Preventive Medicine Reports 50 (2025) 102982



Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: www.elsevier.com/locate/pmedr



Associations of multiple adverse childhood experiences, attachment insecurity and loneliness with physical and mental health difficulties in a representative Slovak sample

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ARTICLE INFO

Keywords:
Representative sample
Slovakia
ACE-IQ
Mental health difficulties
Physical health difficulties
Attachment
Loneliness

ABSTRACT

Objectives: This study aimed to examine the occurrence of adverse childhood experiences (ACE) in the adult Slovak population and to examine the relationships between mental and physical health, ACE, attachment anxiety and avoidance, and loneliness.
Sample and settings: A cross-sectional study with a representative Slovak sample ($n = 1018$, mean age 46.24 years, 48.7 % men) collected in April 2019 data on ACE (Adverse Childhood Experiences International Questionnaire; ACE-IQ), attachment (Experiences in Close Relationships Revised; ECR-R-14), mental and physical health (SF-8 Health Survey; questions on long-term health difficulties) and loneliness single-item question. Nested linear regression models were employed to analyzed the associations.
Results: Over 75 % of respondents reported at least one ACE, and nearly a third reported four or more. Community violence (43.6 %), violent treating of a household member (38.1 %), emotional abuse (34.4 %) and emotional neglect (30.9 %) were the most common ACE. The average number of ACE was 2.7 (± 2.6). Multiple ACE were associated with attachment insecurity and loneliness. ACE were found to be significantly associated with both physical and mental health. Attachment anxiety and avoidance were linked to mental health, but only attachment anxiety remained significant when loneliness was included. Loneliness was associated with mental and physical health difficulties.
Conclusion: ACE and loneliness are associated with physical health difficulties. ACE, attachment anxiety and loneliness are linked to mental health difficulties. Preventing child maltreatment and addressing loneliness are key to mitigating the long-term health effects of ACE.

1. Introduction

Childhood adversities have been associated with impaired health and development during childhood (Oh et al., 2018), dysfunctional family dynamics (Scully et al., 2020), risky health behavior during adolescence (Bellis et al., 2014b; Wiehn et al., 2018) and adulthood (Bellis et al., 2014a) as well as mental and physical health problems later in life (Hughes et al., 2017; Petruccelli et al., 2019). Specifically, mental health problems may include conditions such as depression, anxiety disorders, substance use disorders, and suicidal ideation. Physical health problems can manifest as sleep disturbances, cardiovascular diseases, obesity, diabetes, gastrointestinal problems, and chronic pain.

Experiencing abuse and neglect from a caregiver directly influences the attachment system in terms of insecurity (higher attachment anxiety and/or attachment avoidance) (Baer and Martinez, 2006), which is also associated with dysregulated physiological responses to stress, risky health behaviors and susceptibility to physical illness (Pietromonaco and Beck, 2019). Studies have identified a "trajectory of loneliness" linking childhood maltreatment, attachment and health outcomes: evidence supports associations between childhood maltreatment and feeling lonely (Lin and Chiao, 2022), insecure attachment and loneliness (Benoit and DiTommaso, 2020) and loneliness and health (Richard et al., 2017). The health consequences of adverse childhood experiences (ACE) may also bring an economic burden. Bellis et al. (2019) claim that a 10 % reduction in ACE prevalence across Northern America and Europe by means of prevention programs could equate to

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https://doi.org/10.1016/j.pmedr.2025.102982
Received 29 August 2024; Received in revised form 11 January 2025; Accepted 15 January 2025
Available online 18 January 2025
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annual saving of 3 million disability-adjusted life days (approximately 8200 of disability-adjusted life years), or 105 billion USD.

There is a lot of unclarity in the definition of ACE. Kalmakis and Chandler (2014) state that this inconsistent use of the concept of ACE weakens the claim that ACE are associated with negative physical, psychiatric and developmental health outcomes. ACE are operationally defined as *childhood events, varying in severity and often chronic, occurring in a family or social environment and causing harm or distress* (WHO, 2018). Such adverse experiences include multiple types of abuse, neglect, violence between parents or caregivers; other kinds of serious household dysfunction, such as alcohol and substance abuse, and peer, community and collective violence.

