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# Adverse childhood experiences, marital status and depressive symptoms in later life among the Chinese middle-aged and older adults : the mediating role of marital status

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## Abstract

**Background** Many studies have shown that adverse childhood experiences (ACEs) lead to adverse social relations in middle-aged and older adults and harm physical and mental health, but few studies have focused on the impact of ACEs on marital status in middle-aged and older adults and the potential influence of marital status between ACEs and depressive symptoms.

**Purpose** This study aimed to analyze the effect of ACEs on marital status and depressive symptoms in the Chinese middle-aged and older adults, and to explore the mediating role of marital status in the association between ACEs and depressive symptoms in middle-aged and older adults.

**Method** This study used the China Health and Retirement Longitudinal Study (CHARLS) 2014 life history survey and 2015 and 2018 follow-up data to analyze, ten ACEs conditions and marital status were collected by questionnaire, using the Center for Epidemiological Studies Depression Scale (CESD-10) 10-item short form to assess depressive symptoms. The association between cumulative ACEs and marital status was assessed by constructing a multinomial logistic regression (MLR) model, as well as a binary logistic regression model to assess the association between ACEs and depressive symptoms. The mediating role of marital status in the association between ACEs and depressive symptoms was also assessed.

**Results** A total of 10,246 individuals aged 45 years or older were included in the analysis. Compared to individuals who did not experience ACEs, those who experienced two or more ACEs had a higher risk of being unmarried (separated/divorced/never married) (OR = 1.67, 95% CI = [1.10, 2.51]) and a higher risk of depressive symptoms (OR = 1.66, 95% CI = [1.49, 1.84]) in middle and old age. Unmarried status partially mediated the association of ACEs with depressive symptoms.

**Conclusion** Chinese middle-aged and older people who experienced two or more ACEs have higher risks of unmarried status and depressive symptoms, and unmarried status partially mediated the ACEs-depressive symptom

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association. These findings reveal the fact that we need to develop life-cycle public health strategies to reduce exposure to ACEs and society should give more attention to the marital status of older people, thereby reducing the risk of depression among middle-aged and older adults in China.

**Keywords** Adverse childhood experiences, Marital status, Depressive symptoms, Mediation analysis

## Introduction

Adverse Childhood Experiences (ACEs) refer to various forms of stressful or traumatic events occurring during childhood, such as neglect, child abuse, family dysfunction and so on [1–3], which can also be seen as childhood adversity. ACEs are considered the basic determinants of lifetime well-being in multiple dimensions (including psychosocial, behavioral and physiological functions), affect the establishment of intimate relationships during a lifetime, leading to poor marital status among middle-aged and older adults and in a range of physical and mental health problems [4–6].

Research has consistently shown that people who are married tend to have lower levels of mental disorders [7] and higher levels of perceived social support [8, 9]. Social support generally refers to social resources available to a person as result of their relationships, social circles and interactions that provide them assistance in times of need and/ or feeling of attachment [10]. House long ago noted, the “minimum condition for experiencing social support, is to have one or more stable relationships with others.” Being married usually defines the existence of one such relationship—one in which normative expectations involve the giving and receiving of social support. In China, marriage is one of the most important social relationships for most adults and nearly everyone eventually marries. In 2005, around 98% of women and 90% of men were married by the age of 30–34. By the age of 35–39, almost all women were married and less than 5% of men remained single [11, 12]. A large body of research suggests a beneficial association between marriage and health [13, 14]. Married people live longer, on average, and have fewer physical and mental health problems [15–17]. A study of 15,586 people over the age of 45 in China showed that married middle-aged and older adults were at less risk of depression than those who were separated or divorced, widowed, or unmarried [18].

Depression is one of the most common mental disorders, affecting nearly 3.8% of the global population [19]. In China, a national survey reported that about 30% of men and 43% of women aged 45 and older experienced depressive symptoms [20]. Many studies have demonstrated that ACEs function in the life course on depression susceptibility [21, 22]. However, few studies have explored the influence of ACEs on the marital status, depressive symptoms, and the role of marital status in the association between ACEs and depressive symptoms in middle-aged and older adults in China. With the

accelerated population elderly aging, understanding the factors and the underlying mechanisms that may increase the risk of depression in middle-aged and older adults has become an important public health priority.

