Childhood Trauma and Psychological Sub-Health Among Chinese Adolescents: The Mediating Effect of Internet Addiction

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Abstract

Background. The factors related to psychological sub-health (PSH) have been widely described, but the research on the mechanism behind the complex relationship between childhood trauma and PSH is limited. This study investigated the current situation and risk factors of PSH among Chinese adolescents, and explores the direct influence of childhood trauma on PSH. And hypothesizes that Internet addiction (IA) plays a mediating effect between childhood trauma and PSH.

Methods. The mental health survey was conducted in China's Anhui Province in October 2020. Childhood trauma, IA and PSH were measured by the Childhood Trauma Questionnaire (CTQ), Young's Internet Addiction Test (IAT) and the Multidimensional Sub-health Questionnaire of Adolescent (MSQA). Our hypothesis is further verified by the structural equation model (SEM).

Results. In this study, 866 adolescents were selected as subjects, the prevalence of PSH in adolescents was 25.8%, and left-behind children, boarding or adolescents who have had non-suicidal self-injury (NSSI) are more likely to have PSH. In addition, 57.5% and 23.2% of the participants reported childhood trauma and IA, both of which had a direct impact on PSH and increased the risk of PSH by about 2 times (OR=1.95, CI=1.32~2.89, P < 0. 01) and 5 times (OR=5.20, CI=3.55~7.60, P < 0. 01), respectively. The SEM showed that the fitting condition of the model is good (CMIIN/DF = 1.139, GFI=0.998, TLI=0.999, CFI=1.00, RMSEA=0.013). The SEM results revealed that childhood trauma predicted PSH directly or indirectly through IA. IA has been confirmed to have partial mediating effects between childhood trauma and PSH.

Conclusions. Childhood trauma has direct and indirect effects on PSH, and IA plays a mediating role in the indirect effect. Therefore, clarifying these relationships is helpful in formulating and implement effective interventions to improve psychological health (PH) in Chinese adolescents.

1. Introduction

PSH means that people's bodies and minds are in the state of transition between disease and health. It mainly refers to the health state of low-quality and low experience of people in terms of body, mind and emotion, primarily manifested as unexplained mental fatigue, emotional disturbance, disordered thinking, panic, anxiety, neuroticism, inferiority, indifference, loneliness, recklessness, and even the idea of suicide [1]. Since the psychological state of adolescents is in the stage of transition from immaturity to maturity, their PH is easily affected by the external environment. As estimated, 10–20% of children and adolescents worldwide suffer from PH problems [2]. The prevalence rate of PSH state among adolescents in my country is 15.50% [3]. During the COVID-19 epidemic, the PH of more than 20% of Chinese adolescents has been affected [4]. Compared with the past, the prevalence of behavioral and emotional problems seems to have increased [5, 6]. Given the negative outcomes associated with poor PH problems among adolescents, such as suicide, behavioral problems and emotional distress, we need to further explore the risk factors that increase PSH in order to better prevent the emergence of PSH or alleviate PSH symptoms.

Childhood trauma is defined as adverse life events experienced from birth to age 18 that [7], if not handled properly, can be risk factors for PSH, such as anxiety, depression and self-harm/suicide. Its incidence is high, with up to two-thirds of the population experiencing adverse childhood traumas before the age of 18 [8]. The prevalence of adverse childhood trauma is even greater in China, and the prevalence of adolescents can reach 79.01% [9]. Childhood trauma has been linked to lower PH levers and more severe mental health problems, and the higher the frequency of adverse childhood trauma, the higher the incidence of PH problems [10, 11]. Childhood trauma is a common risk factor for lifelong psychosomatic diseases, and different ways (intermediary mechanisms) contribute to these negative effects, including biological regulation mechanism, psychosocial mechanism and so on [12].

