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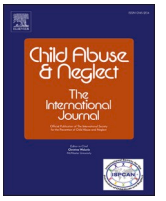

# Association between adverse childhood experiences and marital status among Japanese older adults

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ABSTRACT

*Background:* Marital status is a well-known social determinant of health. Adverse childhood experiences (ACEs) affect attachment, critical to establishing and maintaining intimate relationships, such as marital status.
*Objective:* This study examined the association between ACEs and marital status among older Japanese adults.
*Participants and setting:* This research used data from a nationwide population-based study among functionally independent people aged 65 and above in Japan.
*Methods:* ACEs were assessed by self-reported questionnaires on the following experiences before 18 years old: parental death, parental divorce, parental mental disease, exposure to intimate partner violence, physical abuse, psychological neglect, psychological abuse, and poverty. Marital status was asked as currently having a spouse (including common-law marriage), widowed, divorced, or unmarried. Associations between the total number of ACEs and marital status were analyzed by multinomial logistic regression.
*Results:* Three or more ACEs showed higher risks of being widowed, divorced, or unmarried. Psychological neglect led to higher divorce risks among males (RRR, 95%CI = 1.41, 1.13–1.76) and females (RRR, 95%CI = 1.56, 1.28–1.89). Childhood poverty showed higher risks of unmarried among males (RRR, 95%CI = 1.25, 1.02–1.53) and females (RRR, 95%CI = 1.41, 1.18–1.69). Association between ACEs and divorce risks showed gender differences (RRR, 95%CI of having three or more ACEs in males: 2.19, 1.66–2.90; in females: 3.45, 2.71–4.38; p for interaction = 0.034).
*Conclusions:* ACEs showed higher risks of being widowed, divorced, and unmarried among older Japanese people. Policy to tackle ACEs and research investigating how ACEs, attachment, and relationship quality influence marital status are required to promote well-being in later life.

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## 1. Introduction

Marital status is an essential social determinant of health. As early as the 19th century, it was reported that health and mortality outcomes for married individuals were better than those who were unmarried (Farr, 1859; Hu & Goldman, 1990). The benefits of marriage were empirically identified by various health-related indicators in systematic reviews (Ikeda et al., 2007; Sommerlad et al., 2018; Wang et al., 2020). For example, a systematic review of individuals born between 1897 and 1939 in Europe, Asia, Brazil, and the US identified a lower risk of dementia for married compared to those who were never married or widowed (Sommerlad et al., 2018). Moreover, mortalities of cancer, cardiovascular disease, and coronary heart disease were associated with being unmarried in individuals aged between 42.1 and 73.2 years old in 1997 and 2018 across 21 studies in Europe, Asia, and North America (Wang et al., 2020). A similar pattern was also found in Japan, showing higher mortality risks in unmarried individuals (Ikeda et al., 2007). Even if people get married, poor marital functioning directly influences allostatic load, including immune, endocrine, cardiovascular, and neurosensory functioning (Kiecolt-Glaser & Newton, 2001). Those in stressful marriages showed poorer health than those in non-stressful marriages and divorced (Burman & Margolin, 1992; Williams, 2003), and the effects of long-term marital strain on health become more significant over time (Umberson et al., 2006).

Among the determinants of marital status, attachment is one of the most critical. Notably, emotional ties such as trust, love, and mutual respect, developed through attachment (Bailey et al., 2015), are essential to maintaining a marriage (Karimi et al., 2019). Bowlby developed the attachment theory, proposing that children need a secure base to develop attachment relationships with their caregivers (Bowlby, 1969). As a result of the experiences with their caregivers, children develop an internal working model (Bowlby, 1969, 1976) of self, others, and relationships that make the way to deal with stress or threat (Bowlby, 1982; Waters et al., 2002). To be more specific, a lack of consistent and reliable attachment relationships adversely affects psychosocial development (Bowlby, 1969, 1976; Lieberman et al., 2011), eventually resulting in a lack of self-worth being loved and a lack of trust in others (Bowlby, 1969, 1976; Cyr et al., 2010; Huynh et al., 2022). Later, Bowlby (1980) developed a hypothesis to interpret trauma survivors' psychological mechanism named defensive exclusion (Bowlby, 1980). Traumatized individuals eliminate clues that are evocative to the individual's attached figures due to psychological pains, which results in two cognitive/behavioral patterns: 1) the individual's behavioral system is deactivated, and 2) the individual attributes bad situations to others then repeats the behavior (Bowlby, 1980). Previous studies showed consistent findings with this hypothesis. Adults with avoidant and ambivalent styles tend to avoid intimate relationships and reject the need for close relationships (Feeney & Noller, 1990; Mikulincer & Erev, 1991). Other studies also showed that individuals with childhood trauma experience a higher risk of dysfunctional relationships (DiLillo et al., 2009).

Adverse childhood experiences (ACEs) are parental loss, child maltreatment, and family dysfunction during childhood (Felitti et al., 1998). ACEs are recognized as a fundamental determinant of well-being throughout life from multi dimensions, including psychosocial, behavioral, and physiological functioning. For example, a higher number of ACEs is associated with the probability of disorganized attachment (Murphy et al., 2014), lower psychosocial functioning in marital relationships (Mosley-Johnson et al., 2019), higher risk behavior such as heavy drinking, drug use, and suicide attempts (Merrick et al., 2017), and higher mortality (Bellis et al., 2014; Brown et al., 2009; Rod et al., 2020). The extensive literature examined the quality of marital relationships' oversight influence of ACEs (Shonkoff & Garner, 2012). Although ACEs are known to interrelate and co-occur, many studies focused on specific types of ACEs in intimate relationships (Dong et al., 2004). There is a scarcity of research that systematically examines the association between ACEs and marital status, specifically among older adults.