The present study proposes the following hypothesis: ACEs are directly related to depressive symptoms and are indirectly influenced by marital status as a mediator in Chinese middle-aged and elderly.

## Materials and methods

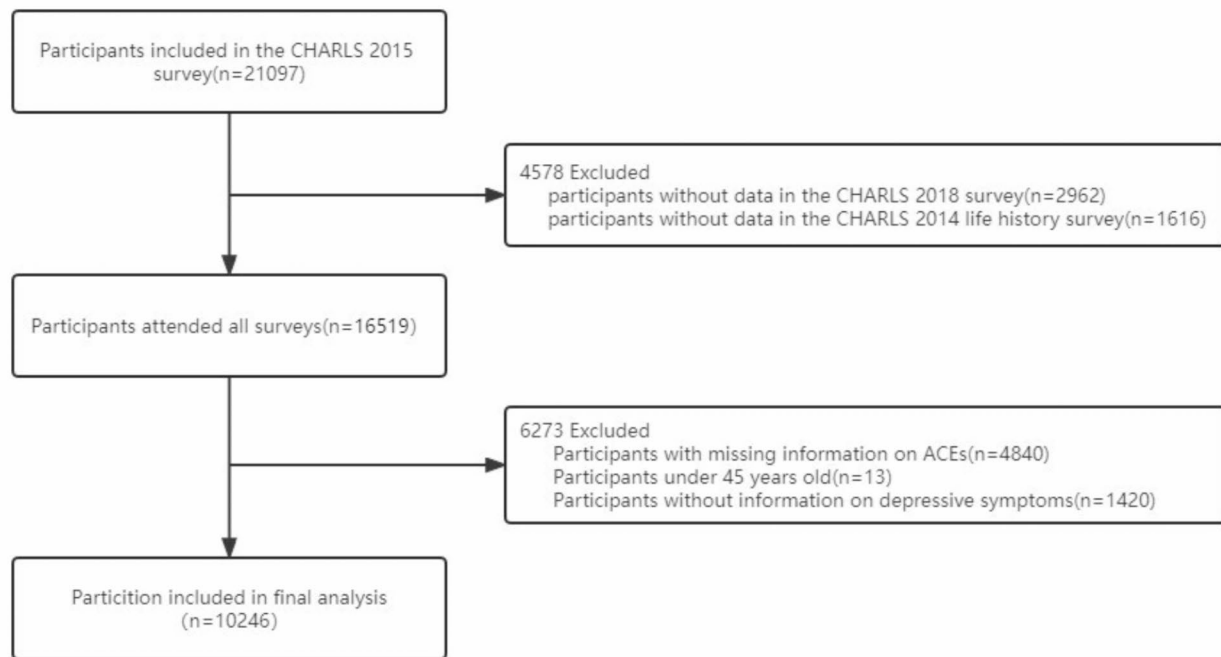
### Study design and population

#### *CHARLS introduction*

This study used survey data from the China Health and Retirement Longitudinal Study (CHARLS). CHARLS is a nationally representative longitudinal survey of the middle-aged and older adults using a multi-stage probability sampling selection strategy [23]. The conduct of CHARLS periodical surveys conformed to stringent quality control policies. CHARLS conducted field investigations and face-to-face interviews in 150 counties and 450 communities (villages) of 28 provinces (autonomous regions and municipalities) in 2011, 2013, 2015, and 2018, respectively. And a special life-course-specific survey was conducted in 2014. For each round, face-to-face interviews were conducted by trained interviewers through computer-assisted personal interviewing. Information on demographics, lifestyles, physical activity, and medical history was recorded in well-designed structured questionnaires. The institutional review board of Peking University approved the conduct of CHARLS (Approval No. IRB00001052-11015). All participants provided written informed consent prior to participation (<https://charls.charlsdata.com/index/zh-cn.html>). The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

#### *The crowd screening process*

Datas from the 2015 survey, 2018 survey and 2014 life history survey were used in this study. The sample size of the third wave was 21,097, and we excluded 10,851. The inclusion criteria was: participated in three surveys in 2014, 2015 and 2018. The exclusion criteria were: (1) missing information on ACEs, (2) age below 45 years, and (3) missing information on depressive symptoms assessment. See Fig. 1 for details.



