Effect of family-related adverse childhood experiences on self-rated health in childhood and adulthood——childhood friendships as moderator

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A B S T R A C T

Although many existing studies have shown that family-related adverse childhood experiences (ACEs) have a negative effect on individual health, few studies have examined the role of childhood friendships in the relationship between ACEs and health outcomes. The present study used ordered logistic regression analyze the data from the China Health and Retirement Longitudinal Study (CHARLS) conducted in 2014, which is a national representative survey, to investigate the impact of family-related ACEs on self-rated health in childhood and adulthood and the moderating effects of childhood friendships. We found that respondents whose ACEs included physical and emotional neglect, parental physical illness, parental mental illness, family economic hardship, experience of starvation, lived in insecure neighborhood, and lived in unclean community, had a lower self-rated health in childhood and adulthood than those without ACEs. Peer relationship moderates the impact of family-related ACEs—namely, family economic hardship and parental physical illness—on health outcomes, and the increase of peer relationship can reduce adverse effects. Our findings suggest that family-related ACEs are not only related to health in the early life, but also to health outcomes in adulthood. Childhood friendships can reduce the adverse effects of ACEs on health outcomes throughout an individual's life course. Therefore, it is necessary to actively cultivate children's peer relationship networks and improve the quality of childhood friendship.

1. Introduction

1.1. Background

Recent studies have shown an increasing evidence indicating an association between family-related adverse childhood experiences (ACEs) and health outcomes (Edwards, Holden, Felitti, & Anda, 2003; Felitti et al., 1998; Monnat & Chandler, 2015; Reiser, Mcmillan, Wright, & Asmundson, 2014). The negative impact of family-related ACEs on children's health was identified. For instance, Lynch et al. (2016) found that family-related ACEs, such as parental deaths and family economic difficulties, were significantly associated with childhood obesity, and Bethell, Newacheck, Hawes, and Halfon (2014) found that American children with family-related ACEs had a higher incidence of chronic diseases than children without ACEs. The impact of ACEs on children's health may vary depending on the number and intensity of ACEs. Heerman, Krishnaswami, Barkin, and McPheeters (2016) found that the prevalence of obesity in children with two types of family-related ACEs was significantly higher (20.4%) than those without ACEs.

Clarkson-Freeman (2014) and Kerker et al. (2015) also found that children who experienced three or more ACEs had a higher risk of experiencing adverse health outcomes compared to those with no ACEs. In addition, Thompson et al. (2015) distinguished three types of adverse experiences, namely, "chronic ACEs," "early ACEs only," and "limited ACEs," and found that the group of "chronic ACEs" had increased self-reported health concerns at the age of 18 than other groups.

The negative impact of ACEs on health outcomes in adulthood has been also widely recognized in existing literature. Scholars have demonstrated that exposure to adversity in childhood, including domestic violence, parental mental illness, sexual abuse, loss, and poverty, is a known risk factor for long-term physical and mental health problems (Turrell et al., 2007; Chartier, Walker, & Naimark, 2010; Oladeji, Makanjuola, & Gureje, 2010; Kalmakis & Chandler, 2015; Balistreri & Alvira-Hammond, 2015; Porche, Costello, & Rosen-Reynoso, 2016). A graded dose-response effect has also been identified, whereby the impact on health outcomes increases as the number and frequency of ACEs increases (Brown et al., 2009; Clarkson-Freeman, 2014; Dong et al., 2004; Dube, Felitti, Dong, Giles, & Anda, 2003; Hughes et al.,

2017). For example, Felitti et al. (1998) found that participants with higher ACE scores were twelve times more likely to have adverse health outcomes as adults compared to those with lower ACE scores. A relatively strong graded relationship has also been found between the number of adverse childhood experiences, such as psychological/emotional abuse, physical neglect, psychological neglect of basic needs, and poor health (Ramiro, Madrid, & Brown, 2010). Furthermore, high cumulative ACE scores have been associated with depression, anxiety, and other mental health conditions in adulthood (Chapman et al., 2004; Edwards, Holden, Anda, & Felitti, 2003; Whitfield, Dube, Felitti, & Anda, 2005; Cambron, Gringeri, & Vogel-Ferguson, 2014); alcoholism and illicit drug use (Anda et al., 2002; Dube, Anda, Felitti, Edwards, & Croft, 2002); and greater engagement in high-risk behaviors (Chang, Jiang, Mkandarwire, & Shen, 2019; Hillis, Anda, Felitti, & Marchbanks, 2001). In sum, previous studies analyzed the relationship between family-related ACEs and health outcomes in the course of life from different aspects, and revealed that adverse experiences in early life have a significant impact on health outcomes.

What has been examined in the literature are protective factors that may mediate against the negative effects of ACEs. Studies have suggested that, compared to those with fewer advantages, individuals with a greater number of identified and developed advantages, especially interpersonal strengths, tend to have fewer behavioral health problems (Accomazzo, Israel, & Romney, 2015; Whitson, Bernard, & Kaufman, 2013). As an important part of interpersonal relationship, peer relationship have been addressed in existing studies to have a significant impact on the emotional and behavioral development of people, and positive relationship may play an important role in moderating the negative effects of ACEs. For example, scholars have found that adolescents with close relationship to friends are less likely to engage in risky or delinquent behaviors and are less likely to experience mental health problems (Brendgen, Vitaro, & Bukowski, 2000; Helsen, Vollebergh, & Meeus, 1997; Logan-Greene, Green, Nurius, & Longhi, 2014). Sege et al. (2017) also found that compared with people who lack supportive relationship, people exposed to four or more ACEs who felt supported by friends in childhood had significantly lower rates of poor health in adulthood. Landers, Johnson, Armstrong, Mcgrath, and Dollard (2020) further found that peer relationship as a protective factor can explain the relationship between bad childhood experiences and youth outcomes such as risk behaviors, and behavioral needs across life course. Therefore, peer relationship may moderate the relationship between ACE scores and individual health outcomes. Specifically, we hope that good peer relationship can better explain how ACEs affect the subjective health outcomes of individuals. However, existing research often ignores the role of childhood friendships as a resilience resource in reducing the adverse effects of ACEs; thus, this study takes this factor into consideration and analyzes the moderating effect of childhood friendships on the relationship between family-related ACEs and health outcomes.