A population-based survey in the US, which included 29,229 individuals whose average age was 48 years old from five states, found significant associations between higher ACEs and a higher probability of divorce or separation and lower probabilities of married or widowed (Font & Maguire-Jack, 2016). Another study, which included 17,530 men and 23,978 women aged 18 to 54 from 13 states, found that people with more ACEs were likelier to be unmarried couples or experience divorce or separation (Anderson, 2017). However, these two studies included relatively younger respondents. Also, Anderson (2017) dropped widowed individuals from the analysis, and Font and Maguire-Jack (2016) merged widowed and married; therefore, these studies might not sufficiently capture respondents' marital status, resulting in an underestimation of the association between ACEs and marital status.

Sex or gender differences matter in marriage life. Empirically, men enjoy more excellent health benefits from marriage than women (Ben-Shlomo et al., 1993; Gove, 1973). Saxbe et al. (2008) identified that sex differences were linked to cortisol levels; higher satisfaction levels with marriage showed a more robust basal cortisol cycle for women. Regarding gender, in general, women experience less access to income, wealth, time, and low status in the household (Doyal, 2003), and Wanic and Kulik (2011) hypothesized that lower status in marital relationships for women increases the risk of adverse consequences in marriage. Thus, there is a need to analyze the factors with stratification by gender.

The Japan Gerontological Evaluation Study (JAGES), which targets older adults aged 65 and above without functional dependence across Japan, assessed ACEs and marital status. Using this data set, marital status is more accurate compared to the previous studies. Based on the above, this study examines the following hypothesis among older people in Japan: 1) there are cumulative effects of ACEs on marital status, i.e., the risks of being widowed, divorced, and unmarried, 2) each ACE has a differential impact on the marital status of older adults, and 3) these associations differ by gender.

## 2. Methods

### 2.1. Sample

This study used data from the Japan Gerontological Evaluation Study (JAGES), a nationwide population-based survey conducted in

2013 and 2016. The JAGES investigated the social determinants of health among individuals aged 65 and older whose activities of daily life have been independent since 2003 by mailing self-reported questionnaires (Kondo et al., 2018). The data used in this study were sampled from 30 municipalities in 14 prefectures in 2013 and from 40 in 18 in 2016 in Japan. The target population size was 193,694 for the questionnaire in 2013 and 276,469 in 2016. Of the target populations, there were 137,736 respondents (response rate = 71.1 %) in 2013 and 194,352 respondents (response rate = 69.5 %) in 2016. The surveys excluded those who needed functional support. Hence, the data comprised 128,239 respondents in 2013 and 180,021 in 2016. ACEs were asked in a randomly selected sample by self-reported questionnaires, about one-fifth of the total sample in 2013 (n = 25,656/128,239) and one-eighth of the total sample in 2016 (n = 22,129/180,021). The present analysis was conducted after setting the following exclusion criteria: 1) those who did not completely answer the questions on ACEs; 2) those who did not answer about marital status; 3) those who answered "other" in marital status; and 4) those who did not answer about their sex. We found those who participated in both surveys in 2013 and 2016. This study excluded 2013, as marital status might have changed during the three years (N = 1957). Finally, the analytic sample comprised 39,738 respondents (20,135 in 2013 and 19,603 in 2016). Supplemental Fig. 1 shows the Flowchart of the samples for analysis.

### 2.2. Measurements

In the JAGES, marital status was asked using the following answer items: 1) having a spouse (including common-law marriage), 2) being widowed, 3) being divorced, 4) never married, and 5) others. This study correspondingly named 1) married, 2) widowed, 3) divorced, and 4) unmarried as marital status, excluding respondents who answered "other."

With regards to ACEs, JAGES in 2013 asked about the following experiences that occurred before 18 years old (yes/no responses): 1) parental death, 2) parental divorce, 3) parental mental disease, 4) exposure to intimate partner violence (IPV), 5) physical abuse, 6) psychological neglect, 7) psychological abuse, and 8) childhood poverty (Amemiya et al., 2019; Tani et al., 2019; Tani et al., 2020). The JAGES in 2016 added the questionnaire of if their parent passed away because of war and if their parent died for other reasons. Therefore, this paper made a variable as "parental loss" for the participants of JAGES in 2016 if they experienced either/both cases of parental bereavement due to war and/or the other reasons for the analysis. Although the original ACEs study by Felitti et al. (1998) did not include childhood poverty, a recent ACEs study considered childhood poverty an ACE (Hughes & Tucker, 2018). This study calculated the total number of ACEs and categorized them as zero, one, two, and three or more for further analysis.

