Research paper

A mixed method study to examine the mental health problems of college students who had left-behind experiences

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Abstract

Background: China's rapid urbanization has created a large number of labour transferring from rural to urban areas and large numbers of college students with left-behind experience (LBE). LBE was an important influencing factor on college students' mental health.

Methods: A mixed method involving quantitative survey and qualitative interview was emplyed to explore the influence of LBE on mental health of college students. In the quantitative survey, 1605 college students from three different universities of Shandong province in China were recruited. Their mental health status was measured using Symptom Check-list 90(SCL-90 scale) compiled by American psychologist Derogatis. In the qualitative interview, 40 college students with left-behind experience from the same three universities were interviewed.

Results: The prevalence estimate of total mental health problems among left-behind students was 2.14 times higher than that among those without left-behindexperience. LBE increased the problems of somatization, obsessive-compulsion (Ocd), international sensitivity, depression, anxiety, hostility, terror, paranoia, psychoticism and other symptoms. The result of qualitative interview showed the mental health problems of the college students with left-behind experience were mainly on anxiety, depression, Ocd, interpersonal sensitive and hostility, which was consistent with the results of quantitative survey.

Limitation: Representativeness of the sample is the major limitation of our study. Due to rare similar studies performed in other countries, we could not compare the results in China to that in other countries.

Conclusion: Left-behind experience was an important factor associated with the mental health of college students. The mental health of college students with LBE needs more attention.

1 Introduction

Due to China's special national conditions and urban-rural dual structure, urban and rural economic development is unbalanced,which results in a large number of labour transferring from rural to urban areas, also large numbers of migrant parents and left-behind children (LBC). LBC are the children who are left behind in their hometown for more than half a year and cared for by one parent, grandparent, relatives or their parents' friends (Ye et al.,2005; Zhang, 2006). The LBC phenomenon is not only appearing in China, but also in the world. However, due to China's urban–rural dual structure, the phenomenon of LBC is particularly prominent in China (Liu et al., 2020). By the end of August 2018, there were approximately more than 6.97 million LBC in China (Report on China's child welfare and protection policy 2019). As a special group, due to their special experience during childhood, LBC may have many different characteristics from the children without left-behind experience.

Life course theory shows that the changes and events in the life course from childhood to adulthood, marriage, parenthood to old age will have an impact on the individual development. In the book *Children of the Great Depression*, Elder pointed out that the personal life course was embedded in the historical time and the events they experience in their life years (Elder,.1975). LBC, living in a special family environment during their childhood, they will experience special events and bear special pressure, which maybe change their characteristics. For example, physical inaccessibility and lack of communication may disrupt parent–child attachment. Many studies have reported that, compared with a single-parent family or the absence of both parents, both parents' company is more conducive to children's growth and development, and parents' absence has a detrimental impact on the emotional and behavioral functions of children and adolescents (Amato et al. 1993; Li et al.,2014; Asen et al.,2017; Astrup et al.,2017; Bryant et al.,2017). Lack of parental care, support, guidance and communication may have many negative emotional impacts on the children, such as poor psychological safety (Li et al., 2014; Bryant et al.,2017). Probably due to parents' absence, LBC usually have less communication with their parents, and the content of the communication was monotonous, caring more about the child's physical health and academic performance than their mental health (spiritual world). Then, many mental health problems arise, such as depression, sensitive interpersonal relationships, social anxiety, and so on (Zhang et al.,2018; Su et al., 2019). A meta-analysis of social anxiety of LBC in rural China's areas showed the prevalence estimate of social anxiety among rural LBC was 36.1% (N = 18544), which was higher than that of non-left-behind children (20.2%) (Li, et al., 2019).

China's rapid economic development and urbanization not only create a large number of LBC, but also large numbers of college students with left-behind experience. The special experience of their adolescence has a great impact on college students' mental health. By the end of 2017, there are about 26.958 million college students in China, and the proportion of students with left-behind experience was about 23.5% (Pang et al., 2018). College period is a developmentally crucial period when students make the transition from late adolescence to emerging adulthood (Arnett, 2000). Mental disorders in early adulthood are associated with long-term adverse outcomes in later adulthood, including persistent emotional and physical health problems (Scott et al., 2016), relationship dysfunction (Kerr et al., 2011). College students are a special group who are passing through a critical transition period. Previous studies have shown high rates of mental disorders, especially depression and anxiety, among college students (Ye et al., 2016.). Bruffaerts R's survey, as part of the International College Student Project of the WHO World Mental Health Surveys(WMH-ICS), found that approximately one in three freshman were reported having mental health problems, with internalizing and externalizing problems both associated with reduced academic functioning (Bruffaerts et al., 2018).

The definition of college students with left-behind experience was first proposed by Zhang in 2006 (Zhang, 2006), who defined them as college students who had left-behind experience before they went to college. At present, there has been no uniform definition of college students with left-behind experience, mainly not consistent in age, then in the duration of left-behind and the type of parents' absences (Wen, 2010; He,et al., 2013; Song, et al., 2013; Jin, et al., 2019)Comparing with these ordinary college students, college students with left-behind experience are more prone to have mental health problems. The mental health problems of college students with left-behind experience were first summarized by Zhang in 2006 (Zhang,2006). Then, Zhang conducted a survey through qualitative interview and psychological consultation, which indicated that left-behind experience, was an important influencing factor on the psychological health of college students. If the girls took on the responsibility of caring for their siblings, the left-behind experience would affect their sense of safety and responsibility. For example, some left-behind students were more independent and more considerate of other people's feelings, and showed higher inverse quotient indices (a person's ability to tolerate frustration and to deal with adversity) (Shu, et al., 2008). The prevalence estimate of behavior problems among college students with left-behind experience was higher than that of college students without left-behind experience, and the prevalence estimate of boys was higher than that of girls (Li et al., 2019). Zhangstudy also found there were significant correlations between the college students' parenting styles, parent-child communication and emotion regulation strategies (Zhang et al., 2016). Growing under the conditions of lack of parental companions, low family conditions and growing environments, these left-behind students tended to be more sensitive and less confident than the students without a left-behind experience. The tendency to social anxiety was 9% higher than that of students without left-behind experience. Their mental health level was significantly lower, which indicated that left-behind experience had a negative impact on personality formation and subjective well-being (Lu,. 2016; He, 2013). Moreover, college students with left-behind experience are more likely to experience a series of negative traumatic experiences when they suffer from social trauma. Then their cognitive system may interpret these traumatic experiences as a kind of "anger feeling" or "hostile information", which will cause impairment of their cognitive ability, and then strengthen their tendency of aggressive behavior (Liu et al.,2014; Jin et al,2019). Also, some of these students' personality traits are introverted unstable (depressive), low self-confidence, low self-worth and interpersonal value. This type of personality tends to be anxious, worried and depression (Wang, 2018; Liu, 2020; Zhang, 2019). Some studies found that left-behind students were more likely to be psychological imbalance and emotional disorders, a fragile mentality, and affective disturbance. Some students had lower self-esteem, more negative emotions, fewer positive coping styles, low life satisfaction, low subjective well-being and so on. They seemed to be more sensitive in interpersonal communication and inferior. Many of these students have cognitive bias of not being loved by their parents (Wang et al.,2018; Wang et al.,2018; Han, 2020; Shi, 2020). Above all, the mental health problems of college students with left-behind experience attract more and more scholar's attention, and there are rare similar studies in countries other than China. In addition, there are more and more studies on the characteristics of LBE, the relationship between social supports and mental health of left-behind students, mental health and subjective well-being, mental health and left-behind experience, parent-child relationship, and so on.

