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The associations between adverse childhood experiences and body pain among middle-aged and older adults: findings from China

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Abstract

Background Adverse Childhood Experiences (ACEs) have been implicated in the development of body pain, yet research on their impact on body pain and its progression remains scarce. This study aimed to examine the associations between ACEs and the presence and areas of body pain, as well as their developmental trajectories among middle-aged and older Chinese adults.

Methods We included participants aged 45 years and above from the China Health and Retirement Longitudinal Study (CHARLS) conducted between 2011 and 2018. Retrospective data on ACEs and pain sites were collected with questionnaires. The presence of pain at different body sites was categorized into three areas: head & neck, trunk, and limbs. ACEs consisted of ten types of adverse experiences and were cumulatively scored. For the cross-sectional analysis (2011), logistic regressions were performed to estimate the associations between ACEs and pain presence in specific areas. In the longitudinal analysis (2011–2018), we further applied group-based trajectory modelling (GBTM) to determine the developmental trajectories of body pain. Multinomial logistic regressions were then conducted to estimate the associations between ACEs and pain trajectories.

Results In the cross-sectional analysis ($n=8157$), ACEs were positively associated with the presence of pain in the head & neck (odds ratio [OR] = 3.55, 95% confidence intervals [CI] = 2.37–4.74), trunk (OR = 3.28, 95% CI = 2.47–4.34), and limbs areas (OR = 2.30, 95% CI = 1.77-3.00) compared to no ACEs. These associations varied by sex and residence. In the longitudinal analysis ($n=5188$), GBTM identified three developmental trajectories of body pain ($n=9521$): high-increasing (7.44%), low-moderate (33.67%) and maintained-low trajectories (58.89%) trajectories. Compared to participants without ACEs, individuals had three ACEs and 4 or more ACEs were consistently associated with low-moderate (three ACEs: OR = 2.26, 95% CI = 1.81–2.83, four or more ACEs: OR = 3.11, 95% CI = 2.51–3.87) and high-increasing (three ACEs: OR = 3.28, 95% CI = 2.03–5.30, four or more ACEs: OR = 6.78, 95% CI = 4.30-10.68) body pain trajectories across sexes and residence.

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Conclusion This study highlighted the significant association between ACEs and body pain among middle-aged and older Chinese, emphasizing the importance of preventing or mitigating ACEs as a strategy for the prevention and management of body pain.

Keywords Adverse childhood experiences, Body pain, Trajectory, Middle-aged and older adults

Introduction

Pain, defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage [1], is a widespread and diverse phenomenon. Previous research has shown that a considerable number of adults experience frequent or chronic body pain, such as low back pain, headaches, and joint pain [2]. As of 2016, 20.4% of the American population [3] and 31.5% of the Chinese population reported experiencing body pain [4]. This condition imposes a substantial socioeconomic burden, amounting to nearly $5,800 per person annually in medical expenses and lost productivity in the United States [5]. In China, body pain causes over ¥1,000 billion per year in additional medical expenses [6]. Furthermore, body pain can also lead to a serious disease burden, contributing to the significant global rise in disability-adjusted life years (DALYs) [7], potentially leading to adverse physical and psychological health consequences such as anxiety, depression, limited mobility [7], and opioid abuse [8], all of which can exert a negative impact upon a person's quality of life. Therefore, it is crucial to investigate the underlying risk factors and predictors of body pain development.

Adverse Childhood Experiences (ACEs) are traumatic experiences happened in childhood, which can lead to various adverse health outcomes. ACEs include a wide range of experiences, such as abuse [9], bullying [10], neglect [11], and household dysfunction [10]. Given the complex and multifactorial etiology of body pain, evidence suggests that ACEs may play a significant role in its development [12]. Although several studies have examined the association between ACEs and body pain [13–15], most have focused on a single type of ACEs, limiting our understanding of the cumulative impact of multiple ACEs on body pain. Furthermore, body pain varies in severity, patterns, and progression over time [16, 17], yet few studies have explored the associations between ACEs and these aspects of body pain. From a life course perspective, large population-based studies are needed to investigate the associations of various ACEs with body pain and its progression, to better understand the complex interplay of early life factors in this prevalent health issue.

