Addictive-Like Behaviors Increase The Risk of Suicide Behaviors in Chinese Middle School Students: A Latent Class Analysis

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Abstract

Background

In adolescents, multiple addictive-like behaviors (ALBs) occur frequently together which are likely to be associated with suicide behaviors (SBs), increasing the risk of suicide. This study aimed to clarify the potential subgroups of ALBs in Chinese adolescents, and examine the associations between different patterns of ALBs and SBs.

Methods

A total of 22,628 middle school students were enrolled in this study. Self-reported ALBs and SBs were investigated by questionnaires. Latent class analysis (LCA) was performed based on five ALBs [smoking, alcohol use (AU), diet pills use (DPU), screen time (ST), problematic mobile phone use (PMPU)]. Multivariate logistic regressions were used to examine the associations between the different patterns of ALBs and SBs.

Results

Four subgroups of ALBs were identified by LCA, including high-risk class (smoking/AU/DPU/PMPU/ST), moderate-risk class 1 (DPU/PMPU), moderate risk class 2 (smoking/AU/ST), and low-risk class. Compared with the low-risk class, all of the moderate-risk class 1, moderate-risk class 2 and high-risk class had higher risks of suicide ideation, suicide plan, and suicide attempt.

Conclusions

These findings suggested that the patterns of ALBs were related to SBs in Chinese adolescents. Accordingly, considerations of different classes of ALBs may be essential for developing effective preventive programs.

1. Introduction

Suicide behaviors (SBs) are the second leading cause of death of adolescents, and the major public health problem in China and around the world, which include suicide ideation, suicide plans, and suicide attempt [1]. In Chinese middle school students, the rate of suicide ideation, suicide plan, and suicide attempt were 20.8%, 7.69%, and 6.3%, respectively [2, 3]. A Canadian study showed the rate was 10.8% for suicide ideation and 3.0% for suicide attempt in adolescents [4]. In addition, 17% American teens had considered suicide, 14% have made suicide plan and 8% had attempted suicide, according to the Centers for Disease Control and Prevention [5]. SBs are significantly associated with completed suicide, depression, schizophrenia and, so on [6]. Adolescence is very vulnerable mostly because of their

immature brain, limbic system, and prefrontal cortex, therefore, there is a great possibility for them to be influenced by the environment [7, 8]. Therefore, they may be lacking the ability to judge their harmful behaviors properly, and get in trouble with some harmful behaviors such as mental health disorders and psychiatric disorders, and then SBs.

Addictive disorders include substance-use disorders (e.g., drug, alcohol, tobacco addiction, etc.), and behavioral disorders (e.g., game, internet, mobile phone addiction, etc.) with the characteristics of (1) long time and large amounts; (2) can't quit or cut down and impaired control; (3) craving and strong desire; and (4) continued [9, 10]. It has been known that mental health problems, nicotine, and alcohol could influence the brain maturation and development of adolescents [7], and substance-use disorders were associated with juvenile delinquency and suicide [11]. In recent studies, it has been cleared that mental health problems and smoking are strongly associated with SBs [12–14]. Alcohol drinking that is usually related to smoking [14, 15] was also reported to associate with SBs [16]. Adolescents are likely to misperceive their status of weight, especially, girls perceive themselves as overweight even though their weights are normal [17]. Diet pills using is one of the unhealthy ways for people to lose their weight. It has been reported that among American young adults, 10% of men and 17% of women use weight-lose products for losing weight [18]. Being obsessed with losing weight by using diet pills, may eventually cause depression, psychiatric disorders, and suicide [19, 20]. In addition, non-substance addictive behaviors, such as long-time use of cell phones and media, are reported to be correlated with mental health problems, psychiatric disorders, and thought of suicide, probably due to the increase of sleep problems [21–24].

These findings suggest that the associations between addictive behaviors with SBs which are important and interesting, need to be further clarified. Under this circumstance, in this study, we focused on the addictive behaviors of smoking, alcohol use (AU), diet pills use (DPU), problematic mobile phone use (PMPU), and screen time (ST), and examined their potential relationship with SBs. Noteworthy, in this study, we adopted the method of self-report but not clinical diagnosis, we thus named these behaviors as addictive-like behaviors (ALBs) to differentiate from standard addictive behaviors. However, it should be noted that ALBs usually do not occur separately, but tends to occur simultaneously [25]. In recent years, a few researchers have begun to identify the distinct classes of ALBs [26] by latent class analysis (LCA). McFeeters et al. examined the subclasses of stressful life events related to suicide [27], and Bernanke et al. identified the relationship between mental health problems and SBs [28]. However, there are few studies directly paying attention to the associations between addictive behaviors and SBs based on LCA. So, it is important to consider multiple factors/behaviors and their interactions for the prevention of suicide in adolescents.

