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Association of Unhealthy Behaviors with Self-Harm in Chinese Adolescents: A Study Using Latent Class Analysis

Rong Yang [1,2,3,4,†], Danlin Li [1,2,3,5,†], Run Tian [6], Jie Hu [1,2,3], Yanni Xue [1,2,3], Xuexue Huang [1,2,3], Yuhui Wan [1,2,3], Jun Fang [1,2,3,7,8,*] and Shichen Zhang [1,2,3,*]

1 Department of Maternal, Child and Adolescent Health, School of Public Health, Anhui Medical University, Hefei 230032, China; yangrong_work@163.com (R.Y.); 15378228735@163.com (D.L.); hujie@stu.ahmu.edu.cn (J.H.); x1365569xue@163.com (Y.X.); h17856922873@163.com (X.H.); wyhayd@163.com (Y.W.)
2 MOE Key Laboratory of Population Health Across Life Cycle, Hefei 230032, China
3 Anhui Provincial Key Laboratory of Population Health and Aristogenics, Hefei 230032, China
4 Department of Epidemiology, School of Public Health, Cheeloo College of Medicine, Shandong University, Jinan 250012, China
5 School of Public Health, Medical College of Soochow University, Suzhou 215123, China
6 Department of Occupational and Environmental Health, School of public health, Guilin Medical University, Guilin 541199, China; tianrun@stu.glmc.edu.cn
7 Department of Toxicology, School of Public Health, Anhui Medical University, Hefei 230032, China
8 Faculty of Pharmaceutical Science, Sojo University, Ikeda 4-22-1, Kumamoto 860-0082, Japan
* Correspondence: fangjun@ph.sojo-u.ac.jp (J.F.); zhangshichen@ahmu.edu.cn (S.Z.); Tel.: +81-96-326-4137 (J.F.); +86-551-65161169 (S.Z.)
† These authors contributed equally to this work.

Abstract: Previous studies have demonstrated the link between individual unhealthy behaviors and self-harm, but little is known about the influence of multiple unhealthy behaviors on self-harm among adolescents. This study aims to identify the potential patterns of unhealthy behaviors and to examine their associations with self-harm, which may become a useful tool for the screening of self-harm in adolescents. A total of 22,628 middle school students (10,990 males and 11,638 females) in six cities was enrolled in this study by multistage stratified cluster sampling from November 2015 to January 2016. Latent class analysis (LCA) was performed based on five kinds of unhealthy behaviors (unhealthy losing weight (ULW), tobacco use (TU), alcohol use (AU), screen time (ST), and mobile phone dependence (MPD)). Multivariate logistic regressions were used to examine associations between identified subgroups and self-harm. Four subgroups of unhealthy behaviors were identified. Class 1 (71.2%) had the lowest engagement in unhealthy behaviors. Class 2 ((ULW/MPD), 22.3%) had a relatively high prevalence of ULW and MPD. Class 3 ((TU/AU/ST), 3.2%) had a relatively high prevalence of TU, AU, and ST. Class 4 (3.3%) consistently engaged in unhealthy behaviors. Compared to class 1, class 2 (ULW/MPD), class 3 (TU/AU/ST), and class 4 showed OR (95%CI) values of 2.101 (1.964–2.248), 2.153 (1.839–2.520), and 3.979 (3.407–4.645) ($p < 0.001$ for each), respectively. Class 1, class 2 (ULW/MPD), and class 3 (TU/AU/ST) engagement in unhealthy behaviors was associated with increased self-harm. These findings strongly suggested that self-harm prevention efforts focusing on multiple unhealthy behaviors should be seriously considered for early detection of self-harm.

Keywords: unhealthy behaviors; latent class analysis; self-harm; adolescents

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1. Introduction

Self-harm refers to the intentional self-inflicted destruction of body tissue without suicidal intent and for purposes not socially sanctioned. Forms of self-harm include cutting, skin carving, burning, severe scratching/abrading, and punching/hitting [1]. Self-harm has been shown to predict future suicide ideation and attempts above other established

risk factors, such as depressive symptoms and previous suicidality [2]. The prevalence of lifelong health problems in adolescents with self-harm is 17–60% [3]. The international prevalence of self-harm was about 17.2% among adolescents, while that of Chinese middle school students was as high as 22.7% [4,5]. Therefore, self-harm among adolescents needs to be paid special attention.

