

# The relationship between adverse childhood experiences and depressive symptoms among middle-aged and older adults in China: Sleep duration plays a mediating role

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## Research Article

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# **The relationship between adverse childhood experiences and depressive symptoms among middle-aged and older adults in China: Sleep duration plays a mediating role**

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## **Abstract**

**Background:** There is a paucity of research on the link between adverse childhood experiences, sleep duration and depressive symptoms among Chinese middle-aged and older adults. The present study aimed to examine the mediating role of sleep duration between adverse childhood experiences and depressive symptoms in China.

**Methods:** Data were obtained from the China Longitudinal Study of Health and Retirement in 2014 and 2018. A total of 9,914 participants over 45 years old were included in the analysis. We conducted the linear regression model and bootstrap analyses to test the mediating role of sleep duration in the relationship between adverse childhood experiences and depressive symptoms.

**Results:** In this study, childhood socioeconomic disadvantages ( $\beta = 0.46$ ,  $P < 0.05$ ), parental-involved trauma ( $\beta = 0.50$ ,  $P < 0.05$ ), maladaptive parental trauma ( $\beta = 0.15$ ,  $P < 0.05$ ), and other trauma ( $\beta = 1.35$ ,  $P < 0.05$ ) were associated with depressive symptoms among middle-aged and older adults. Sleep duration mediated the associations between childhood socioeconomic disadvantages ( $\beta = 0.40$ ,  $P < 0.05$ ), parental-involved trauma ( $\beta = 0.45$ ,  $P < 0.05$ ), maladaptive parental trauma ( $\beta = 0.11$ ,  $P < 0.05$ ), other trauma ( $\beta = 1.21$ ,  $P < 0.05$ ) and depressive symptoms, respectively.

**Conclusions:** Adverse childhood experiences were associated with depressive symptoms, and sleep duration mediated this association. It is recommended to reduce the negative impact of adverse childhood experiences on depressive symptoms by ensuring adequate sleep.

**Key Words:** depressive symptoms, adverse childhood experiences, sleep duration

## 1. Introduction

As a highly prevalent mental illness and one of the leading causes of disability (James et al., 2018), depression affects approximately 300 million people

worldwide. It has significantly contributes to the global burden of disease(Nobis et al., 2020). Depression in older adults is a growing public health concern worldwide(Ustün et al., 2004). A national survey reveals that a significant percentage of Chinese individuals over the age of 45 suffer from high levels of depressive symptoms(Lei et al., 2014). A cohort study from China indicates that the prevalence of depressive symptoms among middle-aged and older adults was 17.4 %(Liu et al., 2022). Late-life depression increases the risk of dementia and suicide, decreases quality of life(Diniz et al., 2013; Sivertsen et al., 2015; Wang et al., 2014). It is worth noting that the prevalence of depression among Chinese people aged 60 and above was 41%(Bruce, 2001). Consequently, exploring the risk factors for depressive symptoms among Chinese middle-aged and older people is of critical public health importance(Li and Zhou, 2020; Rodda et al., 2011).

Adverse Childhood Experiences (ACEs) refers to all a person's negative experiences during childhood(McLaughlin, 2016). Conditions such as exposure to childhood socioeconomic disadvantages, parental-involved trauma and maladaptive parental trauma or other trauma are manifestations of ACEs(Lloyd and Turner, 2003). According to the WHO's Mental Health Survey, approximately 40% of the population has suffered a childhood adverse event(Kessler et al., 2010). Apart from the short-term effects on childhood and early adulthood health, ACE's effects might persist into later adulthood, contributing to mental disorders such as depression among older adults(Rojas et al., 2025). Specifically speaking, four different types of

ACEs all have an impact on depressive symptoms in middle-aged and older adults(Yu et al., 2024; Zeng and Lyu, 2025). Meanwhile, a study of depressive symptoms in Chinese middle-aged and older adults have found that parents' mental health problems, poor health status, child neglect and abuse had an impact on depressive symptoms(Tian et al., 2019). The link between the two can be explained by the theory of cumulative inequality (CI), which posits that childhood is the key to healthy adulthood(Ferraro and Shippee, 2009). Early exposure to stressful environments predicts disadvantage in adulthood, and this difference can and does widen with age(Goosby, 2013). Although a link between ACEs and depression in middle-aged and older adults has been identified, the underlying mechanisms of this relationship are unknown.