To fill this gap in knowledge, this study aimed to (1) in a cross-sectional analysis, examine the associations between ACEs and body pain presence and areas; (2) in a longitudinal analysis, explore the associations between ACEs and the developmental trajectory of body pain.

Methods

Data resource

The China Health and Retirement Longitudinal Study (CHARLS) is a longitudinal survey to gather extensive health-related data from mainland Chinese residents aged 45 and above. It encompasses a broad array of inquiries pertaining to economic status, physical and psychological health, demographics, and social networks of the ageing population. The baseline survey in 2011 adopted a stratified multi-stage sampling, covering 150 counties or urban districts in 28 provinces [18]. To involve follow-up information and address gaps in the younger age groups of people who newly reach 45 years old, four subsequent waves were launched in 2013, 2015 and 2018, with more than 80% of baseline participants followed up at each wave. More details of the CHARLS survey have been described elsewhere [19].

In this study, we used data on demographics and lifestyles from the CHARLS baseline survey in 2011, information on body pain from the CHARLS health status and functioning survey from wave 1 (2011) to wave 4 (2018), and information on ACEs from the CHARLS life history survey conducted in 2014.

All participants signed an informed consent during the investigation, and the project was approved by the Institutional Review Board at Peking University (IRB approval number for the main household survey: IRB00001052-1101).

Study design

This study consisted of two parts. Part I was based on the baseline survey in 2011 and estimated the cross-sectional associations between the number of ACEs and body pain presence and pain areas. Part II was a longitudinal analysis based on all four waves from 2011 to 2018, where association of the number of ACEs with the developmental trajectories of body pain was investigated. Given the disparities in sex and residence regarding the incidence of ACEs and body pain [20, 21], we conducted a sex- and residence-stratified analysis in Part I and Part II. Additionally, we also estimated the association between ACEs types and body pain presence and pain areas.

Study population

A total of 17,705 participants were included in the baseline survey. After excluding participants under the age of 45 years ($n = 2823$) and those with incomplete data on demographics, body pain and ACEs ($n = 6725$) in 2011, 8157 participants were included in Part I.

For the longitudinal analysis in Part II, 11,446 participants were excluded due to incomplete data on body pain or ACEs across all four waves, resulting in a final sample of 9521 participants. The flowchart of this study is presented in Fig. 1.

Assessment and definition of ACEs

By using a retrospective questionnaire, ACEs were self-reported and could be further categorized into ten non-overlapping types: physical abuse, emotional abuse, witnessing family violence, household substance abuse and incarceration, household mental illness, parental divorce or disharmony, neglect, family member's death, family burden, and adverse environment. Each type was assigned a consistent weight of one and summed to a total ACEs score as a continuous variable. Then the number of ACEs was classified into five levels: 0 ACEs, 1 ACEs, 2 ACEs, 3 ACEs, and 4 or more ACEs. A detailed definition of each ACEs type is provided in Table S1.

Assessment of body pain

A self-report questionnaire was administered by the CHARLS investigators to gather information on body pain during each wave of data collection. The questionnaire began with the question, "Are you often troubled by any pain in your body?" Pain was then categorized as a binary variable (yes/no) based on the participant's response to this question. Pain areas were defined based on 15 specific pain sites, then grouped into three main areas: head & neck, trunk (in chest, stomach, back, waist, or buttocks), limbs (in shoulders, arms, wrists, fingers, legs, knees, ankles, or toes). Pain development was categorized by the changes in the number of pain sites. The elevating number of pain sites meant aggravation of pain and the descending number of pain sites implied mitigation of pain.

Covariates

Covariates in the baseline survey included participant's age, sex (male/female), education level (below primary school/primary school and above), current economic status (low/middle/high), residence (urban/rural), marital status (married/unmarried or widowed), smoking (yes/no), and alcohol drinking history (yes/no).