The known risk factors of self-harm, including genetic, biological, mental disorder, psychological, and environmental factors, are often internalizing or difficult to modify [6]. Traditional health risk behaviors include specific forms of behavior, such as unintentional injury, absence of physical activity, risky sexual behavior, substance abuse, psychiatric addiction, and so on, which are proven to be associated with increased susceptibility to specific diseases or ill health [7,8]. Apart from the above, "new" behaviors such as Internet use, videogame playing, and mobile phone dependence are becoming increasingly common in adolescents [9,10]. In this study, we adopted "unhealthy behaviors" to define the above behaviors. Adolescence is a period in which people face great changes in behaviors and psychology. In this sensitive stage of growth, adolescents are curious and impulsive about new things, and with their peers, engaging in unhealthy behaviors [11]. Several studies have investigated the negative associations between various unhealthy behaviors and self-harm [9,12–14]. For instance, students who frequently use the internet and smoke are more prone to self-harm [10]. In depressed adolescents receiving outpatient treatment, alcohol use patterns predicted both deliberate self-harm and suicidality at one-year follow-up [15]. Laxative abuse was associated with self-harm in individuals with eating disorders [16]. Our previous research results found that the risk of self-harm among middle school students with mobile phone dependence was 2.062 times higher than the control group [9]. Furthermore, watching videos of self-harm-related behaviors can induce teenagers to imitate video content and make corresponding behaviors [17]. More than 2 h of weekend screen time per day by middle school students is a risk factor for self-harm [18]. Hawton et al. found that watching TV and playing computer for a long time not only had bad effects on the mental health of young people but also was a risk factor for repeated self-harm and suicide [6].

Thus, it is important to account for these multifaceted features of unhealthy behaviors to examine their association with self-harm among adolescents. Nevertheless, unhealthy behaviors often co-occur, which increases the risk of chronic disease incidence and mortality, and the co-occurrence of different unhealthy behaviors always not only shows the additive effects but exhibits a synergistic effect [19–22]. However, most research has routinely focused on single behaviors but not investigated the interaction of multiple behaviors and their impact on self-harm. In this context, to elucidate the effect of multifaceted features of unhealthy behaviors on self-harm among adolescents, in this study, we included a comprehensive assessment of the extent to which adolescents engaged in each unhealthy behavior. We aimed to understand the potential patterns of observed behaviors and their influences on self-harm.

Previous studies have shown that the cluster pattern of unhealthy behaviors in adolescents is not the same but is of heterogeneity [23–25]. Heterogeneity is known to be present when a population can be separated into distinct subpopulations or clusters. In the case of unobserved heterogeneity, the subpopulation membership must be inferred from the data. In this context, the subpopulations are termed latent classes since subpopulation membership is unobserved. Emerging statistical techniques such as latent class analysis (LCA) allow multiple behaviors or multiple dependent variables to be investigated together. Segmenting a heterogeneous population into relatively homogenous unobserved subgroups based on behavioral profiles may improve the scope, utilization, and efficacy of interventions by targeting multiple modifiable unhealthy behaviors simultaneously [26].

Based on Jessor's risk behavior theory, unhealthy behaviors tend to co-occur in youth perhaps because they share a common motivation of thrill seeking [27]. Additionally, previous studies have found multiple clustering patterns for unhealthy behaviors and single unhealthy behavior was associated with self-harm among adolescents. We hypothesized

that clusters of students engaging in more unhealthy behaviors will be more likely to report increased self-harm. The primary purpose of this study was to use LCA to examine the distinct unhealthy behavior patterns in a sample of Chinese adolescents. In addition, we also examined the relationship between the identified subgroups and self-harm.

2. Materials and Methods

2.1. Participants and Procedures

We designed a school-based cross-sectional study from November 2015 to January 2016. The study was approved by the Ethics Committee of Anhui Medical University (1 Mar 2014; approval number 20140087). All subjects participated in the study upon receiving informed consent from their parents. The participants were recruited from junior and senior high schools located in six cities in China, including both urban and rural regions, by using convenient cluster sampling. The sampling steps are as follows: firstly, six cities were selected by convenient sampling. These cities were Shenyang (capital of Liaoning Province), Xinxiang (north of Henan Province), Yangjiang (southwest coast of Guangdong Province), Chongqing (one of China's four direct-controlled municipalities), Ulanchap (the central Inner Mongolia Autonomous Region), and Bengbu (a northeastern city of Anhui province). Most of these stations are located in densely populated eastern and southern China. Then, eight schools (two rural junior and two senior schools, two urban junior schools, and two senior schools) were selected in each region based on the stratified cluster sampling. Lastly, four to six classes were selected randomly from each grade in each school. The sample size calculation formula for cross-sectional studies was used to calculate the minimum theoretical sample size for this study ($N = Z_a^2 * P(1-P)/d^2$) [28]. According to previous study, the prevalence of self-harm among Chinese middle school students was 22.7% [5]. Cluster sampling has a large sampling error, the sample size should be increased by about half, and there is a possibility of sample shedding [29]. The sample size should be a minimum of 1,963 using the prevalence of 22.7%. The exclusion criteria include the following: (1) participants who refused to participate in the study; and (2) participants with a history of psychiatric disorder (anxiety, depression, eating disorder, sleep disorders, and so on) reported by parents. In total, 23,137 students took part in this survey. After excluding the incomplete questionnaires with missing data >5% (n = 509), there were 22,628 valid questionnaires with an efficiency rate of 97.8%.