A number of studies have analyzed the link between ACE and long-term negative health consequences, indicating that persons with a history of childhood adversity, especially those reporting multiple ACE (3 and more ACE), have a higher occurrence of some health problems in adulthood compared to persons with no or fewer ACE (Hughes et al., 2017; Petruccelli et al., 2019; Scully et al., 2020).

In recent decades, researchers have attempted to evaluate the prevalence of ACE and have developed questionnaires to detect them. Bernstein et al. (1994) designed the Childhood Trauma Questionnaire, initially comprising 70 items and later refined to 28 items, assessing experiences of abuse and neglect (Bernstein et al., 2003). Felitti et al. (1998) introduced a 17 item ACE questionnaire measuring 10 distinct categories across seven broader domains including various forms of abuse and household dysfunction. In 2009, the World Health Organisation initiated the development of the standardised Adverse Childhood Experiences International Questionnaire (ACE-IQ). This tool, in addition to the previous ACE instruments, has the ability to capture adversities both within and beyond the household environment, facilitating a global understanding and measurement of ACE acsross countries with varying levels of development. Since its introduction, the ACE-IQ has been utilized in research involving adults and adolescents across several continents (Pace et al., 2022). However, studies employing the ACE-IQ in European countries remain scarce, particularly among general populations. Existing research predominantly focuses on high-risk or clinical groups, highlighting the need for more data from representative, non-clinical samples to enhance understanding of the prevalence and impact of ACE within the general population.

Therefore, our aim was 1. to examine the occurrence of adverse childhood experiences in a representative sample of the adult population in Slovakia, and 2. to examine the relationship between the mental and physical health difficulties, adverse childhood experiences, attachment anxiety and avoidance, and loneliness. Our hypotheses were that a higher occurrence of ACE, attachment insecurity and loneliness would be associated with physical and mental health difficulties in adult population.

2. Methods

2.1. Research sample and method of data collection

The data were collected in April 2019 as a part of a broader project investigating psychosocial determinants of health, utilizing computer-assisted personal interviewing (Olsen and Sheets, 2008) conducted by a professional research agency. Participants were selected through stratified sampling (gender, age, education, nationality, place of residence, and region) using data from the Statistical Office of the Slovak Republic. Selected individuals were contacted and informed about the study's purpose, confidentiality, and the voluntary nature of their participation. Trained administrators conducted face-to-face interviews in participants' homes or other mutually agreed locations, ensuring informed consent while providing opportunities for participants to ask questions or withdraw from the study at any time.

The representative Slovak sample consists of 1018 participants, 48.7 % men, aged 18 to 85 years (mean age: 46.2 ± 16.6). Exclusion criteria were: individuals under 18 years of age, those unable to provide informed consent due to cognitive impairment or other limitations, and non-Slovak speaking individuals. Interviews were not conducted in institutional settings as hospitals, prisons, or nursing homes. The same sample was used in previous studies, e.g. Furstova et al. (2022), Kascakova et al. (2022), Purova et al. (2024); Švecová et al. (2021), Švecová et al. (2023).

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the Olomouc University Social Health Institute, Palacky University Olomouc (No. 2019/05).

2.2. Measures

2.2.1. Background characteristics

Age (continuous), gender (male/female), marital status (single, married, divorced, widowed, unmarried mate) and education (primary, skilled operative, high school graduated, college/university) were assessed.

2.2.2. Adverse childhood experiences

The Adverse Childhood Experiences International Questionnaire (ACE-IQ) (WHO, 2018) is designed for administration to people aged 18 years and older; it contains 31 items across the following 13 domains: emotional neglect, physical neglect, parental substance use, parental mental illness, incarcerated family member, parental separation, domestic violence, emotional abuse, physical abuse, sexual abuse, peer violence (bullying), community violence (e.g. witnessing someone being beat up) and collective violence (e.g. witnessing police violence).

