



# Associations of adverse and positive childhood experiences with adult physical and mental health and risk behaviours in Slovenia

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## ABSTRACT

**Background:** Many studies demonstrated the relationship between adverse childhood experiences (ACEs) and diminished health functioning in adulthood. A growing literature has shown that positive childhood experiences (PCEs) co-occurring with ACEs reduce the risks for negative outcomes.

**Objective:** The aim was to investigate how ACEs and PCEs are simultaneously associated with health outcomes in adulthood, including self-rated health, physical and mental health outcomes, and health-risk behaviours.

**Methods:** A panel sample of 4,847 Slovenian adults was used and the data were weighted to closely resemble the Slovenian population. A series of logistic regression analyses were performed to examine how ACEs and PCEs predict the risk of various health outcomes.

**Results:** Significant associations, as measured by adjusted odds ratios, were found between higher ACEs exposure and each of the 16 health outcomes evaluated. Adjusting for above median PCEs attenuated the association between ACEs and 6 health outcomes (poor self-rated physical and mental health, depression, anxiety, suicide attempt, physical inactivity; OR for  $\geq 4$  vs. 0 ACEs, 1.48–9.34). Mirroring these findings, above median PCEs were associated with lowered odds of these 6 health outcomes after adjusting for ACEs (OR for above vs. below median PCEs, 0.46–0.67), but not with odds of physical health outcomes and most of the health-risk behaviours. Stratified analyses by ACEs exposure level showed that the association between PCEs and self-rated health remained stable across ACEs exposure levels, while the association between PCEs and mental health outcomes and physical inactivity varied across ACEs exposure levels.

**Conclusions:** Our results suggest that above median PCEs attenuate the association between ACEs and poor self-rated health, mental health problems, and physical inactivity in later life, and are negatively associated with these health problems even in the concurrent presence of ACEs. Interventions to promote PCEs can help to reduce unfavourable long-term health outcomes following childhood adversity.

## Asociación de experiencias infantiles adversas y positivas con la salud física y mental, y las conductas de riesgo de los adultos en Eslovenia

**Antecedentes:** Muchos estudios demostraron la relación entre las experiencias adversas en la infancia (ACE) y una disminución en el funcionamiento de la salud en la edad adulta. Una creciente literatura ha demostrado que las experiencias infantiles positivas (PCE) que concurren con ACE reducen los riesgos de resultados negativos.

**Objetivo:** El objetivo era investigar cómo las ACE y PCE se asocian simultáneamente con los resultados de salud en la edad adulta, incluida la salud autoevaluada, las condiciones de salud física y mental y las conductas de riesgo para la salud.

**Métodos:** Se utilizó una muestra de panel de 4.847 adultos eslovenos y los datos se ponderaron para asimilarlos a la población eslovena. Se realizó una serie de análisis de regresión logística para examinar cómo los ACE y PCE predicen el riesgo de varios resultados de salud.

**Resultados:** Se encontraron asociaciones significativas, medidas por razones de probabilidades ajustadas, entre una mayor exposición a ACE y cada uno de los 16 problemas de salud evaluados. El ajuste de los PCE por encima de la mediana atenuó la asociación entre los ACE y 6 problemas de salud (mala salud física y mental autoevaluada, depresión, ansiedad, intento de suicidio, inactividad física; OR para  $\geq 4$  frente a 0 ACE, 1,48-9,34). Reflejando estos hallazgos, los PCE por encima de la mediana se asociaron con probabilidades más bajas de estos 6 problemas de salud después de ajustar por ACE (OR para PCE por encima o por debajo de la mediana, 0,46-0,67), pero no con mayores probabilidades de problemas de salud física y la mayoría de las conductas de riesgo para la salud. Los análisis estratificados por nivel de exposición a las ACE mostraron que la asociación entre los PCE y la salud autoevaluada se mantuvo estable en los niveles de exposición a los ACE, mientras que la asociación entre los PCE y los resultados de salud mental y la inactividad física varió entre los niveles de exposición de los ACE.

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## 关键词

童年期不良经历; 童年期积极经历; 身体健康; 心理健康; 健康风险行为

## HIGHLIGHTS

- ACEs were associated with various health problems evaluated in this study.
- After controlling for ACEs, PCEs were associated with self-rated physical and mental health, depression, anxiety, suicidal attempt, and physical inactivity.
- Interventions that address PCEs should be promoted.

**Conclusiones:** Nuestros resultados sugieren que los PCE por encima de la mediana atenúan la asociación entre los ACE y una pobre autoevaluación de la salud, los problemas de salud mental y la inactividad física en la edad adulta, y se asocian negativamente con estos problemas de salud incluso en la presencia concurrente de ACE. Las intervenciones para promover los PCE pueden ayudar a reducir los resultados de salud desfavorables a largo plazo luego de adversidades en la infancia.

### 斯洛文尼亚中童年期不良和积极经历与成人身心健康和风险行为的关系

**背景:** 许多研究表明了童年期不良经历 (ACE) 与成年后健康功能下降之间的关系。越来越多的文献表明, 与ACE一起发生的童年期积极经历 (PCE) 减少了负面结果的风险。

**目的:** 旨在研究ACE和PCE如何同时与成人包括自评健康, 身心健康状况以及健康风险行为的健康结果关联。

**方法:** 使用4,847名斯洛文尼亚成年人的面板样本, 对数据进行加权以使其与斯洛文尼亚人口近似。进行了一系列逻辑回归分析, 以考查ACE和PCE如何预测各种健康结果的风险。

**结果:** 发现较高的ACE暴露与评估的16种健康问题中的每一种之间都存在由调整优势比衡量的显著相关。控制PCE高于中位数可以减弱ACE与6种健康问题 (较差的自评身心健康, 抑郁, 焦虑, 自杀尝试, 缺乏身体活动;  $OR \geq 4$  vs. 0 ACE, 1.48-9.34) 之间的关联。反向操作这些发现, 在控制ACE后, PCE高于中位数与这6个健康问题的更低几率有相关 (PCE高于中位数 vs PCE低于中位数,  $OR$  为0.46-0.67), 但与身体健康状况和大多数健康风险行为的几率无关。ACE暴露水平的分层分析表明, PCE与自评健康之间的关联跨ACE暴露水平保持稳定, 而PCE与心理健康结果和缺乏身体活动之间的关联跨ACE暴露水平有所不同。