A questionnaire survey was administered in the classroom by researcher staff and teachers with guidance and explanations on each item for the participants. The students were allowed to withdraw from the study if they were not willing to participate. Students completed a self-report questionnaire during 20–30 min in the classroom.

2.2. Design of Questionnaires

Socio-demographic variables were recorded as follows: age, gender, registered residence, household structure, accommodation type, parental educational level, and self-reported family economic situation.

Table A1 showed the main measures. Self-harm was assessed by the Adolescent Non-Suicidal Self-Injury Assessment Questionnaire, which included eight items (hit, cut, fire, bite, pull hair, bang head, a toxic substance, and pinch or scratch), such as "Have you ever hit yourself in the past 12 months?". All the response options were "yes" or "no". When the answer was "yes" for any single item or more, the students were judged as having self-harm behaviors in the past 12 months. The reliability and validity have been demonstrated in a previous study, in which the Cronbach's alpha coefficient was reported to be 0.776 [30]. The Cronbach's α coefficient for this study was 0.779.

Tobacco use, alcohol use, and unhealthy weight loss were assessed with three questions. Tobacco use was assessed by asking "During the past 30 days, how many days did you smoke cigarettes?" with response options of 0 = 0 day; 1 = 1 to 9 days; 2 = 10 to 19 days; or 3 = 20 to 30 days, and alcohol use was assessed by asking "During the past 30 days, on how many days did you have at least one drink of alcohol?" with response

options of 0 = 0 day; 1 = 1 to 9 days; 2 = 10 to 19 days; or 3 = 20 to 30 days [27,31]. Unhealthy weight loss was assessed with the following question, "During the past 30 days, have you taken any diet pills or diet tea without a doctor's advice to lose weight?", with response options of 0 = 0 time; 1 = 1 time; 2 = 2 to 3 times; 3 = 4 and over 4 times. For the item, participants could choose 0 as no and other options as yes [31,32]. The validity of adolescent self-reported data on behaviors related to tobacco, alcohol, and drug use has been assessed [33].

The screen time of the participants was assessed by the self-report question, "On weekdays, how much time do you spend playing games or doing things unrelated to study on the computer every day on average?". According to the standard of the American Academy of Pediatrics and previous studies [34–36], screen time >2 h/day is defined as too long screen time. Mobile phone dependence was measured by the Self-rating Questionnaire for Adolescent Problematic Mobile Phone Use (SQAPMPU) [37]. It consists of 13 items with responses on a 5-point Likert scale (never, occasionally, sometimes, often, and always) and covers three dimensions including six questions for withdrawal symptoms (e.g., "If I don't have a phone, I will feel overwhelmed"), four questions for craving (e.g., "I always feel that I don't have enough time to use my phone"), and three questions for physical and mental health status (e.g., "Too much mobile phone use leads to insufficient sleep"). The Cronbach's alpha coefficient for this study was 0.923. According to the previous studies, participants in this study were categorized as mobile phone dependent when this score was $\geq P_{75}$ [9,38,39].

2.3. Statistical Analysis

The database was entered by EpiData 3.1 (The EpiData Association, Odense, Denmark) and analyzed in Mplus (Version 7.4, Muthén & Muthén, Los Angeles, CA, USA) and SPSS 23.0 (SPSS Inc., Chicago, IL, USA). Firstly, the Chi-square test was performed to assess group differences concerning their statistical significance. Secondly, LCA was applied to identify unhealthy behavior patterns. Finally, the multivariable logistic regression models were used to examine the associations of subclasses of unhealthy behaviors and self-harm. For the main variable (unhealthy behaviors and self-harm), we used mode to supplement missing categorical data.