Based on Elder's life course theory and the special growth experience of the college students with left-behind experience, we conducted a cross-sectional study using mixed method combining quantitative survey and qualitative interview to examine the influence of left-behind experience on the mental health of college students. Quantitative survey was used to examine the mental health level (somatization, obsessive-compulsion (Ocd), interpersonal sensitivity, depression, anxiety, hostility, terror, paranoia, psychoticism and other symptoms) of college students with left-behind experience, also the influence of some demographic and social support variables. Then through qualitative interview, in-depth information about the mental health problems of the college students with left-behind experience was obtained, which can be used as a supplement to the quantitative survey.
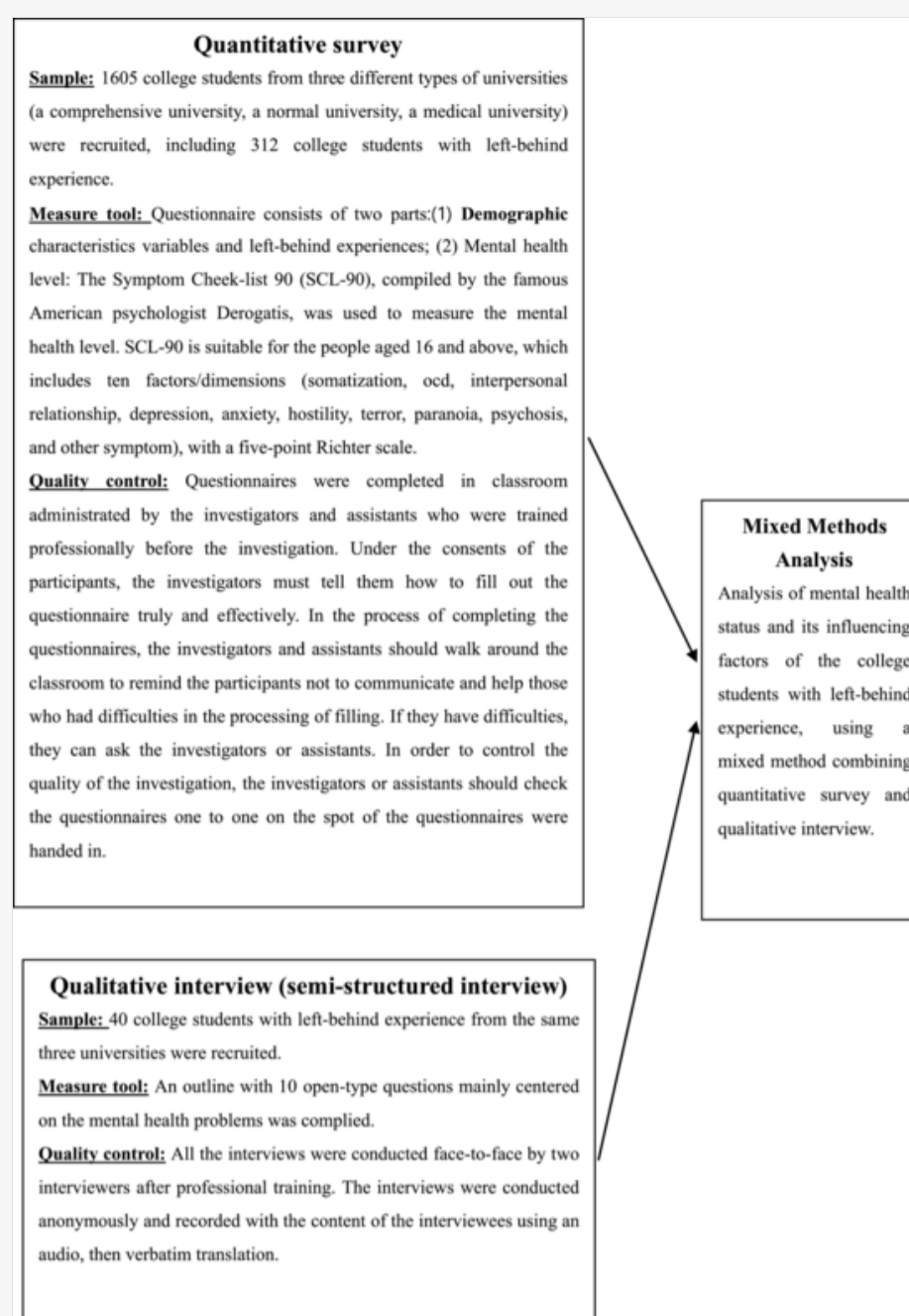
2 Methods

2.1 *Participants*

Definition of the college students with left-behind experience: Based on the definition of LBC and China's College Entrance Examination Policy (allowing social groups to participate in the college entrance examination), we finally adopted Zhang's definition of college students with left-behind experience: as long as you once have had a left-behind experience(for more than half a year) before going to college, you will be defined as a college student with left-behind experience (Zhang, 2006).

In order to calculate the sample size by considering the prevalence of mental health problems among college students with left-behind experience, we referred to the proportion of left-behind students in nine studies in a meta-analysis (The proportion of left-behind students with left-behind experience in the meta-analysis was 23.5%, 20565 college students and 4833 students with left-behind experience) (Pang et al., 2018; Hu et al.,2008; Cai et al.,2009; Li et al.,2014; Yang et al.,2014; Zhang et al.,2015; Lei et al.,2015; Zhang et al.,2016; Su et al.,2016). We chose a 95% confidence level (α), allowable error (δ) of 3% and a computational formula of $N = Z^2{}_{\alpha/2} \times P \times (1\text{-}P)/\delta^2$. When P=0.5 and δ =3%, N was the largest sample size, with 1057. In order to ensure the sample size and representativeness of the left-behind students, we thus expanded the final target sample size by 30% (N = 1374). To account for invalid questionnaires and other potential limitations, based on the percentage of valid questionnaires of 91% a pre-survey in one medical university, with a sample size of 455 in Yantai city(Liu et al., 2015), we inflated the final target sample size by about 20% and recruited about 1650 college students finally. **In the qualitative interview,**forty college students with left-behind experience from the same three universities were recruited for semi-structured interviews about the major mental health problems.

2.2 *Procedures*

A mixed method study involving quantitative survey and qualitative interview was conducted in Yantai of Shandong Province, eastern China (**Fig. 1.**). Due to Yantai's good economy, geographical location and education level, larger numbers of college students are attracted from other provinces, especially some central and western provinces, where there are a large number of left-behind children. **In the quantitative survey,** a cluster convenience sampling method was used to recruit the participants. In the first stage, three different types of universities (a comprehensive university, a normal university and a medical university) were recruited from five undergraduate universities in Yantai of Shandong Province. In the second stage, considering the representativeness of majors, 16 different majors (science, engineering and liberal arts) enrolled nationwide were selected from these three universities. In the third stage, class taken as the unit, one class from all grades of each major was selected. **In the qualitative interview,** purposeful sampling method was used to recruited interviewees based on the definition of the college students with left-behind experience. Their discussions were all in relation to the mental health problems, and lasted 20 to 30 minutes. All the interviews were digitally recorded, transcribed verbatim, and fully anonymized with the consent of the participants.

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Fig. 1

Quantitative survey

Sample: 1605 college students from three different types of universities (a comprehensive university, a normal university, a medical university) were recruited, including 312 college students with left-behind experience.

Measure tool: Questionnaire consists of two parts:(1) **Demographic** characteristics variables and left-behind experiences; (2) Mental health level: The Symptom Check-list 90 (SCL-90), compiled by the famous American psychologist Derogatis, was used to measure the mental health level. SCL-90 is suitable for the people aged 16 and above, which includes ten factors/dimensions (somatization, ocd, interpersonal relationship, depression, anxiety, hostility, terror, paranoia, psychosis, and other symptom), with a five-point Richter scale.

Quality control: Questionnaires were completed in classroom administrated by the investigators and assistants who were trained professionally before the investigation. Under the consents of the participants, the investigators must tell them how to fill out the questionnaire truly and effectively. In the process of completing the questionnaires, the investigators and assistants should walk around the classroom to remind the participants not to communicate and help those who had difficulties in the processing of filling. If they have difficulties, they can ask the investigators or assistants. In order to control the quality of the investigation, the investigators or assistants should check the questionnaires one to one on the spot of the questionnaires were handed in.

Mixed Methods Analysis
Analysis of mental health status and its influencing factors of the college students with left-behind experience, using a mixed method combining quantitative survey and qualitative interview.

Qualitative interview (semi-structured interview)

Sample: 40 college students with left-behind experience from the same three universities were recruited.

Measure tool: An outline with 10 open-type questions mainly centered on the mental health problems was complied.

Quality control: All the interviews were conducted face-to-face by two interviewers after professional training. The interviews were conducted anonymously and recorded with the content of the interviewees using an audio, then verbatim translation.

Design of the study using a mixed method of quantitative survey and qualitative interview

2.3 Measurements

2.3.1 Measurement in the quantitative survey

A self-compiled questionnaire including two departments (demographic and social supports variables, mental health measurement) was used as the measurement tool in the quantitative survey. Demographic and social support variables were mainly about gender, rural or urban source, only child or not, separation type with their parents, duration of being left-behind, education level of the parents and the people they lived with during the left-behind time, their relationship with people, and so on.

Symptom Checklist 90 (SCL-90) was chosen as the measuring tools of mental health in our study. The original version of SCL-90 was compiled by an American psychologist Derogatis in 1977 on the basis of his Hopkin's symptom checklist (HSCL,1973), which is composed of 90 self-assessment items and is divided into 10 dimensions (Derogatis, 1977; Hoffmann et al.,1978). On the basis of the version widely used in China, Derogatis developed the latest norms for different age groups, and changed the obscure interpretation of the original version to an easy to understand version that we used in this study, which is suitable for Chinese people. As one of the most well-known checklists of psychological symptoms, SCL-90 scale contains a list of symptoms of 90 items and ten dimensions (somatization, obsessive-compulsion (Ocd), interpersonal sensitivity, depression, anxiety, hostility, terror, paranoia, psychoticism and other symptoms). Therefore, the evaluation results are comprehensive and reliable (a high reliability: the Cronbachα is 0.982 in this study). SCL-90 is suitable for participants over 16 years of age, the items are rated on a five-point Likert scale, and mainly from the feeling, emotion, thinking, consciousness, behavior, life habits, interpersonal relationship, diet and sleep and other aspects to assess whether a person has some psychological symptoms and how serious it is. It has a good ability to distinguish people with psychological symptoms (who may be at the edge of psychological disorder or psychological disorder). According to the Chinese norm, if the total score of the SCL-90 scale is more than 160 points, this indicates a subject with mental health problems, as do positive responses to any dimension/factor's mean score of more than 2 points (the total score of each dimension divided by its item number).

