settings and in the general population with generalized anxiety disorder\textsuperscript{11}. The GAD-2 includes the first two items of the GAD-7 as follows: "Feeling tense, anxious, or nervous" and "Unable to stop or control worrying." It measures the frequency of well-reported anxiety symptoms (not at all = 0, a few days = 1, more than half the days = 2, and almost every day = 3), and the gross score on the GAD-2 spans from 0 to 6, with a recommended threshold of 3 or more for the population in general.

**Risky Sexual behavior** The information on heterosexual intercourse (Yes/No) were collected through single-choice/answer questions.

**Statistical analysis**

Descriptive analysis was conducted using counts and percentages to describe baseline characteristics. Chi-square tests were used to compare the occurrence of sexual behaviors among different groups. Multivariable Logistic regression models were employed to estimate odds ratios (ORs) and 95% confidence intervals (CIs) to elucidate the relationship between screen time and sexual behaviors. Three models with different levels of adjustment were constructed. Model 1 was a crude model, while Model 2 adjusted for gender, age, smoking, and alcohol consumption. Model 3 further adjusted for factors such as parental education level and family income. A P-value < 0.05 for correlation was considered statistically significant.

In addition, we further carried out hierarchical analysis. According to the gender of the study object, whether drinking or smoking, family economy, parents' education background, etc., the correlation between the occurrence of risky sexual behavior and screen time under different conditions was explored.

Structural equation modeling (SEM) was employed to investigate the linkages between the variables, structural equation modeling was chosen because of its multiple benefits and SEM analysis was conducted using Amos. Mediated structural models were tested using 5000 bootstrap samples with great likelihood estimation and 95% bias corrected confidence intervals. Direct effect models, indirect effect models, and mediated effect models were measured. The direct and indirect effects models examined the direct and indirect effects of screen time and psychological state on adolescent sexual behavior risk. Mediated models examined the effects of video screen time on adolescent mental health and sexual behavior occurrence, and the effects of psychological state on adolescent risk for sexual behavior occurrence.

Model fit can be determined by the root mean square error of approximation (RMSEA), which is a population-based index that is not strongly affected by sample size, it has a correspondingly explicit adjustment based on simulation of errors in the corresponding degrees of freedom. According to Browne and Cudeck\textsuperscript{12}, RMSEA 0.05 is appropriate and beyond 0.10 is poor. RMSEA 0.05 should be a minimum and a minimum of 0.10 is not good. Other fit metrics such as the standardized root mean square residual (SRMR), the comparative fit index (CFI), and the Tucker-Lewis index (TLI) are also listed, as well as the values of CFI and TLI above 0.90, value of SRMR less than 0.05 indicating a good fit.

**Results**

**Descriptive statistics**
Table 1 displays the demographic characteristics of the participants. The study included 4054 adolescents. The mean age of the study participants was 17.64 years, of which 1655 were males and 2399 were females, there were 620 only children and 3434 non-only children, which accounted for 84.7% of the participants, and the number of those who reported risky sexual behaviors was 113, and the number of those who did not report risky sexual behaviors was 3,941. Analysis of the results of the chi-square test showed that their grade, age, gender, smoking and alcohol consumption, father's educational level, mother's educational level, and family economic circumstances were related to sexual behaviors. The analysis of the results of the chi-square test showed that their grade, age, sex, smoking and drinking, paternal education, maternal education, family economic status were related to sexual behavior.

**Association between screen time and risky sexual behavior**

The unadjusted model revealed a significant correlation between screen time \( \geq 3 \) hours/day and a higher incidence of sexual behavior (\( OR=2.733, \) and 95% CI: 1.362-5.485,\( P=0.005 \)), Model 2 made adjustments for factors such as gender, age, use of tobacco and alcohol, and found that as the screen time increased, the risk of sexual behavior also increased. Model 3 further adjusted for parental education, family and economic and other factors, which showed that compared to individuals who spent screen time <1 hours/day, those who \( \geq 3 \) hours/day had an increased risk of sexual behavior(\( OR=2.566, 95\% CI:1.073-6.138, P=0.034 \)). which could be seen in Table 2.