Age was also asked via the questionnaire and categorized as 65 to 69 years old, 70 to 74 years old, 75 to 79 years old, and 80 years old or above. Socioeconomic status (SES), marital status, and ACEs seem inextricable to link one another. For example, individuals with high SES tend to postpone marriage and childrearing, but groups with low SES tend to give birth before marriage and are less likely never to marry (Karney, 2021). Also, several studies identified that ACEs are associated with later economic outcomes (Currie & Widom, 2010; Mersky & Topitzes, 2010), job performance (Anda et al., 2004), and educational attainment in later life (Mersky & Topitzes, 2010). Thus, education and occupation were considered mediators of the association between ACEs and marital status. The number of years of formal education year was asked in the following categories: 1) shorter than six years, 2) six to nine years, 3) ten to 12 years, 4) 13 years or longer, and 5) others. For further analysis, we collapsed the education as nine years or shorter (the compulsory education period is nine years in Japan), ten to 12 years (high school), 13 years or longer (college), and others. Missing values of the education period and the answer of "others" were treated as dummy variables. The occupation was classified as non-manual, manual, and not employed by asking, "What was the longest occupation you were in?" Non-manual includes professional/engineering occupation and administrative posts; manual includes clerical work, sales/service, general work, agriculture, forestry/fisheries, self-employment, and other; and not employed includes never worked. This study treated missing values of occupation as dummy variables.

### 2.3. Ethics

The JAGES protocol was approved by the Ethics Committee in Research of Human Subjects at Nihon Fukushi University (No. 1314), in Research of Human Subjects at the National Center for Geriatrics and Gerontology (No.992), and Chiba University Faculty of Medicine (No. 2493).

### 2.4. Analysis

First, demographic variables, proportions of each ACE and the number of ACEs, and current marital status were described by gender. Second, we examined the proportions of having other ACEs for each type of ACE. Then, multinomial logistic regression was used to analyze the association between ACEs and marital status. This study examined the associations using three models: 1) the crude model, 2) Model 1, which adjusted age, and 3) Model 2, which adjusted age, education, and occupation. To examine if gender modifies the effect of cumulative ACEs on marital status, an interaction term of ACE and gender was entered into the model. In addition, this study analyzed the association of each ACE with marital status by multinomial logistic regression stratified by gender. All statistical analyses were conducted via Stata/MP version 16.1 (STATA Corp., College Station, TX, USA). The level of statistical significance was set at $p < 0.05$ (two-tailed).

## 3. Results

Table 1 shows the demographic characteristics of the study participants by gender. In the sample, 53.6 % were female, and the average age was 73.8 (SD = 6.16) years old (30.3 % were 65–69 years old, and 19.1 % were 80 years old and above). Regarding the number of years of formal education, males obtained significantly more extended education periods than females (30.1 % of males received 13 or longer years of education, while only 18.5 % of females did). With regards to occupation, "not employed" individuals were 9.5 % for females and 1.3 % for males, and a significantly higher percentage of non-manual workers were seen in males (37.1 %) than in females (11.4 %). Males showed a significantly higher percentage of experiencing ACEs both in any ACEs and the number of ACEs. The most prevalent ACE was poverty, and then parental death and psychological neglect followed. Most respondents were married (87.1 % for males and 61.5 % for females), followed by widowed (7.3 % for males and 31.4 % for females), divorced (3.2 % for males and 4.4 % for females), and unmarried (2.5 % for males and 2.6 % for females).

Table 2 shows the concurrence of ACEs. Physical abuse showed the highest concurrence of other ACEs for males and females (94.4 % and 96.0 %, respectively). However, more than half of individuals who experienced physical abuse were affected by other types of ACEs, such as psychological neglect (51.9 % for males and 54.3 % for females), psychological abuse (49.6 % for males and 60.9 % for females), and poverty (78.0 % for males and 76.8 % for females). Although poverty was the most prevalent among all ACEs at 50.8 % for males and 37.9 % for females, it showed the lowest percentage of coincidence of other ACEs.

Table 3 illustrates the association between the number of ACEs and marital status for males and females. For both genders, three or more ACEs showed significantly high relative risk ratios (RRRs) of widowed, divorced, and unmarried (Table 3). Having three or more ACEs was more likely to be widowed among older adults (RRR, 95 % confidence interval [95 % CI] for male: 1.47, 1.20–1.81; for female: 1.35, 1.17–1.55) in the crude model. The significant associations remained after adjusting covariates in model 2 in both genders. Looking at the details of being divorced, RRRs were higher in females than males. For example, the RRRs of being divorced with three or more ACEs were 2.34 (95 % CI: 1.79–3.07) for males while 3.52 (95 % CI: 2.78–4.45) for females in the crude model, and such a pattern was found in all models. Higher ACEs score showed higher RRRs of being unmarried for both genders. The RRRs of being unmarried with three or more ACEs were higher in males (RRR, 95%CI: 2.52, 1.88–3.38) than in females (1.86, 1.32–2.63) in the crude model. However, the RRRs of being unmarried in Model 2 became similar for males (RRR, 95%CI: 2.27, 1.67–3.09) for females (2.24, 1.58–3.17). There were dose-response relationships between cumulative ACEs and the risk of being widowed, divorced, and unmarried in both males and females (p for trend $<0.05$). As a result of adding the interaction of gender on the association between cumulative ACEs and marital status in Model 2, the risk of being divorced was modified by gender when the number of ACEs reaches three or more (RRR, 95%CI:1.48, 1.03–2.12; p for interaction = 0.034).