2.3.2 Measurement in the qualitative interview

An interview outline (**Appendix: Supplementary file**) about the mental health problems compiled by investigators was used to explore the mental health problems of college students with left-behind experiences. The outline of interviews focused on their mental health problems, mainly focusing on five aspects: anxiety, depression, Ocd, interpersonal relationship and hostility problems.

2.4 Statistical analysis

2.4.1 Analysis methods in the quantitative survey

The primary outcomes were total mental health score of SCL-90 and the scores of its ten dimensions, which were all treated as binary response variables ((1)Total score of the SCL-90 scale ≥ 160 points: positive mental health problems, 1; and total score of the SCL-90 scales<160 points: no mental health problem, 0; (2) The score of each dimension of the SCL-90 scale ≥ 2 points: positive, 1 and the score of each dimension of the SCL-90 scale < 2 points: negative, 0).

First, prevalence estimates were calculated for students with and without experience (we will call them controls in this study), respectively, and Chi-square test was used to assess the prevalence differences between students with and without left-behind experience in terms of total mental health problems and ten dimensions of the SCL-90 scale. Then a generalized linear model (GLM) was used to show the association between left-behind experience and mental health problems when controlling for other confounding factors. GLM is an extension of traditional linear models that allows the mean of a population to depend on a linear predictor through a nonlinear link function and allows the response probability distribution to be any member of an exponential family of distributions. Many widely used statistical models are generalized linear models including logistic regression model. In our study, a binary logistic regression model was used to analyze the influence of left-behind experience on the mental health of college students while controlling for other confounding factors. A GLM always including three components:

$$Linear component : \eta_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{1i} + \dots + \beta_m x_{mi} \tag{1}$$

$$Random component : \varepsilon_i = Y_i - \eta_i \tag{2}$$

$$Link function : \eta_i = g(\mu_i) \tag{3}$$

In our study, we chose $Logit : g_1(\pi) = \ln\left(\frac{\pi}{1-\pi}\right)$ as the link function, therefore the model of the generalized linear model is:

$$logit(\pi) = \ln(Odds) = \ln\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p \tag{4}$$

In Eq. (4), π is the prevalence estimate of having total mental health problems or any of the ten dimensions of the SCL-90 scale. β_0 is a constant, β_p is the regression coefficient which represents the effects of X_p on the predictive value of individual incidence π (Y=1).

After confirming the impact of left-behind experience on the mental health of college students by GLM based on data of all college students involved in this study, Chi square tests only based on data of college students with left-behind experience were used to analyze the associations between the mental health and social supports that these left-behind students got during the left-behind time. All tests were two tailed and significance was determined using P<0.05. All statistical analyses were performed using IBM SPSS Statistics V22.0.

2.4.2 Analysis method in the qualitative interview

The contents of interviews were all recorded by recorder with the consent of the interviewees, and then transcribed word for word. The transcribers, interviewers and observers discussed the content of the transcriptions together. Finally, we used thematic framework analysis method to analyze the qualitative data and summarized the main contents according to the interview outline.

3 Results

3.1 Results of the quantitative survey

In the quantitative survey, 1650 college students were recruited and 1605 students completed the questionnaire, with a response rate of 97.27%. Among these 1605 participants, there were 312 college students who once had left-behind experience before they went to college, with a proportion of 19.44%. The characteristics of the participants were shown in **Table 1** .
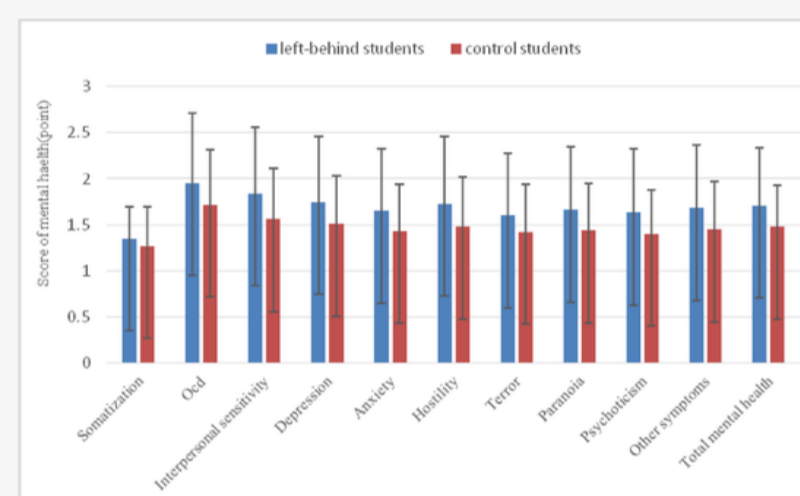
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Table 1

The demographic characteristics of the participants (N=1605)

Variables	Options	Left-behind students (N, %)	Control (N, %)
University	Medical university	131(42.0)	639(49.4)
	General university	76(24.2)	354(27.4)
	Comprehensive university	105(33.7)	300(23.2)
Gender	Male	124(39.7)	375(29.0)
	Female	188(60.3)	918(71.0)
Grade	Freshman	108(34.6)	467(36.1)
	Sophomore	83(26.6)	360(27.8)
	Junior	92(29.5)	397(30.7)
	Senior	29(9.3)	69(5.3)
Urban or rural source	Urban	63(20.2)	461(35.7)
	Rural	249(79.8)	832(64.3)
Only child or not	Only child	110(35.3)	519(40.1)
	Not only child	202(64.7)	774(59.9)

Fig. 2 shows that the mean scores of total mental health and its ten dimensions of the SCL-90 scale among left-behind students were all higher than that of control students. There were significant differences in terms of prevalence estimate of total mental health problems and its ten dimensions between left-behind students and control students, a higher prevalence estimate of total mental health problems (35.6%) in the left-behind students than that in control students (20.0%) (Chi-square tests, all $P<0.001$) (**Table 2**). For the left-behind students, the ten dimensions of SCL-90 scale, the prevalence estimate of Ocd problem was the highest (44.2%), followed by interpersonal sensitivity problem (40.4%). Among these left-behind students, 41.3% had separated from one or two parents two years or more and 58.7% less than two years. 36.5% of them had one parent migrating and 31.7% had both parents migrating. In specific, we used the GLM to identify the association between left-behind experience and mental health problems when controlling for other confounding factors (**Table 3**). The result shows that left-behind experience was an important influencing factor on the mental health and its ten dimensions of the SCL-90 scale. Left-behind students had 2.14 times odds to get mental health problems (OR=2.14, 95%CI:1.62 to 2.81) than non-left-behind students (after adjusting for university, gender, grade, rural or urban source, only child or not). Left-behind experience increased the odds of somatization (OR=3.39, 95%CI:1.52 to 7.57), Ocd (OR=1.95, 95%CI: 1.50 to 2.53), international sensitivity (OR=2.44, 95%CI: 1.87 to 3.20), depression (OR=2.05, 95%CI:1.53 to 2.73), anxiety (OR=2.26, 95%CI: 2.26 to 3.07), hostility (OR=2.09, 95%CI: 1.10 to 3.97), terror (OR=2.37, 95%CI:1.75 to 3.22), paranoia (OR=2.42, 95%CI:1.79 to 3.25), psychoticism (OR=2.29, 95%CI:1.68 to 3.14), other symptoms (OR=2.08, 95%CI:1.54 to 2.79).

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Fig. 2

Mean score of the total mental health and ten dimensions of the SCL-90 scale (Mean score of total mental health= total score of the SCL-90 scale divided by 160. Mean score of each dimension of SCL-90 scale=the total score of each dimension divided by the item's number of each dimension.)

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Table 2

Comparison of the prevalence eatimates between left-behind students and controls.

Dimension of SCL-90	Left-behind students (n=312)	Controls (n=1293)	χ^2-value
Somatization	64/312(20.5)	104/1293(8.0)	41.70**
Ocd	138/312(44.2)	369/1293(28.5)	28.64**
Interpersonal sensitivity	126/312 (40.4)	270/1293(20.9)	51.44**
Depression	93/312 (29.8)	210/1293(16.2)	30.21**
Anxiety	83/312 (26.6)	171/1293(13.2)	33.77**
Hostility	97/312 (31.1)	215/1293(16.6)	33.57**
Terror	85/312 (27.2)	169/1293(13.1)	37.90**
Paranoia	90/312 (28.8)	181/1293(14.0)	39.48**
Psychoticism	78/312 (25.0)	154/1293(11.9)	34.83**
Other symptoms	86/312 (27.6)	199/1293(15.4)	25.51**
Total mental health	111/312(35.6)	258/1293(20.0)	34.65**

Note: (1) Positive of each of the ten dimensions of SCL-90 scale: the score of each dimension is more than 2 points.
(2) Positive prevalence of the total mental health: The total score of the SCL-90 scale is more than 160 points.
(3) Chi-square tests were used to compare the differences between left-behind students and controls (two-tailed). **: P<0.001.

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Table 3

Determinants of mental health problems of college students by generalized linear model (n=1605, OR (95%CI)).