Sleep disorders are a very common health problem and have a cumulative effect over time(Institute of Medicine Committee on Sleep and Research, 2006). Previous studies indicated that ACEs are associated with difficulty falling asleep(Rojo-Wissar et al., 2021). At the same time, people who experienced childhood adversity have higher levels of self-reported sleep disturbances in adulthood(Gal et al., 2011). Moreover, short and long sleep duration was significantly associated with increased risk of depression in adults(Zhai et al., 2015). Sleep disorders may be a sign of risk for major depression(Chen et al., 2012). A cross-sectional study of Chinese older adults showed that short sleep duration increased the risk of depressive

symptoms(Luo et al., 2022). However, no studies have explored sleep duration as an intrinsic mechanism of this relationship.

This study aimed to test the mediating role of sleep duration between ACEs and depressive symptoms. It also provides policy recommendations for improving mental health and preventing depression in middle-aged and older adults.

## **2 Methods**

### **2.1 Data and samples**

The current research used data from waves 2014 and 2018 of the China Health and Retirement Longitudinal Study (CHARLS), a biennial survey conducted on a nationally representative sample of Chinese residents aged 45 years and older living in mainland China(Zhao et al., 2014). Participants was selected using the multi-stage probability proportionality (PPS) method. The CHARLS assessment included the social, economic, and health status of community residents. For the purposes of our research, we utilized the data from 2014 and matched personally identifiable information from 2018. The survey data in 2014 and 2018 interviewed 20,948 and 21,789 individuals, respectively. ACEs were selected from 2014 data because only 2014 data investigated life course questionnaire; depressive symptoms, sleep duration and potential confounding variables from 2018 data. Firstly, this study matched the data in 2018 with the life course questionnaire data in 2014 by personal identity document (n =23,060). Secondly, participants younger than 45 years old in the 2018 data were excluded (n =232). Thirdly, participants with missing values on key

variables in both waves ( $n = 12,914$ ) were excluded to obtain complete and accurate data. Finally, the study sample consisted of 9,914 older adults. (see supplementary file: Figure S1 Variables and related question in CHARLS survey to assess childhood adversities).

## 2.2 Measurements

### 2.2.1 Assessments of depression symptoms

In this study, depressive symptoms were measured by the 10-item Center for Epidemiologic Studies Depression Scale (CES-D), which has been widely used in many countries and showed high reliability and validity (Chang et al., 2016; Wang et al., 2018). The questionnaire consisted of 10 items with four answers on a 4-point scale ranging from 0 to 3, which represented “rarely or none of the time” to “most or all the time”. The total depression score ranges from 0-30, with higher scores indicating a higher level of depressive symptoms (Lei et al., 2014).

### 2.2.2 Assessment of adverse childhood experiences

In this study, adverse childhood experiences included four different types: childhood socioeconomic disadvantages, parental-involved trauma, maladaptive parental trauma, and other trauma. The latter three variables were potential traumatic events, assessed and categorized based on the inventory used to evaluate the risk of early trauma for mental disorders and physical illnesses in adulthood, as well as a study classifying childhood adversity according to the WHO's World Health Mental Health Survey (Kessler et al., 2010; Lloyd and Turner, 2003; Turner et al., 2016).

Detailed definitions of the indicators for the four types of ACEs mentioned above and related issues are presented in Table S1 Variables and related question in CHARLS survey to assess childhood adversities (Supplementary file).