The ACE-IQ can be evaluated in two ways: in binary or frequency scoring. In binary scoring, used in present study, the respondent answers "yes/no" to all questions. After adding up the scores in all subscales, a summary score from 0 to 13 is obtained. If the participant answered yes (either once, several times or frequently), the answer is considered to be yes. Frequency scoring assesses how often the event occurred (often, mostly, sometimes, rarely, never). This scoring allows differentiation between more and less severe forms of ACE experiences. The Slovak version of the ACE-IQ was developed through back-translation by two trauma experts. After pretesting on 10 diverse respondents, minor modifications were made to clarify instructions, with input from trauma, psychology, and sociology experts. The internal consistency of the scale on this sample was $\alpha = 0.78$.

2.2.3. Attachment

The Slovak shortened version of the Experiences in Close Relationships Questionnaire Revised (ECR-R) (Fraley et al., 2000) contains 14 self-assessment items that focus on measuring relational attachment in adulthood. Respondents answer questions on a Likert scale from 1 to 7, where 1 indicates strong disagreement and 7 indicates strong agreement. The statements are divided into two dimensions: anxiety and avoidance. The Slovak shortened version, the ECR-R-14, has been shown to be reliable and valid (Švecová et al., 2021). The internal consistency of the subscales on this sample was $\alpha = 0.89$ and $\alpha = 0.94$ for anxiety and avoidance, respectively.

2.2.4. Physical and mental health

The SF-8 Health survey assesses eight items commonly represented in health surveys: 1. General Health Perceptions, 2. Physical Functioning, 3. Role Physical, 4. Bodily Pain, 5. Vitality, 6. Social Functioning, 7. Mental Health and 8. Emotional Roles (Ware et al., 2000). For the purposes of this study, the score of physical health difficulties (subscales 1 to 5) and the score of mental health difficulties (subscales 6 to 8) were calculated as summary scores SF8-PH and SF8-MH. The SF-8 questionnaire was translated into Slovak following the standard IQOLA forward-backward translation methodology (Bullinger et al., 1998) and validated by Purova et al. (2024). The internal consistency of the

subscales on this sample was α = 0.92 and α = 0.85 for physical and mental health, respectively.

Long-term health complaints were measured by the item "Do you have any long-lasting disorder or disability? Please, mark all possibilities which are related to you". Respondents chose from the following list of health conditions commonly used in epidemiological studies: hypertension, cerebral insult/haemorrhage, ischemic heart disease, asthma, chronic pulmonary disease, diabetes, obesity, arthritis, back pain, gastric and duodenal ulcer, inflammatory bowel disease, cancer, dermatitis (eczema), allergy, migraine, pain of unclear origin, pelvic pain – in women, diseases of thyroid gland, depression, anxiety or no disease.

2.2.5. Loneliness

Perceived loneliness was measured by one question focusing on subjective experience. Participants rated on a Likert scale from 1 (not at all) to 7 (very much) their agreement with a sentence: "I have been feeling lonely for the last year."