The relationships among the variables were examined, which could be seen in Figure 1. The results indicated that screen time had a significant positive impact on sexual behavior (\( \beta = 0.01, P < 0.05 \)), suggesting that people with longer screen time may have higher risk of sexual behavior. The screen time was associated with psychological distress (\( \beta =0.03, P < 0.05 \)), indicating that people with longer smart entertainment time may affect mental health. Furthermore, psychological distress was shown to have an effect on the occurrence of risky sexual behavior(\( \beta =0.04, P < 0.05 \))

**Association of risky sexual behavior across participant background characteristics.**

Table 3 presents the relationship between screen time and engagement in risky behaviors as revealed through subgroup analysis. We observed that alcohol consumption, gender, and parental education level were associated with the occurrence of individual risky behaviors. Compared to non-drinkers, individuals who consumed alcohol had a significantly higher risk of being in dangerous behaviors. Regarding gender, males had a higher threat for the occurrence of risky behaviors. Children with parents who had a high school education or lower were at higher run of hazardous behaviors.

Fit indices are provided in Table 4. The CFI yielded a value of 0.934, indicating a favorable fit in this study. The TLI, a measure of relative fit, was computed to be 0.910. The RMSEA for this material was 0.041, reflecting a satisfactory fit. The SRMR was calculated to be 0.011, further supporting an acceptable fit.

**Discussion**
The results of the prospective analysis showed that screen time $\geq 3h$ was accompanied by an increased risk of sexual behavior in adolescents. This association may be related to adolescents' mental health status. Our findings strengthen the understanding of the adverse effects of electronic equipment time on the occurrence of sexual behavior in adolescents and emphasize that reducing screen time is necessary to improve adolescent health.

The widespread availability of mobile devices during adolescence has triggered a burgeoning debate about beneficial and deleterious effects on the health and development of young people. Adolescence is a period of remarkable development of brain regions under the influence of biological and environmental factors, as confirmed by in vivo neuroimaging, which demonstrates persistent and significant changes in structural organization and morphology throughout the adolescent region of the human brain, characterized by a decrease in gray matter and an increase in white matter, with lasting effects on cognition. Cognitive abilities that foster effective self-regulation have been reported to enhance during adolescence, and there are neural correlates of information processing efficiency, such as axonal myelin formation and the formation of higher-order cognitive functioning, including the anterior cingulate cortex (ACC), prefrontal cortex (PFC), as well as parietal lobe areas. Studies have shown that the amount of time adolescents spend watching videos is associated with reduced white matter, shorter time spent participating in networks, longer time spent participating in networks with mid-range connections, and shorter time spent connecting between frontal, frontal, and parietal regions with reduced connectivity. Abnormalities in these circuits are usually associated with problems and disorders in impulse modulation and are more likely to encounter difficulties in modulating components. We hypothesize that excessive video time may further affect the cognitive abilities of adolescents by affecting white matter, and that their ability to self-regulate, including emotions, will be relatively weaker than those who spend less time on video, thereby increasing the risk of depression and adolescent sexual behavior. Therefore, based on our findings and support from previous studies, we suggest that there is a need to limit adolescents' use of cellular phones for recreational purposes in order to more effectively improve their cognitive levels and further promote their well-being and healthy development.

Previous research has found a significant relationship between screen exposure time and the occurrence of sexual behavior among adolescents. Similarly, our study indicated that the screen time more than 3h per day is correlated with an elevated risk of engaging in risky sexual behaviors. The network provides a wealth of health information, particularly in the realm of sexual health. Its anonymity, accessibility and low cost of the Internet make it a convenient source to provide information. The internet offers many conveniences for young people, such as finding reproductive health-related knowledge without the embarrassment of personal consultations. It is an important tool for adolescents to acquire health knowledge and address health-related issues. It is alarming, however, about the accuracy of obtaining the information. The Internet provides people with a vast amount of information, but the amount of information is huge and the content is mixed. Adolescent, due to their limited cognitive abilities and inability to discern accurate information, may struggle to obtain positive, healthy, and accurate knowledge and are susceptible to being influenced by harmful or incorrect information. As a result, attitudes towards reproductive health may be influenced by inaccurate information. Studies have shown that the majority of students use the internet to
search for sexual partners. The widespread use of electronic devices allows young people to spend more time privately establishing social relationships, including sexual ones. In certain aspects, this may be a contributing factor to the higher risk of engaging in sexual activities among individuals who use electronic devices for long periods of time. Our research may provide new evidence of the adverse health effects of electronic device usage on children and adolescents.