	Total mental health	Somatization	Ocd	Interpersonal sensitivity	Depression	Anxiety	Hostility	Terror	Paranoia	Psychoticism	Other symptoms
Having left-behind experience or not	-	-	-	-	-	-	-	-	-	-	-
Yes	**2.14 (1.62,2.81) ****	**3.39 (1.52,7.57) ****	**1.95(1.50,2.53)****	**2.44(1.87,3.20)****	**2.05(1.53,2.73)****	**2.26(1.67,3.07)****	**2.09(1.10,3.97)****	**2.37(1.75,3.22)****	**2.42(1.79,3.25)****	**2.29(1.68,3.14)****	**2.08(1.54,2.79)****
No	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
University	-	-	-	-	-	-	-	-	-	-	-
Medical	0.93 (0.69, 1.25)	0.80(0.54,1.20)	1.09(0.83,1.42)	1.03(0.80.1.39)	1.25(0.92,1.71)	0.86(0.61,1.22)	0.99(0.73,1.37)	0.96(0.68,1.35)	0.92(0.66,1.28)	1.32(0.94,1.86)	1.00(0.73,1.39)
General	1.14 (0.81, 1.62)	1.48(0.89,2.46)	1.24(0.91,1.70)	1.18(0.84,1.66)	1.16(0.81,1.66)	0.96(0.65,1.44)	1.06(0.74,1.53)	0.99(0.67,1.47)	1.01(0.69,1.50)	1.35(0.90,2.02)	1.18(0.81,1.72)
Comprehensive	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Gender	-	-	-	-	-	-	-	-	-	-	-
Male	1.10 (0.83, 1.46)	0.82(0.57,1.20)	**1.56(1.20,2.02)****	1.03(0.78,1.36)	0.86(0.64,1.15)	0.96(0.70,1.33)	0.95(0.71,1.28)	0.89(0.65,1.22)	0.89(0.65,1.21)	0.91(0.65,1.26)	1.05(0.77,1.43)
Female	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Grade	-	-	-	-	-	-	-	-	-	-	-
Freshman	1.14(0.67,1.93)	**2.39(1.22,4.67)***	1.35(0.84,2.17)	1.27(0.76,2.11)	0.94(0.53,1.65)	1.41(0.79,2.52)	1.51(0.89,2.57)	1.37(0.77,2.42)	1.49(0.86,2.58)	0.96(0.52,1.78)	1.29(0.73,2.28)

Sops	1.17(0.68,2.01)	1.65(0.84,3.22)	1.60(0.98,2.62)	1.31(0.78,2.20)	0.84(0.47,1.49)	1.31(0.73,2.37)	1.38(0.80,2.36)	1.31(0.73,2.35)	1.53(0.88,2.68)	1.07(0.57,2.03)	1.03(0.58,1.83)
Junior	1.06(0.62,1.84)	1.72(0.87,3.38)	1.09(0.67,1.78)	1.21(0.72,2.04)	1.02(0.57,1.83)	1.30(0.72,2.35)	1.38(0.80,2.38)	1.33(0.74,2.40)	1.59(0.90,2.80)	1.01(0.54,1.92)	1.23(0.69,2.21)
senior	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Residence	-	-	-	-	-	-	-	-	-	-	-
/Urban	**0.71(0.53,0.95)***	0.71(0.47,1.08)	**0.65(0.50,0.85)****	0.79(0.59,1.05)	0.79(0.58,1.09)	**0.70(0.50,0.99)***	0.79(0.58,1.08)	0.81(0.58,1.14)	0.91(0.66,1.27)	0.84(0.59,1.20)	0.99(0.72,1.36)
Rural	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
only child or not	-	-	-	-	-	-	-	-	-	-	-
Yes	0.92(0.69,1.22)	0.82(0.56,1.21)	0.83(0.64,1.08)	1.05(0.80,1.39)	1.06(0.78,1.43)	0.91(0.66,1.26)	0.99(0.73,1.37)	0.93(0.67,1.28)	0.90(0.66,1.24)	1.20(0.86,1.69)	1.02(0.75,1.39)
No	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Abbreviations: OR odds ratio, 95%CI: 95% confidence interval. OCD= Obsessive-compulsion

The results of influences of demographic and social support characteristics on the mental health of college students with left-behind experience are all shown in **Table 4**. Significant difference was found in the prevalence estimate of mental health problems among the groups divided by type of primary caregiver during the left-behind time, education level of the parents, the education level of the people the students living with during the left-behind time, the people around care about the students during the left-behind time, the relationship with the teachers and classmates, and so on. Taking the influence of primary caregivers on the mental health for example, there were significant differences in the prevalence estimates of total mental health problems, somatization, depression, anxiety and hostility among the students with different primary caregivers during the left-behind time. The prevalence estimate of total mental health problems (34.2%) and somatization (34.2%) were the highest among the students cared by relatives, the prevalence estimate of depression (38.5%) were the highest among the students cared by grandparents, the prevalence estimate of anxiety (36.8%) was the highest among the students cared by relatives, and the prevalence estimate of hostility (37.8%) was the highest among the students living alone during the left-behind time. In addition, with different education levels of the left-behind students' parents and the people they lived with during the left-behind time, these students had significant different proportions of mental health problems. Of note, when left-behind students encountered problems, only 23.7% (74/312) were willing to communicate with their parents rather than communicating with other people or solving by themselves. Compared to left-behind students who chose to solve problems alone, those who were willing to communicate with their parents had a significant higher prevalence estimate of total mental problems (54.5% [12/22] vs 24.3% [18/74], Chi-square test, P<0.001).

alt-text: Table 4

Table 4

ⓘ The table layout displayed in this section is not how it will appear in the final version. The representation below is solely purposed for providing corrections to the table. To preview the actual presentation of the table, please view the Proof.

Prevalence estimates of total mental health problems and the ten dimensions of SCL-90 scale among college students with left-behind experience.