In this context, by using exploratory LCA, in this study we identified the potential classes of ALBs based on a large population of Chinese adolescents, and examined the associations between the classes of ALBs and SBs. This study may provide a new thought for suicide prevention and improve adolescents' mental health.

2. Methods

2.1. Data and Participants

This study used information from a large cross-sectional survey in China, which was approved by the Ethics Committee of Anhui Medical University (approval number 20140087). The data were collected from November 2015 to January 2016. In this study, 23,137 adolescents (Aged 12 to 19 years) were enrolled from junior school and senior high school, located in six cities of China, including both urban and rural regions, by using multistage stratified cluster sampling. Six cities were selected by convenient sampling, including Shenyang (capital of Liaoning Province), Bengbu (Northeastern of Anhui province), Yangjiang (Southwest coast of Guangdong Province), Chongqing (one of China's four direct-controlled municipalities), Ulanqab (Central Inner Mongolia Autonomous Region) and Xinxiang (North of Henan Province). Then, eight schools (two rural junior and two senior high schools, two urban junior and two senior high schools) were selected in each region based on the stratified cluster sampling. Lastly, four to six classes were randomly selected from each grade (grades seven to twelve) in each school, all students from the selected classes were invited to the study, excluding participants who have a history of psychiatric disorders or are being treated with psychiatric medication (Participants with psychiatric disorders were primarily self-reported or reported by parents).

According to the principle of informed consent, the research staff explained the aim and process of the study to the students participating in the survey, and students were allowed to choose to participate or not. Students are required to complete the questionnaires during class time in about 20–30 minutes. The questionnaires were completed anonymously with unified instructions. A research staff was responsible for the quality control of the questionnaires to answer the questions from the recipients and for collecting and proofreading the questionnaire. Excluding the incomplete questionnaires (with more than 5% missing data), 22,628 valid questionnaires were received with an effective recovery rate of 97.8%. The mean age of the participants in this study was 15.36 ($SD = 1.79$) years. Of the 22,628 participants, 10,990 students were male (48.6%) and 11,638 were female (51.4%).

2.2. Measures

Socio-demographic variables included sex, grade, place of residence, having any siblings, residing in school or commuting to school, parental educational level, self-reported family economy, and the number of friends.

Concerning SBs, according to the youth risk behavior surveillance system (YRBSS), the suicide ideation related question is "In the past 12 months, how many times have you ever think about killing yourself?"; the suicide plan related question is "how many times have you ever made some plan for killing yourself?"; and the suicide attempt related question is "In the past 12 months, how many times have you ever put any behaviors about killing yourself?". The answer was coded as a dichotomous variable (yes/no) [29].

The definition of smoking and AU were based on YRBSS from the Centers for Disease Control and Prevention [30]. Regarding current smoking status, the item is “How many days did you smoked in the last month?” with the options of “0” as 0 days, “1” as 1 to 9 days, “2” as 10 to 19 days, and “3” as 20 to 30 days. And about current AU status, the item is “How many days in the last month have you had at least one class of alcohol?” with the options of “0” as 0 days, “1” as 1 to 9 days, “2” as 10 to 19 days, and “3” as 20 to 30 days. For these two items, choose 0 as no and other options as yes [30]. DPU was measured with the item “Do you use diet pills or tea to lose their weight in the last month?”, with “1” indicating none, “2” indicating only once, “3” indicating twice to three times, and “4” indicating more than four times. Participants not answering “none” were judged as they have DPU [31]. The validity of these items was demonstrated in previous studies [29].

PMPU was assessed via the Self-rating Questionnaire for Adolescent Problematic Mobile Phone Use (SQAPMPU), the standardized questionnaire for PMPU in adolescents [32]. It consists of 13 items that respond to a 5-point Likert scale (never, occasionally, sometimes, often, and always). Based on the prior literature, SQAPMPU global scores ≥ 28 were judged as PMPU [16, 33, 34]. In this study, the Cronbach’s alpha coefficient was 0.923.