The results report on the impact of screen time on mental health. In contemporary society, problematic use of electronic devices is associated with their content and screen time. The amount of time and energy spent on electronic devices can affect various aspects of individuals' lives. Some studies have found that the use of electronic devices can disrupt people's physical and mental well-being. The exponential growth of internet usage globally, particularly among young people, has raised concerns about potential negative effects. For example, the increasing popularity of social media is considered a potential explanation for the rise in mental health issues among adolescents. In developed countries, excessive use of electronic devices is closely associated with many negative health or well-being outcomes, and the rapid proliferation of the internet has brought unprecedented changes to the lives and psychological conditions of Chinese people. A growing number of research has found a significant correlation between internet use and increased psychological distress among young people, including depression, anxiety, suicidal ideation, attention-deficit hyperactivity disorder, and self-mutilation. These findings are consistent with our research results. In a longitudinal study, increased internet use was found to increase the risk of depression in females and the risk of future self-harm in males. It is worth noting that an increase in internet usage time may amplify the prevalence and impact of these exposures.

Our study demonstrates that alcohol consumption, lower maternal education level, and the male population have a higher tendency to commit risky behaviors. This may be attributed to the detrimental effects of alcohol on cognitive processing and the narrowing of individual attention, leading to short-sighted focus on immediate environmental cues rather than long-term goals or consequences. This may make individuals less likely to consider the potential outcomes of their actions and more prone to engaging in risky behaviors. Alcohol intoxication often facilitates sexual activity without taking protective measures, which can result in adverse outcomes such as unintended pregnancies and sexually transmitted infections. Previous research conducted by Wight et al. The survey among Scottish teenagers also found that Scottish parents with higher levels of education were likelier to have a discussion about sex with one's children. This may suggest that having a higher level of parental education is associated with greater sexual knowledge and self-efficacy. Therefore, individuals with higher parental education levels may engage in discussions with their children about relevant issues to prevent the occurrence of risky behaviors.

The mental health status of adolescents influences the development of sexual intimacy, sexual identity, and reproductive potential, and vice versa. Poor sexual health also affects an individual's mental well-being, increasing the risk of depression and suicide. Previous research conducted in high-income and middle-income countries has shown that mental health may have a major role in risky sexual behavior and HIV/AIDS. Different online sexual behaviors have been found to be associated with mood disorders, depression, and other psychological issues. Some studies suggest that women who experience
depression or psychological distress are more likely to report an increase in unprotected sexual activity, a higher number of sexual partners, more sexual activity under the effects of alcohol or drugs, and an increase in the prevalence of sexually transmitted infections\textsuperscript{34, 35}. Risky sexual behavior can be an expression of anger or a way to alleviate tension. Anxiety is associated with a higher number of sexual partners, which may reflect that sexual activity can serve as a way to relieve tension in individuals with social anxiety syndrome. Therefore, it is necessary to provide adolescent-friendly psychological and sexual healthcare services. At the same time, it is important to consider the influence of psychological factors while providing reproductive health knowledge and services to adolescents. By establishing comprehensive adolescent personality traits and coping mechanisms, promoting timely access to contraception knowledge, and advocating for effective contraceptive measures, unsafe sexual behavior among adolescents can be reduced or eliminated, leading to a decrease in unintended pregnancies and induced abortions among adolescents.

**Conclusion**

This is one of only a handful of studies to examine the impact of screen time on sexual behavior, our findings suggest that longer time of screen increases the occurrence of sexual behavior in adolescents. Therefore, Behavioral interventions to help improve personal screen time should be considered in situations involving health education for adolescents to actively prevent near-term damage to adolescents caused by sexual behavior. However, this current study is far from conclusive, and much more work is needed to develop a more complete understanding of these issues. We used a considerable sample of data to translate our information. Despite the use of a large sample, limitations need to be taken into account when interpreting our findings. First, the use of self-report questionnaires means that the variables tested are accessible in a conscious manner, and we must consider the reality that these variables reflect self-perceptions that may reveal biased response tendencies. For example, the sexual behavior problem is a relatively sensitive topic, and the sexual behavior reporting rate of this study was 3.33%, which is lower than the rate of the same age group. Second, despite the large sample size, it contained primarily adolescents and individuals from vocational schools, which limited our ability to generalize the sample to other populations. In addition, the current study used a cross-sectional design of the baseline data, which we believe is defensive as the first step; however, which limits our ability to address issues of causality, hence a longitudinal design will be needed to clearly prove this causal conclusion. Furthermore, our mediation model was obtained from previous studies, of course only possible reasonable models of how different variables of interest are related.

**Declarations**

Conflicts of interest: The author have no conflicts of interest to declare.

**Acknowledgments**

We would like to thank the adolescents, and families for their time and effort.
**Ethics approval and consent to participate**

The study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of the Medical Ethics Committee of the First Affiliated Hospital of Xi’an Jiaotong University (No. XJTU1AF2023LSK-272).