With the rapid development of the economy, science and technology, the Internet is becoming more and more popular. The Internet brings great convenience to our lives, but at the same time, it also brings a severe problem: IA, that is one's ability to use the Internet cannot be controlled [13, 14]. This use of the Internet is excessive and morbid [15]. Although IA has no corresponding chemical component that causes physical problems, it can also cause dependence and psychosocial problems just like drug addiction [16]. It is reported that the prevalence of IA in Asian adolescents and young adults ranges from 2.4–37.9% [17]. The prevalence rate among Chinese adolescents ranges from 10.4–20.44% [14, 18]. In recent years, online courses are becoming more and more common and abundant, which increases the opportunities and time for adolescents to get in touch with the Internet, which may increase the prevalence of IA. Studies have shown that IA can lead to depression, anxiety and other PH problems [19, 20]. Some researchers have indicated that the occurrence of IA is related to a series of psychological factors, including childhood trauma, especially sexual abuse and emotional neglect have the most significant impact. IA is also said to be related to emotional abuse, which is controversial [21–23]. The phenomenon of IA among adolescents is becoming very common, which obviously has a negative impact on their physical and psychological health, so it has gradually attracted the attention of the society.

Therefore, the primary purpose of this study was to describe the prevalence of PSH, childhood trauma and IA among adolescents in Anhui. The second objective was to examine the validity of the direct association between childhood trauma and PSH and the mediating role of IA between childhood trauma and PSH using the SEM.

2. Materials And Methods

2.1 Participants

This survey was approved by the Ethics Committee of Chaohu Hospital of Anhui Medical University (2019-kyxm-012). First of all, two cities were randomly selected in Anhui province, and then students from 6 schools were randomly selected from the two cities as the object of study, from October 2020 to October 2021. Participants in this survey should meet the following conditions: (1) minors (< 18 years old), and (2) volunteer to participate in this survey. Exclusion criteria: adolescents with severe mental or physical illness or impaired audiovisual function. Obtain informed consent from participants and their

guardians (parents or other caregivers). Then before filling out the relevant scale, we have explained the process and purpose of the research to participants and read instructions to ensure they fully understand the research. Then, students fill the unified questionnaires anonymously.

2.2 Measures

2.2.1 Multidimensional Sub-health Questionnaire of Adolescent (MSQA)

The psychological sub-health status was evaluated by the MSQA, which included 39 items, including three dimensions: emotional problems, conduct problems and social adaptation difficulties. Items with sub-health symptoms lasting more than one month (i.e., score > 4) are considered positive items. The higher the score, the longer duration of sub-health symptoms, and the number of positive items ≥ 8. Then, the participant is assessed to be in the PSH state [24]. The scale has good reliability and validity and is widely used in China [25, 26].

2.2.2 Childhood Trauma Questionnaire (CTQ-SF)

The simplified version of the CTQ-SF includes 28 items, the symptoms ranged from never (1) to always (5). The higher the score, the more traumatic experience and the more abuse. The scores of moderate and severe in each subscale were as follows: emotional abuse > 12, physical abuse > 9, sexual abuse > 7, emotional neglect > 14, physical neglect > 9. Participants with a moderate or severe self-assessment score were marked 1 on each of the five subscales, indicating that they had suffered this type of trauma [27]. CTQ-SF has been widely used in Chinese adolescents and has been proved to have good reliability and validity [25, 28].

2.2.3 Young’s Internet Addiction Test (IAT)

The IAT consists of 20 items designed to measure IA. These items were rated on a scale of 5, from 1(rarely) to 5(always). The total score is 20 to 100 points. The higher the score, the deeper the IA. According to the criteria, 20–49 points are normal, and ≥ 50 points are mild to severe IA [29, 30]. Its Chinese version has good reliability and validity [31].

2.3 Statistical Analysis

SPSS 25.0 and AMOS 24.0 software packages were used for data analysis. The Chi-square test was carried out on the classified variables. Independent sample T-test or Mann-Whitney U test was used for variable comparison between the PH group and the PSH group. Spearman or Pearson correlation analysis described the correlation between continuous variables. As well, the risk factors of PSH of the subjects were studied by binary Logistic regression analysis.

SEM was used to verify the hypothesis that IA is mediating in the relationship between childhood trauma and PSH in adolescents. PSH is a latent variable, which consists of emotional problems, behavioral problems and social adaptation difficulties. The degree of fitting of the hypothesis model to sample data is evaluated by the following goodness-deviation measures: Chi-square degrees of freedom ratio (CMIN/DF), Goodness-of-fit index (GFI), Adjusted goodness-of-fit index (AGFI), Normal fit index (NFI), relative fit index (RFI), Incremental fitting index (IFI), Tacker-Lewis's index (TLI), Comparative fitting index (CFI) and Root mean square error of approximation (RMSEA). If the CMIN / DF value is less than 2, the values of GFI, AGFI, NFI, RFI, IFI, TLI and CFI, are above 0.9, and the RMSEA value is less than 0.08, the model fits well. All the Significance was set at 2-tailed $P < 0.05$.