#### 2.2.2.1 Childhood socioeconomic disadvantages.

In this study, child socioeconomic disadvantage was a composite count of four dichotomous indicators (0-4): (1) parental illiteracy; (2) hunger experience; (3) flee from famine; (4) a worse economic situation than neighbors have.

#### 2.2.2.2 Parental-involved trauma.

Parental-involved trauma was a composite count (0–4) of four dichotomous indicators: (1) parental death; (2) parental mental illness; (3) parental substance abuse; (4) domestic violence.

#### 2.2.2.3 Maladaptive parental trauma.

Maladaptive parental trauma was measured as a composite count ranging from 0 to 2, incorporating two dichotomous indicators: (1) physical abuse; (2) Neglect.

#### 2.2.2.4 Other trauma.

Other trauma was assessed as a composite count ranging from 0 to 2, comprising two dichotomous indicators: (1) being bullied; (2) serious physical illness.

### 2.2.3 Mediating factor

#### 2.2.3.1 Sleep duration

Sleep duration was examined by asking respondents: "During the past month, how many hours of actual sleep did you get at night (average hours for one night)?"

Several studies from China have used this method of measuring sleep duration(Jing et al., 2020; Li et al., 2017; Yin et al., 2023). Sleep duration between 0 and 24 hours.

#### 2.2.4 Covariates

Potential confounding variables in this study included demographic characteristics, health behavior, and healthy status. Demographic characteristics included marital status (single or married), gender (male or female), age (years), residence (rural or urban), educational attainment (illiterate or primary school and above) and individual income (yuan). To avoid the influence of extreme values, the value of individual income is the logarithm in the empirical analysis of this paper. Health behavior comprised smoking (yes or no) and alcohol drinking (yes or no). Healthy status is characterized by chronic diseases. The number of chronic diseases was categorized into three groups (no chronic condition, one chronic condition, or multimorbidity).

#### 2.3 Statistical analysis

All statistical analyses were performed by using Stata 16.0. We conducted descriptive analyses using means (SD) for continuous variables and frequency (percentage) for categorical variables. The study used a three-step testing procedure to explore the potential mediating effects of sleep duration on the relationship between ACEs and depressive symptoms. (1) linear regression analysis was used to explore the association between ACEs and sleep duration, (2) linear regression analysis was performed to estimate the relationship between ACEs and depressive symptoms, (3) to further test the association between ACEs and depressive symptoms when sleep

duration was included as a mediator. All sociodemographic characteristics were controlled for in the above analyses. Lastly, bootstrapping was utilized to test the mediating model, with sampling repeated 500 times to calculate bias-corrected and accelerated 95% confidence intervals (CIs). A significance level of 0.05 (two-tailed) was employed, with mediation considered significant if the bias-corrected and accelerated 95% CI excluded zero.

### **3. Results**

#### **3.1 Characteristics of the Participants**

Table 1 presents the characteristics of the participants. The final sample consisted of 9,914 participants, with a mean age of 59.92 years old. In terms of childhood experiences, 84.57% of respondents experienced socioeconomic disadvantage, 66.87% reported parental-involved trauma, 48.28% indicated maladaptive parental trauma, and 11.25% reported other trauma. 6.27 hours are the average length of sleep. Furthermore, the average depression symptoms score among respondents was 9.60.

#### **3.2 Associations between ACEs and depressive symptoms**

Table 2 illustrates the association of various types of ACEs and depressive symptoms. Across Model 1 to Model 4, the estimates indicate that, after controlling for all covariates, childhood socioeconomic disadvantage was significantly associated with higher depressive symptoms ( $\beta = 0.46$ ,  $P < 0.001$ ). Similarly, parental-involved trauma ( $\beta = 0.50$ ,  $P < 0.001$ ), maladaptive parental trauma ( $\beta = 0.15$ ,

$P < 0.05$ ), and other trauma ( $\beta = 1.35$ ,  $P < 0.001$ ) were each associated with higher depressive symptoms.