2.3. Statistical analyses

To compare the ACE proportions and means between sociodemographic groups, the chi-square and *t*-tests were employed. The descriptive tables of ACE occurrence, stratified by marital status and education, are presented as Supplementary tables S1 and S2 because these sociodemographic variables have not proved to be significant predictors of physical and mental health difficulties. A comparison of age, attachment, loneliness and health according to the reported number of ACE was performed using one-way ANOVA. The post-hoc comparison between groups was performed using Bonferroni and Tukey corrections. In addition to the *p*-values, the effect size η^2 (eta squared) coefficients and Cohen's d were evaluated. For the main analysis, several nested linear models were estimated with hierarchical regression, which facilitates the comparison of models with varying levels of complexity and enables the evaluation of additional variance explained by successive blocks of independent variables. The dependent variables were scores of physical and mental health difficulties (SF8-PH, SF8-MH), while ACE, gender, age, attachment anxiety, attachment avoidance, and loneliness were treated as predictors. The predictors were divided into 3 blocks: block 1 – ACE and sociodemographic characteristics (age, gender, marital status and education); block 2 – adding attachment anxiety and attachment avoidance to block 1; block 3 – adding loneliness to block 2. Each one of the 3 blocks is presented as an individual model (Tables 4 and 5). A power analysis conducted with parameters α = 0.001 and 1-β = 0.95 indicated that the total sample size required for the regression analysis involving eight independent variables varied from $n = 121$ for a large effect size ($f^2 = 0.35$) to $n = 765$ for a small effect size ($f^2 = 0.05$). Due to a large number of statistical tests, significance level was set at $p < 0.001$. All the statistical analyses were performed using the IBM SPSS Statistics software version 21 (IBM Corp., Armonk, New York, NY, USA).

3. Results

3.1. Occurrence of adverse childhood experiences

The sociodemographic characteristics of the sample are presented in Table 1. Table 2 and Supplementary tables 1 and 2 (S1, S2) summarize the occurrence of ACE in the representative sample. The most common ACE reported were community violence (43.6 %), violent treating of a household member (38.1 %), emotional abuse (34.4 %) and emotional neglect (30.1 %). Almost a third (31.4 %) of the sample reported 4 or more ACE. To ensure comparability with prior ACE research, we calculated the "primary" ACE score based on the ten original ACE items proposed by Felitti et al. (1998), excluding bullying, community, and collective violence. With this type of scoring, 22.9 % of the sample reported 4 or more ACEs. Women reported significantly more sexual abuse than men (Cohen's d = 0.240).

Table 1
Sociodemographic characteristics of the representative sample of adults ($n = 1018$), Slovakia, year 2019.

Sociodemographic characteristic	Mean (SD) / n (%) †
Age	46.2 (16.6)
Gender	
Male	496 (48.7)
Female	522 (51.3)
Marital status	
Single	225 (22.1)
Married	553 (54.3)
Divorced	72 (7.1)
Widow/widower	78 (7.7)
Unmarried mate	90 (8.8)
Education	
Primary	137 (13.5)
Skilled operative	272 (26.7)
High school graduate	382 (37.5)
College/university	227 (22.3)

Note: † mean (SD) presented for age only.

3.2. Adverse childhood experiences, attachment, loneliness and physical and mental health

Table 3 shows means and standard deviations of age, attachment anxiety and avoidance, loneliness, and physical and mental health complaints, along with the results of the ANOVA overall group comparison and the corresponding effect sizes. Subsequent post-hoc pairwise comparisons revealed that respondents reporting two or three ACE had more physical health complaints ($p < 0.001$, Cohen's d = 0.39) compared to respondents with no ACE. Respondents with four or more ACE experienced stronger loneliness ($p < 0.001$, Cohen's d 0.59–0.72), had higher score of mental and physical health difficulties ($p < 0.001$, Cohen's d 0.41–0.70 and 0.35–0.73 for mental and physical health, respectively) and more long-term health difficulties ($p < 0.001$, Cohen's d 0.38–0.62) compared to the groups of respondents with less than four ACE. Respondents with four or more ACE had also higher attachment anxiety ($p < 0.001$, Cohen's d 0.45–0.51), compared to those with one or no ACE.