LCA was carried out in Mplus to explore the most likely number of classes based on the five unhealthy behaviors. The optimal model was determined based on six model fit indexes: Akaike information criterion (AIC), Bayesian information criterion (BIC), adjusted Bayesian information criterion (aBIC), Lo–Mendell–Rubin (LMR), bootstrapped likelihood ratio test (BLRT), and entropy. LMR and BLRT were used to make a comparison between the estimated model and a model with k-1 class, or a class with k equaling the number of classes [40]. For the LMR and BLRT, a low and significant p-value imply that the estimated model is superior to the model with one less class [40]. The AIC, BIC, and aBIC are commonly used for comparing different counterpart models, with the lowest value on each indicator suggesting a best-fitting model [41].

3. Results

3.1. Characteristics of Self-Harm

Table 1 presented the prevalence of self-harm by frequency characteristics, which was 32.1% of total enrolled participants. Self-harm was more common in males than females (35.2% vs. 29.1%; $p < 0.001$). Furthermore, statistical significance was found on grade, registered residence, boarding on school days, parents' educational level, self-reported family economy, and the number of friends ($p < 0.05$ for each). Similar results were observed in most single self-harm behavior.

Table 1. Frequency characteristics of self-harm in Chinese adolescent (%).

Variable	Hit	Pull Hair	Bang Head	Pinch or Scratch	Bit	Cut	Fire	Toxic Substance	Total
Gender									
Male	1687 (15.4)	1558 (14.2)	2876 (26.2)	1060 (9.6)	636 (5.8)	555 (5.1)	562 (5.1)	203 (1.8)	3871 (35.2)
Female	1516 (13.0)	1064 (9.1)	1634 (14.0)	1650 (14.2)	948 (8.1)	796 (6.8)	374 (3.2)	93 (0.8)	3390 (29.1)
χ^2	25.124	139.819	521.060	110.153	48.302	32.246	51.465	40.089	96.332
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Grade									
Middle school	1888 (15.7)	1557 (13.0)	2516 (21.0)	1609 (13.4)	962 (8.0)	864 (7.2)	456 (3.8)	192 (1.6)	4132 (34.5)
High school	1315 (12.4)	1065 (10.0)	1994 (18.7)	1101 (10.4)	622 (5.8)	487 (4.6)	480 (4.5)	104 (1.0)	3129 (29.4)
χ^2	52.921	48.482	17.556	50.182	40.873	69.183	7.189	16.948	65.487
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.007	<0.001	<0.001
Registered residence									
Rural	1629 (15.0)	1372 (12.6)	2264 (20.8)	1385 (12.7)	847 (7.8)	660 (6.1)	486 (4.5)	149 (1.4)	3672 (33.7)
Urban	1574 (13.4)	1250 (10.6)	2246 (19.1)	1325 (11.3)	737 (6.3)	691 (5.9)	450 (3.8)	147 (1.3)	3589 (30.6)
χ^2	11.449	21.313	10.033	11.219	19.758	0.334	5.744	0.607	26.357
p	0.001	<0.001	0.002	0.001	<0.001	0.563	0.017	0.436	<0.001
Accommodation type									
Boarding student	1660 (14.7)	1353 (12.0)	2340 (20.7)	1428 (12.6)	791 (7.0)	596 (5.3)	486 (4.3)	132 (1.2)	3725 (32.9)
Commuting student	1543 (13.6)	1269 (11.2)	2170 (19.2)	1282 (11.3)	793 (7.0)	755 (6.7)	450 (4.0)	164 (1.5)	3536 (31.3)
χ^2	4.835	2.944	7.779	8.761	0.005	20.081	1.405	3.540	6.952
p	0.028	0.086	0.005	0.003	0.941	<0.001	0.236	0.060	0.008
Father's educational level [a]									
<High school degree	1836 (14.1)	1539 (11.8)	2665 (20.5)	1558 (12.0)	926 (7.1)	752 (5.8)	522 (4.0)	159 (1.2)	4271 (32.8)
≥High school degree	1324 (14.0)	1052 (11.2)	1795 (19.0)	1112 (11.8)	633 (6.7)	572 (6.1)	389 (4.1)	125 (1.3)	2918 (31.0)
χ^2	0.020	2.401	7.147	0.168	1.372	0.814	0.183	0.472	8.823
p	0.886	0.121	0.008	0.682	0.242	0.367	0.669	0.492	0.003
Mother's educational level [b]									
< High school degree	2020 (14.1)	1713 (11.9)	2909 (20.3)	1749 (12.2)	1044 (7.3)	826 (5.8)	584 (4.1)	171 (1.2)	4696 (32.8)
≥High school degree	1136 (14.0)	868 (10.7)	1544 (19.0)	933 (11.5)	516 (6.4)	498 (6.1)	335 (4.1)	115 (1.4)	2491 (30.7)
χ^2	0.024	7.825	5.029	2.339	6.722	1.362	0.046	2.102	9.751
p	0.876	0.005	0.025	0.126	0.010	0.243	0.830	0.147	0.002
Self-reported family economy									
Bad	628 (19.4)	510 (15.7)	802 (24.8)	524 (16.2)	296 (9.1)	230 (7.1)	169 (5.2)	63 (1.9)	1235 (38.1)
General	2107 (12.9)	1751 (10.7)	3054 (18.7)	1816 (11.1)	1062 (6.5)	887 (5.4)	587 (3.6)	174 (1.1)	5029 (30.8)
Good	468 (15.4)	361 (11.9)	654 (21.5)	370 (12.2)	226 (7.4)	234 (7.7)	180 (5.9)	59 (1.9)	997 (32.8)
χ^2	98.122	66.987	67.766	65.847	29.897	31.978	46.053	27.051	67.759
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Number of friends									
≤2	965 (17.5)	735 (13.3)	1218 (22.1)	845 (15.3)	473 (8.6)	401 (7.3)	251 (4.6)	84 (1.5)	1954 (35.4)
3–5	1278 (13.3)	1042 (10.8)	1808 (18.8)	1099 (11.4)	656 (6.8)	517 (5.4)	352 (3.7)	96 (1.0)	2998 (31.2)
≥6	960 (12.8)	845 (11.3)	1484 (19.8)	766 (10.2)	455 (6.1)	433 (5.8)	333 (4.4)	116 (1.5)	2309 (30.8)
χ^2	67.948	22.413	23.962	83.313	31.502	23.235	9.713	12.487	37.753
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	0.002	<0.001