Statistical analysis

In Part I, the cross-sectional analysis utilized a logistic regression model to estimate the associations of types and the number of ACEs with the presence body pain (dichotomous) and three specific pain areas, demonstrated by odds ratios (ORs) and 95% confidence intervals (CIs).

In Part II, participants were first classified into distinct developmental trajectories of the number of body pain sites from 2011 to 2018, using the group-based trajectory modelling (GBTM). This method estimates distinct trajectories by analyzing longitudinal data and clustering individuals into subgroups. Each individual was assigned to a trajectory group based on their maximum posterior probability, which represents the likelihood that they belong to a specific trajectory. We employed the Auto-Traj SAS macro [43], which selects the optimal number of trajectories by minimizing the Bayesian Information Criterion (BIC) [22]. After testing models with 1 to 8 trajectory groups, we determined that a three-group model provided the best fit, as BIC values increased when additional groups were added, and the process became more computationally intensive. After determining the trajectory groups, a logistic regression model was performed to estimate the association between the number of ACEs and the developmental trajectories of body pain. The ACEs number took 0 as reference, and the pain trajectories took maintained-low as reference. The associations were demonstrated by ORs and 95% CIs.

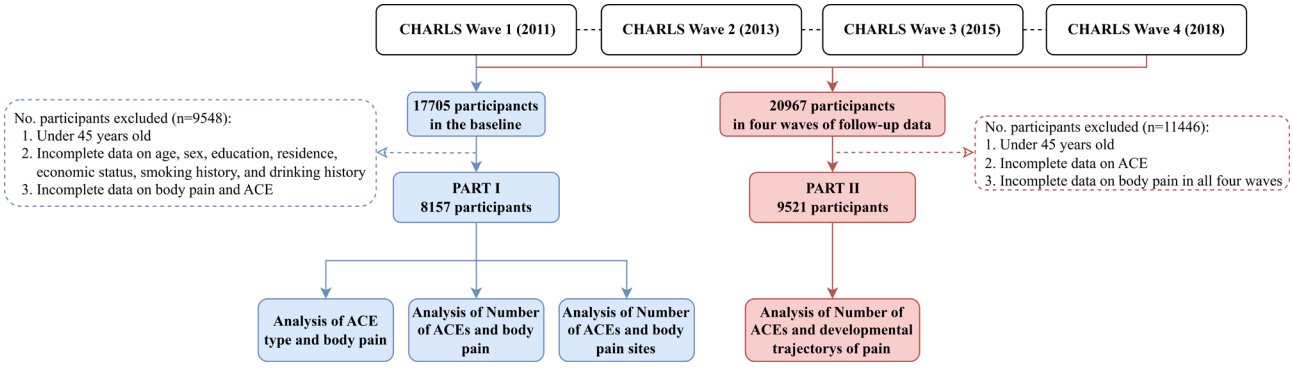

Fig. 1 The flowchart of study

In both Part I and Part II, stratified analyses were performed to estimate the associations among males/females and rural/urban residents, respectively. All models were adjusted for participants' covariates at baseline in 2011 listed above.

All statistical analyses were conducted using the SAS software (version 9.4; SAS Institute Inc., Cary, NC, USA). A two-sided *p*-value of less than 0.05 was indicative of statistical significance.

Results

Part I

Characteristics of participants in 2011

The cross-sectional study included 8,157 participants (mean age 57.20 ± 8.29 years; 3,999 males and 4,158 females). Among them, 53.25% had at least a primary school education, 85.51% were married, 37.17% resided in urban areas, 40.50% had a history of alcohol consumption, and 39.71% had a smoking history. Body pain was reported by 32.06% of respondents (Table S2), 89.74% reported one or more adverse childhood experiences (ACEs), and 25.88% reported four or more ACEs (Table S3).