3. Results

3.1 Socio-demographic Characteristics of Participants

A total of 937 questionnaires were collected, of which 866 were valid, with an effective response rate of 92.4%. As shown in Table 1, The number of participants with PSH was 223, with the prevalence of 25.8%. 50.9% of the participants were male, and 49.1% are female aged 10 to 17 years (mean age: 12.96 ± 1.50 years). Most participants were middle school students, with a total of 516. And most of the participants (59.0%) had siblings, that is, non-only children. Most of their parents' educational level is junior high school or below and, the majority of participants with average family economic conditions. Unfortunately, 16.7% of their parents were divorced, or one of their parents died. According to statistics, about half of the participants are left-behind children (48.8%). The prevalence of left-behind children in PSH was 32.2%, significantly higher than that of non-left-behind children ($P < 0.01$). The incidence of PSH of boarders was higher than that of day students ($P < 0.01$). Among all the subjects, 308 (35.6%) had NSSI, and 47.4% of them were in a state of PSH, which was significantly higher than that of adolescents without NSSI (13.1%, $P < 0.01$). It can be seen that the PH group and the PSH group have no statistical significance in age, gender, grade and only child, and parent's marital status, education level and family economic status were also not statistically significant. However, adolescents who have been or are left-behind children, school accommodation or NSSI are more likely to be in the PSH state.

Table 1
Socio-demographic characteristics of adolescents

Variables	**Total participants(n = 866)**	**PSH(n = 223,25.8%)**	**PH(n = 643,74.2%)**	**Z/X^2**	***P***
Age	12.96(1.50)	13.05(1. 52)	12.92(1.50)	1.15	0.25
Gender				3.23	0.07
Male	441(50.9%)	102(45.7%)	339(52.7%)		
Female	425(49.1%)	121(54.3%)	304(47.3%)		
Grade				2.57	0.11
Primary school	350(40.4%)	80(35.9%)	270(42.0%)		
Middle school	516(59.6%)	143(64.1%)	373(58.0%)		
Left behind status				17.72	**<0.01**
Yes	423(48.8%)	136(61.0%)	287(44.6%)		
No	443(51.2%)	87(39.0%)	356(55.4%)		
Only child				0.01	0.93
Yes	355(41.0%)	92(41.3%)	263(40.9%)		
No	511(59.0%)	131(58.7%)	380(59.1%)		
Father's educational level				2.96	0.09
<9 years	525(60.6%)	146(65.5%)	379(58.9%)		
≥ 9yeaes	341(39.4%)	77(34.5%)	264(41.1%)		
Mother's educational level				1.22	0.27
<9 years	560(64.7%)	151(67.7%)	409(63.6%)		
≥ 9 years	306(35.3%)	72(32.3%)	234(36.4%)		
Parents' marital status				3.25	0.07
Married	721(83.3%)	177(79.4%)	544(84.6%)		
Parental divorce or death of a parent	145(16.7%)	46(20.6%)	88(15.4%)		
Economic situation				3.33	0.19
Better	192(22.2%)	47(21.1%)	145(22.6%)		

PSH: psychological sub-health; PH: psychological health; NSSI: Non-suicidal self-injury

Variables	Total participants(n = 866)	PSH(n = 223,25.8%)	PH(n = 643,74.2%)	Z/X^2	*P*
General	625(72.2%)	158(70.9%)	467(72.6%)		
Poor	49(5.7%)	18(8.1%)	31(4.8%)		
Accommodation type				13.00	**<0.01**
Yes	193(22.3%)	69(30.9%)	124(19.3%)		
No	673(77.7%)	154(69.1%)	519(80.7%)		
NSSI				117.21	**<0.01**
Yes	308(35.6%)	146(65.5%)	162(25.2%)		
No	558(64.4%)	77(34.5%)	481(74.8%)		
PSH: psychological sub-health; PH: psychological health; NSSI: Non-suicidal self-injury					

3.2 Statistical Description and Comparison of Childhood Trauma and IA Between PSH Group and PH Group

As can be seen from Table 2 that more than half of the adolescents (57.5%) have had childhood trauma, and 34.1% of them are in a state of PSH, which is significantly higher than that of adolescents without childhood trauma. Child trauma total score, physical neglect score and emotional neglect score, such as the five factors in adolescents with PSH, were also significantly higher than those in the PH group ($P < 0.01$). In addition, among the 866 subjects, 201 (23.2%) had mild to severe IA, of which the incidence of PSH accounted for 57.7%, while the PSH prevalence of participants without IA was only 16.1%. The total score of IA in the PSH group was also higher than in the PH group ($P < 0.01$).