ST was assessed by the answers to the following questions, “On school days, how long about do you spend time on playing games or using the computer or smartphone to do something unrelated to your studies every day? (i.e. game console, TV show, computer, etc.)”. And too long ST was defined as ST > 2 h/day according to the standard of the American Academy of Pediatrics and previous studies (American Academy of Pediatrics, 2001) [35].

2.3. Statistical analysis

Latent classes of ALBs were identified by LCA (Mplus version 7.4). In this study, we valued latent class models from one to five latent classes to ensure the most suitable number of latent classes. It is shown in previous work that Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) criteria are the primary indices to select latent class model [36], but BIC is a more reliable indicator for the model with fewer parameters or with a large sample size more than one thousand. Accordingly, adjusted BIC (aBIC) via sample size calculation was used in this study to determine the number of latent classes [33]. The best suitable model is that both BIC and aBIC showed the lowest value [37]. In addition, LMR-LRT (Lo-Mendell-Rubin Likelihood Ratio Test) and BLRT (Bootstrapped Likelihood Ratio Test) were also used in this study, which are useful tools for class enumeration, indicating the model of k -classes is better than the model of $k-1$ classes when there are statistical significance ($P < 0.05$) [33, 37].

In addition, IBM SPSS version 23.0 for Windows was used for Chi-square analysis and logistic regression analysis. Chi-square tests were used to compare the prevalence of SBs among different demographic variables. Multiple logistic regression analysis was used to ensure the relationships between ALBs and SBs. And this analysis was adjusted by socio-demographic characteristics. $P < 0.05$ was set as the statistical significance.

3. Results

3.1. Descriptive characteristics of the samples

The prevalence of suicide ideation, suicide plan and suicide attempt were 14.1% (3,195), 7.3% (1,660) and 4.4% (1,000), respectively. Table 1 presented the occurrence of SBs by frequency socio-demographic characteristics. In this study, for all of the three SBs the higher rate was found in students of junior school, urban students, non-resident students, higher father's educational level, low self-reported family economy, and fewer friends than the correspondence groups ($P < 0.05$ for each). In addition, a higher rate of suicide ideation was found in the female and only child. And for suicide plan, the higher rate was in only child and higher mother's educational level ($P < 0.05$ for each) (Table 1).

Table 1
Descriptive socio-demographic characteristics of the sample in the study, n(%)

Variable	Total sample	Suicide ideation	Suicide plan	Suicide attempt
Sex				
Male	10990 (48.6)	1430(13.0)	826(7.5)	512(4.7)
Female	11638(51.4)	1765(15.2)	834(7.2)	488(4.2)
χ^2		21.63 ^{***}	1.02	2.90
Grade				
Junior school	11993(53.0)	1809(15.1)	963(8.0)	586(4.9)
Senior high school	10635(47.0)	1386(13.0)	697(6.6)	414(3.9)
χ^2		19.56 ^{***}	18.06 ^{***}	13.17 ^{***}
Place of residence				
Rural	10882(48.1)	1460(13.4)	758(7.0)	449(4.1)
Urban	11746(51.9)	1735(14.8)	902(7.7)	551(4.7)
χ^2		8.54 ^{**}	4.23 [*]	4.27 [*]
Having any siblings				
No	9720(43.0)	1458(15.0)	772(7.9)	448(4.6)
Yes	12908(57.0)	1737(13.5)	888(6.9)	552(4.3)
χ^2		10.89 ^{**}	9.22 ^{**}	1.45
Resident students				
Yes	11320(50.0)	1525(13.5)	758(6.7)	414(3.7)
No	11308(50.0)	1670(14.8)	902(8.0)	586(5.2)
χ^2		7.84 ^{**}	13.65 ^{***}	31.14 ^{***}
Father's educational level ^a				
< High school degree	13006(57.5)	1708(13.1)	860(6.6)	525(4.0)
≥ High school degree	9424(41.6)	1427(15.1)	762(8.1)	449(4.8)
χ^2		18.36 ^{***}	12.64 ^{***}	6.97 ^{**}