**结论:** 我们的结果表明, PCE高于中位数会减弱ACE与较差的自评健康状况, 心理健康问题以及之后生活中缺乏身体活动之间的关联, 并且即使在同时存在ACE的情况下, 也与这些健康问题有负相关。提高PCE的干预措施有助于减少童年期逆境后不良的长期健康结果。

## 1. Introduction

More than two decades have passed since the original study on adverse childhood experiences (ACEs), which showed a strong link between multiple exposure to childhood abuse and household dysfunction (before the age of 18) and chronic illness, mental health problems, and health-risk behaviours in adulthood (Felitti et al., 1998). Further studies (e.g. the meta-analysis by Hughes et al., 2017) have consistently shown that ACEs, including neglect in childhood, place individuals, especially those with 4 or more ACEs, at an increased risk of a variety of negative health outcomes, with a particularly strong association between ACEs and adult mental health problems and unhealthy behaviours.

However, individuals are differentially impacted by ACEs. There is an emerging research evidence on how a number of positive experiences in childhood, might offer protection from the harmful impact of ACEs in childhood or later in life (Bethell, Jones, Gombojav, Linkenbach, & Sege, 2019; Crandall et al., 2019; Karatzias et al., 2020). According to the ecological-transactional perspective of child maltreatment, protective factors can exist at multiple levels (with reciprocal influences): at the individual level (e.g. presence of inner security related to a sense of self-efficacy), the family level (safe and supportive relationships with caregivers), and the community level (positive relationships with friends, teachers, community support etc.) (Cicchetti & Toth, 2016; Masten & Cicchetti, 2016). Such experiences can generate a resilient functioning in terms of positive

adjustment and healthy functioning across emotional, cognitive, behavioural and/or social domains even despite significant childhood adversity, thus contributing positively to human development, lifelong health and functioning (e.g. Afifi & MacMillan, 2011; Gartland et al., 2019). These experiences have been theoretically and empirically conceptualized and/or labelled differently, e.g. positive childhood experiences (Bethell et al., 2019), counter-ACEs (Crandall et al., 2019), and benevolent childhood experiences (Narayan, Rivera, Bernstein, Harris, & Lieberman, 2018). In this article we use the term positive childhood experiences (PCEs) and examine how these experiences reduce the risks of long-term health consequences often associated with ACEs.

### 1.1. Health outcomes of adverse and positive childhood experiences

In general, health outcomes of childhood adversities can be divided into four broad categories: physical health conditions, mental health conditions, health-risk behaviours, and self-rated health, with existing studies either focusing on selected outcomes from a particular category or including examples from all categories (e.g. Clemens et al., 2018; Felitti et al., 1998; Hughes et al., 2017; Petruccioli, Davis, & Berman, 2019). There is a wealth of research results on health-harming role of ACEs across these outcome categories. However, there is less research investigating the interactive role of ACEs and PCEs in predicting various health outcomes.

Bellis et al. (2018) showed that childhood community assets (e.g. trusted adult, supportive friends, and opportunities to use one's own abilities) mitigated the association between ACEs and retrospectively reported health conditions in childhood (asthma, headaches, digestive conditions, and allergies). While to our knowledge the question of how PCEs can mitigate the negative association between ACEs and physical health in adulthood has not yet been thoroughly addressed in previous research, more is known about the role of PCEs in adult mental health problems. For example, in a sample of low-income pregnant women, Narayan et al. (2018) demonstrated that higher levels of PCEs predicted lower posttraumatic stress disorder symptoms and fewer stressful life events during pregnancy, after accounting for ACEs. In a large representative Wisconsin sample, Bethell et al. (2019) found a protective role of PCEs for depression and/or poor mental health in adults at all levels of ACEs exposure except of 0 ACE. In a sample of Amazon MTurk users, Crandall et al. (2019) also found that PCEs predicted less depression and stress in adults, even after accounting for ACEs. The association between PCEs and these two mental health outcomes was attenuated for participants with  $\geq 4$  ACEs compared to those with  $< 4$  ACEs, but remained significant. A similarly favourable role for mental well-being has been shown for the always available and trusted support of an adult in childhood as a moderator of ACEs harms (Bellis et al., 2017). Karatzias et al. (2020) demonstrated that, while controlling for ACEs, PCEs lower the symptoms of disturbances in self-organization (a component of complex PTSD) in trauma patients, but not PTSD symptoms.

Studies have also shown that the interaction between ACEs and PCEs plays an important role in predicting health-risk behaviours in adulthood. Bellis et al. (2017) found that support from a trusted adult in childhood mitigated the association between ACEs and harmful behaviours in adulthood, including unhealthy diet, smoking, and alcohol consumption. In addition, Crandall et al. (2019) found that PCEs predicted daily fruit and vegetable consumption and fewer sleep problems in adults after accounting for ACEs. However, in stratified analyses, these associations were only significant for individuals exposed to  $< 4$  ACEs (as was the association with vigorous physical activity) and not for those exposed to  $\geq 4$  ACEs. Finally, Crouch, Radcliff, Strompolis, and Srivastav (2019), who focused on self-rated health, showed that safe, stable, and nurturing relationship with at least one adult attenuates the relationship between ACEs and self-reported physical health and mental distress in adulthood.

## 1.2. The current study

The mitigating role of PCEs on selected health problems in the context of ACEs is a newer area of research globally. A better understanding of the

relationships between ACEs, PCEs, and different health outcomes at population level is needed to develop more targeted identification, prevention and intervention policies, and programmes that can reduce the long-term harmful impacts of childhood adversities on various aspects of adult functioning and health (Bethell et al., 2017; Karatzias et al., 2020; Metzler, Merrick, Klevens, Ports, & Ford, 2017).