Vairables	Option	Total mental health	Somatization	Ocd	Interpersonal sensitivity	Depression	Anxiety	Hostility	Terror	Paranoia	Psychoticism	Other symptoms
Length of separation	≥two years	34/129(26.4)	31/129(24.0)	49/129(38.0)	52/129(40.3)	39/129(30.2)	39/129(30.2)	46/129(35.7)	33/129(25.6)	37/129(28.7)	33/129(25.6)	38/129(29.5)
	< two years	54/183(29.5)	33/183(18.0)	89/183(48.6)	74/183(40.4)	54/183(29.5)	44/183(24.0)	51/183(27.9)	52/183(28.4)	53/183(29.0)	45/183(24.6)	48/183(26.2)
	χ^2-value	0.37	1.67	3.48	0.001	0.019	1.48	2.14	0.31	0.00	0.04	0.40
Type of absence	Two parents' absence	25/99(25.3)	17/99(17.2)	42/99(42.4)	39/99(39.4)	28/99(28.3)	25/99(25.3)	28/99(28.3)	26/99(26.3)	23/99(23.2)	22/99(22.2)	22/99(22.2)
	Father absence for work	34/98(34.7)	20/98(20.4)	49/98(50.0)	44/98(44.9)	31/98(31.6)	28/98(28.6)	32/98(32.7)	31/98(31.6)	37/98(37.8)	28/98(28.6)	33/98(33.7)
	Mother absence for work	5/16(31.3)	6/16(37.5)	7/16(43.8)	6/16(37.5)	6/16(37.5)	5/16(31.3)	7/16(43.8)	5/16(31.3)	4/16(25.0)	5/16(31.3)	5/16(31.3)
	Parents' divorce	3/14(21.4)	3/14(21.4)	5/14(35.7)	4/14(28.6)	4/14(28.6)	3/14(21.4)	5/14(35.7)	6/14(42.9)	4/14(28.6)	3/14(21.4)	5/14(35.7)
	Other reasons	21/85(24.7)	18/85(21.2)	35/85(41.2)	33/85(38.8)	24/85(28.2)	22/85(25.9)	25/85(29.4)	17/85(20.0)	22/85(25.9)	20/85(23.5)	21/85(24.7)
	χ^2-value	3.37	3.54	2.19	1.82	0.83	0.68	1.92	5.10	5.79	1.60	4.17
Type of primary caregiver	Father or mother	14/91(15.4)	9/91(9.9)	32/91(35.2)	31/91(34.1)	16/91(17.6)	15/91(16.5)	18/91(19.8)	16/91(17.6)	20/91(22.0)	16/91(17.6)	19/91(20.9)
	Grandparents	36/109(33.0)	21/109(19.3)	53/109(48.6)	49/109(45.0)	42/109(38.5)	30/109(27.5)	37/109(33.9)	33/109(30.3)	36/109(33.0)	32/109(29.4)	30/109(34.2)
	Relatives	13/38(34.2)	13/38(34.2)	17/38(44.7)	19/38(50.0)	11/38(28.9)	14/38(36.8)	14/38(36.8)	12/38(31.6)	9/38(23.7)	11/38(28.9)	13/38(34.2)
	Live alone	25/74(33.8)	21/74(28.4)	36/74(48.6)	27/74(6.5)	24/74(32.4)	24/74(32.4)	28/74(37.8)	24/74(32.4)	25/74(33.8)	19/74(25.7)	24/74(32.4)
	χ^2-value	**10.45***	**13.58****	4.47	4.38	**10.72***	**8.15***	**8.01***	6.16	4.39	4.11	3.76
Education level of your parents	College degree and above	5/32(15.6)	7/32(21.9)	8/32(25.0)	7/32(21.9)	5/32(15.6)	5/32(15.6)	5/32(15.6)	6/32(18.8)	5/32(15.6)	5/32(15.6)	6/32(18.8)
	High school and above	24/84(28.6)	20/84(23.8)	32/84(38.1)	30/84(35.7)	27/84(32.1)	21/84(25.0)	27/84(32.1)	24/84(28.6)	25/84(29.8)	21/84(25.0)	23/84(27.4)
	Junior school	35/132(26.5)	20/132(15.2)	64/132(48.5)	58/132(43.9)	38/132(28.8)	34/132(25.8)	41/132(31.1)	36/132(27.3)	36/132(27.3)	33/132(25.0)	33/132(25.0)
	Primary school	20/60(33.3)	13/60(21.7)	30/60(50.0)	27/60(45.0)	19/60(31.7)	19/60(31.7)	20/60(33.3)	15/60(25.0)	20/60(33.3)	15/60(25.0)	20/60(33.3)
	Illiterate	4/4(100)	4/4(100)	4/4(100)	4/4(100)	4/4(100)	4/4(100)	4/4(100)	4/4(100)	4/4(100)	4/4(100)	4/4(100)
	χ^2-value	**13.65****	**18.74*****	**12.90***	**12.44***	**12.88***	**13.95****	**12.62***	**12.07***	**13.37***	**13.50****	**13.19***
Education level of the people you live with	College degree and above	18/92(19.6)	13/92(14.1)	32/92(34.8)	26/92(28.3)	18/92(19.6)	16/92(17.4)	23/92(25.0)	13/92(14.1)	20/92(21.7)	14/92(15.2)	20/92(21.7)
	High school and above	29/95(30.5)	24/95(25.3)	42/95(44.2)	40/95(42.1)	30/95(31.6)	29/95(30.5)	32/95(33.7)	32/95(33.7)	29/95(30.5)	29/95(30.5)	26/95(27.4)
	Junior school	25/73(34.2)	17/73(23.3)	41/73(56.2)	35/73(47.9)	26/73(35.6)	27/73(37.0)	30/73(41.1)	24/73(32.9)	26/73(35.6)	22/73(30.1)	24/73(32.9)
	Primary school	9/35(25.7)	7/35(20.0)	13/35(37.1)	12/35(37.1)	10/35(28.6)	7/35(20.0)	6/35(17.1)	7/35(20.0)	6/35(17.1)	8/35(22.9)	6/35(17.1)
	Illiterate	7/17(41.2)	3/17(17.6)	10/17(58.8)	12/17(70.6)	9/17(52.9)	4/17(23.5)	6/17(35.3)	9/17(52.9)	9/17(52.9)	5/17(29.4)	10/17(58.8)
	χ^2-value	6.48	4.05	**9.72***	**14.06****	**10.31***	**9.64***	8.62	**17.73*****	**11.17***	7.53	**12.82***
Do you think the people around care about you during the left-behind time?	Never	10/36(27.8)	9/36(25.0)	10/36(27.8)	13/36(36.1)	8/36(22.2)	10/36(27.8)	12/36(33.3)	9/36(25.0)	8/36(22.2)	11/36(30.6)	9/36(25.0)
	A little	14/34(41.2)	13/34(8.2)	16/34(47.1)	18/34(52.9)	14/34(41.2)	16/34(47.1)	18/34(52.9)	13/34(38.2)	19/34(55.9)	13/34(38.2)	18/34(52.9)
	Sometimes	29/67(43.3)	26/67(38.8)	38/67(56.7)	39/67(58.2)	29/67(43.3)	26/67(38.8)	32/67(47.8)	26/67(38.8)	28/67(41.8)	23/67(34.3)	27/67(40.3)
	Very care about	35/175(20.0)	16/175(9.1)	74/175(42.3)	56/175(32.0)	42/175(24.0)	31/175(17.7)	35/175(20.0)	37/175(21.1)	35/175(20.0)	31/175(17.7)	32/175(18.3)
	χ^2-value	**16.17*****	**34.62*****	**8.56***	**16.45*****	**11.73****	**19.50*****	**26.4*****	**9.97***	**25.02*****	**11.83****	**24.07*****
The relationship with your teachers and classmates	Very care about	23/120(19.2)	15/120(12.5)	38/120(31.7)	33/120(27.5)	21/120(17.5)	19/120(15.8)	27/120(22.5)	19/120(15.8)	24/120(20.0)	21/120(17.5)	22/120(18.3)
	More care about	47/167(28.1)	30/167(18.0)	82/167(49.1)	77/167(46.0)	57/167(34.1)	45/167(26.9)	51/167(30.5)	49/167(29.3)	49/167(29.3)	42/167(25.1)	47/167(28.1)
	Little care about	12/17(70.6)	13/17(76.5)	12/17(70.6)	11/17(64.7)	10/17(58.8)	12/17(70.6)	13/17(76.5)	10/17(58.8)	11/17(64.7)	9/17(52.9)	12/17(70.6)
	Not care about	6/8(75.0)	6/8(75.0)	6/8(75.0)	5/8(62.5)	5/8(62.5)	7/8(87.5)	6/8(75.0)	7/8(87.5)	6/8(75.0)	6/8(75.0)	5/8(62.5)
	χ^2-value	**28.57*****	**52.60*****	**17.14*****	**16.35*****	**21.10*****	**39.18*****	**27.70*****	**31.46*****	**23.55*****	**21.35*****	**25.80*****
Have good friends or not in school	Yes	61/247(24.7)	42/247(17.0)	103/247(41.7)	93/247(37.3)	66/247(26.7)	58/247(23.5)	67/247(27.1)	56/247(22.7)	61/247(24.7)	49/247(19.8)	56/247(22.7)
	No	27/65(41.5)	22/65(33.8)	35/65(53.8)	33/65(50.8)	27/65(41.5)	25/65(38.5)	30/65(46.2)	29/65(44.6)	29/65(44.6)	29/65(44.6)	30/65(46.2)
	χ^2-value	**7.21***	**8.95***	3.08	3.68	**5.40***	**5.91***	**8.70***	**12.50*****	**9.95***	**16.85*****	**14.21*****
The person you usually communicate with when encounter problems?	Parents	18/74(24.3)	15/74(20.3)	27/74(36.5)	23/74(31.1)	17/74(23.0)	16/74(21.6)	21/74(28.4)	18/74(24.3)	15/74(20.3)	16/74(21.6)	16/74(21.6)
	Classmate or friend	50/199(25.1)	32/199(16.1)	86/199(43.2)	80/199(40.2)	55/199(27.6)	47/199(23.6)	55/199(27.6)	49/199(24.6)	55/199(27.6)	41/199(20.6)	52/199(26.1)
	Net friend	6/12(50.0)	8/12(66.7)	9/12(75.0)	7/12(58.3)	7/12(58.3)	7/12(58.3)	6/12(50.0)	6/12(50.0)	7/12(58.3)	8/12(66.7)	6/12(50.0)
	Counselor or teacher	3/5(60.0)	1/5(20.0)	3/5(60.0)	3/5(60.0)	3/5(60.0)	2/5(40.0)	2/5(40.0)	2/5(40.0)	3/5(60.0)	3/5(60.0)	2/5(40.0)
	Solve alone	12/22(54.5)	8/22(36.4)	13/22(59.1)	13/22(59.1)	11/22(50.0)	11/22(50.0)	13/22(59.1)	10/22(45.5)	10/22(45.5)	10/22(45.5)	10/22(45.5)
	χ^2-value	9.31	*****	8.96	8.27	**13.23***	**14.66****	**11.60***	8.23	**13.20***	**21.79*****	8.45

Note: A chi-square test was used to compare the prevalence estimates of mental health among different groups. Fisher exact test was used to compare the positive rate among different groups of "the person you usually communicate with when encounter problems". *Significance at the 0.05 level; ** Significance at the 0.01 level; *** Significance at the 0.001 level.

3.2 Results of qualitative interview

Among these forty left-behind students in the qualitative interview, 42.5% were male and 57.5% were female. Freshmen accounted for 32.5%, sophomores and thirds accounted for 30% and 25%, and senior accounted for 12.5%. The mental health problems we found in the qualitative interviews mainly in the following several dimensions.

3.2.1 Anxiety

Through interviews, we found that students who are sensitive, suspicious and more paranoid may be more prone to anxiety disorders. Some of these left-behind students were always nervous, sometimes would be irritable and restless, especially when they encountered something unexpected or something that put a lot of pressure on them. They dared not go to dinner alone or go shopping, because they always felt others were looking at them with strange eyes. During the interview, through observation, we found that some students were so nervous that they kept shaking while speaking, and their expressions were extremely restrained.