Note. ^a198 students have no information about their father. ^b188 students have no information about their mother; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Variable	Total sample	Suicide ideation	Suicide plan	Suicide attempt
Mother's educational level ^b				
< High school degree	14335(63.4)	1938(13.5)	973(6.8)	606(4.2)
≥ High school degree	8105(35.8)	1207(14.9)	654(8.1)	375(4.6)
χ^2		8.10	12.64***	1.96
Self-reported family economy				
Bad	3240(14.3)	622(19.2)	347(10.7)	196(6.1)
General	16345(72.2)	2090(12.8)	1035(6.3)	623(3.8)
Good	3043(13.4)	483(15.8)	278(9.1)	181(6.0)
χ^2		100.55***	92.98***	51.51***
Number of close friends				
≤2	5514(24.4)	1017(18.4)	560(10.2)	324(5.9)
3 ~ 5	9620(42.5)	1225(12.7)	580(6.0)	345(3.6)
≥6	7494(33.1)	953(12.7)	520(6.9)	331(4.4)
χ^2		112.43***	90.41***	43.50***
Note. ^a 198 students have no information about their father. ^b 188 students have no information about their mother; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.				

3.2. Identification of latent class

The rates of smoking, AU, DPU, and ST were found in a total of 2.8% (635), 16.8% (3799), 4.8% (1,086), and 16.3% (3,690) among Chinese adolescents, respectively. According to LCA, the patterns of ALBs were identified. As shown in Table 2, the five-class model didn't report the best log-likelihood value and the P value of LMR-LRT and BLRT both were not statistically significant, it was thus not considered further. Both BIC (77654.647) and aBIC (77581.554) were found the lowest in the four-class model, which LMR-LRT and BLRT were statistically significant ($P < 0.001$). Although, P value of the LMR-LRT and BLRT test was also significant for 2-class and 3-class models, the 4-class model showed the lowest AIC, BIC, and aBIC values. These findings indicated the better fitness of this 4-class model than other models in the present study. Accordingly, we utilized the 4-class model and thus identified four latent classes (Table 2).

Table 2
Model fit statistics for each of the fitted latent class analysis models.

Statistic	<i>df</i>	AIC	BIC	aBIC	LMR-LRT	BLRT	Entropy
2 Classes	11	77820.87	77909.17	77874.21	< 0.0001	< 0.0001	0.581
3 Classes	17	77531.15	77667.6	77613.58	< 0.0001	< 0.0001	0.78
4 Classes	23	77470.03	77654.65	77581.55	< 0.0001	< 0.0001	0.728
5 Classes	29	77473.07	77705.85	77613.69	0.0822	0.1935	0.717
Note. <i>df</i> : degrees of freedom; AIC: Akaike Information Criteria; BIC: Bayesian Information Criteria; LMR-LRT: Lo-Mendell-Rubin Likelihood Ratio Test; BLRT: Bootstrapped Likelihood Ratio Tests.							

As shown in Fig. 1, latent class 1 was recognized as the low-risk class, which was composed of 16113 (71.2%) of the samples. In this group, the participants reported the lowest rate of all the four ALBs, and none of them reported PMPU (0%). In contrast, latent class 4 was the high-risk class which included 3.3% (747) of the samples. The majority of the students in this class reported smoking (28.8%), AU (88.6%), DPU (30.1%), ST (69.6%), and all of them were engaged in PMPU (100%). The other two latent classes were called moderate-risk class 1 and moderate-risk class 2, which contained 22.3% (5,055) and 3.2% (713) of the samples, respectively. Moderate-risk class 1 (latent class 2) showed high reporting rates on DPU (9.1%) compared to moderate-risk class 2 and PMPU (79.1%) which was thus defined as “DPU and PMPU” class; on the contrary, moderate-risk class 2 (latent class 3) showed high reporting rates on smoking (20.9%), AU (71.6%) and ST (44.5%) which was thus defined as “smoking, AU and ST” class (Fig. 1).

3.3. Multiple logistic regression analysis

Table 3 showed the associations between the latent class of ALBs and SBs. After adjusting for significantly different socio-demographic characteristics, compared with the low-risk class, all other groups were seen to be positively related to SBs. Concerning suicide ideation the adjusted *OR* (95% *CI*) was 3.30 (3.03–3.59), 2.35 (1.91–2.88), and 6.08 (5.16–7.16) for moderate-risk class 1, moderate-risk class 2, and high-risk class, respectively. Compared with the low-risk class, the results of suicide plan suggested the values of *OR* (95% *CI*) of moderate-risk class 1, moderate-risk class 2 and high-risk class were 3.20 (2.49–4.11), 3.92 (3.50–4.39), and 7.96 (6.58–9.61), respectively. Moreover, compared with low-risk class, the others classes had higher risks of suicide attempt ($OR_{\text{high-risk class}} = 12.36$, 95 % *CI*: 9.95–15.35; $OR_{\text{moderate-risk class 1}} = 5.59$, 95 % *CI*: 4.81–6.49; $OR_{\text{moderate-risk class 2}} = 4.17$, 95 % *CI*: 3.07–5.66) (Table 3).