In this study we build off the study by Crandall et al. (2019) which examined how PCEs and ACEs jointly predict adult mental health and health behaviours, and off the study by Bethell et al. (2019) which examined whether PCEs predict adult depression and/or poor mental health and adult-reported social and emotional support in the presence of ACEs. In our study, we investigate how PCEs and ACEs concurrently predict a wide range of health outcomes in adults, similar to those from the first published ACE study which focused on 'the many of the leading causes of death in adults' (Felitti et al., 1998, p. 245): selected physical diseases, mental health conditions, health-risk behaviours, and self-rated health. In the present study, however, some of the health outcomes were considered more broadly (e.g. chronic respiratory diseases instead of chronic bronchitis or/and emphysema) or in more detail (e.g. harmful alcohol consumption was determined on the basis of the alcohol units consumed) compared to the study by Felitti et al. (1998). In addition, anxiety was included among mental health outcomes (as the second most frequently reported mental disorder after depression in our study), and chronic neck or back pain and chronic headaches/migraines were added to physical health outcomes (as existing research underlines the link between childhood trauma and chronic pain conditions; Davis, Luecken, & Zautra, 2005).

While in Felitti et al.'s (1998) study participants provided a general rating of their health, in our study, participants self-rated their mental and physical health separately (e.g. Levinson & Kaplan, 2016; McAlpine, McCreedy, & Alang, 2018). Collecting data on self-rated health, in addition to data on medical diagnoses, is important against the background of previous findings that show modest correlations between objective indicators of illness and subjectively rated health (Bailis, Segall, & Chipperfield, 2003; Singh-Manoux et al., 2006) and the incremental predictive value of self-rated health beyond objective measures of health function (Jylhä, 2009; Levinson & Kaplan, 2016; McAlpine et al., 2018).

The study uses a large and heterogeneous sample of Slovene adults with similar demographic characteristics to the general population – compared to existing ACE studies from other European countries, this is the largest sample covering such a diverse population (comp. Nagy, Szabó, Hann, & Kósa, 2019). It offers an insight into a country where ACEs have not been studied so

far. Results similar to those in other Western European countries were expected (e.g. Häuser, Schmutzer, Brahler, & Glaesmer, 2011; Hughes, Lowey, Quigg, & Bellis, 2016). Although a former Yugoslav republic, Slovenia used to be the 'westernmost' country of the Eastern European, communist bloc, gaining independence in 1991 and joining EU in 2004. In terms of family and child rearing trends, Slovenia is considered to be more modernized than the Eastern and Southern Europe (e.g. Švab, Renner, & Kuhar, 2011). At the same time, Slovenia is characterized by particularly strong informal support networks of care (e.g. for children and the elderly) compared to European older and newer members (Kuhar, 2011).

Consistent with previous research, we expected that exposure to multiple ACEs (i.e. 1, 2–3,  $\geq 4$ ) would predict negative health outcomes in adulthood, including physical and mental health outcomes, health-risk behaviours, and self-rated health. On the other hand, we expected that high (i.e. above median) PCEs would predict better health outcomes in these areas. Furthermore, we examined whether controlling for below vs. above median PCEs would mitigate the association between ACEs exposure and negative health outcomes and whether the association between PCEs and better health outcomes would remain significant after controlling for ACEs exposure. Finally, we examined the stability of the association between below vs. above median PCEs and health outcomes across ACEs exposure levels.

## 2. Methods

### 2.1. Participants and procedure

The data for this study were collected as part of the research project *Adverse childhood experiences and consequences in adulthood*, conducted by the University of Ljubljana, Faculty of Social Sciences, and the National Institute of Public Health of the Republic of Slovenia. The survey was conducted by an outsourced survey agency. Non-probability quota sampling was used to recruit participants from the agency's online survey panel with demographic characteristics similar to those of the general population. The panel is comprised of individuals who provided informed consent to participate in online surveys and receive some form of small compensation for their participation. Data was collected online between February and April 2019. 5,397 panellists fully completed the survey, which amounts to a response rate of 9.7% (the low response rate was to be expected given the average length of the survey – 27 minutes – and the sensitive subject matter of the questions). After validity checks were performed including both technical criteria (speedsters and technically inappropriate surveys were identified) and content criteria (e.g. inconsistent answers on questions including a time component), 457

surveys were excluded, resulting in a sample of 4,940 participants aged between 18 and 75. Data were weighted using an iterative proportional fitting that aligns survey respondents with population benchmarks, with demographic benchmarks (gender, age, education, and statistical regions) obtained from SiStat Data Portal (SURS, 2018). However, due to missing values on all items from the Resilience Questionnaire, 93 participants were excluded from the analyses for the present study, yielding a final sample of 4,847 participants. The mean age of the participants and the breakdown by gender and education are shown in Table 1. The study was approved by the National Medical Ethics Committee, Ministry of Health (approval number 0120–236/2019/4).

### 2.2. Measurement instruments

The survey for this study included items measuring ACEs, PCEs, physical and mental health outcomes, health-risk behaviours, and other constructs not included in this study. The questionnaires for measuring ACEs and PCEs were translated into Slovenian by the authors. The cultural adaptation was carried out

**Table 1.** Demographic characteristics, descriptive statistics for ACEs and PCEs, and prevalences of health outcomes for the total sample.

	Total sample	
	UnW No.	W %/M (SD)
Age		
Mean	4847	46.5 (15.2)
Gender		
Male	2340	51.3
Female	2507	48.7
Education		
Less than high school	1042	43.5
High school	1878	31.3
Post-secondary and graduate	1927	25.3
Adverse childhood experiences (ACEs)		
Mean	4847	2.3 (2.2)
0 ACEs	1172	24.0
1 ACE	1031	20.6
2–3 ACEs	1397	28.5
$\geq 4$ ACEs	1247	26.9
Positive childhood experiences (PCEs)		
Mean	4847	8.9 (3.4)
PCEs < <i>Mdn</i>	2161	47.3
PCEs $\geq$ <i>Mdn</i>	2686	52.7
Poor self-rated physical health	1498	34.1
Poor self-rated mental health	1135	24.3
Physical health outcomes		
Cardiovascular diseases	999	23.2
Respiratory system diseases	725	15.9
Digestive system diseases	733	16.3
Cancer	221	4.8
Neck or back pain	1193	26.2
Chronic headache, migraine	373	7.3
Mental health outcomes		
Depression	545	12.3
Anxiety	481	9.8
Suicide attempt	339	7.5
Health-risk behaviours		
Smoking	2043	46.1
Harmful alcohol use	205	4.2
Drug use	409	8.5
Physical inactivity	701	15.5
Obesity	728	15.2

UnW = unweighted, W = weighted.



through a review conducted by four other experts and through cognitive testing of the whole survey with 12 representatives of the population studied (according to age, gender, and the level of education). Cognitive testing was conducted in paper-pencil form and participants were asked to write down and point out any difficulties they had in understanding or answering the questions, as well as suggestions for changes. Based on participant feedback, we changed the order of some questionnaires in the survey and rephrased some items.