**Fig. 1** Flowchart of the study participation

## Measurements

### Definition of the ACEs

In the life history survey, investigators collected participants' adverse childhood experiences before the age of 17 through face-to-face interviews, and following previous studies [2, 3, 24], we collected ten ACE indicators, including 10 adversities (i.e., physical abuse, household substance abuse, domestic violence, unsafe neighborhood, being bullied, emotional neglect, household mental illness, family members imprisoned, parental separation or divorce, and parental death). Detailed definitions of ACE indicators and incidence rates are presented in the Supplementary Table 1. Each ACE indicator was dichotomized and encoded as 0 for absent or 1 for present. The cumulative score of threat-related and deprivation-related ACEs was further generated by summing the number of ACEs experienced in each dimension. Participants in this study were categorized into experiencing 0, 1, and  $\geq 2$  ACEs based on cumulative ACE counts.

### Measurement of depressive symptoms

In the 2018 follow-up survey, depression was assessed using 10 items of the Center for Epidemiologic Research Depression Scale (CES-D). The CES-D has been validated as an effective screening tool for depressive symptoms in the Chinese middle-aged and older adults [25]. What's more, the CESD-10 was highly validated in the general population, indicating adequate reliability and validity for the community-based older adults

in China [26]. CES-D has 10 items with four scales: "3=always," "2=often," "1=sometimes or rarely," and "0=never," where the fifth and eighth items are reverse scored. The scale is rated on a scale of 0–30; the higher the score, the more severe the depression. Based on previous studies [27], we defined a score of 10 or higher as having depressive symptoms and divided participants into two groups based on the presence of depressive symptoms.

### Definition of marital status

Based on the information collected in the third wave of the questionnaire in 2015, the participants were asked to answer "What is your current marital status?" and "Do you now have a partner living together as a spouse (cohabitation)?" According to the above problems, CHARLS provided 7 response options: 1 Married with spouse present; 2 Married but not living with spouse temporarily for reasons such as work; 3 Separated (no longer living together as a spouse); 4 Divorced; 5 Widowed; 6 Never married; 7 Cohabitated. Participants who chose option 2 had the marital relationship remained despite their temporary separation, while participants who chose option 3 were no longer living together as spouses. According to the past studies [28, 29], whether married depends on whether he/she can get social support from the spouse, we categorized a participant's marital status into Married(1,2,7), Unmarried(3,4,6),

Widowed(5). Besides, being widowed is more likely to be unexpected, it is listed separately in this study.

**Covariates**

In order to minimize the estimation bias as well as to prevent over-adjustment [30], a directed acyclic graph was constructed using DAGitty software to select (The final minimally sufficient adjustment set) [31]. Since educational attainment, residential situation, per capita household expenditure, participation in leisure activities in later life, smoking history, alcohol consumption history, Activities of Daily Living (ADL) scale(bathing, dressing, eating, getting out of bed, using the toilet, and controlling urination.1 point for each failure to complete each item), Instrumental Activities of Daily Living (IADL) scale(using a cell phone, managing money, taking medication, shopping, and cooking.1 point for each failure to complete each item), and socio-economic level of childhood could be potential mediators [4]. We finally used socio-demographic characteristics from the Wave 3 questionnaire as covariates, including age, gender (“male” and “female”), ethnicity (“Han Chinese,” “ethnic minorities”), and type of hukou (“urban or city,” “rural”), as shown in the directed acyclic graph in Supplementary Fig. 1.