Males reported higher rates of certain ACEs compared to females, including physical abuse (41.56% vs. 30.30%), witnessing domestic violence (23.31% vs. 19.53%), household substance abuse and incarceration (9.33% vs. 6.16%), and adverse environment (43.81% vs. 40.74%). However, household mental illness was reported less frequently among males than females (25.38% vs. 28.02%). Similarly, rural participants were more likely to report ACEs than urban participants. The number of ACEs also varied by sex and residence (Table S3).

Cross-sectional association of ACEs and body pain presence

Associations of ACE types and number of ACEs with body pain presence

The results of cross-sectional associations are shown in Table 1. Participants with increasing numbers of ACEs had higher odds of experiencing body pain, with the highest risk in those with four or more ACEs (OR = 2.72, 95% CI = 2.13–3.47). Sex- and residence-stratified analyses showed that having two ACEs was associated with body pain only in females (OR = 1.62, 95% CI = 1.17–2.23) and rural participants (OR = 1.53, 95% CI = 1.12–2.09), whereas having three or more ACEs was associated with body pain across all groups.

Most specific ACEs types were associated with an increased likelihood of body pain (Table S9). Physical abuse, emotional abuse, witnessing domestic violence, household mental illness, parental divorce or disharmony, family member's death, family burden, and adverse environment all showed significant associations. No significant associations were found for household substance abuse and incarceration, or neglect. These associations were generally consistent across sex and residence groups, although some variations were observed.

Associations between the number of ACEs and specific body pain area

Participants with two or more ACEs had increased odds of pain in the head and neck, trunk, and limbs, with odds ratios escalating with the number of ACEs (Table 2). Those with one ACEs were associated only with pain in the head & neck and trunk.

Sex differences were observed in these associations. Males showed increased odds of head and neck pain only with four or more ACEs (OR = 2.69, 95% CI = 1.50–4.81), whereas females showed increased risks starting from one ACEs (one ACEs: OR = 1.69, 95% CI = 1.08–2.66; four or more ACEs: OR = 3.66, 95% CI = 2.38–5.63). Exposure to one ACEs was significantly associated with trunk pain in females but not in males.

Residential differences were also noted. Rural participants with two or more ACEs had significantly increased odds of head and neck pain, whereas no significant associations were found among urban participants.

Part II

Characteristics of participants in the longitudinal analysis

A total of 9,521 participants were included in the longitudinal analysis (see Table S4). Over a median follow-up

Table 1 The baseline associations between number of ACEs and body pain, by sex and residence

ACEs	OR (95%CI)	OR (95%CI)		OR (95%CI)	
	Total (*n* = 8157)	Male (*n* = 3999)	Female (*n* = 4158)	Urban (*n* = 3032)	Rural (*n* = 5125)
Number of ACEs					
0	1.00	1.00	1.00	1.00	1.00
1	**1.38 (1.07, 1.78)**	1.36 (0.90, 2.07)	1.37 (0.99, 1.89)	1.46 (0.96, 2.23)	1.31 (0.95, 1.81)
2	**1.50 (1.17, 1.93)**	1.33 (0.89, 2.00)	**1.62 (1.17, 2.23)**	1.41 (0.93, 2.15)	**1.53 (1.12, 2.09)**
3	**2.16 (1.68, 2.79)**	**1.99 (1.33, 2.98)**	**2.30 (1.65, 3.19)**	**1.87 (1.22, 2.87)**	**2.28 (1.66, 3.13)**
≥4	**2.72 (2.13, 3.47)**	**2.67 (1.81, 3.94)**	**2.71 (1.97, 3.72)**	**2.25 (1.48, 3.43)**	**2.93 (2.16, 3.97)**

Note OR, odd ratio. CI, confidence interval. ACEs, adverse childhood experience. The associations of number of ACEs with body pain were assessed by logistic model, adjusting for age, gender, residence, educational level, economic status, smoking history, and alcohol consumption

Table 2 The baseline associations between the number of ACEs and body pain areas, by sex and residence