### 2.2.1. Adverse childhood experiences

We measured ten categories of ACEs. Five categories referred to child abuse and neglect (i.e. emotional abuse and neglect, physical abuse and neglect, sexual abuse) and five to household dysfunctions (i.e. domestic violence among adult household members, their substance abuse, mental illness, incarceration, and parental separation/child abandonment/parental death). Each ACE category was measured using 1–5 items. Items for individual categories were designed on the basis of the original ACE study (Dube, Anda, Felitti, Croft, & Giles, 2001; Felitti et al., 1998), CDC's The Behavioural Risk Factor Surveillance System, and the WHO's Adverse Childhood Experiences International Questionnaire (Table S1 in Supplementary Materials). The abuse and neglect items required responses on a frequency scale (never, once, sometimes, often, very often). The answers to the household dysfunction items were yes and no. If a participant indicated that at least one of the items for an individual ACE had been present (answer 'yes' on household dysfunction items) or that he or she had experienced the adverse situation at least a few times (answers 'sometimes', 'often', or 'very often' on physical and emotional abuse and neglect items) by the time he or she was 18, a point was earned for that ACE. In the case of sexual abuse, a point was given also for the answer 'once' at any of the corresponding items. Ten categories of child maltreatment and adverse household characteristics have been summed into an index of ACEs exposure (i.e. ACEs score), which can range from 0 to 10 ACEs. Cronbach's alpha for the ACEs score was 0.75.

### 2.2.2. Positive childhood experiences

The 14-item Resilience Questionnaire (RQ) (Rains & McClinn, 2013) was used to measure PCEs. Although RQ was primarily developed for parenting education, it has also been used in research (see Hiles Howard et al., 2015; Sciola, Wilkes, & Griffin, 2019). The items contain protective factors that research has consistently shown to contribute to resilient functioning despite of or in the aftermath of adversity (Masten & Cicchetti, 2016), i.e. positive experiences in the context of family and community, including love, caring, social and instrumental support (e.g. When I felt really bad, I could almost always

find someone I trusted, to talk to.), and on a sense of inner security (e.g. I was independent and a go-getter.) The participants have to rate each of the 14 statements on a five-point scale (from 1 – definitely not true to 5 – definitely true). Item 9 (My family, neighbours and friends talked often about making our lives better.) was omitted due to a very low factor loading in the present study. All items rated 4 or higher were identified as PCE. The PCEs were combined into an index of PCEs exposure (i.e. PCEs score), with values ranging from 0 to 13. Psychometric characteristics of the RQ have not been reported before. In the present study, principal component analysis yielded a single-component structure of data. Alpha reliability coefficient in our sample was 0.83.

### 2.2.3. Physical health outcomes

Participants indicated on a dichotomous answer scale (yes/no) whether they had ever been diagnosed with the following chronic illnesses in their lives: cardiovascular diseases (high blood pressure, heart diseases, stroke), respiratory system diseases (chronic bronchitis, chronic obstructive pulmonary disease, emphysema, asthma), digestive system diseases (diseases of the liver, stomach, intestines), cancer, chronic neck or back pain, and chronic headache or migraine. Participants subjectively rated their physical health on a 5-point scale (from 1 – very poor to 5 – very good). In line with the literature recommendations (Finnäs, Nyqvist, & Saarela, 2008), this variable was dichotomized with values from 1 to 3 indicating poor self-rated health and values 4 and 5 indicating good self-rated health.

### 2.2.4. Mental health outcomes

Participants also indicated on a dichotomous answer scale (yes/no) whether they were diagnosed by a psychiatrist or physician at any time in their lives with a depression and anxiety disorder and whether they had ever tried to commit suicide in their lives. They also provided a subjective rating of their mental health on a 5-point scale (from 1 – very poor to 5 – very good); the answers were dichotomized for further analyses (values 1–3 vs. 4–5; see Finnäs et al., 2008).

### 2.2.5. Health-risk behaviours

Participants were classified as smokers if they currently smoked or had smoked daily at any time in their lives, whereby smoking included cigarettes, cigars, water pipes etc. Harmful alcohol use was measured in accordance with the guidelines of the Slovenian National Institute of Public Health (2014) as a consumption of at least 15 alcohol units per week for men and 7 for women. One unit of alcohol contains 10 grams of pure alcohol, which is equal to one decilitre of wine or one spike of spirits (0.3 dl) or half a bottle of beer (2.5 dl) or 2.5 decilitre of must. Participants chose one of the multiple answers about the number of alcohol units they consume weekly. The use of illicit drugs was

indicated for participants who answered that they now use or have used any illicit drug (e.g. heroin, cocaine, marijuana) more than one or few times. Physical inactivity was indicated for participants who reported engaging in physical activity for at least 30 minutes per day on 0 days per week. An indicator of obesity was a physician-diagnosed of obesity at any time in one's life.

### 2.2.6. Controls

Age (continuous by year), gender and education (less than high school, high school, post-secondary and graduate education)<sup>1</sup> were used as controls in logistic regression analyses.

### 2.3. Data analyses

First, demographic characteristics and prevalences of all health outcomes were examined for the entire sample. The mean ACEs and PCEs scores were computed. In line with previous research (e.g. Bellis et al., 2017; Bethell et al., 2019), the ACEs score was combined into score groups indicating four ACEs exposure levels (0, 1, 2–3, and  $\geq 4$  ACEs), and was treated as an ordinal variable. Similarly, PCEs score was divided into two score groups based on a median split ( $< 10$  vs.  $\geq 10$ ; e.g. Beutel et al., 2017; Crandall et al., 2019; Young-Wolff et al., 2019). Aggregated scores simplify reporting of results and increase power to detect statistical significance (see also Bethell et al., 2019). Chi-square tests were used to compare gender and education categories by ACEs exposure levels and below vs. above median PCEs. The mean age of participants was compared between ACEs exposure levels using a one-way ANOVA, and between below vs. above median PCEs it was compared using an independent samples t-test.