Statistical methods: Chi-square test. [a] 198 students had no information about their father; [b] 188 students had no information about their mother.

3.2. Latent Class Analysis of Unhealthy Behaviors

The prevalence of tobacco use, alcohol use, unhealthy weight losst, screen time, and mobile phone dependence was 2.8%, 16.8%, 4.8%, 16.3%, and 25.4%, respectively. Patterns of unhealthy behaviors were identified by LCA in Mplus to five classes. The five classes model did not replicate the best log-likelihood value and was therefore not considered further. The four-class model was chosen as the optimal model, for which bootstrap validation procedures also demonstrated a good fit ($p < 0.001$, Table 2).

Figure 1 showed the estimated probabilities of unhealthy behaviors among the four identified latent classes. Class 1 (71.2%, n = 16,184) was the lowest risk cluster, in which the students were unlikely to have unhealthy behaviors. In this class, few students reported unhealthy losing weight (1.8%), tobacco use (0.5%), alcohol use (8.6%), or screen time (8.1%), and none of them had mobile phone dependence. In contrast, class 4 was defined as the highest risk cluster which included 3.3% (n = 747) of the participants, in which the majority of adolescents engaged in unhealthy weight loss (30.1%), tobacco use (28.8%), alcohol use (88.6%), and screen time (69.6%). Moreover, all of them reported mobile phone dependence in this class (100%). Furthermore, we found two moderate risk classes (class 2

and class 3), which we defined as those engaging in at least one or two of the negative behaviors but not all. Class 2 (22.3%, n = 5055) was characterized by relatively little tobacco use (1.5%), alcohol use (16.1%), or screen time (23.9%), but relatively high percentages of unhealthy weight loss (9.1%) and mobile phone dependence (79.1%). Finally, 3.2% of the participants belonged to class 3 (n = 713), which was characterized by relatively little unhealthy weight loss (5.8%) and mobile phone dependence (21.1%), but relatively high percentages of tobacco use (20.9%), alcohol use (71.6%), and screen time (44.5%). There was generally a good distinction among the four classes in this optimal model, based on an overall entropy value of 0.728, indicating good classification quality based on the threshold of 0.7 suggested by Nagin [42].