Sample	Number of ACEs	Body Pain Areas		
		Head & neck	Trunk	Limbs
Total ($n=8157$)	1	**1.51 (1.04, 2.18)**	**1.54 (1.14, 2.07)**	1.24 (0.93, 1.63)
	2	**1.91 (1.33, 2.73)**	**1.97 (1.48, 2.63)**	**1.32 (1.00, 1.74)**
	3	**2.44 (1.70, 3.50)**	**2.49 (1.86, 3.34)**	**1.99 (1.51, 2.62)**
	≥4	**3.35 (2.37, 4.74)**	**3.28 (2.47, 4.34)**	**2.30 (1.77, 3.00)**
Sex stratification	Male ($n=3999$)			
	1	1.13 (0.59, 2.15)	1.38 (0.86, 2.21)	1.41 (0.87, 2.30)
	2	1.42 (0.77, 2.61)	**1.58 (1.00, 2.48)**	1.31 (0.81, 2.10)
	3	1.74 (0.94, 3.19)	**1.87 (1.18, 2.95)**	**2.11 (1.32, 3.38)**
	≥4	**2.69 (1.50, 4.81)**	**2.74 (1.77, 4.25)**	**2.64 (1.67, 4.15)**
	Female ($n=4158$)			
	1	**1.69 (1.08, 2.66)**	**1.63 (1.11, 2.38)**	1.14 (0.80, 1.60)
	2	**2.18 (1.40, 3.40)**	**2.27 (1.56, 3.29)**	1.33 (0.95, 1.87)
	3	**2.88 (1.84, 4.50)**	**3.07 (2.10, 4.49)**	**1.93 (1.37, 2.73)**
	≥4	**3.66 (2.38, 5.63)**	**3.64 (2.52, 5.26)**	**2.10 (1.51, 2.93)**
Urban-rural stratification	Urban ($n=3032$)			
	1	1.38 (0.78, 2.46)	**1.79 (1.06, 3.02)**	1.16 (0.73, 1.86)
	2	1.15 (0.64, 2.08)	**2.00 (1.19, 3.36)**	1.16 (0.73, 1.86)
	3	**1.81 (1.01, 3.23)**	**2.92 (1.73, 4.91)**	1.52 (0.95, 2.44)
	≥4	**2.89 (1.66, 5.04)**	**3.44 (2.06, 5.73)**	**2.07 (1.31, 3.27)**
	Rural ($n=5125$)			
	1	1.60 (0.98, 2.59)	1.40 (0.98, 2.01)	1.26 (0.89, 1.79)
	2	**2.48 (1.56, 3.93)**	**1.92 (1.36, 2.72)**	1.39 (0.99, 1.95)
	3	**2.91 (1.82, 4.65)**	**2.26 (1.58, 3.22)**	**2.21 (1.57, 3.10)**
	≥4	**3.78 (2.41, 5.94)**	**3.15 (2.24, 4.42)**	**2.43 (1.75, 3.36)**

Note ACEs, adverse childhood experience. The associations of the number of ACEs with body pain areas were assessed by logistic model, adjusting for age, gender, residence, educational level, economic status, smoking history, and alcohol consumption. Number of ACEs took 0 as the reference

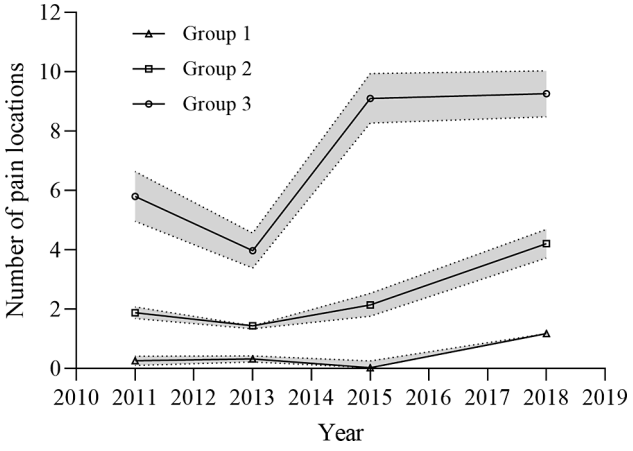

Fig. 2 Three developmental trajectories of the number of body pain sites from 2011 to 2018

period of seven years, we observed 2,471 new-onset cases of body pain.