Tables 4 and 5 illustrate the association between each ACE and marital status for males and females. Interestingly, no ACEs were associated with the significantly higher risk of being widowed for both genders in Model 2. The RRRs of being divorced by each ACE

**Table 1**
Demographic characteristics of the study participants.

| | | Male | | Female | | P-value |
|---|---|---|---|---|---|---|
| | | N | % | N | % | |
| Age | 65–69 years old | 5714 | 31.0 | 6342 | 29.8 | 0.017 |
| | 70–74 years old | 5272 | 28.6 | 6126 | 28.8 | |
| | 75–79 years old | 4033 | 21.9 | 4682 | 22.0 | |
| | 80+ years old | 3413 | 18.5 | 4156 | 19.5 | |
| Education period | 9 years or shorter | 5941 | 32.2 | 8072 | 37.9 | <0.001 |
| | 10 to 12 years | 6786 | 36.8 | 8990 | 42.2 | |
| | 13 or longer years | 5542 | 30.1 | 3939 | 18.5 | |
| | Other and missing | 163 | 0.9 | 305 | 1.4 | |
| Occupation | Non-manual | 6835 | 37.1 | 2429 | 11.4 | <0.001 |
| | Manual | 10,139 | 55.0 | 14,340 | 67.3 | |
| | Not employed | 234 | 1.3 | 2016 | 9.5 | |
| | Missing | 1224 | 6.6 | 2521 | 11.8 | |
| ACEs | Parental death | 5066 | 27.5 | 5411 | 25.4 | <0.001 |
| | Parental divorce | 506 | 2.8 | 440 | 2.1 | <0.001 |
| | Parental mental disease | 193 | 1.1 | 149 | 0.7 | <0.001 |
| | Exposure to IPV | 816 | 4.4 | 698 | 3.3 | <0.001 |
| | Physical abuse | 337 | 1.8 | 151 | 0.7 | <0.001 |
| | Psychological neglect | 2665 | 14.5 | 2094 | 9.8 | <0.001 |
| | Psychological abuse | 1093 | 5.9 | 1039 | 4.9 | <0.001 |
| | Poverty | 9371 | 50.8 | 8081 | 37.9 | <0.001 |
| Number of ACEs | 0 | 6055 | 32.9 | 9223 | 43.3 | <0.001 |
| | 1 | 6928 | 37.6 | 7583 | 35.6 | |
| | 2 | 3913 | 21.2 | 3425 | 16.1 | |
| | 3+ | 1536 | 8.3 | 1075 | 5.1 | |
| Marital status | Married | 16,045 | 87.1 | 13,112 | 61.5 | <0.001 |
| | Widow | 1339 | 7.3 | 6694 | 31.4 | |
| | Divorce | 584 | 3.2 | 942 | 4.4 | |
| | Unmarried | 464 | 2.5 | 558 | 2.6 | |

**Table 2**
Relationships of ACEs (N = 18,432 for males and N = 21,306 for females).

| | | Exposed to another ACE (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number (%) | Parental death | Parental divorce | Mental disease | Exposure to IPV | Physical abuse | Psychological neglect | Psychological abuse | Poverty | Additional ACEs (%) |
| Male | | | | | | | | | | |
| Parental death | 5066 (27.5%) | | 182 (3.6%) | 105 (2.1%) | 217 (4.3%) | 116 (2.3%) | 808 (16.0%) | 322 (6.4%) | 3170 (62.6%) | 3491 (68.9%) |
| Parental divorce | 506 (2.7%) | 182 (36.0%) | | 25 (4.9%) | 73 (14.4%) | 36 (7.1%) | 171 (33.8%) | 66 (13.0%) | 370 (73.1%) | 444 (87.8%) |
| Parental mental disease | 193 (1.0%) | 105 (54.4%) | 25 (13.0%) | | 33 (17.1%) | 23 (11.9%) | 52 (26.9%) | 41 (21.2%) | 141 (73.1%) | 177 (91.7%) |
| Exposure to IPV | 816 (4.4%) | 217 (26.6%) | 73 (9.0%) | 33 (4.0%) | | 162 (19.9%) | 306 (37.5%) | 245 (30.0%) | 635 (77.8%) | 737 (90.3%) |
| Physical abuse | 337 (1.8%) | 116 (34.4%) | 36 (10.7%) | 23 (6.8%) | 162 (48.1%) | | 175 (51.9%) | 167 (49.6%) | 263 (78.0%) | 318 (94.4%) |
| Psychological neglect | 2665 (14.5%) | 808 (30.3%) | 171 (6.4%) | 52 (2.0%) | 306 (11.5%) | 175 (6.6%) | | 462 (17.3%) | 1736 (65.1%) | 2041 (76.6%) |
| Psychological abuse | 1093 (5.9%) | 322 (29.5%) | 66 (6.0%) | 41 (3.8%) | 245 (22.4%) | 167 (15.3%) | 462 (42.3%) | | 764 (69.9%) | 933 (85.4%) |
| Poverty | 9371 (50.8%) | 3170 (33.8%) | 370 (4.0%) | 141 (1.5%) | 635 (6.8%) | 263 (2.8%) | 1736 (18.5%) | 764 (8.2%) | | 4978 (53.1%) |
| Female | | | | | | | | | | |
| Parental death | 5411 (25.4%) | | 113 (2.1%) | 69 (1.3%) | 166 (3.1%) | 52 (1.0%) | 564 (10.4%) | 284 (5.3%) | 2670 (49.3%) | 3012 (55.7%) |
| Parental divorce | 440 (2.1%) | 113 (25.7%) | | 13 (3.0%) | 57 (13.0%) | 21 (4.8%) | 99 (22.5%) | 64 (14.6%) | 258 (58.6%) | 332 (74.5%) |
| Parental mental disease | 149 (0.7%) | 69 (46.3%) | 13 (8.7%) | | 24 (16.1%) | 8 (5.4%) | 28 (18.8%) | 30 (20.1%) | 98 (65.8%) | 132 (88.6%) |
| Exposure to IPV | 698 (3.3%) | 166 (23.8%) | 57 (8.2%) | 24 (3.4%) | | 61 (8.7%) | 196 (28.1%) | 187 (26.8%) | 479 (68.6%) | 588 (84.2%) |
| Physical abuse | 151 (0.7%) | 52 (34.4%) | 21 (13.9%) | 8 (5.3%) | 61 (40.4%) | | 82 (54.3%) | 92 (60.9%) | 116 (76.8%) | 145 (96.0%) |
| Psychological neglect | 2094 (9.8%) | 564 (26.9%) | 99 (4.7%) | 28 (1.3%) | 196 (9.4%) | 82 (3.9%) | | 424 (20.3%) | 1110 (53.0%) | 1424 (68.0%) |
| Psychological abuse | 1039 (4.9%) | 284 (27.3%) | 64 (6.2%) | 30 (2.9%) | 187 (18.0%) | 92 (8.9%) | 424 (40.8%) | | 640 (61.6%) | 851 (81.9%) |
| Poverty | 8081 (37.9%) | 2670 (33.0%) | 258 (3.2%) | 98 (1.2%) | 479 (5.9%) | 116 (1.4%) | 1110 (13.7%) | 1039 (7.9%) | | 3996 (49.5%) |