The results of nested linear regression are presented in Tables 4 and 5. The background characteristics and ACE (Model 1) explained 41.4 % of the total variance of physical health difficulties and 22.9 % of the total variance of mental health difficulties. In this model, worse physical and mental health was significantly associated with more ACE ($\beta = 0.20$, $p < 0.001$, and $\beta = 0.22$, $p < 0.001$, respectively) and age ($\beta = 0.57$, $p < 0.001$, and $\beta = 0.36$, $p < 0.001$, respectively), worse mental health was additionally associated with females ($\beta = 0.13$, $p < 0.001$). After gradually adding attachment and loneliness to the model (Models 2 and 3), the proportion of the explained variance gradually increased by 3.8 % and 11.8 % in physical and mental health difficulties, respectively. In the final models (Models 3), there were significant relationships found between physical health and age ($\beta = 0.53$, $p < 0.001$), ACE ($\beta = 0.15$, $p < 0.001$), and loneliness ($\beta = 0.17$, $p < 0.001$), and these factors explained 45.2 % of the total variance. In case of mental health, significant associations were found with age ($\beta = 0.31$, $p < 0.001$), gender ($\beta = 0.09$, $p < 0.001$), ACE ($\beta = 0.13$, $p < 0.001$), attachment anxiety ($\beta = 0.13$, $p < 0.001$), and loneliness ($\beta = 0.28$, $p < 0.001$), and these factors explained 34.7 % of the total variance.

4. Discussion

This study aimed 1) to examine the occurrence of retrospectively assessed ACE in a representative sample of the Slovak Republic and 2) to assess links between ACE, attachment insecurity, perceived loneliness,

Table 2
Occurrence of adverse childhood experiences in the representative sample of adults (n = 1018), Slovakia, year 2019.

			Total	
	Male	Female	Binary scoring	Frequency scoring
Adverse Childhood Experiences (ACE)	n (%)	n (%)	n (%)	n (%)
Subscales of ACE-IQ				
1. Physical abuse	132 (26.6)	108 (20.7)	240 (23.6)	17 (1.7)
2. Emotional abuse	176 (35.5)	174 (33.3)	350 (34.4)	31 (3.0)
3. Sexual abuse	7 (1.4)	31 (5.9) *	38 (3.7)	15 (1.5)
4. Alcohol and/or drug abuser in the household	60 (12.1)	53 (10.2)	113 (11.1)	113 (11.1)
5. Incarcerated household member	12 (2.4)	9 (1.7)	21 (2.1)	21 (2.1)
6. Someone chronically depressed, mentally ill, institutionalized, or suicidal	20 (4.0)	20 (3.8)	40 (3.9)	40 (3.9)
7. Household member treated violently	200 (40.3)	188 (36.0)	388 (38.1)	121 (11.9)
8. One or no parents, parental separation or divorce	161 (32.5)	170 (32.6)	331 (32.5)	331 (32.5)
8a Parents separated or divorced	54 (10.9)	49 (9.4)	103 (10.1)	103 (10.1)
8b Death of parent	116 (23.4)	134 (25.7)	250 (24.6)	250 (24.6)
9. Emotional neglect	164 (33.1)	151 (28.9)	315 (30.9)	93 (9.1)
10. Physical neglect	103 (20.8)	90 (17.2)	193 (19.0)	32 (3.1)
11. Bullying	70 (14.1)	67 (12.8)	137 (13.5)	9 (0.9)
12. Community violence	231 (46.6)	213 (40.8)	444 (43.6)	47 (4.6)
13. Collective violence	51 (10.3)	40 (7.7)	91 (8.9)	91 (8.9)
Total ACE				
ACE-IQ total score [mean (SD)]	2.8 (2.7)	2.5 (2.6)	2.7 (2.6)	0.9 (1.5)
No ACE	110 (22.2)	123 (23.6)	233 (22.9)	547 (53.7)
1 ACE	101 (20.4)	123 (23.6)	224 (22.0)	268 (26.3)
2 to 3 ACE	119 (24.0)	122 (23.4)	241 (23.7)	128 (12.6)
≥ 4 ACE	166 (33.5)	154 (29.5)	320 (31.4)	75 (7.4)
Primary ACE[a]				
Primary ACE-IQ total score [mean (SD)]	2.1 (2.2)	1.9 (2.0)	2.0 (2.1)	0.8 (1.3)
No ACE	157 (31.7)	162 (31.0)	319 (31.3)	570 (0.56)
1 ACE	101 (20.4)	130 (24.9)	231 (22.7)	257 (27.0)
2 to 3 ACE	114 (23.0)	121 (23.2)	235 (23.1)	122 (12.0)
≥ 4 ACE	124 (25.0)	109 (20.9)	233 (22.9)	51 (5.0)

Note: *p < 0.001 χ^2-test or t-test comparison of male and female; [a]10 primary items of ACE-IQ without bullying, community, and collective violence; ACE = adverse childhood experiences; SD = standard deviation.

and physical and mental health difficulties.