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

Statistic	2	3	4	5
df	11	17	**23**	29
AIC	77,820.870	77,531.146	**77,470.028**	77,473.069
BIC	77,909.166	77667.604	**77,654.647**	77,705.851
aBIC	77,874.209	77,613.578	**77,581.554**	77,613.690
LMR-LRT	<0.0001	<0.0001	**<0.0001**	0.0822
BLRT	<0.0001	<0.0001	**<0.0001**	0.1935
Entropy	0.581	0.780	**0.728**	0.717
Classification probability	0.16325 0.83675	0.21937 0.06633 0.71429	**0.03301** **0.71208** **0.03151** **0.22340**	0.09475 0.01039 0.02417 0.83905 0.03164

Note. df, degrees of freedom; AIC, Akaike information criteria; BIC, Bayesian information criteria; aBIC, adjusted Bayesian information criteria; LMR-LRT, Lo–Mendell–Rubin likelihood ratio; BLRT, bootstrapped likelihood ratio test. Bold: Represents the selected model.

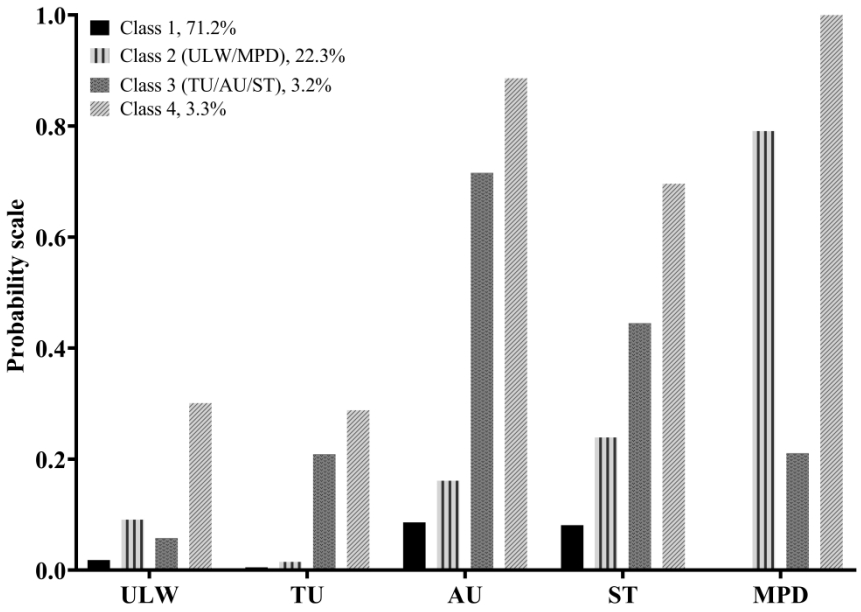

Figure 1. Four classes of unhealthy behaviors of the best-fitting four-class pattern. Note. ULW, unhealthy weight loss; TU, tobacco use; AU, alcohol use; ST, screen time; MPD, mobile phone dependence.

3.3. Multivariate Logistic Regression Analyses

After extracting the four latent classes, individuals were assigned to different classes. As shown in Figure 2, factors that were considered to potentially interact were gender, grade, registered residence, accommodation type, parents' educational level, self-reported

family economic status, number of friends, and cities. Results from multivariate logistic regression analyses indicated the subgroups of unhealthy behaviors associated with self-harm. Compared with class 1, class 2, class 3, and class 4 were positively related to self-harm, with the OR (95%CI) of 2.101 (1.964–2.248), 2.153 (1.839–2.520), and 3.979 (3.407–4.645) ($p < 0.001$ for each), respectively.