### 3.3 Mediating effect of sleep duration on the relationship between ACEs and depressive symptoms

In Table 3, Models 1, 3, 5, and 7 show that without including any mediating variables, respectively, childhood socioeconomic disadvantage ( $\beta = 0.46$ ,  $P < 0.001$ ) parental involved trauma ( $\beta = 0.50$ ,  $P < 0.001$ ) maladaptive parental trauma ( $\beta = 0.15$ ,  $P < 0.001$ ) other trauma ( $\beta = 1.35$ ,  $P < 0.001$ ) had a significant effect on direct effect on depressive symptoms was significant. In addition, after adding sleep duration as a mediating variable to the above models, Models 2, 4, and 8 indicated that the relationships between childhood socioeconomic disadvantage ( $\beta = 0.40$ ,  $P < 0.001$ ) ,parental involved trauma ( $\beta = 0.45$ ,  $P < 0.001$ ) ,other trauma ( $\beta = 1.21$ ,  $P < 0.001$ ) and depressive symptoms remained significant. Model 6 illustrated that the relationship between maladaptive parental trauma ( $\beta = 0.11$ ,  $P > 0.05$ ) and depressive symptoms was no longer significant.

Furthermore, we employed the bootstrap method to explore the mediating effects of sleep duration. This method involved 500 repetitions of sampling, with the results presented in Table 4. Table 4 was designed to analyze the mediating effect of sleep duration between four distinct ACEs and depressive symptoms, respectively. All models were controlled for demographic and family characteristics, socioeconomic status and variables, and the health status of the respondents. It can be seen from

Table 4 that the confidence interval of the sleep duration's indirect effect does not include 0. Consequently, it is considered that there exists a significant mediating effect.

#### **4. Discussion**

Using nationally representative data, this study investigated the mediating role of sleep duration in the relationship between ACEs and depressive symptoms among middle-aged and older adults in China. The results of the study revealed that ACEs was positively associated with depressive symptoms directly and also indirectly through sleep duration.

The results of the analysis regarding ACEs and depressive symptoms align with findings from previous studies(Tian et al., 2019), which indicated that people who experienced ACE are more likely to suffer from depressive symptoms as they age. The following two points can explain this. First, this phenomenon is due to the intergenerational transmission of socioeconomic status. Children of a family with higher socioeconomic status have access to better living conditions and education, making them less susceptible to depressive symptoms in old age. Notably, a large proportion of older people had suffered from acute food shortages and the Great Famine (1959–1961) in childhood(Cui et al., 2020), particularly within our study population. Hunger caused by food shortages during childhood was associated with significantly increased odds of depressive symptoms(Stickley and Leinsalu, 2018).

Second, Children raised by parents with mental illness may experience negative emotions such as fear, anxiety and depression at home, coupled with poor parental behaviors like substance abuse, domestic violence, neglect and suicide. Over time, these children may lack adequate care from their parents, leading to an increased risk of developing depressive symptoms later in life(Weissman et al., 1997). Consistent with our results, other trauma also exerts effects on depressive symptoms in older adults. Chronic illness, pain and disability can have a serious impact on psychosocial health and increase the risk of depression.

Results from our study indicated that sleep duration was a mediator in the relationship between ACEs and depression symptoms. There are several plausible explanations for the pathway of sleep duration between ACEs and depressive symptoms. First, recent evidence suggests that ACEs are associated with adult sleep duration(Olsen et al., 2024). In addition, it has been found that children affected by ACEs have altered sleep status(Chapman et al., 2013). Second, results from a cross study based on the National Health and Nutrition Examination Survey from 2009 to 2016, sleep duration was independently associated with higher rates of depression(Dong et al., 2022). Consequently, sleep duration plays a crucial role in individual's overall health. It is plausible to suggest that childhood adversity contributes to the risk of depression through its impact on sleep duration, highlighting sleep as a key link between childhood adversity and poorer health status.