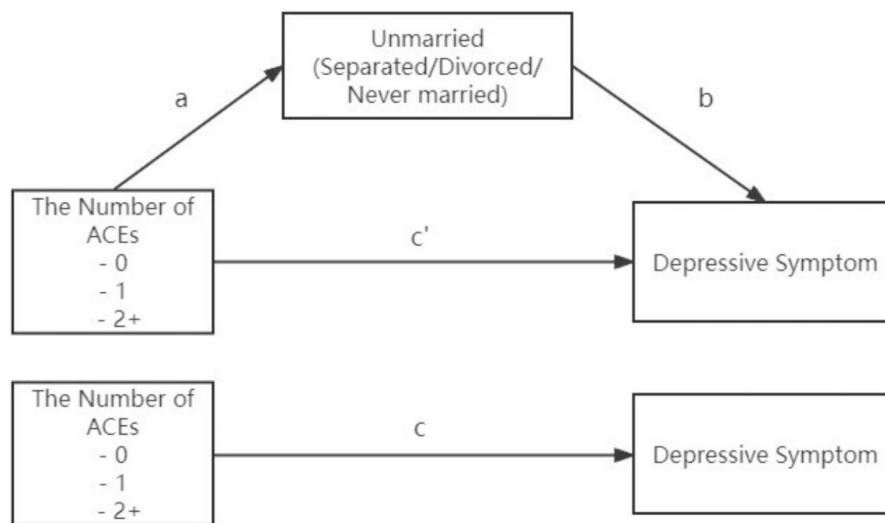
**Statistical analysis**

Descriptive statistics were used to describe the characteristics of CHARLS participants in different ACEs count groupings. Continuous variables are presented as mean (standard deviation, SD), and categorical variables are presented as frequency (percentage). When analyzing the univariates, we used  $\chi^2$  and ANOVA to test the significance of the differences between the groups of different

ACEs. In subsequent analyses, we filled in the missing data using multivariate Imputation by Chained Equations filling method, processed using the MICE package in the R software [32].

In the main analyses, we separately constructed multinomial logistic regression models to assess the association of ACEs with marital status and binary logistic regression models to assess the association of ACEs with depressive symptoms, which compared crude and adjusted models, with the adjusted models controlling for age, gender, household type, and ethnicity.

We performed a mediation effect analysis using the R software mediation package based on the counterfactual framework [33] to explore the mediation role of marital status between ACEs and depressive symptoms (Fig. 2). Specifically, the mediation analysis model was adjusted for potential confounders, including age, gender, education, type of hukou, and ethnic adjustment. The total effect refers to the effect of ACEs on depressive symptoms in middle-aged and older adults, while the indirect effect indicates the amount of mediation exerted through marital status on the relationship between an elevated number of ACEs and late-life depressive symptoms. The direct effect represents the effect of ACEs on late-life depressive symptoms while controlling for mediator variables. Since the mediation and dependent variables were categorical variables, the outcome model and the mediation model were logistic regression models. Direct and indirect effects were analyzed using the Bootstrap method and estimate the 95%CI for error correction, 95%CI excluding 0 indicating the statistical results were significant and resampled 1000 times. In addition, we



**Fig. 2** A conceptual mediation model of unmarried between ACEs and depression in middle-aged and old people

analyzed the association of each ACE with marital status, depressive symptoms, and possible mediating effects.

For sensitivity analyses, first, we filled in the data of participants with missing ACEs using multiple interpolation methods and repeated our main study. Then, mediated effects were analyzed using CES-D scores as continuous variables, the mediating model was a logistic regression model, the outcome model was a linear regression model, and the significance of the mediating effects at different scales was tested using the product distribution method.

All statistical analyses were performed using R4.3.1, and a two-tailed  $P < 0.05$  was considered statistically significant.

## Results

### Characteristics of the study population

Table 1 lists the characteristics of the 10,246 participants and the significance of the differences between the groups grouped by counts of ACEs. Overall, 4962 males and 5284 females were included in the study; mean age was  $58.62 \pm 8.90$ ; 9195 participants were rural hukou; 9453 participants were Han; 8939 participants were primary education or below; 146 were divorced at baseline and 906 were widowed. The mean CES-D score for all participants was  $8.24 \pm 6.42$ , with 3605 participants had depressive symptoms, their CES-D score 10. 73% of the participants experienced at least 1 ACE and 42% experienced 2 or more ACEs.

### Association of ACEs with marital status

When analyzing the effect of ACEs on marital status, the multiple logistic regression results are shown on Table 2. Two or more ACEs showed a significant high risk of being unmarried relative to participants not experiencing ACEs (OR=1.75,95%CI:1.16–2.63), and this significant association persisted after adjusting for covariates. No significant effect of ACEs on the risk of widowhood in middle-aged and older adults was observed.

### Effect of ACEs and marital status on depressive symptoms

Table 3 shows the effect of ACEs, marital status on depressive symptoms in middle-aged people after adjusting for potential confounders. Middle-aged and older adults who experienced two or more ACEs had a higher risk of depression than no ACEs (Model 1:OR=1.67;95%CI 1.49–1.86). Being unmarried and widowed had a significant high risk of depression relative to being married (Model 2:OR,95%CI for unmarried:2.46,1.76–3.43; for widowed: 1.22,1.05–1.42). After mutual adjustment, the effect remained significant (Model 3).