4.1. Occurrence of ACEs-IQ in the Slovak Republic

More than three-quarters of the Slovak population reported at least one ACE, consistent with global findings (Pace et al., 2022). In the present study, nearly a quarter of respondents reported one to three ACE, and almost a third reported four or more ACE. Comparable ACE data from Europe are limited. For example Tang et al. (2020) found ACE

Table 3
Descriptive statistics of age, physical and mental health difficulties scores, attachment anxiety and avoidance and loneliness; differences between groups divided according to occurrence of adverse childhood experiences in the representative sample of adults (n = 1018), Slovakia, year 2019.

Scale: Mean (SD)	No ACE (n = 233)	1 ACE (n = 224)	2 to 3 ACE (n = 241)	≥4 ACE (n = 320)	p	Effect size η^2
Age	42.8 (15.4)	44.9 (16.4)	46.8 (16.5)	49.3 (17.1)	< 0.001	0.02
ECR-R-14						
Attachment anxiety	15.1 (9.0)	14.5 (8.3)	16.4 (8.8)	19.1 (9.8)	< 0.001	0.04
Attachment avoidance	22.1 (12.8)	22.2 (14.0)	22.0 (11.9)	24.9 (11.9)	0.02	0.01
Loneliness	1.9 (1.4)	2.0 (1.5)	2.1 (1.5)	3.1 (1.9)	< 0.001	0.09
SF-8						
Physical health (SF8-PH[a])	9.1 (3.9)	9.7 (4.1)	10.7 (4.3)	12.2 (4.6)	< 0.001	0.08
Mental health (SF8-MH[a])	4.5 (2.2)	4.7 (2.1)	5.2 (2.4)	6.2 (2.5)	< 0.001	0.08
Long-term health problems	1.0 (1.4)	1.0 (1.3)	1.3 (1.4)	1.9 (1.8)	< 0.001	0.06

Note: [a] Summary scores of SF-8 subscales, a higher summary score indicates worse health; comparison performed with one-way ANOVA; SD = standard deviation; ACE = adverse childhood experiences; ECR-R-14 = Experiences in Close Relationships Questionnaire Revised; SF-8 = SF-8 Health Survey; SF8-PH = physical health difficulties; SF8-MH = mental health difficulties.

Table 4
Results of linear regression models assessing the associations of background characteristics, adverse childhood experiences, attachment anxiety and avoidance, and loneliness with physical health difficulties in the representative sample of adults (n = 1018), Slovakia, year 2019.

	Model 1		Model 2		Model 3	
Independent variable	Beta	SE	Beta	SE	Beta	SE
ACE	0.20*	0.04	0.17*	0.04	0.15*	0.04
Gender (female vs male)	0.08	0.22	0.07	0.21	0.05	0.21
Age (years)	0.57*	0.01	0.56*	0.01	0.53*	0.01
Marital status	0.03	0.10	0.03	0.10	0.02	0.09
Education	−0.07	0.11	−0.06	0.11	−0.05	0.11
Attachment anxiety			0.07	0.01	0.02	0.01
Attachment avoidance			0.13*	0.01	0.07	0.01
Loneliness					0.17*	0.08
R^2	41.4		43.5		45.2	

Note: All beta coefficients are standardised; * p < 0.001; SE = standard error; ACE = adverse childhood experiences.

Table 5
Results of linear regression models assessing the associations of background characteristics, adverse childhood experiences, attachment anxiety and avoidance, and loneliness with mental health difficulties in the representative sample of adults (n = 1018), Slovakia, year 2019.