In China, adverse family experiences encountered in childhood have clearly changed and became more diverse compared to those of the past. For example, the Third Wave Survey on the Social Status of Women in China conducted by All-China Women's Federation and National Bureau of Statistics in 2011 showed that 24.7% women experienced different forms of domestic violence from their spouses throughout matrimony, and growing up in an environment of domestic violence was detrimental to an individual's health. The divorce rate in China has also risen to 32% in 2018 from 6.6% in 1979 (Ministry of Civil Affairs of China, 2018); consequently, the proportion of children who experience the breakdown of their original family during their childhood is also increasing. The negative experience of childhood family breakdown has become a potential risk factor for the healthy growth of individuals.

With the aforementioned diversified trend of family-related ACEs in China, the long-term effects of these negative experiences on individual health outcomes are a focus area for current research (Chang, Jiang, Mkandarwire, & Shen, 2019) and are greatly significant to reveal the causal mechanism of health inequality. Therefore, we believe that the impact of family-related ACEs on an individual's health may be a long-term and longitudinal accumulation process that spans an individual's life course.

1.2. Research hypothesis

This study uses retrospective survey data to examine the effects of family-related ACEs on an individual's health outcomes in childhood and adulthood, as well as the moderating role of childhood friendships. Based on this, we establishes the following research hypotheses.

Research Hypothesis 1. Family-related ACEs have a significant impact on an individual's childhood health outcomes. People with family-related ACEs have worse self-rated health in childhood than those without ACEs.

Research Hypothesis 2. Family-related ACEs have a significant impact on an individual's adulthood health outcomes. People with family-related ACEs have worse self-rated health in adulthood than those without ACEs.

Research Hypothesis 3. Childhood friendships moderate the relationship between family-related ACEs and health outcomes. High-quality peer relationship may reduce the adverse effects of family-related ACEs on self-rated health in adulthood.

2. Methods

2.1. Data

This research uses the data from the China Health and Retirement Longitudinal Study (CHARLS, http://charls.pku.edu.cn/zh-CN), a large-scale survey conducted by the National School of Development at Peking University, and is a high-quality micro-data study of China's population and society. CHARLS targets middle-aged and elderly families and individuals over 45 years old in China and uses a multi-stage sampling method to select respondents. This study mainly uses data from the third wave survey conducted in 2014, and this wave of surveys focuses on the life course of the elderly in China. This survey also collects the individual's life history information such as education history, fertility history, marriage history, employment history of the elderly through a retrospective method; in particular, it surveys family-related ACEs and subjective self-rated health status of the respondents, and provides a good foundation for us to study the impact of family-related ACEs on individual health outcomes. A total of 20543 participants were selected from 28 county-level units for investigation in this wave, but after deleting the missing observations, the final valid sample for this study was 13953. The work has been approved by the appropriate ethical committees related to the institution(s) in which it is performed and that subjects gave informed consent to the work.

2.2. Variables

2.2.1. Dependent variables

The dependent variables for this study are self-rated health in childhood and self-rated health in adulthood. Self-rated health in childhood refers to the self-rated health status of the respondent before the age of 15 (including 15 years), and is measured on a five-point scale, including "very good," "good," "fair," "poor," and "very poor." Self-rated health in adulthood refers to the self-rated health level of the respondents at the time of the survey, and is also measured using a five-point scale of "very good," "good," "fair," "poor," and "very poor." The minimum value of the independent variable is 1, and the maximum value is 5. The subjective self-rating of health is used in this study as a measurement of health because self-reported views on health provide unique insight that objective measures do not. For example, an

individual's experience of health problems is different from objective measures of health problems. Two people may have the same chronic health condition, but one could report the experience of said health problem as much more debilitating than the other. Individuals exposed to ACEs have increased risk for psychopathology and are more likely to view their health as negative. Reporting on self-rated health outcomes has merit since it captures individuals' perceptions of their health and thus highlights how ACEs impact quality of life. Moreover, Murray and Chen (1992) and Bailis, Segall, and Chipperfield (2003) established that subjective self-rated was an effective measure of an individual's health and can reflect an individual's physical function and overall health status.