**Consent for publication**

The participants or their guardians provided their written informed consent to participate in this study.

**Competing interests**

The authors declare that the research was conducted in the absence of any commercial or financial relationships. This manuscript has not been published nor is it being considered for publication elsewhere. There are no conflicts of interest to declare, associated with the publication of this manuscript.

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**Data availability**

No datasets were generated or analysed during the current study.

**Author contributions**

BZ&YJ: Methodology, Formal analysis, Writing - review & editing.

WX&SZ&JX&HN&JF&PH&XL: Resources, Writing - review & editing.

WY: Conceptualization, Resources, Methodology, Supervision, Project administration, Funding acquisition, Writing review.

**References**


Tables

Table 1 Basic characteristics of the study subjects
<table>
<thead>
<tr>
<th>Variables</th>
<th>total (n=4054)</th>
<th>risky sexual behavior</th>
<th>t/χ²</th>
<th>P</th>
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<td>n=113</td>
<td>n=3941</td>
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<td>803</td>
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Table 2 Logistic regression analysis of screen time and risky sexual behavior occurrence

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1(^1)</th>
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<th>Model 2(^2)</th>
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<th>Model 3(^3)</th>
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<tr>
<td></td>
<td>OR(95% CI)</td>
<td>P</td>
<td>OR(95% CI)</td>
<td>P</td>
<td>OR(95% CI)</td>
<td>P</td>
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<td>screen time(h/d)</td>
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<td>1h/d</td>
<td>1.415(0.556, 3.585)</td>
<td>0.400</td>
<td>1.393(0.541, 3.586)</td>
<td>0.493</td>
<td>1.803(0.605, 5.374)</td>
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<tr>
<td>2h/d</td>
<td>1.573(0.814, 4.033)</td>
<td>0.212</td>
<td>1.538(0.805, 4.099)</td>
<td>0.151</td>
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<td>≥3h/d</td>
<td>2.733(1.362, 5.485)</td>
<td>0.005</td>
<td>2.485(1.220, 5.062)</td>
<td>0.012</td>
<td>2.566(1.073, 6.138)</td>
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Table 3 Subgroup Analysis on the Association of screen time and risky sexual behavior occurrence
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<th>$P$</th>
<th>$OR^2 (95% CI)$</th>
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<tr>
<td>Yes</td>
<td>4.154(0.976,17.685)</td>
<td>0.054</td>
<td>6.515(0.784,54.113)</td>
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<tr>
<td>No</td>
<td>1.848(0.821,4.159)</td>
<td>0.138</td>
<td>2.053(0.776,5.434)</td>
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<td>drinking</td>
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<tr>
<td>Yes</td>
<td>2.277(0.689,7.520)</td>
<td>0.177</td>
<td>3.961(1.176,13.345)</td>
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<tr>
<td>No</td>
<td>2.318(0.973,5.522)</td>
<td>0.058</td>
<td>1.535(0.433,5.441)</td>
<td>0.507</td>
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<td>gender</td>
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<tr>
<td>Female</td>
<td>1.598(0.470,5.433)</td>
<td>0.453</td>
<td>0.834(0.226,3.083)</td>
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<tr>
<td>Male</td>
<td>4.253(1.816,9.962)</td>
<td>0.001</td>
<td>5.075(1.526,16.873)</td>
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<td>father's degree</td>
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<tr>
<td>University and above</td>
<td>0.696(0.122,3.981)</td>
<td>0.683</td>
<td>0.594(0.080,4.428)</td>
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<tr>
<td>High school and below</td>
<td>3.318(1.519,7.246)</td>
<td>0.003</td>
<td>3.582(1.267,10.129)</td>
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<tr>
<td>mother's degree</td>
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<tr>
<td>University and above</td>
<td>0.620(0.106,3.615)</td>
<td>0.595</td>
<td>0.211(0.018,2.442)</td>
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<tr>
<td>High school and below</td>
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<td>3.878(1.368,10.996)</td>
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Table 4 The model fit test of structural equation model

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<th>index</th>
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<td>CFI</td>
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<td>TLI</td>
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<td>RMSEA</td>
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<td>0.039</td>
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<tr>
<td>SRMR</td>
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Figures
Figure 1
The path diagram of structural equation model.

Note: Rectangles and ovals represent observed and latent variables, respectively. FE (father's education) ME (mother's education). Solid line means the result was meaningful, the dotted was not meaningful. Rectangles and ovals represent observed and latent variables, respectively. FE (father's education) ME (mother's education). Solid line means the result was meaningful, the dotted was not meaningful.