**Table 3**
Association between ACEs and marital status by gender (N = 18,432 for males and N = 21,306 for females).

| | | Marital status (reference: married) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Widow | | | Divorce | | | Unmarried | | |
| | | Crude | Model1 | Model2 | Crude | Model 1 | Model 2 | Crude | Model 1 | Model 2 |
| | | RRR (95%CI) | RRR (95%CI) | RRR (95%CI) | RRR (95 % CI) | RRR (95 % CI) | RRR (95 % CI) | RRR (95 % CI) | RRR (95 % CI) | RRR (95 % CI) |
| Male | 0 | ref. | ref. | ref. | ref. | ref. | ref. | ref. | ref. | ref. |
| | 1 | 1.13 (0.99–1.29) | 1.11 (0.97–1.28) | 1.06 (0.92–1.22) | 1.21 (0.98–1.49) | 1.23 (1.00–1.52) | 1.19 (0.97–1.47) | 1.10 (0.87–1.39) | 1.18 (0.93–1.50) | 1.10 (0.87–1.41) |
| | 2 | **1.21 (1.04–1.41)** | 1.15 (0.98–1.35) | 1.06 (0.90–1.24) | **1.30 (1.02–1.64)** | **1.35 (1.06–1.71)** | **1.28 (1.00–1.63)** | **1.33 (1.02–1.73)** | **1.53 (1.17–1.99)** | **1.36 (1.04–1.78)** |
| | 3+ | **1.47 (1.20–1.81)** | **1.51 (1.22–1.86)** | **1.34 (1.08–1.65)** | **2.34 (1.79–3.07)** | **2.36 (1.80–3.10)** | **2.19 (1.66–2.90)** | **2.52 (1.88–3.38)** | **2.73 (2.03–3.67)** | **2.27 (1.67–3.09)** |
| Female | 0 | ref. | ref. | ref. | ref. | ref. | ref. | ref. | ref. | ref. |
| | 1 | **1.08 (1.01–1.16)** | 1.05 (0.97–1.13) | 1.00 (0.93–1.07) | **1.32 (1.12–1.54)** | **1.33 (1.13–1.56)** | **1.30 (1.11–1.53)** | 1.04 (0.85–1.26) | 1.03 (0.85–1.26) | 1.11 (0.91–1.35) |
| | 2 | **1.13 (1.03–1.23)** | **1.11 (1.01–1.22)** | 1.03 (0.94–1.13) | **1.70 (1.41–2.05)** | **1.72 (1.42–2.07)** | **1.66 (1.37–2.02)** | 1.26 (0.99–1.60) | 1.27 (1.00–1.61) | **1.41 (1.10–1.80)** |
| | 3+ | **1.35 (1.17–1.55)** | **1.49 (1.29–1.73)** | **1.35 (1.16–1.57)** | **3.52 (2.78–4.45)** | **3.54 (2.80–4.48)** | **3.45 (2.71–4.38)** | **1.86 (1.32–2.63)** | **1.93 (1.37–2.72)** | **2.24 (1.58–3.17)** |

Model1: adjusted for age; Model2 adjusted for age, educational period, and occupation.
Bold letters represent significant results (* $p < 0.05$, ** $p< 0.01$, *** $p< 0.001$).

tend to be higher for females than males, and the type of ACEs with a significant association is more diverse for females. Parental death, psychological abuse, and poverty were significantly more likely to experience divorce only in females. In contrast, parental divorce and psychological neglect were significant risk factors for divorce in both genders. Regarding unmarried status, poverty was a significant common risk factor in both genders. Psychological neglect remained significant only for males, even after adjusting covariates and all other ACEs.