Table 2
Prevalence of childhood trauma and Internet addiction and comparison between groups

Variables	Total participants (n = 866)	PSH (n = 223)	PH (n = 643)	Z/X^2	*P*
Childhood trauma	50.29(14.25)	58.20(15.54)	47.54(12.68)	-9.48	**<0.01**
Yes	498(57.5%)	170(76.2%)	328(51.0%)	43.12	**<0.01**
No	368(42.5%)	53(23.8%)	315(49.0%)		
Physical neglect	9.57(3.26)	10.86(3.37)	9.12(3.10)	-6.55	**<0.01**
Emotional neglect	11.98(5.05)	13.45(5.46)	11.46(4.79)	-4.87	**<0.01**
Physical abuse	6.50(3.06)	7.58(4.04)	6.12(2.53)	-6.28	**<0.01**
Emotional abuse	7.66(3.50)	9.85(4.43)	6.90(2.73)	-10.55	**<0.01**
Sexual abuse	5.93(2.61)	6.51(3.41)	5.73(2.23)	-4.49	**<0.01**
Internet addiction	39.19(15.37)	51.18(17.50)	35.04(12.04)	-12.43	**<0.01**
Yes	201(23.2%)	116(52.0%)	85(13.2%)	139.85	**<0.01**
No	665(76.8%)	107(48.0%)	558(86.8%)		
PSH: psychological sub-health; PH: psychological health;					

3.3 The Relationships Among Childhood Trauma, PSH State and IA

Spearman correlation analysis results of childhood trauma, PSH and IA scores are shown in Table 3. The total score of childhood trauma was positively correlated with the scores of emotional problems($r = 0.41$, $p < 0.01$), behavioral problems($r = 0.40$, $p < 0.01$) and social adaptation difficulties($r = 0.40$, $p < 0.01$). There was also a positive correlation between childhood trauma and IA ($r = 0.36$, $p < 0.01$). In addition, the

relationship between IA and emotional problems ($r = 0.50$, $p < 0.01$), behavioral problems ($r = 0.52$, $p < 0.01$), and social adaptation difficulties ($r = 0.56$, $p < 0.01$), was also a significant positive correlation. There was also a correlation between the subscales of childhood trauma and PSH (min $r = 0.20$, max $r = 0.83$, all $P < 0.01$). Therefore, the mediating effect can be further analyzed.

Table 3

Relationships among childhood trauma, internet addiction and psychological sub-health state. (n = 866)

Variables	1	2	3	4	5	6	7	8	9	10
1. Childhood trauma	1.00									
2. Physical neglect	0.71**	1.00								
3. Emotional neglect	0.83**	0.49**	1.00							
4. Physical abuse	0.55**	0.26**	0.32**	1.00						
5. Emotional abuse	0.65**	0.32**	0.38**	0.51**	1.00					
6. Sexual abuse	0.45**	0.25**	0.24**	0.44**	0.36**	1.00				
PSH state										
7. Emotional problems	0.41**	0.29**	0.23**	0.24**	0.47**	0.19**	1.00			
8. Behavioral problems	0.40**	0.30**	0.22**	0.25**	0.49**	0.21**	0.83**	1.00		
9. Social adaptation problems	0.40**	0.30**	0.22**	0.27**	0.45**	0.22**	0.82**	0.77**	1.00	
10. Internet addiction	0.36**	0.27**	0.21**	0.22**	0.38**	0.22**	0.50**	0.52**	0.56**	1.00

PSH: psychological sub-health **p < 0.01.