Student A: I often had nightmares. During the dream, I was always scared and unsteady, and then I would be awakened. Always, I did not know why I was always scared. If there were a lot of things happened lately, I often had some bad dreams and would not sleep well at night. When I woke up, my heart beat faster and was sweaty all over.

Student B: If I encountered something, whether it happened to my family or to myself, I could not sleep well. Even if I fell asleep, I would always dream. Then the next day, I would have no vigor for class, and could not concentrate on what the teacher was saying.

Student C: During the left-behind time, my parents went out for work, I lived with my grandparents who were old and had big generation gap with me. My grandparents' ideas were so feudal that when they educated me, I often could not help getting angry at them.

Student D: I lived with a relative during my left-behind time. Because I lived in someone else' house, I always had a feeling of being left-behind and under the fence. I was afraid of troubling others, so I always did everything by myself. I never dared to express my true thoughts, often suppressing my emotions and feel anxious.

Student E: *As long as something unexpected happens, it will give me a lot of pressure. I will be very nervous, sometimes fidgety, unable to sleep*

Student F: *Before every examination or interview, or when I encounter something unpleasant, I will be anxious for many days and tremble nervously.*

Student G: If something happens, whether it is about my family or myself, I will not sleep well during a long time. Even if I fall asleep, I will dream all the time. Then I will have no spirit for class the next day.

3.2.2 Depression

We obviously found that some of these left-behind students were in a low mood and not active. They were often putting "let it go", "it is nothing serious", "It is not important" or "unnecessary" on their lips, lacking of vitality and energy. Nearly half of the respondents said that they often felt worthless and hopeless. When they were asked whether they once had thoughts of death, most students said they did not have such thought. But some of these students said that death did not matter to them, and it was not terrible.

Student A: *If others can do things well and I cannot do them well, then I will strongly feel stupid and useless. Moreover, it will make me feel worthless.*

Student B: In high middle school, I always felt particularly depressed because of my study. Now, I do not worry about study, but worry about money every day, which make me particularly irritable. There was a time I always wanted to hit someone and throw things. In short, many things make me depressed at every stage of my life.

Student C: There is no thought of suicide, but I often think that death is not terrible, and it does not matter.

Student D: I am often inexplicably depressed, do not want to go out, just want to stay alone, not communicate with any classmates or teachers, and always think about one thing "How much is the meaning of life or study anyway?"

Student E: I often can't control my mood, especially easy to cry. For example, once a time, I was in a bad mood and passed by the car back home. When I asked for help from the staff of station, she criticized me, and I cried for a long time. I felt that many people in the station were looking at me. The more I thought about it, the more I cried and couldn't stop.

3.2.3 Obsessive-compulsion (Ocd)

Due to living with their grandparents or relatives for a long time, or living alone, these left-behind students always lacked of parental care and education. In this case, although they formed an independent personality and qualities (especially the female students, play the role of mother caring for the little brother or sister), they always showed a kind of escapism, insecure and uncertain about many things. Meanwhile, they often had some meaningless impulses, thoughts and actions that they did not have to. But due to lack of security and certainty, even though they knew these behaviors were not necessary or meaningless, they always could not get rid of it. In psychology, these symptoms are called obsessive-compulsion (Ocd).

Student A: When I was a kid, I used to be left-behind at home alone, and often locked at home. So now, I always think about whether the door is locked, even I had locked it already. I always do something over and over again until I can make sure that I have done it well.

Student B: I often suspect that there is a problem in one part of my body. There was no problem after repeated inspections in the hospital, but I still suspect, and this matter have been troubling me until now. Meanwhile, there are many unnecessary thoughts or words circling in my head. Sometimes, I could hear some sounds that others can't hear.

Student C: Because of my childhood experience of being alone at home, I am not sure about many things and think about one thing repeatedly. I often ask my roommate if we have locked the door when we get to the classroom, which makes my roommates often laugh at me.

3.2.4 Interpersonal sensitivity

Some left-behind students said they had inferiority, uneasiness, discomfort, primness and negative expectation in the interpersonal communication, which were the typical characteristics of the left-behind students. During the interview, we also found that these students were low self-esteem and restrained. They don't dare to express themselves or communicate with others.

Student A: I often don't know what to say, and I think this may be related to my personality. In front of the person I am not familiar with, I always feel uncomfortable and hardly speak. In a word, I can't be myself.

Student B: I don't like to go to parties or places with lots of people unless I have to. If the person I communicate with is of a higher level, a higher identity, or I think an excellent person, I will be not comfortable enough to express myself.

Student C: Just when I was in college, our classmates all spoke Mandarin. Because I used to speak my hometown dialect before I went to college, sometimes I did not know how to express what I wanted to say. I often had this feeling, which always made me dare to talk with others.

Student D: Living in other's home, unlike in my own home, I always can't be myself and feel like I am an outsider. So, I don't dare to trouble others, and I don't know how to ask for help, so I often do everything by myself. I know it because I don't know how to communicate with others, and I dare to communicate with others.

3.2.5 Hostility

During the interview, we also found that some students were unconfident and always thought in the bad direction when encountering problem. Some students always could not trust others, and always had a hostile towards others. When asked the questions of "Do you have hostile thoughts, feeling or behaviors?" or "Do you think someone else is trustworthy or not?", one of the students said: *"I can't believe in others. I think most people have a desire for self-protection from the bottom of their hearts. I remember Wang Yinglin (a historian in Southern Song Dynasty of China) said in his Three Character Classic that human nature was good at the beginning, but I think human nature is selfish". And another student sad: "if you make a mistake, you will easily forgive yourself, but if others make a mistake, it is not so easy to forgive. So, in the process of human interaction, whether between parents and children, or among friends, and all kind of relationships, I think it's all about interests, common or different interests", she also said "I think the relationship between people, whether it's between parents and children, or with friends, and then all kinds of relationship, as well as with the country, I think they are all exchange of interests."*

4 Discussion

The prevalence estimate of total mental health problems was 35.6% among the left-behind students, which was much higher than the prevalence estimate of 20.0% among the control students. There were also significant differences in the prevalence estimates of the ten dimensions of SCL-90 scale between left-behind students and controls, and the prevalence estimates of the left-behind students were all higher than that of controls. These findings were in line with those in former studies, which showed that the prevalence was higher than the norm of Chinese college students (Green et al., 2015; Xing et al., 2009). Our study also confirmed that left-behind experience was a significant influencing factor for the college students' mental health, which was consistent with the study of Zhang (Zhang, 2006). The quantitative analysis in this study indicates that growth environment is an important factor influencing one's personality and character, especially the family environment, which is consistent with the results of the qualitative interviews. This study also shows that lacking of family supports and parents' company at the key stage in the life course, children and adolescents may not be able to develop the ability of managing their emotions well and be prone to mental health problems, which is consistent with the studies about the mental health left-behind children (Tang et al., 2018; Zhang, 2016; Jia, 2014).

For the left-behind students, of the ten dimensions of SCL-90 scale, the prevalence estimate of Ocd problem was the highest (44.2%), followed by interpersonal sensitivity problem (40.4%). Compared to control students, left-behind students were more likely to have an Ocd problem (OR= 1.95, 95%CI:1.50 to 2.53) and interpersonal sensitivity problem (OR=2.44, 95%CI:1.87 to 3.20). This reminded us that due to left-behind experience, the most obvious personality traits of the left-behind students were sensitivity, lack of security and certainty, low self-identify and interpersonal skills (Shi, 2016), which was also consistent with the findings in our qualitative interview. In addition, the prevalence estimates of somatization, depression, anxiety, hostility, terror, paranoia, psychosis and other symptoms problems among male students were all higher than the prevalence estimates among female students. Since girls usually mature earlier, left-behind experience has given them many positive effects. Due to parents' absence, girls are relatively independent and take the role of caring for their brother or sister (Zhang, 2006; Shu et al., 2008; Wang, 2008). Meanwhile, the results of quantitative analysis in our study indicates that left-behind experience can make them obsessive-compulsive disorder and interpersonal sensitivity, which were consistent with the findings of our qualitative interviews. Left-behind students living with grandparents and relatives will be more independent than other college students will. In this situation, these students might reduce their need for interpersonal communication and be more sensitive in the process of interpersonal communication (Luo et al., 2017; Wang, 2018).

Among these left-behind students in the quantitative survey, 41.3% had separated from one or two parents two years or more, and 58.7% less than two years. 36.5% of them had one parent migrating and 31.7% had both parents migrating. Although we did not find significant difference in the prevalence of total mental health problems and the ten dimensions of the SCL-90 scale among the groups of 'duration of left-behind' and 'both or one parent migrating', but from the impact of "caregivers during the left-behind time" on the left-behind students' mental health, we could see that there were significant difference in the prevalence estimates of total mental health, somatization, depression, anxiety and hostility among different caregivers. Students living with the relatives had higher prevalence estimates of somatization and anxiety than that among ordinary students, which was consistent with the findings of Wangs study (Wang, 2018) and our qualitative interview. Some left-behind students said living with grandparents or relatives during the left-behind time, they always could not be themselves, dare not express their true ideas, and depressed for a long time. In this growth environment for a long time, these students may be more prone to anxiety, un-confidence, international sensitive problems and lower social adaptability. Some studies indicated that left-behind children revealed a failure of provision, protection and participation; and the failure may have a negative impact on left-behind children's development, and make them lack of security and self-confidence (Wang, 2008; Zhang, 2018). Some left-behind students in our interviews said they often had some meaningless impulses, thoughts and actions that they do not need to do. Although they know these behaviors are not necessary or meaningless, they always can't get rid of it.