Using trajectory modeling (parameters in Table S5 and trajectories illustrated in Fig. 2), we identified three distinct body pain trajectories: (1) Maintained-low group (58.89%, $n=5,607$), where participants remained at low levels of body pain; (2) Low-moderate group (33.67%, $n=3,206$), where participants progressed from low to moderate levels of body pain; and (3) High-increasing group (7.44%, $n=708$), where participants experienced high and increasing levels of body pain.

Among all participants, 50.13% were female, 40.25% had an education level below primary school, 14.59% were unmarried or widowed, 63.26% resided in rural areas, 39.90% had a history of smoking, and 40.53% had a history of alcohol consumption.

Note Group 1, the maintained-low trajectory; group 2, the low moderate trajectory; group 3, the high-increasing trajectory. The gray area represents the 95% CI for the curve estimated.

Associations between number of ACEs and developmental trajectory of body pain

We selected the maintained-low trajectory as the reference group, as it represents the most stable and minimal pain pattern. As shown in Table 3, compared to participants with no ACEs, those with ACEs had an increased risk of developing body pain: In the low-moderate group, the ORs for participants with 1, 2, 3, and 4 or more ACEs were 1.31 (95% CI: 1.05–1.64), 1.80 (95% CI: 1.45–2.24), 2.26 (95% CI: 1.81–2.83), and 3.11 (95% CI: 2.51–3.87), respectively. In the high-increasing group, the ORs for

Table 3 The association of ACEs with the developmental trajectory of body pain from 2011 to 2018

Sample	Number of ACEs	Group1	Group 2	Group 3
Total (*n* = 9521)	1	1.00	**1.31 (1.05, 1.64)**	1.54 (0.93, 2.52)
	2	1.00	**1.80 (1.45, 2.24)**	**2.16 (1.33, 3.50)**
	3	1.00	**2.26 (1.81, 2.83)**	**3.28 (2.03, 5.30)**
	≥4	1.00	**3.11 (2.51, 3.87)**	**6.78 (4.30, 10.68)**
Sex stratification	Male (*n* = 4748)			
	1	1.00	1.33 (0.93, 1.91)	1.98 (0.55, 7.11)
	2	1.00	**1.49 (1.06, 2.11)**	2.46 (0.71, 8.47)
	3	1.00	**2.20 (1.56, 3.11)**	**4.30 (1.28, 14.47)**
	≥4	1.00	**2.72 (1.95, 3.80)**	**9.78 (3.03, 31.57)**
	Female (*n* = 4773)			
	1	1.00	1.28 (0.96, 1.70)	1.47 (0.85, 2.53)
	2	1.00	**2.08 (1.56, 2.76)**	**2.26 (1.33, 3.85)**
	3	1.00	**2.23 (1.65, 3.00)**	**3.11 (1.82, 5.31)**
	≥4	1.00	**3.47 (2.60, 4.63)**	**6.40 (3.86, 10.60)**
Urban-rural stratification	Urban (*n* = 2895)			
	1	1.00	1.31 (0.90, 1.89)	3.30 (1.12, 9.76)
	2	1.00	**1.84 (1.28, 2.64)**	2.78 (0.91, 8.44)
	3	1.00	**1.89 (1.30, 2.75)**	**4.93 (1.66, 14.61)**
	≥4	1.00	**2.22 (1.53, 3.21)**	**9.74 (3.40, 27.87)**
	Rural (*n* = 4985)			
	1	1.00	1.29 (0.97, 1.71)	1.15 (0.65, 2.03)
	2	1.00	**1.77 (1.34, 2.33)**	**2.01 (1.17, 3.44)**
	3	1.00	**2.43 (1.84, 3.22)**	**2.93 (1.71, 5.03)**
	≥4	1.00	**3.59 (2.74, 4.70)**	**6.25 (3.76, 10.39)**