3.4 Risk Factors of PSH State

Risk factors for adolescent PSH state were analyzed by binary logistic regression (Table 4), NSSI (OR = 4.03, CI = 2.82 ~ 5.76, P < 0. 01), childhood trauma (OR = 1.95, CI = 1.32 ~ 2.89, P < 0. 01) and IA (OR = 5.20, CI = 3.55 ~ 7.60, P < 0. 01) are the risk factors of PSH. Specifically, the PSH of adolescents with NSSI was 4.03 times higher than that of adolescents without NSSI, and participants with childhood trauma were 1.95 times higher than those without childhood trauma. The incidence of PSH with IA is 5.20 times higher than that of adolescents without IA.

Table 4
Risk factors for psychological sub-health (n = 866).

	B	SE	Wals	*P*	OR	95%CI	
						Lower	Upper
Left behind	0.31	0.19	2.69	0.10	1.36	0.94	1.97
Accommodation	0.03	0.22	0.02	0.89	1.03	0.68	1.57
NSSI	1.39	0.18	58.30	**<0.01**	4.03	2.82	5.76
Childhood trauma	0.67	0.20	11.26	**<0.01**	1.95	1.32	2.89
Internet addiction	1.65	0.19	71.86	**<0.01**	5.20	3.55	7.60
Constant	-2.76	0.21	179.17	<0.01	0.06		
SE, standard error; OR, odds ratio; CI: confidence interval; NSSI: Non-suicidal self-injury							

3.5 The Mediating Effect of Internet Addiction

According to the hypothesis of this study, the latent variable SEM is constructed using AMOS24.0(Fig. 1). The independent, mediating and dependent variables of the structural equation are childhood trauma, IA and PSH in this SEM. Due to the poor fitting degree of the directly used model, a MI modification method was used in this study. The modified results show that the fitting condition of the model is good (CMIIN/DF = 1.139, GFI = 0.998, TLI = 0.999, CFI = 1.00, RMSEA = 0.013) and is acceptable.

As in Table 5, the model results showed that the path from childhood trauma to PSH (β=0.22, t=6.96, p<0.001;95%CI [0.17,0.30]); From Childhood trauma to IA (β=0.17, t=5.20, p<0.001;95%CI [0.11□0.23]) □ From IA to the PSH state of adolescent□β=0.43, t=12.74, p<0.001;95%CI [0.36,0.50] □□these three paths were significant at P < 0.001 level.

Table 5
The path inspection

Path inspection	Non-standardized coefficient	Standardization coefficient	S.E.	C.R.	*P*
Childhood trauma→IA	0.15	0.17	0.03	5.19	***
IA→PSH	15.36	0.43	1.21	12.74	***
Childhood trauma→PSH	6.89	0.22	0.99	6.96	***

SE: standard error .C.R: Divide the regression weight estimate by the estimate of its standard error. ***p < 0.001.IA: Internet addiction. PSH: Psychological Sub-Health

In this study, the Bootstrap method (sampling 2000 times at the 95% confidence interval) was used to test the mediating role of IA. The results are as follows (Table 6): The deviation confidence intervals of mediating effect of IA and direct effect are (1.42-3.32) and (4.91-9.00), respectively, which do not include 0, so the mediating effect of IA and direct effect are significant. And the proportion of them is 24.86% and 75.14% respectively. Thus, IA plays a partial mediating effect in the relationship between childhood trauma and PSH.

Table 6
Analysis of mediating of internet addiction, direct effect and total effect

	Effect value(Standardization)	SE	Bias-corrected 95%CI		*P*	Ratio of effect
			Lower	Upper		
Mediating effect of IA	0.07	0.47	1.42	3.32	**0.001**	24.86
Direct effect	0.23	1.03	4.91	9.00	**0.001**	75.14
Total effect	0.30	1.10	6.99	11.28	**0.001**	

SE: standard error. Independent variables, dependent variables and mediating variables are childhood trauma, psychological sub-health and Internet addiction, respectively. IA: Internet addiction.

4. Discussion

There was a Chinese study that suggested that the COVID-19 pandemic has a significant influence on the PH of children and adolescents [32] . This study, still in the COVID-19 phase, showed the PSH prevalence of 25.8%, which as predicted was significantly higher than the before. Our survey results show that left-behind children, boarding students and adolescents with NSSI are more likely to be in the PSH state. Further findings highlight that childhood trauma and IA increased the risk of PSH by 1.95 and 5.20 times.

And SEM also verified the initial hypothesis that childhood trauma directly or indirectly has a positive predictive effect on PSH through IA. In other words, IA plays a partial mediating effect in the relationship between childhood trauma and PSH.