On the basis of these findings, we make the following two recommendations for the development of comprehensive measures to prevent ACEs and thereby reduce the incidence of depression. First, childhood and early adulthood should be a major period of special attention for the public and relevant sectors. Targeted policies and interventions, such as the development and implementation of specific curricula for trauma healing, resilience enhancement, and the emotional and psychological well-being of victims, can ultimately benefit society by reducing the risk of depression in older adults decades later. Second, policymakers should develop more effective sleep health interventions, such as control of sleep duration. This could improve the health of people with ACEs and reduce the negative effects of ACEs.

Several limitations should be acknowledged. Firstly, information on any childhood adversity was drawn from respondents' memories, which may have contributed to recall bias. Respondents who experienced ACEs may be too distressed to amplify their memories of adversity, leading to biased reporting. Secondly, the measurement of sleep duration in this study was subjective and could be measured in the future by methods such as objective sleep monitoring.

## **5. Conclusions**

Using nationally representative data, this study explored multiple pathways linking four aspects of ACEs including childhood socioeconomic disadvantage, parental-involved trauma, maladaptive parental trauma, and other trauma to depressive symptoms among middle-aged and older individuals. In addition, these

results also demonstrate that the effect of ACEs on depressive symptoms is partially mediated by sleep duration among middle-aged and older adults in China. From the perspective of public health, childhood should be a critical period with particular concern from both public and relevant authorities. More resources should be invested in preventing the occurrence of these ACEs as early-life preventive efforts. By monitoring sleep duration, the health of populations with ACEs can be improved, thereby reducing the negative effects of depressive symptoms.

### **Abbreviations**

|       |                                        |
|-------|----------------------------------------|
| ACEs  | Adverse Childhood Experiences          |
| CES-D | Epidemiologic Studies Depression Scale |
| WHO   | World Health Organization              |
| CI    | Confidence Interval                    |

### **Supplementary Materials**

A supplement that includes a table and a figure.

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### **Author contributions**

WQY and CCZ conceptualized and designed the study. TYG was responsible for data collection. XHQ and HXJ conducted data analysis and interpretation. XHQ drafted the initial version of the manuscript. WQY, CCZ, DZ, and SJC critically reviewed and revised the manuscript for important intellectual content. All authors read and approved the final version of the manuscript.

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### **Data availability**

The data that support the findings of this study are openly available in CHARLS website: <http://charls.pku.edu.cn>.

### **Declarations**

#### **Ethics approval and consent to participate**

Ethics approval and consent to participate

The data used in this study were derived from the China Health and Retirement Longitudinal Study (CHARLS), a publicly available secondary database. The original CHARLS survey was approved by the Ethical Review Committee of Peking University. All participants provided informed consent before participating in the original survey. The present study used de-identified secondary data, and no additional ethical approval or consent to participate was required.

### **Consent for publication**

Not applicable.

### **Competing interests**

The authors declare no conflicts of interest.

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**Table 1** Sample characteristics ( $N = 9,914$ )

| Variables                                    | Mean ( <i>SD</i> )/ <i>N</i> (%) |
|----------------------------------------------|----------------------------------|
| Childhood Adversities                        |                                  |
| Childhood socioeconomic disadvantage         | 8384 (84.57)                     |
| Parental illiteracy                          | 4564 (46.04)                     |
| Hunger experience                            | 6457 (65.13)                     |
| Flight away from famine                      | 1287 (12.98)                     |
| Worse economic situation than neighbors have | 3535 (35.66)                     |
| Parental-involved trauma                     | 6629 (66.87)                     |
| Parental death                               | 6306 (63.61)                     |
| Parental mental illness                      | 85 (0.86)                        |
| Parental substance abuse                     | 60 (0.61)                        |
| Domestic violence                            | 843 (8.50)                       |
| Maladaptive parental trauma                  | 4786 (48.28)                     |
| Physical abuse                               | 3013 (30.39)                     |
| Neglect                                      | 2737 (27.61)                     |
| Other trauma                                 | 1115 (11.25)                     |
| Being bullied                                | 906 (9.14)                       |
| Physical illness before 15 years old         | 253 (2.55)                       |
| Depressive symptoms                          | 9.60 (5.18)                      |
| Sleep duration                               | 6.27 (1.80)                      |
| Gender                                       |                                  |
| Female                                       | 4527 (45.66)                     |
| Male                                         | 5387 (54.34)                     |
| Age, mean                                    | 59.92 (8.96)                     |
| Residence                                    |                                  |
| Rural                                        | 6918 (69.78)                     |