### Results of the mediation effect analysis of marital status in the association between ACEs and depressive symptoms

Since no significant effect of ACEs exposure on the risk of widowed in older adults was observed, to test whether unmarried status mediated the relationship between ACEs and depressive symptoms, we excluded widowed participants to obtain a subsample ( $N=9340$ ). The results of the mediation analysis in Table 4 showed that unmarried status partially mediated the association of ACEs with depressive symptoms, with the mediation effect being 2.27%(95% CI: 0.34-3.36%) .

### Results of each ACE analysis

The association of each ACE with marital status, depressive symptoms present in Supplementary Table 6 in supplementary file. We found that all 10 ACEs were associated with an increased risk of depressive symptoms, and four of these ACEs(Family members imprisoned, Household mental illness, Being bullied, Unsafe neighborhood) were associated with an increased risk of unmarried status. We also tested the mediating role of unmarried status in the association of these four ACEs with depressive symptoms separately. The results showed (Supplementary Table 7) that unmarried status had a significant mediation effect in the association of Unsafe neighborhood, Family members imprisoned, Household mental illness, Being bullied and depressive symptoms, with 2.54%, 4.49%, 1.08%, 1.57%.

### Results of the sensitivity analysis

According to the results of the sensitivity analysis in Supplementary Table 6, the mediation analysis results using the CES-D score as a continuous variable were consistent with the binary classification results.

## Discussion

A cross-sectional study among Japanese over 65 years showed that ACEs exposure was associated with high risk of being widowed, divorced and unmarried among Japanese elderly [4]. Marriage is one of the most important relationships in an individual's lifetime, strongly affecting the physical and mental health of adults. Studies showed a significant interaction between marital status and depression, and this association was stronger in single/widowed/divorced/separated participants [4, 34, 35]. In China, depression was more prevalent in separated, widowed or divorced than married or cohabiting people [36].

In this study, We investigated the associations of ACEs exposure with marital status and depressive symptoms and the mediating role of unmarried status in the association between ACEs exposure and depressive symptoms in China over the age of 45 years, based on a national survey of middle-aged and older adults. Studies have shown

**Table 1** Baseline characteristics of participants grouped by ACEs counts

Characteristics	Overall	Whether depressed		Statistics	P
	(n = 10246)	No (n = 6641)	Yes (n = 3605)		
Gender, n (%)				233.137	<0.001
Male	4962(48.43)	3585(53.98)	1377(38.20)		
Female	5284(51.57)	3056(46.02)	2228(61.80)		
Age(years), mean(SD)	58.62(8.90)	58.47(8.96)	58.90(8.77)	-2.782	0.005
Nation, n (%)				0.724	0.395
the Han nationality	9453(92.26)	6138(92.43)	3315(91.96)		
Minority nationality	793(7.74)	503(7.57)	290(8.04)		
Household registration type, n (%)				40.21	<0.001
City/town	972(9.56)	719(10.92)	253(7.06)		
Countryside	9195(90.44)	5862(89.08)	3333(92.94)		
Missing	79	60	19		
Residence, n (%)				115.705	<0.001
City/town	3889(37.96)	2773(41.76)	1116(30.96)		
Countryside	6357(62.04)	3868(58.24)	2489(69.04)		
ACEs				111.916	<0.001
0	2743(26.77)	1903(28.66)	840(23.30)		
1	3228(31.51)	2219(33.41)	1009(27.99)		
≥ 2	4275(41.72)	2519(37.93)	1756(48.71)		
Marital status, n (%)				42.807	<0.001
Married	9188(89.73)	6049(91.13)	3139(87.14)		
Unmarried	146(1.42)	73(1.10)	73(2.03)		
Widowed	906(8.85)	516(7.77)	390(10.83)		
Missing	6	3	3		
Educational status, n (%)				136.251	<0.001
Primary and below	8939(87.24)	5609(84.46)	3330(92.37)		
High school/Vocational education	1137(11.10)	885(13.33)	252(6.99)		
University and above	170(1.66)	147(2.21)	23(0.64)		
Residential type, n (%)				1.179	0.278
Live with others	4487(44.17)	2941(44.56)	1546(43.44)		
Live alone	5672(55.83)	3659(55.44)	2013(56.56)		
Missing	87	41	46		
History of drinking (yes), n (%)				62.935	<0.001
Yes	4808(47.05)	3308(49.94)	1500(41.74)		
Missing	28	17	11		
History of smoking (yes), n (%)				87.08	<0.001
Yes	4483(43.84)	3129(47.21)	1354(37.62)		
Missing	19	13	6		
Leisure activity (yes), n (%)				32.806	<0.001
Yes	5022(49.84)	3388(51.95)	1634(45.98)		
Childhood socioeconomic level, n (%)				128.518	<0.001
Very good	102(1.00)	78(1.18)	24(0.67)		
Better	915(8.94)	655(9.88)	260(7.22)		
Same	5514(53.88)	3719(56.07)	1795(49.83)		
Worse	1545(15.10)	988(14.90)	557(15.46)		
Much worse	2158(21.08)	1192(17.97)	966(26.82)		
Missing	12	9	3		
Household expenditure per capita (yuan/year), mean(SD)	14300.30(5111.43)	14947.22(28278.97)	13092.37(23724.20)	5.418	<0.001
Missing	2840	1818	1022		
ADL, n (%)				466.394	<0.001
0	8249(82.96)	5670(88.86)	2579(72.40)		
1	935(9.40)	435(6.82)	500(14.04)		