Left-behind children refer to children aged 0 to 18 who cannot live with their parents and can only remain in the place of residence, because one or both parents have moved to other places for various reasons [33]. Compared with ordinary children, left-behind children are more introverted, withdrawn and quiet, do not readily show their inner thoughts and feelings, are more indifferent and depressed, have an indifferent attitude towards things, and show less interest and concern for things [34] . These children are prone to a series of psychological and behavioral problems [35-37]. Our study also found that left-behind children were more likely to be in the state of PSH than children with parents around them. A previous study in China has shown that the prevalence of widespread psychological problems of junior middle school students in boarding schools was higher than that in non-boarding schools [38] . A survey of American Indian adolescent boarders showed significantly higher suicide rates among boarders than non-boarders [39] . According to the investigation, boarding schools do not pay enough attention to PH work. The reason may be that a whole set of the operating systems for PH education has not been formed, the allocation of teachers for PH education is not enough, and the development of PH education is not perfect, so it is necessary to strengthen PH education in boarding schools.

NSSI refers to intentional self-destruction of body tissue for purposes not approved by society, including cutting, burning, biting and scratching the skin, without suicidal intention [40]. The worldwide prevalence of adolescent NSSI is about 17.2% [41], compared with 23.2% in China [42]. The prevalence of NSSI was 35.6%in this study, which was significantly higher than previous studies. Some researchers have shown a relationship between NSSI and PSH. This study also inversely verified that NSSI behavior was a predictor and risk factor of adolescent PSH. Parents or schools are called on to speculate on the more hidden PH problems of adolescents, through abnormal behaviors that are easy to be detected, and to provide psychological assistance to avoid worse things from happening.

We investigated the participants' childhood trauma, which refers to a chronic form of parental abuse and, or neglect, different from the acute trauma that may occur in childhood related to post-traumatic stress disorder (PTSD, e.g., traumatic accident, single attack, etc.) [43]. Numerous studies have shown that emotional, physical and sexual abuse are associated with high rates of PH problems. The results of the study showed that the majority (57.5%) of participants had at least one type of childhood trauma, which significantly increases the risk of PSH in adolescents. This is consistent with previous studies. Many previous studies have shown that gene expression, abnormal epigenetic changes, abnormal brain structure and function, and dysfunction of the hypothalamic-pituitary-adrenal (HPA) axis may be the essential biological basis for the relationship between childhood trauma and physical and PH problems in later life [44, 45]. Recently, the study of inflammatory factors has also received great attention. Related studies have found that abnormal levels of inflammatory cytokines (TNF-α, IL-6 and acute C-reactive protein) and telomere length may be critical biological indicators of physical and psychological health problems in individuals with childhood trauma [46-49]. From a long-term point of view, childhood trauma

not only increases the incidence of PSH in adolescents, but more seriously, many (but not all) childhood traumas are also associated with many types of mental disorders in the course of life, mainly primary mental disorders. They will continue into adulthood [50].

In this study, IA was used as an innovative point to explore the relationship between childhood trauma and adolescents' PSH state. IA is the excessive and morbid use of the Internet, which will not only lead to a decline in performance, but also lead to a decline in depression, anxiety and PH problems. Especially, with the emergence and increase of online courses, adolescents have more access to the Internet and spend more time on it because of online home-based courses, which may also be one of the reasons for the increase in the prevalence of IA among adolescents. This is also a concern for many parents. In psychiatric clinics, many parents come to consult because their children are addicted to the Internet. In this study, we conducted an IA survey on the participants and found that one in five participants had IA, which greatly increased the risk of PSH. In addition, SEM confirms that childhood trauma has a direct effect on PSH and can also lead to PSH indirectly by IA. Due to IA, sufficient time spent on other personal and social activities will be reduced, including less time spent with friends or family. The problem may develop into more PH problems such as loneliness and depression [51, 52]. However, many longitudinal studies have shown a two-way relationship between IA and PH in adolescents, and either can be a cause or a result of the other. Creating a vicious circle. This study was cross-sectional, making it difficult to determine causality, so the longitudinal survey calculating the incidence rate has more excellent academic value [53]. Many studies have confirmed that childhood trauma is associated with substance addiction and gambling. However, there are few studies on its relationship with IA. In a Turkish study on the risk and severity of IA in college students, emotional abuse appeared to be a major predictor of increased risk of IA among childhood trauma types [54]. Physical abuse has been considered a possible risk factor for IA in Chinese students [55]. The above reminds us that it is also important to assess other types of traumas in adolescents when considering IA.