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|                          |              |
|--------------------------|--------------|
| Urban                    | 2996 (30.22) |
| Educational attainment   |              |
| Illiterate               | 456 (4.60)   |
| Primary school and above | 9458 (95.40) |
| Marital status           |              |
| Single                   | 1002 (10.11) |
| Married                  | 8912 (89.89) |
| Ln(individual income)    | 6.85 (3.37)  |
| Smoking                  |              |
| No                       | 9526 (96.09) |
| Yes                      | 388 (3.91)   |
| Alcohol drinking         |              |
| No                       | 3895 (39.29) |
| Yes                      | 6019 (60.71) |
| Chronic conditions       |              |
| No Chronic Condition     | 5629 (56.78) |
| One Chronic Condition    | 2695 (27.18) |
| Multimorbidity           | 1590 (16.04) |

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**Table 2** The relationship between ACEs and depressive symptoms in middle-aged and older people

| Variables                            | Model 1                 | Model 2                 | Model 3                 | Model 4                 |
|--------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Childhood socioeconomic disadvantage | 0.46*** (0.36, 0.56)    |                         |                         |                         |
| Parental involved trauma             |                         | 0.50*** (0.31, 0.68)    |                         |                         |
| Maladaptive parental trauma          |                         |                         | 0.15* (0.01, 0.30)      |                         |
| Other trauma                         |                         |                         |                         | 1.35*** (1.06, 1.65)    |
| Gender                               |                         |                         |                         |                         |
| Female                               |                         |                         |                         |                         |
| Male                                 | -1.63*** (-1.85, -1.40) | -1.55*** (-1.78, -1.32) | -1.56*** (-1.79, -1.33) | -1.59*** (-1.82, -1.36) |
| Age                                  | -0.02** (-0.03, -0.01)  | -0.02** (-0.03, -0.01)  | -0.01 (-0.02, 0.01)     | -0.01 (-0.01, 0.01)     |
| Residence                            |                         |                         |                         |                         |
| Rural                                |                         |                         |                         |                         |
| Urban                                | -0.52*** (-0.75, -0.29) | -0.61*** (-0.84, -0.39) | -0.64*** (-0.87, -0.41) | -0.64*** (-0.87, -0.41) |
| Educational attainment               |                         |                         |                         |                         |
| Illiterate                           |                         |                         |                         |                         |
| Primary school and above             | 0.12 (-0.35, 0.61)      | -0.03 (-0.50, 0.45)     | -0.06 (-0.54, 0.41)     | -0.03 (-0.51, 0.44)     |
| Marital status                       |                         |                         |                         |                         |
| Divorced/widowed/n ever married      | -1.06*** (-1.3, -0.82)  | -1.06*** (-1.4, -0.72)  | -1.05*** (-1.3, -0.8)   | -1.05*** (-1.3, -0.8)   |