**Table 1** (continued)

Characteristics	Overall	Whether depressed		Statistics	P
	(n = 10246)	No (n = 6641)	Yes (n = 3605)		
2	382(3.84)	156(2.44)	226(6.34)		
3	175(1.76)	54(0.85)	121(3.40)		
4	104(1.06)	35(0.55)	69(1.94)		
5	74(0.74)	20(0.31)	54(1.52)		
6	24(0.24)	11(0.17)	13(0.36)		
Missing	303	260	43		
IADL, n (%)				452.976	< 0.001
0	8250(80.68)	5733(86.52)	2517(69.94)		
1	1210(11.83)	600(9.055)	610(16.95)		
2	425(4.16)	186(2.81)	239(6.64)		
3	191(1.87)	54(0.82)	137(3.81)		
4	107(1.05)	36(0.54)	71(1.97)		
5	42(0.41)	17(0.26)	25(0.69)		
Missing	21	15	6		
Depression score, mean(SD)	8.24(6.42)	4.32(2.82)	15.46(4.67)	-83.72	< 0.001

Notes: ACE=adverse childhood experience; ADL=activities of daily living; IADL=instrumental activities of daily living. Continuous data are reported as the mean (SD), and categorical data are reported as the number (subsample) and percentage of participants

**Table 2** Association between the number of ACEs and marital status

	Marital status (reference: married)			
	Unmarried		Widow	
	Crude OR(95%CI)	Adjusted model <sup>b</sup> OR(95%CI)	Crude OR(95%CI)	Adjusted model <sup>b</sup> OR(95%CI)
Number of ACEs				
0	Reference <sup>a</sup>	Reference <sup>a</sup>	Reference <sup>a</sup>	Reference <sup>a</sup>
1	0.73(0.43,1.21)	0.71(0.42,1.19)	1.17(0.98,1.39)	1.10(0.91,1.32)
2+	1.75(1.16,2.63)**	1.667(1.101,2.512)*	1.16(0.98,1.37)	1.12(0.94,1.34)
P for trend	< 0.001***	0.002**	0.11	0.2

Notes: ACEs=adverse childhood experiences; OR=odds ratio; CI=confidence interval;\*Signs indicate significance (0.01<Pvalue<0.05, \*\*0.001<Pvalue<0.01, \*\*\*Pvalue<0.001).<sup>a</sup>Reference: no ACE exposure. Adjusted model<sup>b</sup>: Age, gender, household registration type, and ethnicity were adjusted