Table 3
Associations of suicide behaviors and latent class of ALBs in Chinese adolescents

Latent class of ALBs	Suicide ideation		Suicide plan		Suicide attempt	
	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)	n (%)	Adjusted OR (95% CI)
High-risk class (smoking /AU/DPU/PMPU/ST)	285 (38.2)	6.08 (5.16 ~ 7.16)***	197(26.4)	7.96 (6.58–9.61)***	153 (20.5)	12.36 (9.95 ~ 15.35)***
Moderate-risk class 1 (DPU /PMPU)	1280 (25.3)	3.30 (3.03 ~ 3.59)***	725(14.3)	3.92 (3.50–4.39)***	487 (9.6)	5.59 (4.81 ~ 6.49)***
Moderate-risk class 2 (smoking/AU/ST)	126 (17.7)	2.35 (1.91 ~ 2.88)***	82(11.5)	3.20 (2.49–4.11)***	54 (7.6)	4.17 (3.07 ~ 5.66)***
Low-risk class	1504 (9.3)	Ref.	656(4.1)	Ref	306 (1.9)	Ref.
Note. OR: odds ratio; CI: confidence interval; Adjusted OR: adjusted for sex, grade, place of residence, having any siblings, resident student, educational level of father and mother, self-reported family economy, and number of friends; *** $P < 0.001$ compared with reference.						

4. Discussion

In this study, we found SBs are a common phenomenon in adolescents in China. Moreover, we found female students showed more suicide ideation (15.17%) than males (13.01%), which is consistent with other reports [4, 38–40]. Usually, females are more prone to have suicide ideation because of their predisposition to depression [40]. Meanwhile, a previous study showed that females had a higher risk of suicide attempt, mostly due to socioeconomic, mental disorders, school, and violence [41]. However, in this study, there was no apparent difference between suicide plan and suicide attempt between males and females, further investigations are needed to clarify this issue. Furthermore, in this study, we found that SBs were more in students of junior students, only child, urban students, non-resident students, higher parents' educational level, low self-reported family economy and fewer friends than the correspondence groups. And this result is partly consistent with previous studies [42, 43].

In the present study, we focused on the different patterns of ALBs, and examined the associations between latent classes of ALBs and SBs in a large Chinese sample. This modeling helps to link a broad range of factors including smoking, AU, DPU, PMPU, and ST behaviors. In this study, we identified four potential classes of ALBs, which is different from previous research examining multiple addictive behaviors among community participants [26], possibly because the types of ALBs are not completely

consistent and the age range or country of the participants are different. Intriguingly, ALBs appeared to show two different clustering patterns in the moderate-risk classes. The moderate-risk class 1 (DPU/PMPU) had high rates of DPU and PMPU. Though previous studies did not show the relationship between DPU and PMPU directly, both unhealthy weight control behaviors (including DPU) and PMPU were reported to be related to adolescent mental health including suicide behaviors [44–46]. Usually, mobile phone use is related to screen media use, but in this study, ST wasn't clustered with PMPU, which may need further investigations to elucidate. In moderate-risk class 2 (smoking/AU/ST), students reported higher rates of smoking, AU, and ST. It is commonly known smoking and AU usually co-exist, which collaboratively influence the health of adolescents [40, 47]. And the present study showed that adolescents who prefer smoking and AU are also more likely to have ST for a long time, which is consistent with previous studies [48]. Our results showed that the proportion of the high-risk class (smoking/AU/DPU/PMPU/ST) was only 3.3%. However, given China's population base, it is necessary to identify and intervene in high-risk class (smoking/AU/DPU/PMPU/ST).