Multiple logistic models were performed, taking group 1 as the reference. Number of ACEs took 0 as the reference; Age took aged under 60 as the reference; Sex took male as the reference; Residence took rural as the reference; Marriage took unmarried as the reference; Education took did not receive formal education as the reference; Economic status took the low as the reference; Smoking and drinking history took non-initiator as the reference

those with 2, 3, and 4 or more ACEs were 2.16 (95% CI: 1.33–3.50), 3.28 (95% CI: 2.03–5.30), and 6.78 (95% CI: 4.30–10.68), respectively.

In sex-stratified analyses using participants with no ACEs as the reference group, both males and females with three or more ACEs had a higher risk of developing body pain in the low-moderate and high-increasing trajectories. Interestingly, females with two ACEs were associated with an increased risk only in the high-increasing group (OR = 2.26, 95% CI = 1.33–3.85). Residence-stratified analyses revealed that the association between having two ACEs and being in the high-increasing group was significant only among rural participants (OR = 2.01, 95% CI = 1.17–3.44).

Discussion

The study explored the complex associations between ACEs and the presence, areas and trajectory of body pain among Chinese middle-aged and older adults. Utilizing both cross-sectional and longitudinal analyses, we found that having ACEs was strongly associated with the presence of body pain, especially among participants with four or more ACEs. Additionally, such associations were evident across all pain areas, including the head & neck, trunk, and limbs. Moreover, our findings indicated a cumulative effect of ACEs on body pain trajectories, with the long-term severity of body pain escalating alongside the increasing number of ACEs. Notably, these associations varied across sexes and residences, highlighting the need for tailored approaches in addressing the impact of ACEs on body pain in different demographic groups.

Our findings are consistent with previous studies, further validating the association between ACEs and body pain. Previous research by Foubert's and Kerker's teams have indicated that ACEs significantly increase the risk of mental health disorders, such as depression and anxiety [23, 24]. Individuals experiencing these disorders often perceive pain as more intense due to heightened attention to pain sensation [25]. Additionally, studies by Chang's and Miller's teams have shown that individuals with ACEs are more likely to adopt unhealthy lifestyles, such as excessive alcohol consumption or smoking, which can directly contribute to the development of body pain [26, 27]. The shared mechanism hypothesis suggests that the emergence of body pain could be attributed to physical dysfunctions resulting from risky behaviors and adverse life events [28]. Previous studies have demonstrated that individuals with ACEs have an elevated risk of becoming either perpetrators or victims of violence in adulthood, which raises the possibility of injury and subsequent pain

[28]. Consequently, the interaction of these factors might lead individuals with ACEs to report pain even in the absence of a clear physical source [29].

Neuroendocrinological factors also play a crucial role in understanding the relationship between ACEs and body pain. Research indicates that ACEs can influence hippocampal receptor function, potentially disrupting stress regulation and heightening pain sensitivity [30]. Additionally, ACEs have been shown to enhance the flexibility within frontoparietal network and default mode network, which are responsible for emotion conceptualization and regulation [31, 32]. This increased flexibility may hinder effective regulation of negative emotions, further exacerbating pain perception. Moreover, ACEs are associated with heightened connectivity within the frontoparietal network, which may amplify negative emotional responses and interfere with emotion regulations [31, 32]. The intricate interplay between cortical-basal ganglia loops and the midbrain dopamine system reinforces attention and habit learning, potentially facilitating a shift in focus from emotional pain to physical pain [29]. This dynamic further complicates the pain experience for individuals with a history of ACEs. In addition, ACEs can impact accelerated epigenetic ageing [33], mitochondrial dysfunction [34], and inflammation [35], all of which contribute to physical illness and body pain.