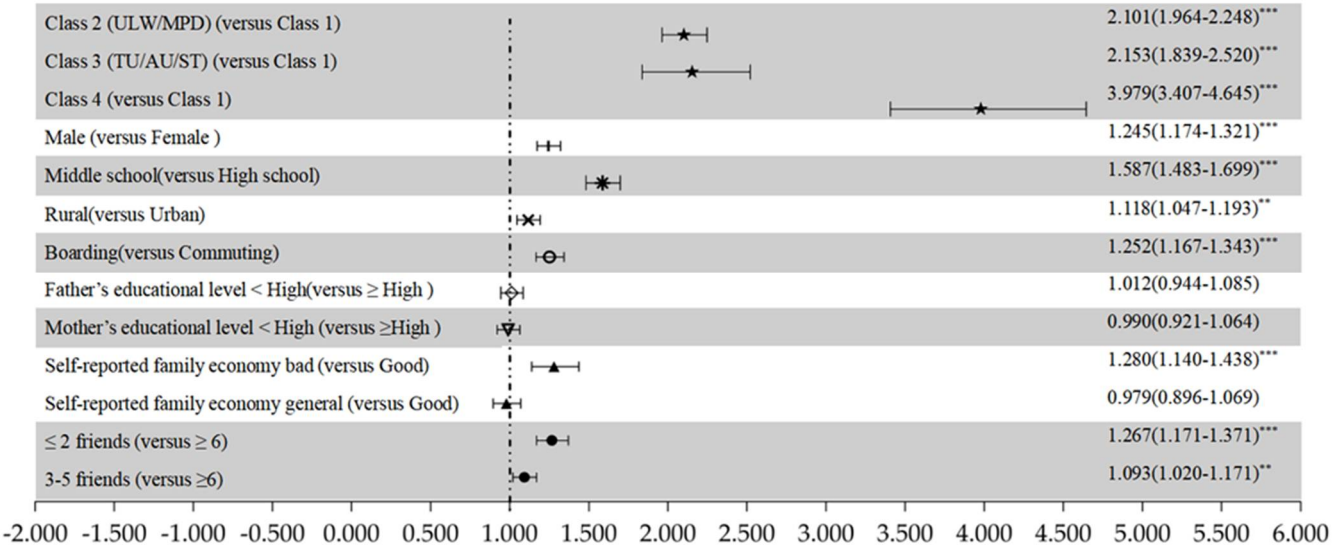

Figure 2. Adjusted odds ratios and 95% confidence intervals for the self-harm with latent subgroups of unhealthy behaviors. ★ latent subgroups; ǀ gender; ✱ grade; × registered residence; ○ accommodation type; ◇ father's educational level; ▽ mother's educational level; ▲ self-reported family economic status; ● the number of friends. Multinomial logistical regression was used. *** $p < 0.001$, ** $p < 0.01$.

4. Discussion

In the present study, we found the rate of self-harm to be 32.1%, which is higher than in developed countries (19.1%, 95% CI: 9.3–35.3%) [43]. Because the definition of self-harm, samples, and the assessment tools are different, the self-reported self-harm ranged from 7.9% to 73.7% among adolescents in the world [44–48]. A meta-analysis shows that the prevalence of self-harm among Chinese adolescents is increasing [5]. From 2015 to 2017, the prevalence reached 28.5% (95% CI: 25.3–31.8%) [5]. Furthermore, the prevalence increased with sample size, indicating the importance of an appropriate sample size [44,48]. We found that self-harm was more likely to occur in males, which was consistent with some previous studies [49], but opposite results were also reported [50]. The reasons for the gender differences in self-harm are still unclear, and further studies are needed to clarify this issue. We found that middle school students reported a higher rate of self-harm than high school students, which was similar to other studies [51,52]. In early–middle adolescence, impulsive choices tend to appear, leading to the occurrence of self-harm [53]. The different rate of self-harm between urban and rural students might be due to the economic development status, parental caregiving, or other social factors. The Diagnostic and Statistical Manual of Mental Disorders Fifth Edition points out that self-harm is motivated by satisfaction, solving interpersonal problems, alleviating negative thoughts or feelings, and generating positive emotions or feelings [3]. The oriental countries represented by China and Japan are a kind of collectivist culture [54]. Under the cultural background of dependence self-construction in the east, individuals emphasize collectivism and pay attention to group relations. Easterners may pay more attention to the function of self-punishment to repair interpersonal relations and restore social reputation. In our study, the students who had fewer friends and the boarding students showed a higher

incidence rate of self-harm. These students may face more interpersonal problems leading to a higher prevalence of self-harm.

Using the LCA, this study identified four distinct subgroups of unhealthy behaviors using five behavior indicators in Chinese students. Students classified in the highest risk cluster (class 4) were likely to engage in multiple unhealthy behaviors such as unhealthy losing weight, tobacco use, alcohol use, screen time, and mobile phone dependence. Although the proportion of students in this class was small (3.3%), the problems cannot be ignored because of the large population base in China. Class 3 (22.3%) reported a high level of tobacco use, alcohol use, and screen time, which is consistent with previous research reporting the strong interaction between smoking and drinking behaviors [55,56]. Interestingly, our results showed that long screen time was included in the same class with drinking and smoking. Furthermore, class 2 (3.2%) comprised primarily of a higher prevalence of unhealthy weight loss and mobile phone dependence. Nevertheless, the previous studies did not find that unhealthy weight loss and mobile phone dependence were included in the same cluster by LCA analyses, although unhealthy weight loss and mobile phone dependence have known associated psychological behaviors [9,57]. Meanwhile, adolescents with unhealthy weight loss behaviors were more likely to engage in delinquency and suicide attempts [58], and it is thus reasonable to assume that unhealthy weight loss is associated with self-harm. Adolescents with comorbid unhealthy weight loss and mobile phone dependence may represent a clustering of traditional and "new" unhealthy behaviors. Surprisingly, screen time and mobile phone dependence were not included in the same class; this may be partly due to teenagers usually having less time to choose an electronic entertainment device during the period of high school. Therefore, screen time and mobile phone dependence did not appear in one class, and the reasons need to be clarified in the future. Hence, these findings support the notion that adolescents who engage in self-harm are not a homogenous class but rather a diverse class.