2.2.2. Independent and control variables

The independent variables in this study are family-related ACEs and peer relationship. For measuring family-related ACEs, existing research usually used retrospective indicators, which allowed respondents to recall family-related ACEs that occurred during childhood. For this approach, Reuben et al. (2016) proved that ACEs prospectively recorded throughout childhood and retrospectively recalled in adulthood were in agreement and also found a strong correlation between retrospective ACEs and subjectively rated health outcomes. In addition, some scholars have measured the following family-related ACEs: emotional abuse, physical abuse, sexual abuse, exposure to substance abuse, mental illness, violent treatment by mother or stepmother, criminal behavior, and parental separation or divorce (Dube et al., 2003). Other scholars used the total score of the following items to measure ACEs, including parental divorce or separation, parental incarceration, witnessing domestic violence, and living with a person with mental illness or suicide risk, living with a person who abuses alcohols or drugs, having experienced socioeconomic difficulties since birth, death of a parent, being a victim or witness of violence in the neighborhood, and being discriminated against or experiencing unfair treatment due to race or ethnic origin (Chang, Jiang, Mkandawire, Shen, & Seedat, 2019). The present study takes into consideration the following family-related ACEs: parents divorced, death of a parent, physical abuse, domestic conflict, parental bias, physical and emotional neglect, substance abuse by parents, incarcerated parents, parental physical illness, parental mental illness, family economic hardship, experience of starvation, lived in insecure neighborhood, and lived in unclean community. All the questions could be answered using "Yes/No," indicating whether the adverse event occurred during childhood.

We refer to Lansford, Yu, Pettit, Bates, and Dodge (2014) for measuring peer relationship. They used three items to measure peer relationship, which were adapted from the "Friendship Qualities Scale" formulated by Bukowski, Hoza, and Boivin (1994). Specifically, we use the following three items to measure peer relationship: "When you were a child, how often did you feel lonely because of not having friends to share your personal problems?"; "When you were a child, did you often have a group of friends from whom you could ask for help and felt comfortable spending time with?"; and "When you were a child, did you often feel happy with you friends?" Items are rated on a four-point scale ranging from "1 = often" to "4 = never." The responses are then averaged to create a best friendship quality composite score. To examine the moderating effect of peer relationship on the relationship between ACEs and health outcomes, this study establishes the interaction terms of family-related ACEs and peer relationship.

The control variables in this study include gender, age, ethnicity, years of schooling, urban-rural and siblings. Demographic variables, such as gender, age, and ethnicity of respondents, have also been found to affect health status (Kwong & Hayes, 2017; Porche et al., 2016; Bellis, Lowey, Leckenby, Hughes, & Harrison, 2013). Thus, this study also uses gender, age, ethnicity, urban-rural, and siblings as control variables. Gender, ethnicity, and urban-rural are dichotomous variables, and age, years of schooling, and siblings are continuous variables.

2.3. Statistical methods

This study uses descriptive statistical analysis methods to show the health differences in childhood and adulthood by gender. The T-test and F-test are used to test the health differences in childhood and adulthood among different types of family-related ACEs. This study establish six ordered logistic regression models to analyze the effects of family-related ACEs on the subjective self-rated health during childhood and adulthood. Missing values are treated using the delete method, and we only use information-completed observations. STATA 14.0 software is used for all the data processing and statistical analysis.

3. Results

3.1. Descriptive statistical analysis

Table 1 presents the average self-rated health scores for males and females with different ACEs in childhood and adulthood. Males' self-rated health scores in childhood (t = 2.438; p=0.014) and adulthood (t = 7.128; p < 0.001) are generally higher than those of females. Second, for both males and females, self-rated health scores in childhood are generally higher (t = 64.688; p < 0.001) than in adulthood. Third, in childhood, in addition to parental substance abuse, the self-rated health scores for those who indicated "Yes" for any of the ACEs are lower than for those who indicated "No" on the ACEs. Similarly, in adulthood, the subjective self-rated health scores of those with ACEs are lower than for those without ACEs. Thus, in both childhood and adulthood, there is a significant difference in self-rated health scores between those with ACEs and without ACEs.

3.2. Ordered logistic regression analysis

To analyze the differences in self-rated health due to family-related ACEs, this study establish six statistical models using self-rated health childhood and adulthood as dependent variables. According to Table 2, from Model 1 to Model 6, the F-statistic is all significant, which illustrates the effectiveness of the model construction.

Models 1–3 use self-rated health in childhood as the dependent variable. In Model 1, the control variables of year of schooling and siblings are significant. Each year of schooling increases, the probability that the respondents' childhood self-rated health is very good increases by 2.8%. Additionally, the more the number of siblings, the better the respondents' self-rated health in childhood.

Regarding the independent variables in Model 2, the peer relationship was found to be significant, which indicates that for every point increase in peer relationship scores in childhood, the likelihood that the respondents' childhood self-rated health is very good will increase by 4.0%. Among the variables related to family-related ACEs, we found that the variables of death of a parent, domestic conflict, physical and emotional neglect, parental physical illness, parental mental illness, family economic hardship, experience of starvation, lived in insecure neighborhood, and lived in unclean community are significant. Specifically, relative to the types of good, fair, bad, and very bad, the probability of people whose parents died in their childhood self-rating that childhood health was very good is 15.3% lower than those whose parents were alive. Those who had experienced family conflict in childhood are 18.6% less likely to have very good childhood self-rated health than those who had not experienced family conflict. Those who had been neglected by their parents in childhood are 14.4% less likely to have very good childhood self-rated health than those who had not been neglected by their parents. The probability of a respondent whose parents had a long-term physical illness reporting that childhood health was very good is 20.7% lower than for those whose parents did not have any physical illness. Those whose parents had mental illness, such as depression, are 19.2% less likely to report very good childhood health than those whose parents had no mental illness. People with bad family

Table 1
The self-rated heath of respondents with different ACES by gender.