	Model 1		Model 2		Model 3	
Independent variable	Beta	SE	Beta	SE	Beta	SE
ACE	0.22*	0.03	0.16*	0.03	0.13*	0.03
Gender (female vs male)	0.13*	0.14	0.11*	0.13	0.09*	0.13
Age (years)	0.36*	0.00	0.36*	0.00	0.31*	0.00
Marital status	0.04	0.06	0.05	0.06	0.03	0.06
Education	−0.06	0.07	−0.05	0.07	−0.04	0.07
Attachment anxiety			0.21*	0.01	0.13*	0.01
Attachment avoidance			0.16*	0.01	0.06	0.01
Loneliness					0.28*	0.05
R^2	22.9		30.1		34.7	

Note: All beta coefficients are standardised; * p < 0.001; SE = standard error; ACE = adverse childhood experiences.

prevalence among 17-year-olds in the United Kingdom to be 25.9 % for one ACE, 32.7 % for two or three, and 19.4 % for four and more (excluding community and collective violence). Simmilarly, a German study (Wiehn et al., 2018) reported 22.9 % for one ACE, 24.7 % for two or three and 24.6 % for four or more (excluding collective violence). Variations in ACE definitions and questionnaires complicate cross-country comparisons.

The most common ACE in Slovakia was community violence (43.6 %). Globally, its prevalence is 34.5 % in adults and 67.5 % in adolescents until the age of 18 (Pace et al., 2022). Community violence has been identified as a distinct ACE class, and is significantly associated with post-traumatic stress disorder (PTSD) in young adulthood (Lee et al., 2020). Violent treatment of a household member was reported by 38.1 % of respondents, similar to 34 % in a German student sample (Wiehn et al., 2018). Witnessing family or community violence can be traumatizing and lead to a PTSD or a complex PTSD (Herman, 1995).

In the present study, over a third of respondents reported emotional abuse, similar to the overall world rate of 30.1 % (Pace et al., 2022). Although present study did not analyze the impact of specific types of maltreatment on health; however, prior research on the same Slovak cohort found emotional abuse to be associated with all of the studied long-term health problems and overall had the strongest associations with deteriorated health (Kascakova et al., 2022). Emotional neglect was reported by 30.1 % of respondents, similar to the 29.30 % global average (Pace et al., 2022). Despite being historically overlooked (Stoltenborgh et al., 2013), emotional neglect has shown detrimental effects on development, including neurobiological consequences (Teicher et al., 2004).

4.2. Sociodemographic factors

In all the models, female gender (compared to male) was more strongly associated with mental health problems. Consistent across Europe, internalising mental disorders, such as anxiety and depression, is more common among women (Boyd et al., 2015).

4.3. Relationship between ACE and mental and physical health

ACE were significantly associated with both physical and mental health, even after adjusting for other variables. Individuals with four or more ACE had significantly more health difficulties. In a German study, ACE co-occurrence negatively affected health in adolescents and young adults (Cohrdes and Mauz, 2020). A systematic review of 96 mostly retrospective studies found that psychosocial and behavioural outcomes had higher odds ratio than medical outcomes with increasing ACE scores (Petruccelli et al., 2019).

4.4. ACE, attachment insecurity, perceived loneliness and health

The present study found that individuals with four or more ACE had higher attachment anxiety and greater feelings of loneliness, consistent with a study of Thomson and Jaque (2017) and Lin and Chiao (2022). People with insecure attachment based on their relationships history with primary caregivers can perceive the world as not safe enough, and it can be difficult to accept support from others in times of need; therefore, they can often feel lonely (Benoit and DiTommaso, 2020).

Attachment anxiety and avoidance were significantly associated with mental health in model without loneliness, with a stronger effect of anxiety. However, only attachment anxiety remained significant after adding loneliness into the model. A meta-analysis of 224 studies showed that overall, attachment anxiety had larger associations with mental health than did attachment avoidance (Zhang et al., 2022).