Moreover, our study uncovered a sex disparity in the association between ACEs and body pain, indicating that women are more vulnerable when facing ACEs; fewer ACEs can increase the risk of pain in certain body parts and lead to a more rapid increase in the number of painful body areas. Pain is inherently a subjective experience that encompasses sensory, cognitive and emotional components [36]. Variations in neural circuitry related to pain perception, including sex-specific brain alterations in chronic pain conditions, may explain these differences [36]. Additionally, lower levels of social support may further amplify susceptibility to pain in different sexes [37]. Furthermore, the study examined disparities in body pain experiences between rural and urban populations, which might be potentially influence by their socioeconomic status (SES) differences. Similar to gender differences, rural populations are also more likely to present worse health outcomes after ACEs. Specifically, the lower SES prevalent in rural communities might heighten vulnerability to emotional disorders and social maladjustment [38], potentially increasing the possibility of developing depression [39, 40]. Previous research by Bonathan's team has linked low SES with the development of body pain [41], reinforcing our findings. These insights provide valuable perspectives for future research, emphasizing the need for targeted interventions on the impact of ACEs on diverse populations.

Innovatively, we employed GBTM to describe the developmental trajectory of body pain. Our findings suggested that ACEs were significantly associated with a deteriorative trajectory of body pain, highlighting the increased risk of sustained pain over time among individuals with ACEs. This aligns with previous studies indicating that populations in long-term disadvantaged situations exhibited unique trajectories of body pain [16, 17, 42]. However, our investigation had not yet elucidated the underlying mechanisms. Consequently, future research should prioritize examining the long-term effects of ACEs on pain development and seek to clarify the mechanisms involved.

Strengths and limitations

The study was dedicated to heightening awareness and mitigating the impact of ACEs. The research analyzed the associations between ACEs and body pain, encompassing both cross-sectional and longitudinal perspectives. The exploration extended assessing the risk of short-term incident body pain to the understanding of its developmental trajectory. These findings contributed to the scientific understanding of the development patterns of body pain.

Although this study revealed significant association between ACEs and body pain, it was essential to acknowledge the existing limitations in the current research. Firstly, while cumulative effects of ACEs were observed, the present study only computed the cumulative number of ACEs, which did not take potential synergistic effects of different types of ACEs into consideration. Secondly, pain was assessed through self-reported information from participants. While we believe that self-reported pain is meaningful and relevant to participants, it may not fully align with findings from medical examinations. Thirdly, the ACE data are retrospective information collected through self-report questionnaires from middle-aged and older adults and cannot avoid recall bias. Fourthly, participants who were pain-free were grouped together with those experiencing minimal pain in the three-trajectory model, which may have limited our ability to fully differentiate between these distinct subgroups. Fifthly, we did not include additional psychosocial and health-related covariates because adjusting for these mediating factors could mask the direct association between ACEs and body pain. Including them could offer deeper insights into the mechanisms underlying this relationship, and future research should consider their potential mediating roles. Finally, the lack of data on stressors experienced in adulthood limited our ability to assess the cumulative impact of stressors across the lifespan, which could influence the interpretation of long-term health outcomes.

Conclusion

This study demonstrated a significant association between ACEs and body pain among middle-aged and older Chinese individuals, as well as explored the disparities in sex and residence. The findings provided a novel perspective to the interpretation of the risk of short-term incident body pain and its developmental trajectory, and underscored the importance of controlling and mitigating ACEs to prevent the development of body pain in this population.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-024-20617-3.

Supplementary Material 1

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Author contributions

Formal analysis: Shang Lou, Ziyue Sheng; visualization: Shang Lou, Ziyue Sheng; writing—original draft: Shang Lou, Ziyue Sheng; writing—review and editing: Weidi Sun, Chenhao Zhang, Wenhan Xiao, Siyu Zhu, Jiajun Hao, Jiali Zhou, Peige Song.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and informed consent

Informed consent was obtained from all participants involved in the study. All participants signed an informed consent during the investigation, and the project was approved by the Institutional Review Board at Peking University (IRB approval number for the main household survey: IRB00001052-1101).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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