		Male				Female			
		Childhood ($x \pm s$)	p-value	Adulthood ($x \pm s$)	p-value	Childhood ($x \pm s$)	p-value	Adulthood ($x \pm s$)	p-value
Parents divorced	No	3.372 ± 1.006	=0.612[a]	2.160 ± 1.037	=0.807[a]	3.358 ± 1.026	=0.945[a]	2.988 ± 1.007	=0.053[a]
	Yes	3.231 ± 0.725		3.230 ± 0.926		3.375 ± 1.025		2.500 ± 0.816	
Death of a parent	No	3.383 ± 1.004	=0.055[a]	3.179 ± 1.042	=0.002[a]	3.368 ± 1.019	=0.065[a]	2.988 ± 1.000	=0.705[a]
	Yes	3.274 ± 1.006		3.005 ± 0.982		3.269 ± 1.076		2.968 ± 1.066	
Physical abuse	No	3.408 ± 0.998	=0.004[a]	3.211 ± 1.044	<0.001[a]	3.384 ± 1.013	=0.004[a]	3.024 ± 1.004	<0.001[a]
	Yes	3.303 ± 1.013		3.065 ± 1.016		3.274 ± 1.060		2.866 ± 1.006	
Domestic conflict	No	3.407 ± 1.037	<0.001[a]	3.184 ± 1.042	=0.014[a]	3.398 ± 1.016	<0.001[a]	3.023 ± 1.008	<0.001[a]
	Yes	3.250 ± 1.027		3.079 ± 1.014		3.230 ± 1.045		2.870 ± 0.997	
Parental bias	No	3.387 ± 0.988	=0.022[a]	3.387 ± 0.998	=0.013[a]	3.365 ± 1.009	=0.333[a]	3.364 ± 1.008	=0.006[a]
	Yes	3.268 ± 1.102		3.268 ± 1.102		3.320 ± 1.112		3.320 ± 1.112	
Physical and emotional neglect	No	3.391 ± 0.997	=0.035[a]	3.391 ± 0.997	=0.104[a]	3.386 ± 1.033	=0.002[a]	3.386 ± 1.033	<0.001[a]
	Yes	3.301 ± 1.031		3.301 ± 1.031		3.269 ± 0.998		3.269 ± 0.998	
Substance abuse by parents	No	3.337 ± 0.998	=0.110[a]	3.180 ± 1.045	=0.381[a]	3.369 ± 1.038	=0.512[a]	3.004 ± 1.009	=0.322[a]
	Yes	3.394 ± 1.008		3.148 ± 1.031		3.347 ± 1.016		2.971 ± 1.006	
Incarcerated parents	No	3.372 ± 1.003	=0.219[a]	3.161 ± 1.036	=0.420[a]	3.359 ± 1.024	=0.001[a]	3.142 ± 1.345	=0.680[a]
	Yes	3.000 ± 1.414		2.909 ± 1.375		2.142 ± 1.069		2.986 ± 1.006	
Parental physical illness	No	3.409 ± 0.985	<0.001[a]	3.211 ± 1.039	<0.001[a]	3.397 ± 1.007	<0.001[a]	3.044 ± 0.990	<0.001[a]
	Yes	3.206 ± 1.072		2.939 ± 0.998		3.187 ± 1.084		2.738 ± 1.043	
Parental mental illness	No	3.399 ± 0.985	=0.002[a]	3.232 ± 1.030	<0.001[a]	3.419 ± 0.997	<0.001[a]	3.058 ± 1.001	<0.001[a]
	Yes	3.267 ± 1.070		2.888 ± 1.016		3.145 ± 1.093		2.741 ± 0.989	
Family economic hardship	Good	3.573 ± 1.028	<0.001[b]	3.408 ± 1.054	<0.001[b]	3.593 ± 1.093	<0.001[b]	3.177 ± 1.044	<0.001[b]
	Fair	3.443 ± 0.922		3.219 ± 1.034		3.398 ± 0.940		3.059 ± 1.004	
	Bad	3.243 ± 1.083		3.030 ± 1.020		3.217 ± 1.106		2.812 ± 0.975	
Experience of Starvation	No	3.475 ± 0.943	<0.001[a]	3.314 ± 1.006	<0.001[a]	3.439 ± 0.997	<0.001[a]	3.142 ± 1.006	<0.001[a]
	Yes	3.326 ± 1.027		3.094 ± 1.043		3.310 ± 1.039		2.896 ± 0.997	
Lived in insecure neighborhood	No	3.145 ± 0.973	<0.001[a]	3.177 ± 1.035	<0.001[a]	3.157 ± 1.117	<0.001[a]	3.003 ± 1.006	=0.003[a]
	Yes	3.388 ± 1.005		2.938 ± 1.032		3.376 ± 1.014		2.806 ± 1.002	
Lived in unclean community	No	3.286 ± 1.026	<0.001[a]	3.212 ± 1.030	<0.001[a]	3.237 ± 1.064	<0.001[a]	3.046 ± 1.002	<0.001[a]
	Yes	3.429 ± 0.986		3.084 ± 1.042		3.413 ± 1.003		2.856 ± 1.005	
Total		3.371 ± 1.005		3.357 ± 1.026		3.160 ± 1.037	=0.560[b]	2.986 ± 1.007	<0.001[b]

Note.
[a] Independent Samples T-Test was used.
[b] F-test was used.

economic conditions were 43% less likely to have very good childhood self-rated health than those with good family economic conditions. Those who had experienced starvation have a 6.8% lower probability of having a very good childhood self-rated health than those who had not experienced starvation. The probability that a person living in an unsafe community has a very good childhood self-rated health is 24.5% lower than that of a person living in a safe community. People living in unclean communities have a 16.8% lower probability of self-rated health in childhood than those living in clean communities.