These college students with left-behind experience may not like to communicate with their parents. When they encountered problems, only 23.7% of the students were willing to communicate with their parents, while others preferred to solve problems by communicating with other people or by themselves most of the time. This might because they did not live with their parents for a long time, which caused alienation of parent-child relationship. However, of note, when interpreting this we need take cautious since we did not compare this phenomenon between college students with and without left-behind experience. Meanwhile, during the left-behind time, due to monotonous communication content, low communication frequency, cognitive deviation of not being deeply loved, inappropriate parent-child communication mode and unreasonable family education mode, these left-behind students were unwilling to express themselves facing their parents (Zhang, 2006; He, 2013; Tang et al., 2018). Coupled with living with the grandparents or relatives, they formed a habit of expression suppression that influenced their mental health (Tang et al., 2018; Zhan et al., 2016; Wang et al.,2015; Zhang et al.,2018). In the quantitative survey, the variable of "The person the students usually communicate with when they encounter problems" was associated with the somatization, depression, anxiety, hostility, paranoia and psychosis problems. In addition, the students who chose to communicate with net friends or other people or solve problems by themselves had a higher prevalence rate of mental health problems than the students who chose to communicate with parents. The results suggested that the communication was very important for children's mental health development.

The study also found that education level of the left-behind students' parents and the people they lived with during the left-behind time had significant influence on the left-behind students' mental health. As the education level decreased, the prevalence rate of mental health problems among left-behind students increased. There were significant differences in the prevalence estimates of Ocd, interpersonal sensitivity, depression, anxiety, terror, psychosis and other symptom problems among different education levels. This may be explained by the former research results that education level influences one's way of communication, emotional expression and family upbringing (Zhan et al., 2016). Due to low education, their

parents tended to be more concerned about the child's physical status and less concerned about the mental health, especially if they rarely met or communicated with each other. One student said that his grandmother was old and the ideas were feudal. Under this condition, the student always got annoyed with her, even if he tried his best not to lose his temper. Some students living with their relatives said "because living with my relatives, I always felt I was an outsider. In order to please them or not bother them, I would do everything that I could do".

5 Limitations

There are some limitations in this study. Firstly, due to the cross-sectional study design, the results from this study cannot be used to establish causality. Cohort studies are therefore needed in the future research to dig deep into the mental health problems of college students with left-behind experience. Secondly, although we have tried our best to improve the representativeness of the sample and the investigative quality of the study, we recruited participants from one city in Eastern China, which was not a nationally representative sample. Therefore, we still need to expand the sampling area and sample size in the future research. In the qualitative interview, the sample size was limited and the conversation was not deep enough. Future studies with larger and national samples should be conducted to make the samples more representative. Thirdly, we could not compare the results we get in China to that in other countries, due to the lack of data on the similar studies conducted in other countries. In addition, at present, there are many Chinese scholars and literatures on the study of mental health of college students with left-behind experiences, and lacks rich English literatures with impact factor, which limits a more comprehensive interpretation.

6 Conclusion

This study indicated that left-behind experience was a significant factor associated with the mental health of college students. There was significant difference in the prevalence estimates of the total mental health problems and the ten dimensions of SCL-90 scale between left-behind students and controls, and the prevalence estimates of the left-behind students were all higher than that of controls. And the mental health problems of left-behind students we found in the qualitative interviews are mainly on anxiety, depression, obsessive-compulsion, interpersonal sensitivity, hostility, which is a supplement to the quantitative survey. However, future high quality cohort studies are required to supplement the evidence. Survey design should be further developed, and a nationally representative sample should be used to evaluate the mental health of college students with left-behind experience.

Uncited references

Hoffmann and Overall, 1978, Li et al., 2018, Aertgeerts et al., 2000, Li et al., 2019, Li et al., 2014, Shu and Zhang, 2008, Wang et al., 2015, Wang and Xiao, 2018, Zhang et al., 2020, Zhan and Wu, 2016, Zhao et al., 2017, Elder, 1975

Declaration of Competing Interest

All the authors declare they have no conflicts of interest.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2021.04.087.

References

The corrections made in this section will be reviewed and approved by a journal production editor. The newly added/removed references and its citations will be reordered and rearranged by the production team.

Amato, P.R., 1993. Children's adjustment to divorce: theories, hypothesis, and empirical support. ~~Journal Marriage Family~~ J. Marriage Fam. 23–28.

Aertgeerts, B., Buntinx, F., Ansoms, S., Fevery, J., 2000. Questionnaires are better than laboratory tests to screen for current alcohol abuse or dependence in a male inpatient population. Acta. Clin. Belg. 57, 241–249.

Asen, N.S., Breivik, K., Wold, B., Boe, T., 2017. Divorce and family structure in Norway: associations with adolescent mental health. ~~Journal Divorce Remarriage~~ J. Divorce Remarriage 1–20.

Astrup, A., Pedersen, C.B., Mok, P.L., Carr, M.J., Webb, R.T., 2017. Self-harm risk between adolescence and midlife in people who experienced separation from one or both parents during childhood. ~~Journal Affect Disorders~~ J. Affect Disord. 208, 582–589.

Bruffaerts, R., Mortier, P., Kiekens, G., Auerbach, R.P., Cuijpers, P., Demyttenaere, K., Green, J.G., Nock, M.K., Kessler, R.C., 2018. Mental health problems in college freshmen: Prevalence and academic functioning. ~~J. Affect Disord~~ J. Affect. Disord. 1225, 97–103.

Bryant, R., Creamer, M., Odonnell, M., Forbes, D., Felmingham, K., Silove, D., 2017. Separated from parents during childhood trauma predicts adult attachment security and post-traumatic stress disorder. Psychol. Med. 47, 2028–2035.

Cai, C.L., 2009. Research on the current situation and educational countermeasures of college students' mental health in southern Fujian. Xiamen University July.

Derogatis, L.R., 1977. The SCL-90: Administration, scoring and procedures manual. John Hopkins University Press, Baltimore.

Elder, G.H., 1975. Children of the Great Depression. The University of Chicago Press, Chicago, USA.

Green, M.A., Subramanian, S.V., Vickers, D., Dorling, D., 2015. Internal migration, area effects and health: Does where you move to impact upon your health? ~~Social Science & Medicine~~ Soc. Sci. Med. 136, 27–34.

He, D.L., 2013. Relationship between subjective well-being and social support of the undergraduates from local university with left-behind experience. ~~Chinese Journal of School Health~~ Chin. J. School Health 08, 952–954.

Hoffmann, N.G., Overall, P.B., 1978. Factor structure of the SCL-90 in a psychiatric population. ~~Journal of Consulting and Clinical Psychology~~ J. Consult. Clin. Psychol. 46, 1187–1191.

Hu, J.H., Li, Q., Zhao, W.J., 2008. The analysis of psychological health of college students with guarded experience and ways to solve it. ~~Researches in Medical Education~~ Res. Med. Educ. 4 (439–440), 448.

Jia, P.P., 2014. The impact of parents' absence on the personality development of left-behind children and its countermeasures—Based on Erickson's personality development stage theory. ~~Journal of Jilin Institute of Education (the first ten days)~~ J. Jilin Inst. Educ. (the first ten days) 354 (06), 32–34.

Jin, T.L., Zhang, L., Wu, Y.T., Yang, H., Liu, Z.H., Huang, M.M., 2019. The effects of social trauma on aggression of College students left at home during their childhood: the mediating role of Alexithymia. ~~Chinese Journal of Special Education~~ Chin. J. Spec. Educ. 06, 91–96.

Kerr, D.C., Capaldi, D.M., 2011. Young men's intimate partner violence and relationship functioning: long-term outcomes associated with suicide attempt and aggression in adolescence. Psychol. Med. 41, 759–769.

Lei, Y., 2015. A survey of mental health status of rural left-behind college students in a Vocational college. ~~Journal of Campus Life & Mental Health~~ J. Campus Life Mental Health 1, 21–24.

Li, H., Zhao, S.Y., Pan, X.Y., 2018. The impact of students with left-behind experiences on childhood: The relationship between negative life events and depression among college students in China. ~~International Journal of Social Psychiatry~~ Int. J. Soc. Psychiatry 64 (1), 56–62.

Li, J., Chang, S.S., Yip, P, 2014. Mental wellbeing amongst younger and older migrant workers in comparison to their urban counterparts in Guangzhou city, China: A cross-sectional study. BMC Public Health 14, 1280.

Li, M.L., Ren, Y.Y., Jiang, F., 2019. A meta-analysis of social anxiety in left-behind children in rural areas of China. ~~Chinese Mental Health Journal~~ Chin. Mental Health J. 11, 839–844.