**Table 3** The influence of numbers of ACEs and marital status on depressive symptoms

	Model 1 <sup>c</sup> OR (95% CI)	Model 2 <sup>c</sup> OR(95% CI)	Model 3 <sup>c</sup> OR(95% CI)
ACEs			
0	Reference <sup>a</sup>	Reference <sup>a</sup>	Reference <sup>a</sup>
1	1.05(0.93, 1.18)		1.07(0.95, 1.19)
2+	1.67(1.49,1.86)***		1.66(1.49, 1.84)***
P for trend	< 0.001***		< 0.001***
Marital status			
Married		Reference <sup>b</sup>	Reference <sup>b</sup>
Unmarried		2.46(1.76, 3.43)***	2.29(1.63,3.21)***
Widowed		1.22(1.05,1.42)***	1.21(1.04,1.40)***

Notes: ACEs=adverse childhood experiences; OR=odds ratio; CI=confidence interval;\*Signs indicate significance (0.01<Pvalue<0.05, \*\*0.001<Pvalue<0.01, \*\*\*Pvalue<0.001).<sup>a</sup>Reference.: no ACE exposure.<sup>b</sup>Reference.: married.<sup>c</sup>models all were adjusted for the covariates, including age, sex, type of residence, and ethnicity

**Table 4** Mediating role of marital status in the number of ACEs–depressive symptom association

	Estimate	95% CI lower	95% CI upper	Pvalue
Total Effect	0.1133	0.0897	0.1360	< 0.001***
Indirect effect	0.0026	0.0003	0.0035	0.022*
Direct effect	0.1107	0.0879	0.1342	< 0.001***
Proportion mediated	0.0227	0.0034	0.0336	0.022*

Notes: ACEs=adverse childhood experiences; CI=confidence interval; It was adjusted according to age, gender, education level, type of residence, and ethnic group.\*Signs indicate significance(0.01<Pvalue<0.05, \*\*0.001<Pvalue<0.01, \*\*\*Pvalue<0.001)

that people experiencing two or more ACEs have a higher risk of being unmarried and a higher risk of developing depressive symptoms in middle age and older compared to the non-exposed group. Unmarried status partially mediated the association between ACEs and depressive symptoms.

Our findings suggest that ACEs are associated with an increased risk of depression in middle-aged and older adults, consistent with previous studies [37–39]. The stress sensitization model suggests that early adversity sensitizes individuals to subsequent proximal stressors (e.g., stressful life events in adulthood), thereby increasing their susceptibility to mental disorders [20]. Thus, adverse childhood experiences as early life adversity may increase the risk of depression in middle-aged and older adults. Zhang et al. showed that individuals who experienced four or more ACEs had a higher risk of subsequent depression compared with those who did not have ACEs [3], but in this study we found that two or more ACE exposures were associated with the risk of depression in Chinese middle-aged and older adults, which may be due to the fact that Zhang et al. included a total of 12 indicators of ACEs in their study and used the depressive symptom assessment data from 2015.

As an important aspect of social participation, marital status plays an important role in subjective well-being. In contrast, negative marital status has been identified as a risk factor for mental and somatic impairment [40, 41]. Previous studies have shown that the ACEs may even affect marital status [42]. Similar to previous findings, we found that childhood family structure affects marital status (i.e., family structure in adulthood) [43]. This study found that middle-aged and older adults experiencing two or more ACEs had a higher risk of being unmarried, with four ACEs (family member incarceration, family mental illness, bullying, and unsafe neighborhoods) associated with an increased risk of unmarried status. Previous studies have shown that individuals who experience adverse childhood experiences are more likely to have deficits in personality functioning [44], in which adults with avoidant and ambivalent styles tend to avoid intimate relationships and reject the need for intimacy [45, 46], which supports our findings. However, unlike a Japanese study [22], the effect of ACEs on widowhood among Chinese middle-aged and older adults was not observed in this study, which may be due to the higher degree of aging society in Japan [47].

We found that unmarried status may partially mediate the association between ACEs and depressive symptoms in middle-aged and older adults, with unmarried status significantly mediating the associations of unsafe neighborhood, family member incarceration, family mental illness, and bullying with depressive symptoms. This could be explained by the fact that individuals who have experienced two or more ACEs are more likely to be unmarried than those who have not experienced ACEs, thereby increasing susceptibility to depression in middle-aged and older adults. This finding is often explained in terms of the attachment theory [48] and complex trauma theory. ACEs influence the establishment of