## 4. Discussion

This study examined the association between ACEs and marital status among functionally independent older Japanese. Overall, we found the following things: 1) three or more ACEs were associated with the risk of being widowed, and the accumulated effects of ACEs matter to becoming widowed rather than none of the specific types of ACEs has the independent effect, 2) childhood poverty was associated with the risk of being divorced only for females, and females had a greater risk of being divorced when having three or more ACEs than males, and 3) unmarried status was associated with having three or more ACEs and childhood poverty in both genders.

Regarding the risk of widowhood, the outcomes imply that the impact of each ACE is small and not specific, but multiple ACEs could lead to the risk of widowhood in both males and females. Even though females are more likely to become widowed than males, this study confirmed that both males and females with three or more ACEs are more likely to become widowed than those without ACEs. In addition, individuals with a higher number of ACEs might experience a higher risk of being widowed because individuals exposed to ACEs significantly tend to choose partners with ACEs (Andersson et al., 2021), and a higher number of ACEs is associated with premature mortality (Bellis et al., 2014; Brown et al., 2009).

Why individuals with ACEs match each other can be considered from two aspects. First, child maltreatment is associated with insecure attachment styles (Baer & Martinez, 2006), and when getting married, people select their mate to sustain initial attachment security (Bartholomew, 1990). In this view, attachment rather than ACEs is the hidden reason. Another is assortative mating theories, which propose that individuals choose partners having their similarities (Trombello et al., 2015), convince that people having similar backgrounds might be attracted to each other.

Marital quality mediates the association between childhood abuse and positive/negative affective symptoms (Fitzgerald & Berthiaume, 2021), and insecure attachment style mediates the association between childhood maltreatment and lower quality intimate relationships (Shahab et al., 2021). Further, insecure individuals showed decreased commitment and trust and increased perception of cost overtime (Keelan et al., 1994). Given these, accumulated stress caused by a high marital strain might eventually lead to widowhood. Further study is required to examine how mediating factors, including attachment, marital quality, subsequent adverse health effects due to ACES for themselves and their partners, and its interactive effects between them influence higher risks of widowhood throughout the marriage.

This study found new knowledge in the association between a specific type of ACEs and the risk of divorce. To the best of our knowledge, the association between childhood poverty and being divorced for females had not been reported; however, prior studies back up this outcome. Parents facing financial strain experience wide-ranging difficulty and are more likely to use parenting practices that lack warmth, which develop insecure attachment (Ho et al., 2022; Laraia et al., 2006; Stansfeld et al., 2008). Also, financial strain

**Table 4**
Relative risk ratios of widowed, divorced, and unmarried by each ACE for males (N = 18,432).

| ACEs | Marital status (reference: married) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Widow | | | Divorce | | | Unmarried | | |
| | Bivariate | Model1 | Model2 | Bivariate | Model1 | Model2 | Bivariate | Model1 | Model2 |
| | RRR | RRR | RRR | RRR | RRR | RRR | RRR | RRR | RRR |
| | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI |
| Parental death | **1.30** | 1.13 | 1.12 | 1.16 | 1.18 | 1.16 | 1.09 | 1.10 | 1.04 |
| | **1.15–1.46** | 1.00–1.27 | 0.99–1.27 | 0.97–1.39 | 0.98–1.42 | 0.96–1.39 | 0.88–1.34 | 0.89–1.36 | 0.84–1.29 |
| Parental divorce | 0.85 | 0.92 | 0.87 | **1.93** | **1.79** | **1.53** | **2.01** | **1.63** | 1.34 |
| | 0.58–1.23 | 0.63–1.34 | 0.59–1.27 | **1.31–2.84** | **1.22–2.64** | **1.03–2.28** | **1.32–3.07** | **1.06–2.51** | 0.87–2.09 |
| Parental mental disease | 1.29 | 1.29 | 1.24 | 1.75 | 1.64 | 1.32 | 1.76 | 1.44 | 1.20 |
| | 0.78–2.14 | 0.77–2.16 | 0.74–2.08 | 0.92–3.34 | 0.86–3.13 | 0.69–2.56 | 0.86–3.61 | 0.69–2.98 | 0.57–2.51 |
| Exposure to IPV | 1.04 | 1.17 | 1.15 | **1.75** | **1.61** | 1.29 | **1.90** | **1.55** | 1.23 |
| | 0.79–1.37 | 0.89–1.55 | 0.85–1.54 | **1.27–2.42** | **1.16–2.23** | 0.90–1.84 | **1.34–2.70** | **1.09–2.21** | 0.83–1.81 |
| Physical abuse | 1.08 | 1.03 | 0.91 | **2.00** | **1.85** | 1.27 | 1.63 | 1.35 | 0.81 |
| | 0.71–1.62 | 0.68–1.58 | 0.58–1.43 | **1.26–3.18** | **1.16–2.95** | 0.75–2.13 | 0.93–2.86 | 0.76–2.40 | 0.43–1.52 |
| Psychological neglect | **1.20** | 1.11 | 1.10 | **1.61** | **1.55** | **1.41** | **1.82** | **1.71** | **1.55** |
| | **1.03–1.39** | 0.95–1.30 | 0.93–1.29 | **1.31–1.97** | **1.26–1.90** | **1.13–1.76** | **1.46–2.27** | **1.36–2.15** | **1.22–1.97** |
| Psychological abuse | 1.13 | 1.12 | 1.07 | **1.48** | **1.42** | 1.11 | **1.73** | **1.60** | 1.29 |
| | 0.90–1.43 | 0.89–1.41 | 0.84–1.37 | **1.10–2.00** | **1.05–1.92** | 0.79–1.55 | **1.26–2.38** | **1.15–2.20** | 0.90–1.83 |
| Poverty | 1.09 | 1.04 | 1.01 | **1.20** | 1.14 | 1.04 | **1.42** | **1.35** | **1.25** |
| | 0.98–1.22 | 0.92–1.16 | 0.90–1.14 | **1.01–1.41** | 0.96–1.35 | 0.87–1.24 | **1.18–1.72** | **1.11–1.64** | **1.02–1.53** |

Model1: adjusted age, occupation, education, Model2: Model1+ all ACEs.
Bold letters represent significant results (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$).

**Table 5**
Relative risk ratios of being widowed, divorced, and unmarried by each ACE for females (N = 21,306).

| | Marital status (reference: married) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Widow | | | Divorce | | | Unmarried | | |
| ACEs | Bivariate | Model1 | Model2 | Bivariate | Model1 | Model2 | Bivariate | Model1 | Model2 |
| | RRR | RRR | RRR | RRR | RRR | RRR | RRR | RRR | RRR |
| | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI | 95%CI |
| Parental death | **1.21** | 1.02 | 1.02 | **1.25** | **1.23** | **1.20** | 0.96 | 0.95 | 0.90 |
| | **1.13–1.30** | 0.95–1.10 | 0.95–1.09 | **1.13–1.30** | **1.06–1.43** | **1.03–1.39** | 0.78–1.17 | 0.77–1.16 | 0.73–1.11 |
| Parental divorce | 0.89 | 1.18 | 1.14 | **3.21** | **3.10** | **2.57** | 1.50 | 1.62 | 1.39 |
| | 0.71–1.11 | 0.93–1.50 | 0.90–1.44 | **2.39–4.32** | **2.30–4.18** | **1.89–3.50** | 0.90–2.50 | 0.97–2.72 | 0.83–2.34 |
| Parental mental disease | 1.00 | 1.03 | 0.96 | 1.43 | 1.40 | 0.96 | 1.98 | 1.79 | 1.61 |
| | 0.70–1.44 | 0.70–1.51 | 0.65–1.42 | 0.72–2.84 | 0.70–2.80 | 0.48–1.95 | 0.91–4.32 | 0.77–4.12 | 0.73–3.55 |
| Exposure to IPV | 0.94 | **1.24** | 1.16 | **1.97** | **1.90** | 1.31 | 1.43 | **1.57** | 1.18 |
| | 0.79–1.12 | **1.03–1.48** | 0.96–1.40 | **1.48–2.61** | **1.43–2.53** | 0.96–1.78 | 0.95–2.16 | **1.04–2.38** | 0.77–1.83 |
| Physical abuse | **1.48** | **1.58** | 1.38 | **3.09** | **2.98** | 1.29 | **2.27** | **2.52** | 1.53 |
| | **1.04–2.10** | **1.09–2.30** | 0.94–2.04 | **1.79–5.32** | **1.72–5.15** | 0.71–2.32 | **1.04–4.95** | **1.15–5.53** | 0.67–3.51 |
| Psychological neglect | 1.09 | 1.07 | 1.05 | **1.93** | **1.91** | **1.56** | 1.24 | **1.37** | 1.16 |
| | 0.98–1.22 | 0.96–1.19 | 0.94–1.18 | **1.61–2.32** | **1.59–2.30** | **1.28–1.89** | 0.94–1.62 | **1.04–1.79** | 0.87–1.55 |
| Psychological abuse | 1.01 | 1.14 | 1.05 | **2.27** | **2.22** | **1.60** | **1.71** | **1.74** | 1.40 |
| | 0.88–1.16 | 0.98–1.32 | 0.90–1.24 | **1.80–2.86** | **1.76–2.80** | **1.23–2.06** | **1.23–2.36** | **1.25–2.41** | 0.98–2.00 |
| Poverty | **1.08** | 1.05 | 1.04 | **1.44** | **1.39** | **1.23** | **1.30** | **1.47** | **1.41** |
| | **1.02–1.15** | 0.99–1.13 | 0.97–1.11 | **1.26–1.64** | **1.21–1.59** | **1.07–1.42** | **1.10–1.54** | **1.23–1.76** | **1.18–1.69** |

Model1: adjusted age, occupation, education, Model2: Model1+ all ACEs.
Bold letters represent significant results (* $p < 0.05$, ** $p< 0.01$, *** $p< 0.001$).

during childhood increases the sensitivity to stress and influences trust, especially in close relationships (Miller et al., 2011; Pearlin et al., 2005), and only women with childhood financial strain feel lower levels of happiness in the context of marital strain (Upenieks & Liu, 2022).