Model 3 incorporates the interaction terms of family-related ACEs and peer relationship. We found the interaction terms between family economic hardship and peer relationship to be significant. For every unit increase in peer relationship scores, the probability of a very good childhood self-rated health for people with fair family conditions is 7.4% higher than those with good family conditions, and the probability for people with poor family conditions is 13.1% higher than those with good family conditions, which indicates that for people with poor family conditions in childhood, the improvement of peer relationship can significantly improve their health. In addition, the interaction term between parental physical illness and peer relationship is also significant. For every unit increase in the peer relationship scores, the probability of very good childhood self-rated health among people whose parents with long-term physical illness is 7.7% higher than that of whose parents without disease.

Models 4–6 use self-rated health in adulthood as the dependent variable. In Model 4, the control variables of gender, ethnicity, urban-rural, age, and years of schooling are significant. In terms of the independent variables of Model 5, the peer relationship is also significant, indicating that an increase of one point in peer relationship scores in childhood increases the probability that respondents' adulthood self-assessment heath is very good by 1.8%. Among the variables of family-related ACEs, we found that divorced parents, physical abuse,

physical and emotional neglect, parental physical illness, parental mental illness, family economic hardship, experience of starvation, lived in insecure neighborhood, and lived in unclean community are significant. The probability of people who have experienced the family-related ACEs of parental divorce (36.3%), physical abuse (11.9%), parental neglect (7.3%), parental physical illness (25.8%), parental mental illness (21.9%), family financial hardship (25.3%), starvation (16.6%), lived in unsafe communities (10.2%), and lived in unclean communities (10.2%) having very good self-reported health in adulthood is lower than for those who have not experienced these ACEs.

Model 6 adds the interaction terms between family-related ACEs and peer relationship. In Model 6, we found that the interaction terms of family economic hardship and peer relationship are significant. For each additional unit of peer relationship scores, the adulthood self-rated health of people with poor family conditions is 11.5% higher than those with good family conditions. This indicates that for people with poor family conditions in childhood, the increase of peer relationship can significantly improve their health.

3.3. Marginal effect

Fig. 1 shows the moderating effects of peer relationship on childhood self-rated health with different economic conditions. This marginal effect is calculated based on Model 3, which includes all the covariates and the interaction terms between family economic status and peer relationship. Peer relationship are found to have a significant moderating effect on the self-rated health in childhood among those with good, fair, and poor family economic conditions. With the increase of the quality of the peer relationship, the difference in childhood self-rated health among people with different family economic conditions is found to be decreasing. People with poor family conditions have a greater improvement in childhood self-rated health than those with better

Table 2

Results of ordered logistic regression models (n = 13953).

Variables	Self-rated health in childhood			Self-rated health in adulthood		
	Model 1 (OR/SE)	Model 2 (OR/SE)	Model 3 (OR/SE)	Model 4 (OR/SE)	Model 5 (OR/SE)	Model 6 (OR/SE)
Gender (Ref. = Male)	1.005	0.952	0.955	0.856***	0.802***	0.804***
	(0.034)	(0.033)	(0.033)	(0.028)	(0.027)	(0.027)
Ethnicity (Ref. = Minority)	0.925	0.942	0.940	1.135**	1.158**	1.162***
	(0.054)	(0.056)	(0.056)	(0.065)	(0.066)	(0.067)
Urban-rural (Ref. = Urban)	1.051	0.969	0.977	1.271***	1.195***	1.200***
	(0.060)	(0.056)	(0.057)	(0.070)	(0.066)	(0.067)
Age	1.002	1.003*	1.003*	0.981***	0.981***	0.981***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Siblings	1.033***	1.011*	1.012**	1.039***	1.023***	1.024***
	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)
Year of schooling	1.020**	1.025***	1.025***	0.990	0.999	0.998
	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)
Peer relationship		1.040***	0.956		1.018*	0.927**
		(0.011)	(0.037)		(0.010)	(0.035)
Parents divorced (Ref. = No)		0.912	1.961		0.637**	0.264
		(0.203)	(1.712)		(0.141)	(0.227)
Death of a parent (Ref. = No)		0.848***	0.812		1.025	1.212
		(0.046)	(0.181)		(0.053)	(0.252)
Physical abuse (Ref. = No)		0.992	1.024		0.881***	0.785
		(0.037)	(0.184)		(0.031)	(0.135)
Domestic conflict (Ref. = No)		0.815***	0.657**		0.943	0.868
		(0.033)	(0.133)		(0.036)	(0.167)
Parental bias (Ref. = No)		1.032	1.250		0.964	0.855
		(0.049)	(0.284)		(0.044)	(0.184)
Physical and emotional neglect (Ref. = No)		0.856***	1.044		0.927**	0.864
		(0.033)	(0.189)		(0.035)	(0.150)
Substance abuse by parents (Ref. = No)		1.036	0.930		0.989	0.911
		(0.034)	(0.148)		(0.031)	(0.139)
Incarcerated parents (Ref. = No)		0.696	0.182		0.829	0.194
		(0.204)	(0.253)		(0.216)	(0.219)
Parental physical illness (Ref. = No)		0.793***	0.435***		0.742***	0.667**
		(0.035)	(0.086)		(0.031)	(0.126)
Parental mental illness (Ref. = No)		0.808***	0.699*		0.780***	0.622***
		(0.034)	(0.129)		(0.031)	(0.108)
Family economic hardship (Ref. = Good)						
Fair		0.669***	0.364***		0.868***	0.560*
		(0.037)	(0.114)		(0.046)	(0.171)
Bad		0.570***	0.204***		0.747***	0.302***
		(0.034)	(0.065)		(0.043)	(0.094)
Experience of starvation (Ref. = No)		0.932**	1.248		0.834***	0.935
		(0.033)	(0.234)		(0.029)	(0.168)
Lived in insecure neighborhood (Ref. = No)		0.755***	1.007		0.898*	1.005
		(0.046)	(0.241)		(0.051)	(0.228)
Lived in unclean community (Ref. = No)		0.832***	0.790		0.885***	0.813
		(0.029)	(0.130)		(0.029)	(0.128)
Parents divorced × Peer relationship			0.909			1.121
			(0.097)			(0.118)
Parent died × Peer relationship			1.005			0.979
			(0.028)			(0.025)
Physical abuse × Peer relationship			0.997			1.014
			(0.021)			(0.021)
Domestic conflict × Peer relationship			1.026			1.010
			(0.024)			(0.023)
Parental bias × Peer relationship			0.977			1.015
			(0.026)			(0.026)
Physical and emotional neglect × Peer relationship			0.976			1.009
			(0.021)			(0.021)
Parents substance abuse × Peer relationship			1.013			1.010
			(0.019)			(0.018)
Parents served time in jail × Peer relationship			1.181			1.208
			(0.203)			(0.172)
Parental physical illness × Peer relationship			1.077***			1.013
			(0.025)			(0.023)
Parental mental illness × Peer relationship			1.019			1.029
			(0.023)			(0.022)
Family economic hardship × Peer relationship						
Fair × Peer relationship			1.074*			1.053
			(0.039)			(0.037)
Bad × Peer relationship			1.131***			1.115***
			(0.042)			(0.040)
Experience of starvation × Peer relationship			0.965			0.986
			(0.021)			(0.021)
Lived in insecure neighborhood × Peer relationship			0.964			0.987