Prevalences of poor self-rated health, physical health outcomes, mental health outcomes, and health-risk behaviours were examined by ACE exposure levels and below vs. above median PCEs. Cochran-Armitage test for trend was used to evaluate the strength of the associations between various health outcomes and ACEs exposure levels, and chi-square test was employed to estimate the association between health outcomes and below vs. above median PCEs. Logistic regression analyses were conducted to examine how ACEs exposure levels increase the risk for various health outcomes (0 ACEs acted as a reference category). All regression models were adjusted for gender, age, and educational attainment. To examine a potential attenuation effect of PCEs, the models were additionally controlled for below vs. above median PCEs. The likelihood-ratio tests were used to determine whether the model deviance significantly decreased after including PCEs as an additional covariate. Similarly, adjusted logistic regression models were constructed to investigate how above median

PCEs decrease the risk for various health outcomes (below median PCEs were a reference category).

For negative health outcomes that were independently predicted by PCEs, chi-square analyses and logistic regression analyses stratified by the four ACEs exposure levels were conducted to examine the stability of their association with below vs. above median PCEs across ACEs exposure levels, controlling for gender, age, and educational attainment.

## 3. Results

### 3.1. Demographic characteristics, descriptive statistics, and prevalences of health outcomes

The distribution of the ACEs score was positively skewed (skew = 0.87,  $SE_{skew} = 0.04$ ; kurt =  $-0.03$ ,  $SE_{kurt} = 0.07$ ; Figure S1 in Supplementary Materials). On average, participants reported having experienced 2.3 out of 10 ACEs measured; 24.0% of participants experienced 0 ACEs and 26.9% reported having had  $\geq 4$  ACEs (Table 1). Conversely, the distribution of the PCEs score was negatively skewed (skew =  $-0.78$ ,  $SE_{skew} = 0.04$ ; kurt =  $-0.26$ ,  $SE_{kurt} = 0.07$ ; Figure S2 in Supplementary Materials). The average number of PCEs reported was 8.9 out of 13 and the median PCEs score was 10, with 47.3% of participants being classified as having below median PCEs and 52.7% as having above median PCEs on the basis of this score. The percentage of participants who rated their physical and mental health as poor was 34.1% and 24.3%, respectively. Prevalences of different physical health outcomes varied between 4.8% for cancer and 26.2% for neck or back pain. Among mental health outcomes the most prevalent was depression reported by 12.3% of participants. With 46.1% smoking was the most frequently reported unhealthy behaviour.

### 3.2. ACEs and PCEs by demographic characteristics

The association between age and ACEs exposure level subgroups was significant with Scheffe's post-hoc test showing that participants exposed to  $\geq 4$  ACEs were older compared to participants who experienced 2–3 ACEs (Table S2 in Supplementary Materials). Also, gender and education level were significantly related to ACEs exposure level, with  $\geq 4$  ACEs more common among women and less educated participants compared to men and participants who attained some post-secondary or graduate education. Participants who reported being exposed to below median PCEs were older compared to those exposed to above median PCEs. Above median PCEs were more frequent among men compared to women and among more educated compared to less educated participants.

### 3.3. Relationship between ACEs and PCEs

The prevalence of adults with different ACEs exposure levels differed significantly by below vs. above median PCEs ( $\chi^2(3) = 955.757, p < .001$ ). Participants with below median PCEs reported having had  $\geq 4$  ACEs much more frequently (80.6%) compared to participants with above median PCEs (19.4%). Conversely, participants with above median PCEs reported having experienced 0 (76.3%) and 1 ACE (70.1%) more often compared to participants with below median PCEs (23.7% and 29.9%, respectively) (Table S3 in Supplementary Materials).

### 3.4. Relationship of health outcomes to ACEs and PCEs

Chi-square analyses revealed that participants with higher ACEs exposure level rated their health worse and reported various mental and physical health conditions (but cancer), and unhealthy behaviours more frequently compared to participants with lower ACEs exposure level (Table S4 in Supplementary Materials). On the other hand, poor self-rated mental and physical health and all physical and mental health conditions and unhealthy behaviours, with the exception of cancer and harmful alcohol use, were less frequently reported among participants with above median PCEs. When interpreting the significance of statistical tests, the sample size within each health problem should be taken into account because larger sample sizes require smaller differences between groups to achieve significance, so in some cases even practically negligible differences are significant (compare, for example, the distribution of smoking and harmful alcohol use across PCEs levels).

The results of the logistic regression analyses showed that after controlling for gender, age, and education, the risk of poor self-rated health, physical and mental health outcomes, and health-risk behaviours increased with increasing ACEs exposure level (Table 2). The risk of cancer was associated only with 2–3 ACEs vs. 0 ACEs. These findings remained stable also after additionally controlling for below vs. above median PCEs. However, PCEs attenuated the negative association between ACEs and some of the health outcomes, i.e. poor self-rated mental and physical health, mental health outcomes, and physical inactivity. The likelihood-ratio tests revealed that in these cases the model deviance decreased significantly after additionally controlling for below vs. above median PCEs. In general, the odds ratios for health outcomes were increasingly higher in individuals with higher levels of ACEs exposure.

After adjusting for covariates (i.e. gender, age, and education), logistic regression analyses revealed that

the risk of poor self-rated health, digestive system diseases, neck or back pain, and chronic headache and migraine was lower for participants with above median PCEs compared to participants with below median PCEs (Table 3). In addition, the risk of all mental health outcomes was lower in the presence of above median PCEs, and so was the risk of illicit drug consumption, physical inactivity, and obesity. In all models, the model deviance decreased significantly after ACEs exposure level was added as a covariate. However, the associations with PCEs only remained significant for self-rated physical and mental health, mental health outcomes, and physical inactivity. These findings indicate that, in the face of concurrent presence of ACEs, PCEs may improve some, but not all, adult health outcomes.