Li, Y.L., Liu, L.J., Yang, J., 2019. The relationship between problem behavior and negative emotions and positive personality traits of college students with left-behind experience. ~~Chinese Journal of Mental Health~~ Chin. J. Ment. Health 4, 318–319.

Li, Y., Wang, P.C., Ling, C., 2014. Study on the mental health of college students who have left-behind experience. ~~Journal of Lanzhou Institute of Education~~ J. Lanzhou Inst. Educ. 12, 155–156.

Liu, C.B., Wang, S.T., 2014. The experience of left-behind and mental health of college students from second generation of floating peasants: based on the perspective of reform in floating population system. ~~Youth Studies~~ Youth Stud. 5, 23–32.

Liu, H.X., Lin, L., Wang, J., 2015. Study of mental health of college students with left-behind experiences in one medical university. ~~Chinese Journal of Hospital Statistics~~ Chin. J. Hosp. Stat. 21 (05), 329–332.

Liu, H.X., Zhou, Z.L., Fan, X.J., Wang, J., Sun, H.W., 2020. The influence of left-behind experience on college students' mental health: a cross-sectional comparative study. ~~International Journal of Environmental Research and Public Health~~ Int. J. Environ. Res. Public Health 17, 1511.

Liu, W., Li, J., Huang, Y.X., Yu, B.L., Qin, R.F., Cao, X.J., 2020. The relationship between left-behind experience and obsessive compulsive symptoms in college students in China: the mediation effect of self-esteem. ~~Psychology, Health & Medicine~~ Psychol., Health Med. 10 1748667.

Lu, S., 2016. Well-being of migrant and left-behind children in China. New Brunswick Rutgers, New Jersey Oct.

Pang, R., Peng, J., 2018. Meta-analysis on the mental health status of Chinese college students with left-behind experience. ~~Pract Prev Med~~ Pract. Prev. Med. 4, 467–468.

Scott, K.M., Lim, C., Hamzawi, A., Alonso, J., Bruffaerts, R., Caldas, J.M., 2016. Association of mental disorders with subsequent chronic physical conditions: world mental health surveys from 17 countries. ~~JAMA Psychiatr~~ JAMA Psychiatr. 73, 150–158.

Shi, J.Y., Chen, Z.T., Yin, F., 2016. Resilience as moderator of the relationship between left-behind experience and mental health of Chinese adolescents. ~~International Journal of Social Psychiatry~~Int. J. Soc. Psychiatry March,14.

Shu, Y., Zhang, L.H., 2008. Left-behind: the years that are unforgettable. ~~Legal System~~Legal Syst. 3, 273–274.

Song, G.W., He, Y.F., Ding, L., Lv, L.C., Zhou, K., 2013. On the relationship between mental health, resilience and subjective well-being of secondary school students left at home in childhood. ~~Chinese Journal of Special Education~~Chin. J. Spec. Educ. 2, 87–91.

Su, N.N, Wang, J.Q., Huang, H.L., 2016. Research and countermeasures of the mental health of freshmen with left-behind experience. ~~Medical Innovation of China~~Med. Innov. China 06, 73–76.

Tang, W.J., Wang, G., Hu, T., Dai, Q., Xu, J.J., 2018. ~~Mental health and psychosocial problems among Chinese left-behind children: A cross-sectional comparative study~~Mental health and psychosocial problems among Chinese left-behind children: a cross-sectional comparative study. ~~Journal of Affective Disorders~~J. Affect. Disord. 241, 133–141.

Wang, L.F., Feng, Z.Z., Yang, G.Y., 2015. The epidemiological characteristics of depressive symptoms in the left-behind children and adolescents of Chongqing in China. ~~Journal of Affective Disorders~~J. Affect. Disord. 177, 36–41.

Wang, L.L., Wu, W., Qu, G.B., Tang, X., Sun, Y.H., 2018. ~~The personality traits of left-behind children in China: A systematic review and meta-analysis~~The personality traits of left-behind children in China: a systematic review and meta-analysis. ~~Psychology, Health & Medicine~~Psychol., Health Med. Oct,30.

Wang, Y.H., 2008. The relationship between children's left behind experience, social support, coping style and college students' subjective well-being. ~~Chinese Journal of Health Psychology~~Chin. J. Health Psychol. 16 (04), 388–389.

Wang, Y.Y., Xiao, L., 2018. The prevalence of depressive symptoms in 'left-behind children' in China: a meta-analysis of comparative studies and epidemiological surveys. ~~Journal of Affective Disorders~~J. Affect. Disord. 244, 209–216.

Xing, H.Y., Wang, J.H., Gao, X.H., 2009. Study on the mental health of common university students. ~~Modern Preventive Medicine~~Mod. Prevent. Med. 36 (23), 1196–4497 4500.

Yang, X.L., Feng, X.G., Cui, Z.T., 2014. Relation of left-behind experience to psychological resilience and psychopathological symptoms in college students. ~~Chinese Mental Health Journal~~Chin. Ment. Health Jo. 3, 227–233.

Ye, Y.L., Wang, P.G., Qu, G.C., 2016. Associations between multiple health risk behaviors and mental health among Chinese college students. ~~Psychology, Health & Medicine~~Psychol., Health Med. 21 (03), 377–385.

Zhang, C.Y., Xu, W., Lu, H.Y., 2020. Longitudinal relationship between inferiority and aggression in Chinese college students: The moderation of left-behind experience. Personality and Individual Differences 109791.

Zhan, Q.S., Wu, Y., 2016. The effect of parenting styles on emotion regulation strategies from college students once left at home by their parents working in cities: the mediating effect of parent-child communication. ~~Chinese Journal of Special Education~~Chin. J. Spec. Educ. 10, 40–46.

Zhang, J.H., Yan, L.X., Qiu, H.Y., Dai, B.R., 2018. Social adaptation of Chinese left-behind children: Systematic review and meta-analysis. ~~Children and Youth Service Review~~Children Youth Serv. Review 95, 308–315.

Zhang, L.H., 2019. Psychological analysis of the college students with 'left behind experience'. Report on China's child welfare and protection policy. https://news.sina.com.cn/c.

Zhang, P.N., 2016. Study of left-behind experienced college students' mental health status and its influencing factor.

Zhang, Q.S., Wu, Y., 2016. The effect of parenting styles on emotion regulation strategies from college students once left at home by their parents working in cities: The mediation effect of parent-child communication. ~~Chinese Journal of Special Education~~Chin. J. Spec. Educ. 10, 40–46.

Zhao, C.Y., Zhou, X.D., Wang, F., Jiang, M., Hesketh, T., 2017. ~~Care for left-behind children in rural China: A realist evaluation of a community-based intervention~~Care for left-behind children in rural China: a realist evaluation of a community-based intervention. ~~Children and Youth Services Review~~Child. Youth. Serv. Rev. 82, 239–245.

Zhan, L.Y., Lian, Q., Wang, F., 2016. Correlation between self-efficacy, social support and mental health of college freshmen with left-behind experience. ~~Chinese Journal of School Health~~Chin. J. School Health 37, 614–617.

Zhang, Y., Peng, L.C., Yuan, K.J., 2015. A comparative analysis of the psychological status of college students with left-behind and floating experience. ~~Theory and Practice of Contemporary Education~~Theory Pract. Contemporary Educ. 4, 143–146.

Highlights

- It may be very useful and reliable for exploring the influence of left-behind experiences on college students' mental health using a mixed method involving quantitative survey and qualitative methods. The main results of the two methods were consistent and complemented each other.

- Our study provides some data and basis for understanding the mental health problems of college students with left-behind experience. These students are a special group that is emerging on a large scale and quickly, especially in China. Currently, there are rare similar studies in countries other than China, so the results of the study may be a meaningful reference to many similar countries or other settings that are undergoing large-scale and rapid urbanization.

- The result of the quantitative survey indicated that left-behind experience was an important factor associated with college students' mental health, and it could increase the prevalence estimate of mental health problems (after controlling confounding factors using the generalized linear model). College students with left-behind experience are more prone to have mental health problems, including the prevalence of somatization, Ocd, interpersonal sensitivity, depression, anxiety, hostility, terror, paranoia, psychosis and other symptoms problems. And different left-behind experiences and social supports during the left-behind time had different effects on college students' mental health.

Q2

- Through interviews, we found that some left-behind students said they often had some meaningless impulses, thoughts and actions that they do not need to do. And they didn't like to communicate with their parents when they encountered problems, which might be associated with the somatization, depression, anxiety, hostility, paranoia and psychosis problems.

Appendix Supplementary materials

Multimedia Component 1

alt-text: Image, application 1

Queries and Answers

Q1

Query: Please confirm that givennames and surnames have been identified correctly.

Answer:

Q2

Query: Please confirm that the provided email "zzliang1981@163.com" is the correct address for official communication, else provide an alternate e-mail address to replace the existing one, because private e-mail addresses should not be used in articles as the address for communication.

Answer:

Q3

Query: This section comprises references that occur in the reference list but not in the body of the text. Please position each reference in the text or, alternatively, delete it.

Answer:

Q4

Query: Please check funding information and confirm its correctness.

Answer: