

## ORIGINAL RESEARCH

# Do adverse childhood experiences contribute to social isolation in young single-person households? A sex-based inquiry

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(Dohun Song)**Abstract**

**Background:** Adverse childhood experiences (ACEs) have been associated with increased social isolation in adulthood. This study examines the relationship between ACEs and social isolation among young adults living alone and investigates whether this association varies between females and males. **Methods:** Data were obtained from the “2021 Youth Social and Economic Survey” conducted by the National Youth Policy Institute of Korea. A hierarchical regression analysis and a simple slope test were performed on 445 young adults living alone in Korea (Mean age = 28.01, Standard Deviation = 4.08, males 59.3%, females 40.7%). **Results:** The findings indicated that a higher number of ACEs was associated with greater social isolation and that this relationship was significantly moderated by sex, with ACEs having a stronger impact on social isolation in females than in males. **Conclusions:** This study highlights the need for sex-specific interventions. Females may benefit from programs aimed at strengthening emotional support and social relationships, while males may respond more effectively to interventions that encourage participation in structured activities such as group programs and sports. Future research should further investigate how ACEs influence social isolation across diverse sex identities and develop targeted intervention strategies.

**Keywords**

Adverse childhood experiences (ACEs); Sex differences; Single-person households; Social isolation; Young adults

## 1. Introduction

Social isolation refers to a state of disconnection from meaningful relationships within a social network, often leading to loneliness and emotional distress [1, 2]. This issue has been increasingly recognized as a significant social problem in various countries, including the United Kingdom, the United States, and Sweden [3, 4], and similar concerns have emerged in South Korea as well. While social isolation was previously most commonly observed among older adults, such as elderly individuals living alone, it is now affecting individuals across all life stages due to the rising prevalence of single-person households. In particular, young adults, defined as those aged 18 to 34, are experiencing an increasing risk of social isolation as more of them live independently [5, 6].

Young adulthood is typically a period characterized by active social engagement, relationship-building, and participation in various activities. Experiencing social isolation during this stage can disrupt emotional and psychological well-being, leading to increased anxiety and depression [7, 8]. Prolonged social isolation among young adults has been associated with various negative outcomes. These include emotional detachment from family and peers, reduced personal control, in-

creased psychological distress, and, in severe cases, suicidal tendencies [9]. The risk is particularly pronounced among young adults living alone, as they often lack strong emotional and financial support networks, making it more difficult for them to cope with loneliness and social disconnection [10]. Unlike individuals in multi-person households, who benefit from built-in social interactions and emotional stability, those living alone face greater challenges in maintaining social relationships [11]. The rapid increase in single-person households in South Korea, where young adults comprise the largest proportion of this demographic [12], highlights the urgent need to examine the factors contributing to social isolation among this group. The rapid increase in young single-person households is closely tied to the social and economic changes occurring in South Korea, which can act as a factor exacerbating social isolation during youth [13]. The rising youth unemployment rate and unstable employment conditions hinder young people's ability to achieve economic independence, negatively impacting their ability to build social networks [14]. Additionally, the competitive educational and workplace environments limit the time and space available for forming social relationships, increasing the likelihood of feelings of isolation among young people [15].

Previous research has identified various factors influencing social isolation in young adults, including age, educational attainment, employment status, type of employment, and income level [16–18]. Specifically, Algren *et al.* [17] found that individuals with lower educational attainment and those who were unemployed reported significantly higher levels of social isolation and loneliness, which were often accompanied by health-risk behaviors such as smoking and alcohol consumption. In a German cohort study, Röhr *et al.* [19] reported that adults experiencing financial hardship and infrequent social contact were significantly more likely to be socially isolated. Moreover, Cloutier-Fisher *et al.* [18] conducted a qualitative analysis showing that individuals with highly limited social support networks experienced deeper feelings of subjective isolation, which were closely associated with emotional isolation.

However, most of these studies have focused on immediate or situational causes, overlooking that social isolation may often develop cumulatively rather than as a sudden event [19]. According to the life-course perspectives, social isolation is shaped by experiences accumulated throughout childhood, adolescence, and adulthood [20], meaning that early-life experiences play an important role in shaping an individual's ability to form and maintain social relationships later in life. For instance, individuals who lack emotional support during childhood may struggle to establish strong social networks in adulthood, increasing their risk of persistent social isolation [21]. Similarly, those who experienced family conflict or neglect may find it difficult to build trust-based relationships, further contributing to their isolation [22]. Given this perspective, it is necessary to consider social isolation not merely as an outcome of present circumstances but as a phenomenon influenced by early life experiences.

Among the various early-life factors contributing to long-term social isolation, adverse childhood experiences (ACEs) have been recognized as a particularly significant determinant. ACEs encompass a range of stressful or traumatic events occurring during childhood. These include abuse, neglect, domestic violence, parental mental health issues, parental divorce, and economic hardship [23, 24]. These experiences do not remain confined to childhood but have lasting consequences, affecting mental and physical health well into adulthood and impairing an individual's ability to form and maintain social relationships [22, 25]. Studies have shown that individuals with a history of childhood abuse report higher levels of social isolation [26], while those who have experienced peer bullying or victimization are more likely to withdraw from social interactions [27]. In South Korea, research on ACEs has been expanding, with reports indicating that as of 2021, 57.3% of Korean adults had experienced at least one ACE [28]. Furthermore, ACEs have been linked to an increased risk of social isolation and depression [29, 30]. Based on these findings, the present study aims to examine the relationship between ACEs and social isolation among young adults living alone.

When analyzing the impact of past experiences, such as ACEs, it is important to consider that their effects may differ based on individual characteristics [31]. According to the diathesis-stress model, individual vulnerability (diathesis) in-

teracts with stress from major negative events to contribute to the development of psychological problems [32]. Sex is one such characteristic that influences this interaction. Females may be more sensitive to trauma or stress due to differences in physiological hormones, socialization processes, and psychological systems, leading to a higher prevalence of Post-Traumatic Stress Disorder (PTSD) or depressive symptoms compared to males [33]. Previous studies have shown that females are more emotionally affected by ACEs, making them more likely to develop psychological issues, such as depression and anxiety [34, 35]. In contrast, males often express their emotional distress through behavioral manifestations such as aggression and addiction rather than direct emotional expression [36].

Given these sex differences, the impact of ACEs on social isolation may not be uniform across males and females. However, while numerous studies have examined the overall relationship between ACEs and social isolation [37, 38], few have systematically explored how this association differs by sex. To address this gap, the present study examines how ACEs influence social isolation among young adults living alone and explores whether this relationship differs between males and females based on secondary data from the “2021 Youth Social and Economic Survey” conducted by the National Youth Policy Institute of Korea.

## 2. Materials and methods

### 2.1 Research model

This study examines whether the relationship between ACEs and social isolation among young adults living alone varies by sex. The research model established is illustrated in Fig. 1.

### 2.2 Data and study participants

This study utilized raw data from the “2021 Survey on the Social and Economic Conditions of Youth” by the National Youth Policy Institute of Korea. The survey targeted individuals aged 18 to 34 across the country and was conducted between 19 July and 31 October 2021. A total of 2041 respondents participated in the survey, in which a multi-stage sampling method and face-to-face interviews were used to collect detailed information on socioeconomic conditions, ACEs, social networks, health status, and overall well-being. Given its comprehensive scope, this dataset is well-suited for investigating the association between ACEs and social isolation among young adults.

For this study, the analysis focused on young adults aged 18 to 34 who identified as single-person household members. Among the 2041 survey respondents, 445 individuals met this criterion and were selected as the final study sample.

This study was approved by the Institutional Review Board (IRB) of Jeonbuk National University (IRB Number: JBNU 2025-01-007). All procedures adhered to the ethical principles outlined in the Declaration of Helsinki. The data were obtained from the National Youth Policy Institute (NYPI), and the requirement for informed consent was waived by the IRB due to the use of de-identified secondary data.

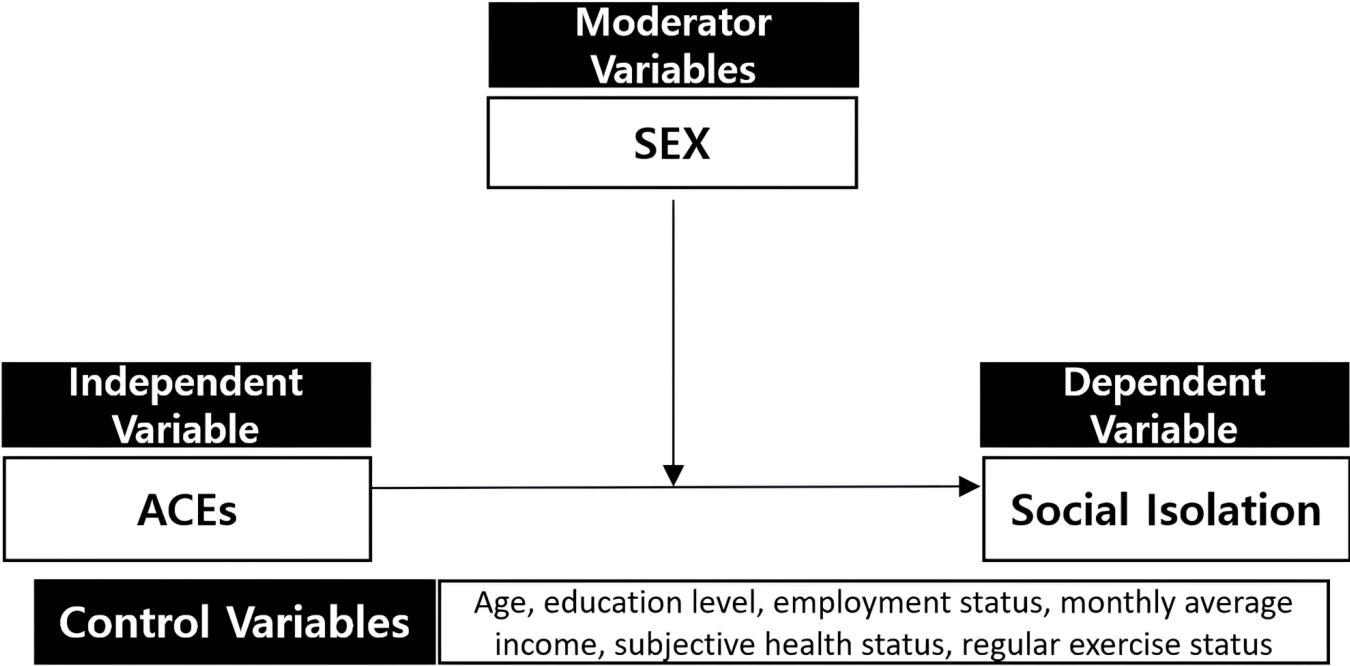


FIGURE 1. Research model. ACEs, Adverse childhood experiences.

2.3 Measurement tools

2.3.1 Dependent variable: social isolation

Social isolation was assessed using the Revised University of California, Los Angeles (UCLA) Loneliness Scale, which evaluates individuals’ perceived levels of isolation and deficiencies in social networks. While originally developed to measure subjective loneliness, recent studies have demonstrated its applicability in assessing social isolation, as it captures aspects related to both emotional loneliness and the absence of social connections [21, 39].

Although loneliness and social isolation are conceptually distinct, several items in the scale, such as “There is no one I can rely on” and “I feel isolated from those around me”, directly reflect a lack of social networks, making the scale a suitable supplementary tool for measuring social isolation [40]. In addition, the UCLA Loneliness Scale has been validated for reliability and validity in South Korea [41].

The scale consists of 18 items, including “I feel I lack companionship”, “I feel there is no one I can turn to”, “I think there are people around me to talk to”, and “I feel isolated from others”, among others. Responses were rated on a 4-point Likert scale ranging from “Not at all true” (1 point) to “Always true” (4 points). Positively worded items were reverse-coded, and total scores were calculated for analysis, with higher scores indicating greater levels of social isolation. The internal consistency of the scale was confirmed, with a Cronbach’s  $\alpha$  of 0.873.

2.3.2 Independent variable: adverse childhood experiences

ACEs were measured using six items from the national survey, which assessed experiences of early-life adversity. The items included: (1) “Experiencing sudden financial difficulties in the family”, (2) “Being subjected to excessive corporal

punishment or emotional abuse by a caregiver”, (3) “Having a family member with emotional difficulties”, (4) “Losing someone close”, (5) “Frequent school transfers or relocations”, and (6) “Being bullied or excluded by others at school or in the neighborhood” [42].

These items align with the ACEs categories proposed by the Centers for Disease Control and Prevention (CDC) [43] and Finkelhor *et al.* [44]. Each reported experience was coded as 1, while the absence of an experience was coded as 0. The total ACE score, ranging from 0 to 6, was treated as a continuous variable, with higher scores reflecting a greater number of adverse experiences. The reliability of the ACEs scale was acceptable, with a Cronbach’s  $\alpha$  of 0.724.

2.3.3 Moderating variable: sex

To examine whether the effect of ACEs on social isolation differs by sex, sex was included as a moderating variable. Respondents were asked to indicate their sex by selecting “Male” or “Female”. For analysis, sex was coded as a moderating variable, with males assigned a value of 0 and females assigned a value of 1.

2.3.4 Control variables

To account for potential confounding factors, this study included age, education level, employment status, and monthly income as control variables, as these factors have been shown to influence social isolation [17, 18, 44]. Additionally, regular exercise status was incorporated as a control variable, given that previous research suggests that physical activity facilitates social network formation and maintenance, while a lack of physical activity may increase the risk of social isolation [17, 21]. Thus, controlling for these variables allowed for a more precise examination of the relationship between ACEs and social isolation.

Education level was categorized into three groups: high

school graduate or lower, 2-year college graduate, and 4-year college graduate or higher. For analysis, high school graduates or those with lower grades were set as the reference category and dummy-coded. Employment status was also treated as a categorical variable. Individuals who were formally employed and received wages were classified as economically active, whereas those who were self-employed, working without pay, or unemployed were categorized as not participating in economic activity. Economic activity participation was used as the reference category and dummy-coded accordingly. Monthly income was measured as a continuous variable in units of 10,000 KRW. Subjective health status was assessed using a 5-point Likert scale, ranging from 1 = Very poor to 5 = Very good, with higher scores reflecting better perceived health. Regular exercise status was also included as a categorical variable, with No regular exercise designated as the reference category in dummy coding.

### 2.3.5 Statistical analysis

All statistical analyses were conducted using Stata/MP 17.0 (StataCorp LLC, College Station, TX, USA). First, frequency and descriptive statistical analyses were performed to examine the demographic characteristics of the study participants and the distributions of key variables. To assess differences in demographic characteristics and main study variables by sex, independent *t*-tests and Chi-square tests were conducted for continuous and categorical variables, respectively. To evaluate whether the relationship between ACEs and social isolation among young adults living alone was moderated by sex, hierarchical regression analysis was performed. Additionally, a simple slope analysis was conducted to further explore the nature of the interaction effect.

## 3. Results

### 3.1 General characteristics of study participants

The general characteristics of the study participants are presented in Table 1. Among the participants, 59.33% were male and 40.67% were female, indicating a higher proportion of males. The mean age was 28.01 years (standard deviation (SD) = 4.08). Regarding education level, 42.02% had a high school education or lower, 18.65% had completed a 2-year college program, and 39.33% held a 4-year college degree or higher. Regarding employment status, 75.28% were employed, whereas 24.72% were unemployed, suggesting that most young adults living alone were engaged in economic activity. The mean monthly income was 532,100 KRW (SD = 88,920 KRW). Subjective health status, assessed on a five-point scale, had a mean score of 4.03 (SD = 0.75), suggesting that participants generally perceived their health positively. In terms of physical activity, 62.92% reported not engaging in regular exercise, whereas 37.08% reported regular exercise participation.

**TABLE 1. General characteristics of the study participants (N = 445).**

| Variables                     | Mean (SD)/n (%) |
|-------------------------------|-----------------|
| Sex*                          |                 |
| Male                          | 264 (59.33)     |
| Female                        | 181 (40.67)     |
| Age (yr)**                    | 28.01 (4.08)    |
| Education Level*              |                 |
| High school or less           | 187 (42.02)     |
| College                       | 83 (18.65)      |
| University or more            | 175 (39.33)     |
| Employment Status*            |                 |
| Employed                      | 335 (75.28)     |
| Unemployed                    | 110 (24.72)     |
| Monthly Income (10,000 KRW)** | 53.21 (88.92)   |
| Subjective Health Status**    | 4.03 (0.75)     |
| Regular Exercise*             |                 |
| Yes                           | 165 (37.08)     |
| No                            | 280 (62.92)     |

\*categorical variable with n (%) reported; \*\*continuous variable with mean (SD) reported. SD, Standard Deviation.

### 3.2 Sex differences in demographic characteristics and key variables

The differences in demographic characteristics and key variables between male and female participants are presented in Table 2. The results indicated that social isolation scores were similar between sexes, with males scoring 33.55 (SD = 0.43) and females scoring 33.52 (SD = 0.59). ACEs scores were slightly higher in females (0.77, SD = 0.09) than in males (0.69, SD = 0.08), though the difference was not statistically significant.

Age differed significantly by sex, with males having a higher mean age (28.42 years, SD = 4.11) compared to females (27.40 years, SD = 3.39) ( $t = 2.64, p < 0.01$ ). Regarding education level, males had relatively higher proportions of participants in both the “high school or less” and “university or more” categories, whereas females had a higher proportion in the “college” category ( $\chi^2 = 15.06, p < 0.01$ ).

Although the results showed that employment status and monthly income did not differ significantly between sexes, the proportion of individuals engaging in regular exercise was significantly higher among males than females ( $t = 5.86, p < 0.05$ ).

### 3.3 Moderating effects of sex on the relationship between adverse childhood experiences and social isolation among young adults living alone

The results of the analysis examining the moderating effect of sex on the relationship between ACEs and social isolation among young adults living alone are presented in Table 3. In Model 1, which included ACEs as the independent variable

**TABLE 2. Differences in demographic characteristics and key variables by sex (N = 445).**

| Variables                     |                     | Sex               |                     | Effect Sizes | p-value |
|-------------------------------|---------------------|-------------------|---------------------|--------------|---------|
|                               |                     | Male<br>(n = 264) | Female<br>(n = 181) |              |         |
| Social Isolation              | Mean (SD)           | 33.55 (0.43)      | 33.52 (0.59)        | 0.004        | 0.964   |
| Adverse Childhood Experiences | Mean (SD)           | 0.69 (0.08)       | 0.77 (0.09)         | −0.067       | 0.490   |
| Age (yr)                      | Mean (SD)           | 28.42 (4.11)      | 27.40 (3.96)        | 0.254        | 0.009** |
| Education Level               | High school or less | 123 (46.59%)      | 64 (35.36%)         | 0.184        | 0.001** |
|                               | College             | 34 (12.88%)       | 49 (27.07%)         |              |         |
|                               | University or more  | 107 (40.53%)      | 68 (37.57%)         |              |         |
| Employment Status             | Employed            | 193 (73.11%)      | 142 (78.45%)        | −0.061       | 0.119   |
|                               | Unemployed          | 71 (26.89%)       | 39 (21.55%)         |              |         |
| Monthly Income (10,000 KRW)   | Mean (SD)           | 53.73 (91.24)     | 52.44 (85.67)       | 0.015        | 0.880   |
| Subjective Health Status      | Mean (SD)           | 4.12 (0.72)       | 3.91 (0.77)         | 0.286        | 0.003** |
| Regular Exercise              | Yes                 | 110 (58.33%)      | 55 (30.39%)         | −0.115       | 0.016*  |
|                               | No                  | 154 (41.67%)      | 126 (69.61%)        |              |         |

\* $p < 0.05$ , \*\* $p < 0.01$ ; *t*-tests were conducted for continuous variables, while Chi-square tests were performed for categorical variables. Effect sizes are reported using Cohen's *d* for continuous variables and Cramer's *V* for categorical variables. SD, Standard Deviation.

along with control variables, ACEs had a significant positive effect on social isolation ( $\beta = 0.199$ ,  $p < 0.001$ ), indicating that individuals who experienced a greater variety of ACEs had higher levels of social isolation.

Model 2 extended Model 1 by incorporating sex as a moderating variable and including an interaction term between ACEs and sex, along with the same control variables. In this model, ACEs remained a significant predictor of social isolation ( $\beta = 0.126$ ,  $p < 0.05$ ). Moreover, the interaction term between ACEs and sex had a significant positive effect on social isolation ( $\beta = 0.130$ ,  $p < 0.05$ ), suggesting that the association between ACEs and social isolation was stronger in females than in males.

Among the control variables, older age was consistently associated with higher levels of social isolation, whereas higher monthly income and better self-rated health were significantly associated with lower levels of social isolation. To further illustrate the moderating effect of sex, the relationship between ACEs and social isolation was visualized (Fig. 2). We found that while social isolation increased with the number of ACEs in both males and females, the steeper slope observed for females indicated that the impact of ACEs on social isolation was more pronounced in females than in males.

#### 4. Discussion

This study examined the impact of ACEs on social isolation among young adults living alone and investigated whether sex moderates this relationship. To achieve this, data from the “2021 Survey on the Social and Economic Conditions of Youth”, conducted by the National Youth Policy Institute

of Korea were analyzed and involved 445 young adults who provided responses to key study variables.

First, the results showed that a greater variety of ACEs is associated with greater social isolation among young adults living alone, aligning with existing research, which suggests that the effects of ACEs are not confined to childhood but extend into adulthood, influencing both physical and mental health [23]. Specifically, ACEs have been shown to contribute to psychological issues, such as depression, anxiety, and loneliness, all of which interfere with the formation and maintenance of healthy interpersonal relationships [22]. Studies conducted in South Korea have also highlighted the link between ACEs and various psychological outcomes, including emotional isolation and difficulties in interpersonal relationships [35]. Thus, our findings confirm that ACEs play a significant role in increasing social isolation during young adulthood.

Second, this study confirmed that sex moderates the relationship between ACEs and social isolation, with a stronger effect observed among females. One possible explanation for this could be that females may experience greater emotional sensitivity and respond more acutely to stressors, as suggested by the stress sensitivity model [32]. This increased sensitivity could magnify the impact of ACEs on emotional stability and interpersonal relationships. Similarly, Anda *et al.* [23] reported that ACEs had a more profound psychological effect on females, and these effects tended to persist into adulthood. Thus, females may be more likely to interpret a lack of emotional support as psychological isolation, leading to stronger feelings of social isolation.

Meanwhile, although males were found to be less affected

**TABLE 3. Effects of adverse childhood experiences on social isolation among young adults living alone and the moderating effect of sex.**

| Category<br>N = 445   |                                               | Model 1        |         |          | Model 2        |         |          |
|-----------------------|-----------------------------------------------|----------------|---------|----------|----------------|---------|----------|
|                       |                                               | B (SE)         | $\beta$ | <i>t</i> | B (SE)         | $\beta$ | <i>t</i> |
| PIndependent Variable | Adverse Childhood Experiences (A)             | 1.210 (0.278)  | 0.199   | 4.35***  | 0.766 (0.354)  | 0.126   | 2.17*    |
| Moderating Variable   | Sex (B) (ref. Males)                          |                |         |          | -1.159 (0.832) | -0.074  | -1.39    |
| Interaction Term      | A × B                                         |                |         |          | 1.125 (0.549)  | 0.130   | 2.05*    |
| Control Variables     |                                               |                |         |          |                |         |          |
|                       | Age                                           | 0.278 (0.092)  | 0.148   | 3.02**   | 0.265 (0.093)  | 0.141   | 2.84**   |
|                       | College (ref. High School or less)            | -1.354 (0.055) | -0.068  | -1.37    | -1.199 (1.004) | -0.061  | -1.19    |
|                       | University or more (ref. High School or less) | -0.790 (0.830) | -0.050  | -0.95    | -0.825 (0.833) | -0.053  | -0.99    |
|                       | Unemployed (ref. Employed)                    | -0.546 (0.831) | -0.031  | -0.66    | -0.607 (0.830) | -0.034  | -0.73    |
|                       | Monthly Income                                | -0.014 (0.004) | -0.162  | -3.56*** | -0.014 (0.003) | -0.160  | -3.52*** |
|                       | Subjective Health Status                      | -2.382 (0.465) | -0.232  | -5.12*** | -2.387 (0.468) | -0.232  | -5.10*** |
|                       | Regular Exercise (ref. No exercise)           | -0.428 (0.722) | -0.027  | -0.59    | -0.489 (0.723) | -0.031  | -0.68    |
| Cons                  |                                               | 36.079 (3.136) | -       | 10.93*** | 36.907 (3.271) | -       | 10.80*** |
| Adjusted $R^2$        |                                               |                | 0.133   |          |                | 0.138   |          |
| <i>F</i>              |                                               |                | 9.54*** |          |                | 8.11*** |          |

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . B, Unstandardized Regression Coefficient. SE, Standard Error.

by ACEs in comparison to females, it is important to note that this does not suggest that social isolation among males is less significant or less concerning [45]. Kawachi *et al.* [46] argued that social isolation in males is often underreported and, as a result, can lead to serious outcomes such as depression and suicide risk. Cultural norms, which often emphasize emotional suppression and independence, may prevent males from recognizing or expressing their feelings of isolation. Therefore, it is essential to adopt targeted strategies to identify and address social isolation in males, ensuring that it is not overlooked or underestimated.

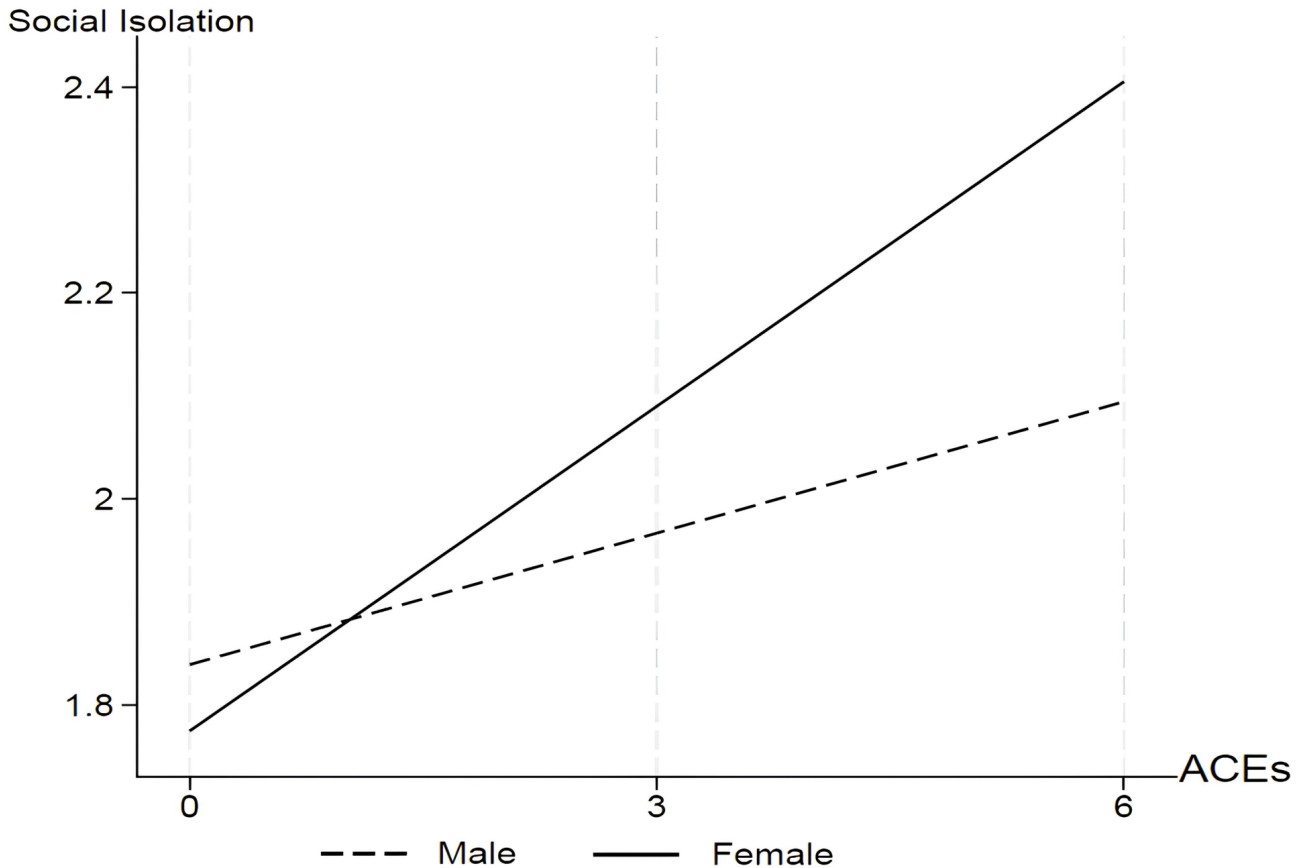
In addition, the sex differences in social isolation associated with ACEs suggest that the type of ACEs experienced may also play a significant role, and previous research has shown that females are more psychologically affected by emotional abuse and neglect, while males are more influenced by experiences of physical abuse [23]. This finding provides valuable insights into the sex differences in social isolation observed in this study. For females, emotional abuse and neglect may increase psychological sensitivity, leading to interpersonal anxiety and a lack of social support networks. In contrast, physical abuse may impair self-esteem and foster behavioral isolation in males. When combined with cultural norms that emphasize emotional suppression and independence, these factors may exacerbate social isolation in males.

Based on these findings, several recommendations for intervention and prevention are proposed. First, there is a clear need for proactive measures aimed at the prevention and early

intervention of ACEs. As demonstrated in this study, a greater variety of ACEs is significantly associated with higher levels of social isolation in young adulthood. ACEs encompass various experiences, including emotional abuse, neglect, witnessing domestic violence, parental separation or divorce, family members' mental health issues, and economic difficulties [25]. The cumulative effects of such diverse adverse experiences can detrimentally impact both psychological well-being and social networks. Thus, an integrated approach could be pivotal in detecting and preventing all forms of ACEs at an early stage.

Currently, Korea's child protection system primarily focuses on physical abuse and neglect [47], with limited attention to other forms of adversity, such as emotional abuse, parental divorce, or exposure to family members' mental health challenges. To address this gap, a comprehensive management system should be established to detect and prevent various types of ACEs. This system could involve collaboration between community-based child protection agencies, schools, and health centers to identify early signs of abuse and intervene effectively. For instance, the UK's Troubled Families Programme has shown success by implementing early interventions such as crisis prevention and initial support, which have helped restore social relationships and stabilize family environments [48].

Moreover, parental stress and economic burdens have been identified as significant contributors to ACEs [23], and family-centered interventions, including psychological counseling and educational programs, should be prioritized



**FIGURE 2. Moderating effect graph.** ACEs, Adverse childhood experiences.

to alleviate parental stress. Additionally, economic support programs are essential. The Triple P (*i.e.*, Positive Parenting Program) in the United States has been recognized for its success in preventing child abuse by reducing parental stress and improving parenting skills [49]. By adapting successful models from the UK and the US to Korea's context, effective prevention strategies for ACEs can be developed. On the other hand, while intervention strategies reported in Western contexts (such as the UK and the US) have been proven effective to some extent, there may be limitations in directly applying them to the cultural and social context of South Korea. South Korea has a strong collectivist culture and family-centered values, with distinct social roles based on sex [50]. For instance, males in South Korea tend to suppress emotional expression and emphasize independence, which may make behavior-focused interventions more effective, whereas females may be more vulnerable to a lack of emotional support, suggesting that emotional interventions could be more beneficial for them [51]. Therefore, it is necessary to adapt the intervention strategies validated in Western contexts to fit the Korean context and reflect sex-related differences in responses. In particular, peer-based group therapy or community-centered interventions may be more effective given the collectivist culture in Korea.

Furthermore, sex-informed approaches may be more appropriate. Herein, our study confirms that the impact of ACEs on social isolation varies by sex. Specifically, females were found to be more likely to experience increased psychological sensitivity after ACEs, and they may face greater challenges

in maintaining social relationships in the absence of emotional support networks [34, 35], which aligns with previous research indicating that ACEs are linked to psychological issues, such as depression and anxiety in females, and that a lack of social support can exacerbate these problems. Consequently, interventions aimed at reducing social isolation in females should focus on strengthening emotional support networks. Group therapy, which provides psychological counseling and emotional support, along with the establishment of community-based support networks, can be effective strategies for alleviating social isolation in females [3, 32].

Interventions that enhance social support may not only reduce social isolation but also improve emotional stability. In contrast, for males, ACEs are less likely to manifest as direct emotional responses, such as depression and anxiety, and are more often expressed through behaviors like social avoidance, addiction, and aggression [36]. Social isolation tends to exacerbate these behavioral problems, and males are typically less inclined to seek emotional support, which increases the risk of prolonged isolation. In South Korea, ACEs in males are significantly associated with social isolation, which is likely to contribute to subsequent mental health issues [51]. Moreover, research by Jiang *et al.* [39] suggests that males often convert emotional difficulties into behavioral responses following ACEs, highlighting the structural barriers that hinder males from accessing social support [40].

Based on the above, these findings highlight the need to adopt sex-informed or sex-based approaches when designing interventions to address social isolation. For instance, Zhang

*et al.* [52] reported that males are more responsive to social interventions that emphasize behavioral changes rather than those focused solely on emotional support. Specifically, interventions involving physical activity (e.g., sports programs, group activities) can promote social connections among males, providing a practical approach to preventing social isolation [21]. Additionally, Miller *et al.* [53] emphasized that males often seek psychological support through informal networks, such as peers, friends, and mentoring programs, rather than formal counseling, suggesting that establishing peer support systems within workplaces or communities could be an effective intervention strategy for males. However, these intervention strategies risk leaning towards an approach based on traditional sex roles. Providing emotional support for females and behavior-focused interventions for males may reinforce fixed response patterns associated with sex. Therefore, there is a need for a more integrated and balanced intervention strategy. For example, males may benefit from enhanced emotional support in addition to behavior-focused interventions, while females could see positive effects on social relationship formation from such behavior-focused interventions [50, 54]. In other words, an approach that combines emotional and behavior-focused interventions may be more effective in addressing social isolation [55].

In light of these findings, interventions for males should incorporate measures that strengthen informal social networks alongside traditional emotional support mechanisms. However, this study has several limitations. First, since it is based on secondary data, sex was classified only as male and female, failing to adequately reflect a broader range of sex identities. Additionally, the study did not thoroughly address the various characteristics of Adverse Childhood Experiences (ACEs). While factors such as age, education level, and income were controlled for, social factors like frequency of social connections and digital connectivity were not, which may also limit the study. Specifically, since frequency of social connections and digital connectivity can significantly influence social isolation in contemporary society, future research should include these factors to analyze the relationship between ACEs and social isolation more precisely. Furthermore, it is essential to build more comprehensive data that reflects diverse sex identities and considers the specific characteristics of adverse childhood experiences. Furthermore, this study emphasizes the need for caution when interpreting the concept of sex due to the linguistic characteristics of the Korean context. In Korea, the distinction between biological sex and sociocultural sex is not as clearly delineated as in Western contexts. Surveys and official statistics often classify sex using binary categories such as “male/female,” without further specification. In this context, the sex variable in this study may reflect not only biological differences but also sociocultural elements. Therefore, interpretations based on sex should be made with an awareness of these linguistic and cultural limitations.

## 5. Conclusions

This study examined the impact of ACEs on social isolation among young adults living alone, demonstrating that ACEs significantly contribute to increased social isolation and sug-

gesting that ACEs may have long-lasting effects on forming and maintaining social relationships in adulthood. Additionally, the relationship between ACEs and social isolation was found to differ by sex, highlighting the need for sex-sensitive intervention strategies.

For females, the absence of emotional support networks is a key factor exacerbating social isolation, for whom psychological counseling and community-based emotional support programs could be particularly effective interventions. In contrast, social isolation in males is more likely to manifest through behavioral issues, such as social avoidance and aggression. Therefore, interventions promoting physical activity and strengthening informal social networks could be more suitable for this group. Future research should further explore sex differences in the impact of ACEs on social isolation, considering the experiences of individuals across various sex identities, to better tailor intervention strategies.

## AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

## AUTHOR CONTRIBUTIONS

KHJ and SJC—designed the research model and methodology. DS—contributed to overall manuscript writing. HJC—prepared the manuscript, contributed to writing and revision, and finalized the manuscript. All authors contributed to writing, reviewing, and approving the final manuscript.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Institutional Review Board (IRB) of the National Youth Policy Institute (Number: 202104-HR-ID-003). All study procedures were conducted following the ethical guidelines of the Declaration of Helsinki. The data used in this study were obtained from the National Youth Policy Institute’s database, and the requirement for informed consent was waived by the IRB due to the use of de-identified secondary data.

## ACKNOWLEDGMENT

Not applicable.

## FUNDING

This research was supported by the National University Development Project at Jeonbuk National University in 2024.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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**How to cite this article:** Kyu-hyoung Jeong, Dohun Song, Seungjong Cho, Heeran J. Cho. Do adverse childhood experiences contribute to social isolation in young single-person households? A sex-based inquiry. *Journal of Men's Health*. 2025; 21(11): 1–10. doi: 10.22514/jomh.2025.130.