In the present study, attachment avoidance was linked to physical health, though this relationship weakend when loneliness was added into the model. Loneliness has been previously studied in older populations as a correlate of a functional decline and death (Perissinotto et al., 2012). At present, loneliness is acknowledged as an arising problem among the younger and middle-aged populations as well, and it has been associated not only with mental but also with physical health problems (Richard et al., 2017). Loneliness mediates the relationship between childhood maltreatment and psychiatric diagnoses (Shevlin et al., 2015), highlighting the need for targeted interventions to address transient or chronic loneliness (Eccles and Qualter, 2021). The clinical importance of loneliness as a mediator highlights the potential of therapeutic interventions that address perceived loneliness and focus on traumatic memories that may perpetuate health problems.

From the perspective of clinical psychiatric and psychotherapeutic practice, as well as for planning social interventions and prevention, the ACE tool and the loneliness question provide valuable information. These aspects are recognised in the Diagnostic and Statistical Manual of mental diseases, DSM5, in the chapter “Other conditions that may be a focus of clinical attention” (APA, 2022) and in an International Classification of Diseases – ICD-10 as *Z*-codes – “related factors” (WHO, 2019).

4.5. Strength and limitations

The strength of this study is that it is based on a representative national sample.

Potential limitation of this study is its cross-sectional design. While neurodevelopmental processes and prior research (e.g., Bellis et al., 2023) suggest links between ACE and negative health outcomes, cross-sectional data cannot establish causality due to potential confounders and the lack of temporal sequencing. Therefore, the findings should be interpreted with caution. Another limitation could be that data about ACE are retrospectively recalled and thus potentially biased. Studies show a tendency to underreport ACE when asked about them retrospectively (Hardt and Rutter, 2004) and even confidentially compared to anonymously (Marcus et al., 2009). We did not have access to participants’ health records; therefore, information regarding mental and physical health difficulties relied on their subjective reports. Self-reported checklists of health conditions are widely used in national studies, and provide a valid option for research (Baumeister et al., 2010). Another limitation is the use of a single-item measure for loneliness, which may lack the depth and reliability of multi-item scales. While our aim was to efficiently capture subjective perceived loneliness, this may limit the generalizability of our findings.This study did not assess the potential effects of individual types of ACE. Negriff (2020) found that childhood maltreatment had a stronger effect than household dysfunction in a common model for mental health symptoms, and she warned healthcare providers not to use only the total ACE score in clinical decision-making.

5. Conclusions and implications

In the present study, ACE and loneliness were associated with physical health difficulties. ACE, attachment anxiety and loneliness were linked to mental health difficulties. Our results highlight the need for universal prevention programs targeting ACE in the general population, particularly child maltreatment (abuse and neglect). Early interventions in family and community settings could reduce the incidence of ACE and their long-term impact on health. In clinical practice, screening for ACE and assessing attachment insecurity and loneliness should be integrated into menatl health assessment. When mental health consequences of ACE arise, therapeutic intervention should focus on addressing trauma histories, improving attachment security and mitigating feelings of loneliness to enhance treament outcomes.

Future research should use longitudinal designs to clarify causal links between ACE, attachment, loneliness, and health. Examining the impact of specific types of ACE and protective factors (e.g.resilience, social support) can further enhance findings. Evaluating the effectiveness of trauma-informed, attachment-based, and loneliness-reduction interventions can help optimize treatment strategies.

Funding

The work was supported by the ERDF/ESF project DigiWELL (No. CZ.02.01.01/00/22_008/0004583).

CRediT authorship contribution statement

Natalia Kascakova: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Jana Furstova:** Writing – review & editing, Visualization, Software, Methodology, Formal analysis. **Jozef Hasto:** Writing – review & editing, Supervision, Conceptualization. **Peter Tavel:** Writing – review & editing, Supervision, Project administration, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We thank the company Focus for the data collection and for all the support.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2025.102982.

Data availability

The datasets generated and analyzed during the current study are not publicly available due to Slovak legislation but are available from the corresponding author on reasonable request.

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