Our study further showed that students who engaged in more ALBs always exhibited a higher risk of SBs. Relative to the low-risk class, all three subclasses (the high-risk class, moderate-risk class 1, and moderate-risk class 2) tend to have higher rates of SBs. It implied that certain ALBs usually occurred simultaneously, concurrently, and mutually affecting SBs, and adolescents exposed to similar conditions may show different outcomes because of the heterogeneity of ALBs. Therefore, different strategies should be developed by targeting different groups of adolescents, to prevent and control the ALBs and SBs. For the general population, such as the students of the low-risk class, series of courses about physical activity and health education to improve their health literacy maybe are effective [33, 49]. Nevertheless, for the high-risk population, mindfulness-based intervention may be the good and necessary way [50–52]. Furthermore, the sense of weight control for adolescents was explained by Social Cognitive Theory that they imitate behaviors from role models, and under this condition, cognitive behavioral therapy may be useful to prevent from unhealthy losing weight by diet pills use [53–54]. In addition, physical activity is a significant way to reduce problematic smartphone use among adolescents [55]. So that for the moderate-risk class 1, cognitive behavioral therapy with physical activity may be an appropriate way. Moreover, adolescents usually receive cigarettes and alcohol firstly from their friends, therefore group therapy, namely, peer education and developing adolescents' skills to say “no”, will be an effective preventive strategy, [56]. Moreover, a previous study indicated that autonomous motivation acted as a significant mediator of changes in ST [57]. Taken together, it may be an effective intervention for moderate-risk class 2 to use group therapy by using peer education and autonomous motivation.

In this study, we used a relatively large sample size, which will better reflect the situation in the whole population. Furthermore, variables of ALBs used in this study covered not only substance use behaviors, but also non-substance use behaviors. More important we utilized the method of LCA to illustrate the association between ALBs and SBs, which will provide more reasonable and useful information for further establishing prevention programs, than single-factor analysis. All these will increase the reliability and applicability of this study. However, there are also some limitations in the present study. Firstly, we used self-reported data, which recall and reporting bias might be inevitable; meanwhile, a cross-sectional

design could not imply causality. Moreover, not all kinds of ALBs were included in this study, and we focused on only one aspect of each behavior. In addition, as regards suicide, the psychological factor may play an important role, which was not included in this study. Further studies and considerations are thus warranted to overcome these barriers.

5. Conclusion

Taken together, similar to many previous studies, we reported here that SBs has a high prevalence rate among adolescents. By focusing on ALBs, we, through LCA analysis, found that ALBs do not act independently in SBs, but act synergistically, which may be related to the interrelated characteristics of ALBs. Namely, if we want to prevent SBs simply by changing a certain kind of ALBs, the result may be unsatisfactory. Therefore, compared with the intervention of some ALBs alone, more benefits can be obtained through the intervention of multiple ALBs in a specific group (high-risk class, moderate-risk class 1 and moderate-risk class 2). Many studies indicated that improvement of mindfulness-based intervention, group therapy, and physical activity can effectively intervene adolescents in risky addictive behaviors. We thus anticipated that SBs of adolescents could be prevented effectively by identifying groups with ALBs, and then developing effective methods targeting these groups of ALBs.

Abbreviations

ALBs	Addictive-like behaviors
SBs	Suicide behaviors
AU	Alcohol use
ST	Screen time
PMPU	Problematic mobile phone use
DPU	Diet pills use
LCA	Latent class analysis
AIC	Akaike Information Criteria
BIC	Bayesian Information Criteria
LMR-LRT	Lo-Mendell-Rubin Likelihood Ratio Test)
BLRT	Bootstrapped Likelihood Ratio Test
<i>df</i>	degrees of freedom
<i>OR</i>	odds ratio
<i>CI</i>	confidence interval

Declarations

Ethics approval and consent to participate

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of Anhui Medical University (approval number 20140087). Approvals from schools, parents and students were obtained before carrying out this survey. Signed informed consent was requested to each participating school, and the students were allowed to participate in the study upon receiving completed written consent form from their parents.

Consent for publication

Not applicable.

Availability of data and materials

The data presented in this study are available on request from the corresponding author.

Competing interests

The authors declare no conflict of interest.

Authors' contributions

Research design and obtained funding: SCZ and JF. Conducted the analysis and interpretation of data: CYG, YYC, ZMX, JH, YNX and XXH. Subjects' recruitment and data collection: SCZ, YHW, XBS, BZ and XQW. Writing—original draft preparation: CYG and XQW. Writing—review and editing: SCZ and JF. All authors read and approved the final manuscript.

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Figures

Figure 1

Four classes of addictive-like behaviors (ALBs) of the best-fitting four-class pattern