Table 2 (*continued*)

Variables	Self-rated health in childhood			Self-rated health in adulthood		
	Model 1 (OR/SE)	Model 2 (OR/SE)	Model 3 (OR/SE)	Model 4 (OR/SE)	Model 5 (OR/SE)	Model 6 (OR/SE)
			(0.029)			(0.028)
Lived in unclean community × Peer relationship			1.006			1.011
			(0.020)			(0.019)
-2LL	36275.132	35860.998	35824.644	40165.172	39822.328	39795.622
LR chi2	56.76**	470.90***	507.25***	382.79***	725.63***	752.34***
Observations	13953	13953	13953	13953	13953	13953

Note: standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.
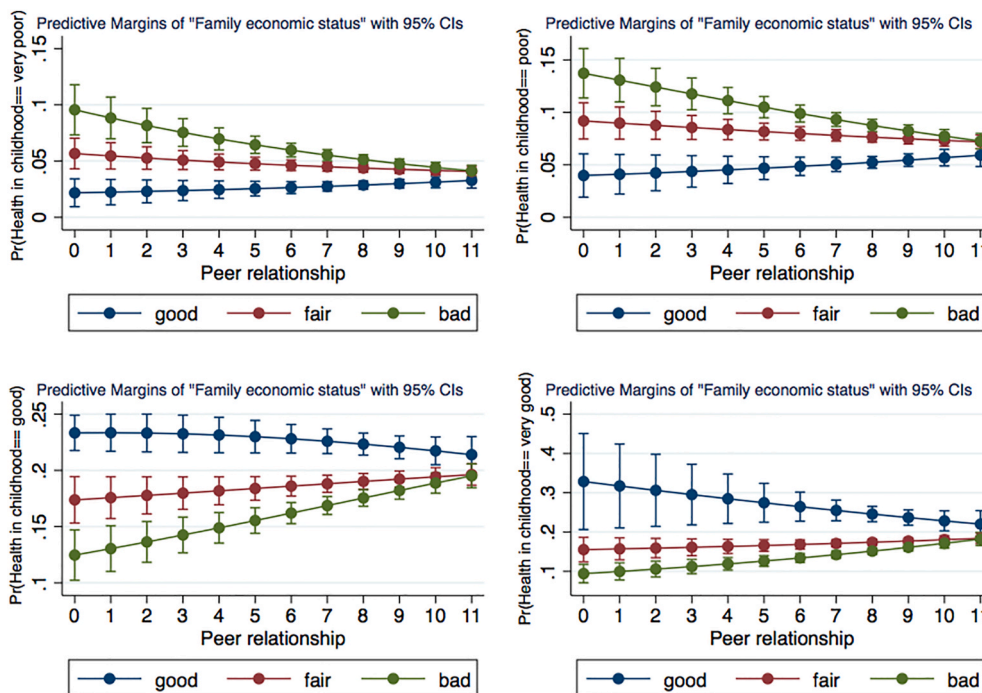
Fig. 1. Effects of peer relationship on self-rated health in childhood by family economic conditions.

family conditions. In other words, the increase in the quality of peer relationship brings better health returns to people with poor family conditions than those with good family conditions. The above findings reveal that, compared with other ACEs, family economic conditions are critical to childhood health. Family poverty in childhood significantly reduces health in childhood, and improvement in the quality of peer relationship can compensate for the negative impact of family poverty in childhood on health.

Fig. 2 presents the moderating effects of peer relationship on childhood self-rated health between those whose parents have long-term physical illness and those whose parents do not have long-term physical illness. The marginal effect in Fig. 2 is calculated based on Model 6, which includes all the covariates and interaction terms between peer relationship and parental physical illness. We find that peer relationship has a significant moderating effect on the childhood self-rated health between those whose parents have long-term physical illness and those whose parents do not have long-term physical illness. With the improvement of the quality of the peer relationship, the increase in childhood self-rated health for those whose parents have long-term physical illness is greater than those whose parents do not have long-term physical illness. In other words, the improvement in the quality of the peer relationship brings health benefits to those whose parents have long-term physical illnesses than those whose parents do not have long-term physical illnesses.