### 3.5. Stratified analyses by ACEs exposure levels

Stratified chi-square analyses by ACEs exposure levels were performed for negative health outcomes that were independently predicted by PCEs (Figure 1). Results revealed that, among participants exposed to increasing levels of ACEs, those with below median PCEs rated their physical health and mental health worse compared to those with above median PCEs. For participants exposed to  $\geq 2$  ACE, a significant association was observed between PCEs and depression and suicide attempt, and for participants with a history of 1 or 2–3 ACEs a significant association was found between PCEs and anxiety disorders. Finally, physical inactivity was more prevalent among participants with below median PCEs who were exposed to 0 or  $\geq 2$  ACE.

The results of the stratified logistic regression analyses showed that, at each ACEs exposure level, the likelihood of rating one's physical and mental health as poor decreased with above median PCEs, although the association between above median PCEs and self-rated health was slightly stronger for those exposed to 0 or 1 ACE than for those exposed to  $\geq 2$  ACEs (Table 4). Above median PCEs were also associated with lower risk of depression and suicide attempt for those with  $\geq 2$  ACE and with lower risk of anxiety for those exposed to 1 ACE, although the differences were also in the expected direction for 0 and  $\geq 2$  ACE. Finally, above median PCEs predicted lower risk of physical inactivity for participants exposed to 0 or  $\geq 2$  ACE. Overall, the results of the stratified analyses showed that the association between PCEs and self-rated physical and mental health was relatively stable across ACEs exposure levels, whereas the association between PCEs and mental health outcomes and physical inactivity varied across ACEs exposure levels.

Table 2. Adjusted odds ratios of poor self-rated health, physical and mental health outcomes, and health-risk behaviours by ACEs exposure levels.

	1 ACE			2-3 ACEs			≥ 4 ACEs			LRT	p value			
	AOR [95% CI]	AOR <sup>a</sup> [95% CI]	AOR [95% CI]	AOR [95% CI]	AOR <sup>a</sup> [95% CI]	AOR [95% CI]	AOR <sup>a</sup> [95% CI]	AOR <sup>b</sup> [95% CI]						
Poor self-rated physical health	1.49	[1.22, 1.81]	1.44	[1.18, 1.76]	1.96	[1.63, 2.35]	1.73	[1.44, 2.08]	2.92	[2.44, 3.50]	2.22	[1.82, 2.69]	53.40	<.001
Poor self-rated mental health	1.51	[1.18, 1.94]	1.44	[1.12, 1.86]	2.55	[2.05, 3.18]	2.11	[1.68, 2.64]	5.24	[4.23, 6.50]	3.50	[2.78, 4.41]	92.03	<.001
Physical health outcomes														
Cardiovascular diseases	1.23	[.99, 1.54]	1.24	[.99, 1.54]	1.07	[.87, 1.32]	1.08	[.87, 1.34]	1.36	[1.10, 1.67]	1.37	[1.09, 1.72]	.05	.828
Respiratory system diseases	1.03	[.80, 1.33]	1.04	[.80, 1.34]	1.33	[1.06, 1.67]	1.36	[1.08, 1.71]	1.86	[1.49, 2.32]	1.95	[1.54, 2.49]	1.00	.317
Digestive system diseases	1.01	[.77, 1.32]	1.00	[.76, 1.31]	1.42	[1.12, 1.81]	1.38	[1.08, 1.75]	2.53	[2.02, 3.17]	2.35	[1.84, 2.99]	2.32	.128
Cancer	1.35	[.89, 2.06]	1.36	[.89, 2.07]	1.58	[1.08, 2.32]	1.61	[1.09, 2.38]	1.22	[.82, 1.82]	1.27	[.83, 1.95]	.18	.668
Neck or back pain	1.03	[.83, 1.27]	1.02	[.83, 1.27]	1.40	[1.16, 1.70]	1.37	[1.13, 1.67]	1.82	[1.51, 2.20]	1.74	[1.42, 2.14]	1.10	.295
Chronic headache, migraine	1.31	[.85, 2.00]	1.32	[.86, 2.02]	2.62	[1.83, 3.76]	2.73	[1.89, 3.94]	3.07	[2.15, 4.37]	3.35	[2.29, 4.91]	1.49	.223
Mental health outcomes														
Depression	1.45	[1.01, 2.08]	1.42	[0.99, 2.03]	2.66	[1.95, 3.63]	2.40	[1.75, 3.30]	5.21	[3.88, 6.99]	4.20	[3.07, 5.75]	14.23	<.001
Anxiety	1.50	[1.02, 2.21]	1.45	[.98, 2.13]	2.36	[1.68, 3.31]	2.08	[1.47, 2.94]	4.61	[3.34, 6.65]	3.54	[2.51, 4.99]	17.00	<.001
Suicide attempt	2.22	[1.25, 1.88]	2.14	[1.20, 3.79]	3.99	[2.39, 6.65]	3.46	[2.06, 5.80]	12.55	[7.74, 20.35]	9.34	[5.65, 15.45]	45.74	<.001
Health-risk behaviours														
Smoking	1.43	[1.19, 1.70]	1.43	[1.20, 1.71]	1.39	[1.18, 1.64]	1.42	[1.20, 1.68]	1.93	[1.64, 2.28]	2.02	[1.68, 2.43]	1.46	.227
Harmful alcohol use	1.29	[.80, 2.08]	1.29	[.80, 2.08]	1.67	[1.09, 2.56]	1.68	[1.09, 2.59]	2.08	[1.36, 3.18]	2.10	[1.33, 3.32]	.01	.903
Drug use	2.59	[1.71, 3.92]	2.58	[1.70, 3.90]	3.32	[2.26, 4.87]	3.26	[2.21, 4.81]	6.09	[4.16, 8.92]	5.86	[3.91, 8.78]	.33	.568
Physical inactivity	1.41	[1.09, 1.82]	1.37	[1.06, 1.78]	1.68	[1.33, 2.13]	1.52	[1.20, 1.93]	1.84	[1.46, 2.32]	1.48	[1.15, 1.91]	18.97	<.001
Obesity	1.31	[1.01, 1.69]	1.29	[1.00, 1.67]	1.37	[1.08, 1.74]	1.31	[1.03, 1.67]	2.08	[1.66, 2.62]	1.91	[1.49, 2.45]	3.10	.078