Our study also examined how these patterns of multiple unhealthy behaviors were associated with self-harm, and the findings support the notion that engaging in multiple unhealthy behaviors is associated with a higher risk of self-harm. To our knowledge, no studies have investigated the relationship of subclasses of unhealthy behaviors on self-harm in adolescents. Therefore, although the comparison of our results with findings from other studies is limited, this study provides important information on possible predictors of self-harm in adolescents. Although there was no direct evidence that subgroups of unhealthy behaviors were related to self-harm, some studies have examined the clustering of health risk behaviors and mental health status among college samples. Findings from these studies showed that students with greater numbers of unhealthy behaviors had increased risks for depression, anxiety, and greater self-perceived psychological stress [23–25], while psychological problems are an important factor leading to self-harm [59,60].

Moreover, understanding the association between unhealthy behaviors and self-harm is imperative for detecting the most at-risk subgroups. Identifying key patterns of unhealthy behaviors during adolescence can shed light on future directions for tailored intervention programs for this population. Across the behavioral cluster domains, some studies explored the effects of changing multiple behaviors simultaneously or sequentially. For interventions targeting tobacco and diet [61], tobacco and alcohol [62], and physical activity and diet [63], simultaneous versus sequential long-term outcomes indicated no significant difference. In an intervention targeting physical activity, tobacco, and dietary sodium, the sequential intervention was inferior to simultaneous intervention [64]. Furthermore, effectively treating two behaviors in an individual reduces medical costs by about 2000 dollars per year [65]. Consequently, it may be efficient to intervene in multiple behaviors at the same time. By targeting multiple health-risk behaviors simultaneously, individuals may be able to transfer their knowledge and experiences from one behavior to another if the domains share similarities [66]. The idea is that changes in one of these behaviors may result in a cascading effect, similar to previous research showing a corresponding decrease in marijuana and alcohol use when quitting smoking [66]. Success in

changing one or more lifestyle behaviors may also increase one's confidence or self-efficacy to improve risk behaviors for which individuals have low motivation to change. As such, health behavior change may serve as a gateway to the overall healthful lifestyle change.

This study employed emerging analytic methodology, LCA, and explored a wide array of unhealthy behaviors among a nationwide sample of Chinese adolescents. However, some limitations existed in this study. Firstly, not all kinds of unhealthy behaviors were included. Secondly, different samples may get different results, so the results of this study need to be verified by more studies in the future. Thirdly, this study focused on only one domain per behavior, for example, unhealthy weight loss was represented by the diet pills or diet tea, while tobacco use was assessed by the number of days smoked during the past 30 days. Finally, in terms of model fit, it should be noted that an entropy value of 0.728 means that more than 25% of our sample was not optimally classified. Further investigations to overcome these limitations are warranted.

5. Conclusions

The present study identified four subgroups of unhealthy behaviors and highlighted their associations with self-harm among Chinese adolescents. Our findings reveal a significant relationship between clustering of unhealthy behaviors with negative self-harm outcomes, specifically, students with greater likelihoods of engaging in unhealthy weight loss, tobacco use, alcohol use, screen time, and mobile phone dependence were most likely to exhibit self-harm. Understanding how self-harm may appear in the context of the interactions of multiple unhealthy behaviors will be important and helpful for institutions to create targeted interventions for those students who may potentially be at higher risk for self-harm. Further studies are warranted to prove and improve the efficacy of interventions focusing on multiple unhealthy behaviors.

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Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

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Appendix A

Table A1. The main measures.

Variable	Measures
Self-harm	Adolescent Non-suicidal Self-injury Assessment Questionnaire
Unhealthy weight loss	During the past 30 days, have you taken any diet pills or diet tea to lose weight?

Table A1. *Cont.*

Variable	Measures
Tobacco use	During the past 30 days, how many days did you smoke cigarettes?
Alcohol use	During the past 30 days, on how many days did you have at least one drink of alcohol?
Screen time	The average hours on weekdays spent playing games or doing things unrelated to study on the computer every day.
Mobile phone dependence	Self-rating Questionnaire for Adolescent Problematic Mobile Phone Use

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