intimate relationships, then a lack of consistent and reliable attachment relationships adversely affects psychosocial development [49–51], eventually resulting in a lack of self-worth being loved and a lack of trust in others [49, 50, 52, 53]. In these views, experiencing multiple ACEs may lead to a high risk of unmarried status. According to complex trauma theory [54], the victim's perceived secure base can actually be their biggest source of danger. The victim's internal working model, or worldview, is built on these perceptions of themselves in relation to others, which can in turn affect their relationships beyond their family of origin. Both multifinality and equifinality may result from similar psychopathological processes triggered by various stressors at the family level. In other words, adverse childhood experiences (ACE) trauma can contribute to the development of depression. In studies of depression, family function is a protective factor that has been found to reduce the likelihood of developing depression [55]. Because according to the family function of McMaster model, family as its members of the physical, psychological and social development environment basis [56], good family function can provide family members with a stable and safe psychological development environment, the sense of belonging in intimate relationship can improve the resilience of the negative consequences of childhood trauma. However, due to the lack of family relationship in adulthood, unmarried people cannot possess the positive psychological regulation effect brought by family function.

The above studies and our results support the conclusion that ACEs are associated with a high risk of unmarried status and depression in middle-aged and older adults, and that marital status may partially mediate the occurrence of depression. Our findings contribute to the understanding of the mechanisms underlying the long-term adverse effects of adverse childhood experiences across the life course. On the one hand, the long-term effects of ACEs on depressive symptoms indicate the importance of life-course intervention strategies for preventing childhood adversity and mental health-related impairments in middle-aged and older people. On the other hand, the family functioning that comes with marriage can create a favorable environment for psychological development that may help break the stress diffusion process and alleviate psychopathology in victims of ACEs.

### Limitations

Our research data are obtained from a representative survey study in China, making the analytical results more reliable. We separately evaluated the association between ACEs exposure and marital status, the association between ACEs exposure and depressive symptoms in Chinese middle-aged and older adults, and also



assessed the mediation role of marital status in the association between ACEs exposure and depressive symptoms, with enlightenment for understanding how ACEs affect mental health in middle-aged and older adults over the life course. Our study has some limitations. Firstly, a large proportion of participants were excluded from the primary analysis due to lost follow-up or missing data, which may introduce selection bias and reduce the generalizability of our findings. Secondly, since the questionnaires used in this study to assess adverse experiences and depression in middle-aged and older adults were both self-reported and subjectively judged, there may be measurement error. Thirdly, exposure to ACEs was retrospectively assessed by self-report, which might induce recall bias. Fourthly, this study did not use the typically-used ACEs score cutoff of 4 or more, the results are less comparable with current literature on ACEs. Fifthly, the quality of marriage was not evaluated. so the heterogeneity of marital quality among married people is not well evaluated. In addition, the population in the study was only limited to the Chinese population, and the conclusions cannot be extended to other countries. In the future, the combination of self-evaluation scale with clinical objective diagnosis may be better used for mental health evaluation, and include more people from different countries and different cultures, which will obtain higher credibility and persuasive results. What's more, further studies examining the role of biological factors in the aetiology or pathophysiology of depression among individuals who experienced ACEs are needed.

## Conclusion

The results of this cohort study suggest that experiences of two or more ACEs are associated with a high risk of unmarried status and depressive symptoms in middle-aged and older Chinese adults. These findings suggest that public health strategies among middle-aged and older adults from a life course perspective are needed to reduce the risk of depression among middle-aged and older adults in China. Such as reduce exposure to ACEs, and pay more attention to the marital status of older adults.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-024-19787-x>.

Supplementary Material 1

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## Author contributions

P Yu and X Wang contributed to "Conceptualization, Methodology, Visualization, Formal Analysis, Writing - Original Draft", they are the co-first authors and they contributed equally to the article. J Liu and H Luo contributed to "Formal Analysis, Writing - Review & Editing". Y Yi contributed to "Supervision, Funding Acquisition, Writing - Review & Editing". All of the authors contributed to this paper and reviewed the manuscript.

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## Data availability

This study uses open data. Researchers can request and download data through the CHARLS website (<https://charls.pku.edu.cn/en/>).

## Declarations

### Ethics approval and consent to participate

The data analyzed in this study are from the China Health and Retirement Longitudinal Study (CHARLS). All methods were conducted in accordance with the Declaration of Helsinki. Each participant provided written informed consent, and the China Health and Retirement Longitudinal Study received ethical approval from the Institutional Review Board of Peking University.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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