Fig. 3 presents the moderating effects of peer relationship on self-

rated health in adulthood among people with different economic conditions. This marginal effect is calculated based on Model 3, which includes all the covariates and the interaction terms between family economic hardship and peer relationship. We found that with the improvement of the quality of the peer relationship, people with poor family conditions have a greater increase in adult self-rated health than those with good family conditions. The improvement in the quality of peer relationship brings higher health returns for people with poor family conditions than those with good family conditions.

4. Discussion

Although there is increasing evidence linking family-related ACEs with long-term health outcomes, few studies so far have included and compared the effects of family-related ACEs on health in childhood and adulthood. Therefore, this study uses empirical data from China to examine the impact of family-related ACEs on self-rated health in childhood and adulthood, and the moderating role of peer relationship on the relationship between family-related ACEs and subjective self-rated health.

This study found that family-related ACEs not only have a negative impact on people's self-rated health during childhood, but also have adverse effects on people's self-rated health in adulthood. Specifically, in childhood, in different types of family-related ACEs, such as death of a parent, domestic conflict, physical and emotional neglect, parental
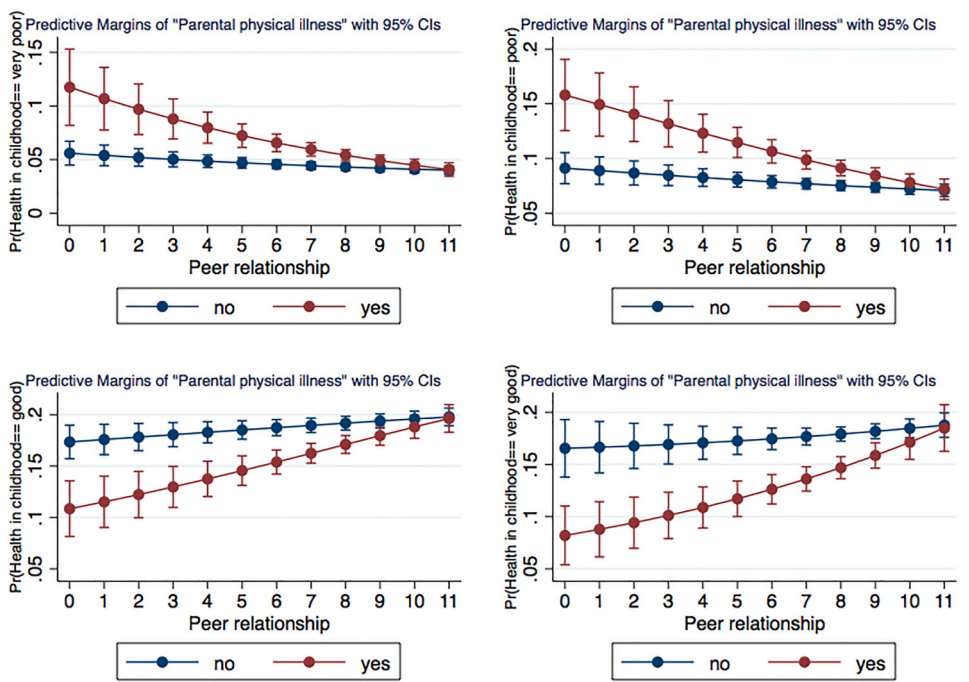
Fig. 2. Effects of peer relationship on self-rated health in childhood by parental physical status.
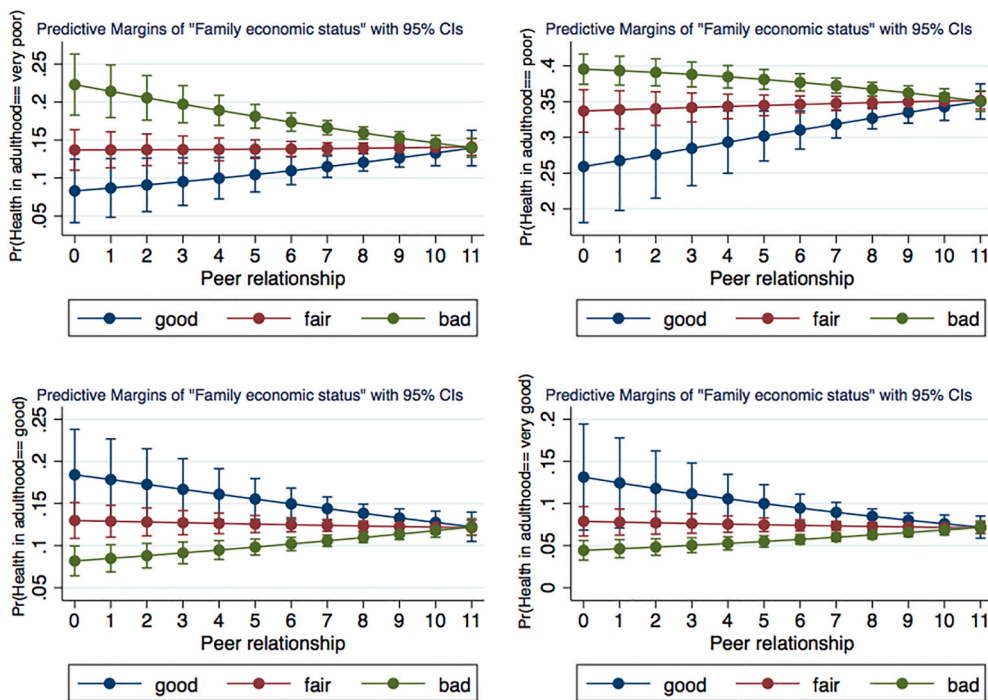