With regards to other types of ACEs, the following are consistent findings with prior studies: there was a dose-response relationship between the number of ACEs and the risk of being divorced (Anderson, 2017; Font & Maguire-Jack, 2016), and there were associations between divorce risks and psychological neglect and parental divorce (Anderson, 2017; Colman & Widom, 2004; Font & Maguire-Jack, 2016). Inconsistent findings were found in parental death, physical abuse, and psychological abuse. Parental bereavement was associated with higher separation rates in females and males (Høeg et al., 2018), but females only in this study. In addition, females had higher divorce risks if they experienced combined childhood violence (Anderson, 2017), or no associations between childhood violence and the risk of divorce (Font & Maguire-Jack, 2016). However, this study identified that females with childhood psychological abuse were more likely to divorce.

Relationships with the mother and the father and the child's gender influence development of attachment and behaviors in close relationships. Children form attachment relationships with their mother and father differently, showing that father's parenting practices predict versatile variation in infant-father attachment security (Cox et al., 1992). Further, selection of intimate partner is associated with opposite-sex parent's caregiving style (Collins & Read, 1990). The prior study described that around 70 % was paternal death among parental bereavement (Høeg et al., 2018), while the survey used in this study did not ask which parent passed away. Considering the historical backgrounds that the participants were raised during/after the World War II, the percentage of father's death is considered to be much higher than mother's death, and such difference might affect the different outcomes (Fujiwara et al., 2023). The inconsistent outcomes of childhood violence might be due to females' versatile attachment, which was developed via the relationships with their fathers. Further study is required to examine how specific type of ACE influences the development of emotional functioning and attachment lead to divorce, considering parental sex difference and stratifying males and females.

Although the dose-response relationship between cumulative ACEs and unmarried risk was consistent with a prior study (Font & Maguire-Jack, 2016), the types of ACEs differ. This study found that higher risks of unmarried were associated with childhood poverty in males and females and psychological neglect in males only; however, any ACEs or child abuse were not associated with never married in prior studies (Anderson, 2017; Colman & Widom, 2004). The fiscal pressure in the family of origin is associated with financial hardships in later life (Donnellan et al., 2009), and couples in low SES are likely never to marry (Karney, 2021). Psychological neglect is directly related to avoidant attachment (Höltge et al., 2023), which brings social isolation and less involvement in romantic relationships, especially for males (Colman & Widom, 2004; May et al., 2022). Childhood poverty affects holistic human developmental aspects, such as physical, psychological, emotional, cognitive functioning (Yoshikawa et al., 2012), and intimate relationships throughout life, as we found in this study. Therefore, it should be emphasized that policy development and implementation to tackle childhood poverty and evaluation of its effects on later well-being in intimate relationships must be inevitable.

Different patterns of associations between ACEs and marital status between males and females can be explained through brain mechanisms. For example, a recent study found interacting effects of ACEs and sex on brain morphology: females with either threat (i.e., the presence of unexpected inputs such as trauma) or deprivation (i.e., the absence of expected inputs) had smaller grey matter volume in a region where the processing of emotions interplays than those without such experiences, while males who experienced

deprivation did smaller than those who experienced threat (Everaerd et al., 2016). Also, females are more accurate in recognizing fearful facial expressions compared to males, using sex-specific brain circuits (Weisenbach et al., 2014). Such evidence may imply that females are more vulnerable to emotional processing and developing attachment relationships when exposed to diverse ACEs (both threat and deprivation). Hence, all professionals in intimate relationships should pay more attention to ACEs and their differential effects on sex for further effective intervention/prevention strategies.

Several limitations should be mentioned before the conclusion. Firstly, the current findings may not apply to different circumstances and younger generations because most of the participants in this study were born during/after World War II, and the meaning of marriage differed from the current pattern. Several recent studies make categories related to other adverse experiences such as war and natural disasters (e.g., Johnson et al., 2020), but this study did not; therefore, the outcomes might have been different if there were other variables of different kinds of ACEs. In addition, marriage had been viewed as an expectation and obligation due to family beliefs in East Asia, including Japan (Bumpass et al., 2009; Rindfuss et al., 2004). The social norm has changed; the individual choice has become more welcomed (Arnett et al., 2014). Such societal change is seen in the statistics; arranged marriages took up more than half in the 1950s while it decreased to only a few percent by the early 21st century (Arnett et al., 2014). Therefore, future study needs to target young or middle-age adulthood to see the effects of ACEs on marital status in the current context. Secondly, information bias, especially recall bias on ACEs, might have influenced the findings, though a previous study reported that retrospective recall of ACEs showed good validity (Hardt & Rutter, 2004). Thirdly, this study excluded those who answered "other" for marital status, wherein those who remarried or divorced multiple times might be included. Fourthly, although we focused on older adults of 65 years or above, survival effect, those with higher ACEs were more likely to die before 65. Thus, the association between ACEs and marital status may have been underestimated.

In conclusion, a higher number of ACEs is associated with being widowed, divorced, and unmarried in older Japanese adults. Therefore, policy to tackle ACEs and further research examining how ACEs, attachment, and couple relationships are related and how they influence marital status is required to promote well-being in later intimate relationships.

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## Declaration of competing interest

The authors have no conflict of interest to disclose.

## Data availability

Data are from the JAGES study. All enquiries are to be addressed at the data management committee via e-mail: dataadmin.ml@jages.net.

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