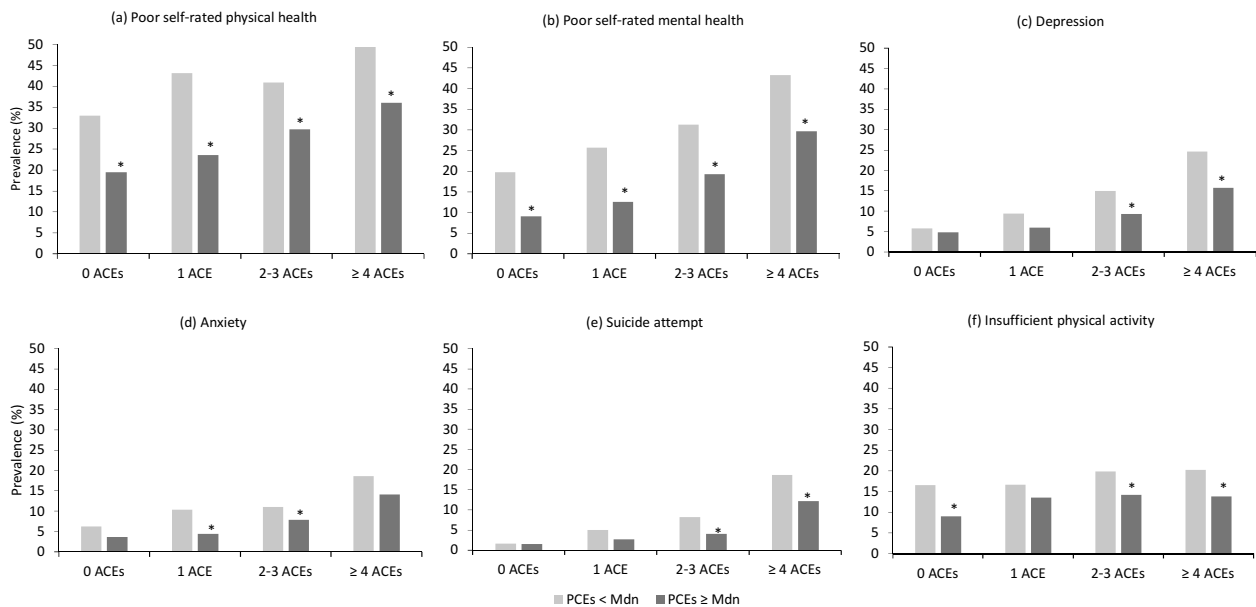
$N_{(univ)} = 4,847$ . All odds ratios are adjusted for gender, age, and educational attainment. <sup>a</sup>Odds ratios are additionally adjusted for below vs. above median PCEs. LRT = likelihood-ratio test statistic (a difference between the deviance of the model not adjusted for PCEs and the deviance of the model additionally adjusted for PCEs).



**Table 3.** Adjusted odds ratios of poor self-rated health, physical and mental health outcomes, and health-risk behaviours by below vs. above median PCEs.

	PCEs ≥ Mdn				LRT	p value
	AOR [95% CI]		AOR <sup>a</sup> [95% CI]			
Poor self-rated physical health	.47	[.42, .54]	.60	[.52, .69]	68.34	< .001
Poor self-rated mental health	.31	[.27, .36]	.46	[.39, .54]	137.75	< .001
Physical health outcomes						
Cardiovascular diseases	.94	[.81, 1.09]	1.02	[.86, 1.20]	9.62	.002
Respiratory system diseases	.86	[.73, 1.00]	1.09	[.92, 1.31]	38.16	< .001
Digestive system diseases	.63	[.54, .74]	.87	[.73, 1.04]	66.81	< .001
Cancer	1.02	[.78, 1.34]	1.07	[.79, 1.44]	6.08	.014
Neck or back pain	.76	[.66, .87]	.92	[.79, 1.07]	36.64	< .001
Chronic headache, migraine	.79	[.63, .98]	1.17	[.91, 1.50]	57.80	< .001
Mental health outcomes						
Depression	.42	[.35, .50]	.67	[.55, .83]	112.31	< .001
Anxiety	.41	[.33, .50]	.62	[.49, .78]	69.36	< .001
Suicide attempt	.29	[.23, .37]	.58	[.44, .76]	327.49	< .001
Health-risk behaviours						
Smoking	.89	[.79, 1.00]	1.09	[.95, 1.24]	58.18	< .001
Harmful alcohol use	.82	[.61, 1.09]	1.02	[.74, 1.40]	11.73	< .001
Drug use	.59	[.48, .73]	.93	[.73, 1.19]	89.77	< .001
Physical inactivity	.61	[.52, .72]	.67	[.56, .80]	13.65	< .001
Obesity	.70	[.59, .82]	.85	[.71, 1.02]	28.25	< .001

N<sub>(UnW)</sub> = 4,847. All odds ratios are adjusted for gender, age, and educational attainment. <sup>a</sup>Odds ratios are additionally adjusted for ACEs. LRT = likelihood-ratio test statistic (a difference between the deviance of the model not adjusted for ACEs and the deviance of the model additionally adjusted for ACEs).



**Figure 1.** Prevalences of poor self-rated health, mental health conditions, and physical inactivity by ACEs exposure levels and below vs. above median PCEs. \*Chi-square p < .05.

**Table 4.** Adjusted odds ratios of poor self-rated health, mental health outcomes, and physical inactivity for above median (vs. below median) PCEs, across ACEs exposure levels.

	0 ACEs	1 ACE	2-3 ACEs	≥ 4 ACEs
	AOR [95% CI]	AOR [95% CI]	AOR [95% CI]	AOR [95% CI]
Poor self-rated physical health	.56 [.41, .76]	.47 [.35, .64]	.70 [.55, .88]	.63 [.47, .85]
Poor self-rated mental health	.39 [.27, .58]	.38 [.26, .54]	.50 [.38, .64]	.54 [.40, .73]
Depression	1.03 [.56, 1.89]	.69 [.41, 1.14]	.65 [.46, .91]	.61 [.42, .89]
Anxiety	.60 [.33, 1.12]	.43 [.25, .72]	.71 [.49, 1.03]	.73 [.49, 1.09]
Suicide attempt	.92 [.31, 2.73]	.55 [.27, 1.11]	.51 [.32, .82]	.62 [.41, .94]
Physical inactivity	.48 [.32, .72]	.80 [.54, 1.17]	.73 [.54, .97]	.66 [.45, .98]

N<sub>(UnW)</sub> = 4,847. All odds ratios are adjusted for gender, age, and educational attainment.