This study is the first to try to explore the mediating effect of IA between childhood trauma and PSH. But the current research results are also limited by methodological factors. First, the study used a cross-sectional design, so the causal relationship is uncertain. To determine the causal relationship, a prospective study on the sequential assessment of IA and PSH will be meaningful. Secondly, our study sample only included adolescents from two cities in Anhui province, so the results may not be well generalizable to the whole of China or other countries. Thirdly, although the sample size was 866, it was not large enough. Finally, given that all variables are assessed subjectively, participants may exaggerate or weaken impressions and assessments of exposure to childhood trauma.

5. Conclusion

Based on previous studies, this study further explored the direct influence of childhood trauma and IA on PSH of adolescents, and explored the mediating role of IA between childhood trauma and PSH. In addition, left-behind children and boarding students, especially adolescents who have had NSSI, should receive more attention from parents, schools, society and clinicians. As childhood trauma is difficult to

cure, but it can be prevented. Since IA plays a role in the relationship between childhood trauma and PSH, and the prevalence of IA is gradually increasing. And to some extent, it can also protect the PH of adolescents and avoid worse things by preventing the occurrence of IA. In general, this study not only further studied the etiology of PSH, but also provided new ideas for the risk assessment and treatment in clinical.

Abbreviations

PSH: psychological sub-health

IA: Internet addiction

CTQ: Childhood Trauma Questionnaire

IAT: Young's Internet Addiction Test

MSQA: Multidimensional Sub-health Questionnaire of Adolescent

SEM: structural equation model

NSSI: non-suicidal self-injury

PH: psychological health

Declarations

Ethics approval and consent to participate: The studies involving human participants were reviewed and approved by the Medical Ethics Committee of Chaohu Hospital of Anhui Medical University (2019-kyxm-012). All research procedures were strictly in line with the principles of the Helsinki Declaration. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Consent for publication: Not Applicable.

Availability of data and materials: As this study is still ongoing, the raw datasets for the current study will not be available until the end of this research project. The data used for this study are available from the corresponding author on reasonable request.

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Figures

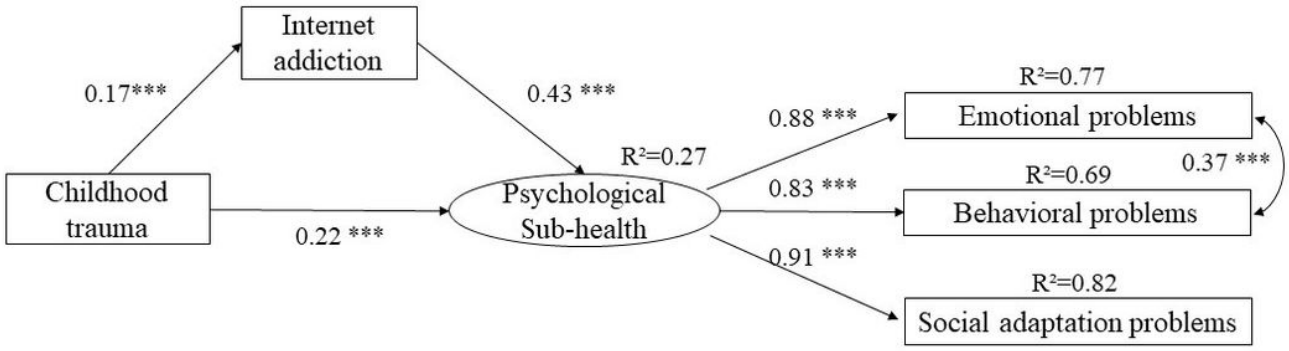

Figure 1

Structural equation model(standardization)

The numbers next to the arrows represent normalized path coefficients. R squared stands for multiple correlations squared. Probability level = 0.322; R^2 stands for multiple correlations. Probability level = 0.322; goodness-of-fit indices: CMIN/DF = 1.139; GFI = 0.998; AGFI = 0.992; NFI = 0.998; RFI = 0.995; IFI = 1.00; TLI = 0.999; CFI= 1.00; RMSEA =0.013. ***$p < 0.001$.