Fig. 3. Effects of peer relationship on self-rated health in adulthood by family economic conditions.

physical illness, parental mental illness, family economic hardship, experience of starvation, lived in insecure neighborhood, lived in unclean community, the childhood self-rated health level of people with family-related ACEs is significantly lower than that of people without family-related ACEs. In adulthood, the self-assessed health in adulthood of those who have experienced family-related ACEs are significantly lower than those who have not in different types of family-related ACEs, such as divorced parents, physical abuse, physical and emotional neglect, parental physical illness, parental mental illness, family

economic hardship, experience of starvation, lived in insecure neighborhood, and lived in unclean community. In other words, people who have had family-related ACEs face higher health risks during this long period from childhood to adulthood. This finding is consistent with the conclusions of existing studies that ACEs are important predictors of health risks in childhood and adulthood (Heerman et al., 2016; Porche et al., 2016). In addition, we also found that peer relationship moderates the impact of family-related ACEs on health outcomes. For each additional unit of peer relationship scores, the probability of a very good

self-rated health in childhood and adulthood for people with bad family conditions is higher than for those with good family conditions, and the probability of very good childhood self-rated health among people whose parents with physical illness is higher than that of those whose parents do not have physical illness. This indicates that high-quality childhood friendships can bridge the health disadvantages caused by family-related ACEs and reduce the adverse effects of these negative experiences.

Regarding the mechanism of the cumulative effect of health in an individual's life course, although existing literature has confirmed the long-term effects of adverse family experiences in childhood on individual health, the microscopic mechanism of the cumulative effect of health in an individual's life course has not yet been identified. The findings of this study further reveal the micro-mechanisms of family-related ACEs on individual health. We believe that family-related ACEs, such as childhood neglect and parents' mental health disorders, will significantly affect the health status in childhood and adulthood; thus, those individuals who experienced family-related ACEs during childhood face the risk of a weak health status in their life course, and this effect is long-term and continuous. In other words, the negative experience of early life has a cumulative effect on an individual's later life course outcome (Dannefer, 2003). Combined with these findings, the negative experience of childhood mainly realizes the cumulative impact on the health outcome of the life course through the occurrence of negative events and shapes the health inequality in the life course.

Several limitations of this study must be considered. First, the disadvantage of retrospective survey data is that it is prone to recall errors; although cases of conflicting information were eliminated during data cleansing, the problem of recall bias may still affect the validity of the conclusions of this study to a certain extent. Second, regarding the measurement of childhood peer relationship, this study only uses a simplified measurement scale, and does not make measurements using multi-dimensional items, such as the Friendship Qualities Scale constructed by Bukowski et al. (1994). Subsequent research can use multidimensional scales to further improve the measurement validity of peer relationship. Third, this study only examines the role of peer relationship in adverse family adverse experiences and self-rated health and does not examine other moderating variables. Later studies can further investigate a greater number of moderating variables to improve the causal path of the relationship between ACEs and health.

5. Conclusion

This research examines the impact of family-related ACEs on subjective self-assessment health in childhood and adulthood, and focuses on the moderating role of peer relationship on family-related ACEs and self-assessment health. Family-related ACEs are not only related to health the early stage of an individual's life course, but also to health outcomes in adulthood. Simultaneously, the quality of childhood friendships can reduce the adverse effects of family-related ACEs on the health outcomes throughout an individual's life course.

The conclusions of this study contribute valuable information for the formulation of health policies. First, family-related ACEs are important predictors of people's health disadvantages. Family-related ACEs not only have an adverse effect on childhood health, but also have a long-term cumulative effect on health in adulthood. Therefore, when we formulate a health policy, the policy vision must be extended to the period of childhood, and we should pay attention to inducement factors that cause health inequality and strive to eliminate the long-term impact of negative family experiences on individual health at its source. Second, this study finds that the quality of peer relationship plays an important role in reducing the health differences in childhood and adulthood caused by family-related ACEs. Therefore, when formulating policies on children's health, we must attach importance to the positive role of childhood friendship in the process of children's growth. In community neighborhood relationship and school fellowships, we must focus on

cultivating and expanding children's peer relationship networks and improve the quality of childhood friendships. Third, the prevention of family-related ACEs is not only a matter of relevance within the family, but also involves other actors, such as society, government, and social organizations. Therefore, in preventing ACEs, it is necessary to highlight the importance of the guiding role of the government, the supportive role of social organizations, and the intervention role of social workers in order to build a comprehensive prevention and intervention system for ACEs.

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Declaration of competing interest

The views expressed in the submitted article are the authors' own and not an official position of the institution or the funders.

Abbreviations

CHARLS   China Health and Retirement Longitudinal Study
ACEs   adverse childhood experiences

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the official website of CHARLS, http://charls.pku.edu.cn/index/zh-cn.html.

Authors' contributions

The author led study conceptualization, design, tools development, and performed statistical analysis and manuscript writing. The author read and approved the final manuscript.

Ethics approval and consent to participate

Ethical approval for this study was granted by Institutional Review Board of Peking University. With the approval of the IRB, written informed consent was received from the respondents.

Consent for publication

This manuscript does not contain any individual person's data in any form.

Ethical statement

All study participants provided informed consent, and the study design was approved by the appropriate ethics review board. We have read and understood your journal's policies, and we believe that neither the manuscript nor the study violates any of these. There are no conflicts of interest to declare.

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