|                       |                        |                        |                        |                        |
|-----------------------|------------------------|------------------------|------------------------|------------------------|
| Married               | 9, -0.72)              | 0, -0.72)              | 8, -0.71)              | 8, -0.71)              |
| Ln(individual income) | -0.13***(-0.17, -0.10) | -0.14***(-0.17, -0.11) | -0.14***(-0.17, -0.11) | -0.14***(-0.17, -0.11) |
| Smoking               |                        |                        |                        |                        |
| No                    |                        |                        |                        |                        |
| Yes                   | -0.14(-0.65, 0.38)     | -0.17(-0.68, 0.35)     | -0.18(-0.70, 0.35)     | -0.19(-0.70, 0.33)     |
| Alcohol drinking      |                        |                        |                        |                        |
| No                    |                        |                        |                        |                        |
| Yes                   | 0.18(-0.04, 0.41)      | 0.21(-0.02, 0.44)      | 0.21(-0.02, 0.44)      | 0.21(-0.02, 0.43)      |
| Chronic conditions    |                        |                        |                        |                        |
| No Chronic Condition  | 0.94*** (0.72, 1.18)   | 0.96*** (0.73, 1.19)   | 0.97*** (0.74, 1.20)   | 0.97*** (0.74, 1.20)   |
| One Chronic Condition | 2.05*** (1.77, 2.33)   | 2.08*** (1.80, 2.36)   | 2.10*** (1.82, 2.38)   | 2.05*** (1.77, 2.32)   |
| Multimorbidity        |                        |                        |                        |                        |

Note: Parentheses include the 95%CI for estimates. \*\*\* $P < 0.001$ ; \*\* $P < 0.01$ ; \* $P < 0.05$ .

**Table 3** The mediating effect of sleep duration on the relationship between ACEs and depressive symptoms at follow-up in older adults ( $N = 9914$ )

| Variables                            | Model 1              | Model 2                 | Model 3              | Model 4                 | Model 5            | Model 6                 | Model 7              | Model 8                 |
|--------------------------------------|----------------------|-------------------------|----------------------|-------------------------|--------------------|-------------------------|----------------------|-------------------------|
| Childhood socioeconomic disadvantage | 0.46*** (0.36, 0.56) | 0.40*** (0.30, 0.50)    |                      |                         |                    |                         |                      |                         |
| Parental involved trauma             |                      |                         | 0.50*** (0.31, 0.68) | 0.45*** (0.27, 0.64)    |                    |                         |                      |                         |
| Maladaptive parental trauma          |                      |                         |                      |                         | 0.15* (0.01, 0.30) | 0.11 (-0.04, 0.25)      |                      |                         |
| Other trauma                         |                      |                         |                      |                         |                    |                         | 1.35*** (1.06, 1.65) | 1.21*** (0.92, 1.50)    |
| Sleep duration                       |                      | -0.56*** (-0.61, -0.51) |                      | -0.57*** (-0.62, -0.52) |                    | -0.57*** (-0.63, -0.52) |                      | -0.56*** (-0.62, -0.51) |

Control variables in both model 1 to model 4: Age, Gender, Residence, Educational attainment, Chronic conditions, Alcohol drinking, Smoking, Marital status, Ln(individual income)

*t* statistics in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

**Table 4** Indirect and direct effects of ACEs by sleep duration on depressive symptoms

| Pathway                                                                 | Indirect effect      | Direct effect        |
|-------------------------------------------------------------------------|----------------------|----------------------|
| Childhood socioeconomic disadvantage→Sleep duration→Depressive symptoms | 0.07*** (0.04, 0.09) | 0.40*** (0.30, 0.50) |
| Parental involved traum→Sleep duration→Depressive symptoms              | 0.04* (0.01, 0.08)   | 0.45*** (0.26, 0.65) |
| Maladaptive parental trauma→Sleep duration→Depressive symptoms          | 0.05** (0.02, 0.08)  | 0.10 (-0.04, 0.25)   |
| Other trauma→Sleep duration→Depressive symptoms                         | 0.13*** (0.08, 0.20) | 1.21*** (0.92, 1.50) |

Parentheses include the 95%CIs for estimates.

\*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ .



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