#### 4. Discussion

Using data from the first Slovenian ACE study, our research extends the literature showing that above

median PCEs attenuate the association between ACEs and poor self-rated health, mental health outcomes (depression, anxiety, and suicide attempt), and

physical inactivity in later life, and lead to better health outcomes in these domains even in the concurrent presence of ACEs.

In line with expectations and previous research (e.g. Bethell et al., 2019; Crandall et al., 2019; Karatzias et al., 2020), a negative association between the ACEs and PCEs was observed, suggesting that individuals exposed to higher levels of adversity in childhood had fewer PCEs and vice versa. The PCEs measured in this study were predominantly focused on positive parent-child relationships, stable family functioning, and external family support, but also included beliefs about one's own autonomy and self-efficacy. According to the available literature (Bellis et al., 2017; Crouch et al., 2019), these factors are likely to be highly relevant not only for promoting positive health outcomes in adulthood but also for mitigating the negative association between ACEs and adult health functioning.

Consistent with the well-documented wide-ranging detrimental associations between multiple adversities in childhood and reduced health outcomes in adulthood (e.g. Clemens et al., 2018; Felitti et al., 1998; Hughes et al., 2017; Petruccioli et al., 2019), our results indicated a graded dose-response relationship between ACEs and all the health outcomes evaluated in this study, but cancer (which was associated only with 2–3 ACEs vs. 0 ACEs). As expected, the results are largely comparable with those of other Western European countries where ACE studies have been conducted so far (e.g. Häuser et al., 2011; Nagy et al., 2019). The adjusted odds ratios for individuals with 4 or more ACEs, compared to individuals with 0 ACEs, for the selected categories of health outcomes obtained in our study were broadly similar to those reported in the meta-analysis by Hughes et al. (2017). They were highest for mental health outcomes where suicide attempts were conspicuous, followed by self-rated health, especially mental health (Hayashi et al., 2015; Poole, Dobson, & Pusch, 2017). In general, adjusted odds ratios were lower for physical health outcomes and health-risk behaviours, except for use of illicit drugs, for which Hughes et al. (2017) also reported strong association with ACEs.

Our results support earlier findings that underpin childhood as a critical period for laying the foundations for good vs. poor health and psychosocial functioning in later life (Shonkoff et al., 2010). Research on the biology of stress has contributed to the understanding that toxic stress caused by ACEs – without adequate supportive relationships and environments – has damaging effects on early brain development and the functioning of other organ systems, as well as on behaviour and health throughout life (Sege & Harper Browne, 2017; Shonkoff et al., 2012). In contrast to some earlier findings, cancer was only weakly

associated with childhood adversity in our study (Holman et al., 2016; Ports et al., 2019).

Our results also showed that PCEs predicted a lower probability of 11 of the 16 evaluated health outcomes: self-rated health, all mental health outcomes, and some physical health outcomes (digestive system diseases, neck or back pain, chronic headache/migraine) and unhealthy behaviours (drug use, physical inactivity, obesity). While ACEs had the strongest negative association with mental health outcomes and self-rated health, PCEs had the strongest positive association with these health outcomes. Our results are consistent with earlier findings that show a significant association between PCEs and depression (Crandall et al., 2019), substance use and physical activity (Bleck & DeBate, 2016), and indicators of allostatic load in adulthood (Slopen, Chen, Priest, Albert, & Williams, 2016).

The literature suggests that PCEs promote adult health by strengthening the individual's ability to regulate emotions. This capacity is crucial in daily life and has been associated with a better ability to down-regulate threat and stress responses and consequently with better physical and mental health (Poole et al., 2017; Sheppes, Suri, & Gross, 2015) and less health-harming behaviours (Espeleta, Brett, Ridings, Leavens, & Mullins, 2018). In the present study, after controlling for PCEs, associations between ACEs and 6 of the 16 health outcomes evaluated were mitigated: a poor self-rated physical and mental health, depression, anxiety, suicide attempt, and physical inactivity. Mirroring these findings, above median PCEs predicted these 6 health outcomes even after controlling for ACEs, while other health outcomes (i.e. physical health, unhealthy behaviour) were no longer predicted. Previous studies have reported similar findings for various indicators of mental health (e.g. Bethell et al., 2019; Chung et al., 2008; Crandall et al., 2019; Karatzias et al., 2020; Narayan et al., 2018) and self-rated health (Crouch et al., 2019), but none have thoroughly examined the relationship between PCEs coexisting with ACEs and physical health in adulthood. Bellis et al. (2017) found that support from a trusted adult in childhood mitigated the association between ACEs and harmful behaviours in adulthood, such as smoking and alcohol consumption. One possible explanation for why PCEs have the most beneficial effects on mental health and self-rated health in adulthood is that these childhood experiences directly contribute to resilience, feelings of security, autonomy, and competence (e.g. Brown & Ryan, 2012; Goldberg, 2000; Rolfe, 2004). A weaker association with physical health and unhealthy behaviours may also be explained by the role of various other factors or mechanisms that influence this relationship, such as cultural and social determinants of health and

unhealthy behaviours (Berkman & Kawachi, 2000; Marmot & Wilkinson, 2006). Nonetheless, there is a need for a larger sample and further analyses to confirm lack of associations for physical conditions and unhealthy behaviours (e.g. they might be related to the way PCEs or health outcomes were measured in this study).

The findings regarding the protective role of PCEs for adult health were further corroborated by stratified analyses by ACEs exposure levels. PCEs showed the strongest association with self-rated mental and physical health, which was relatively stable across all four ACEs exposure levels, although the association was slightly weaker for individuals exposed to  $\geq 2$  ACEs than for those exposed to 0–1 ACE. These results suggest that individuals exposed to increasing numbers of ACEs may receive somewhat less protection and derive fewer positive benefits from PCEs (see also Crandall et al., 2019) in terms of better self-rated health. On the other hand, our results showed that PCEs provided protection against depression and suicide attempt for those exposed to  $\geq 2$  ACEs. While Crandall et al. (2019), who stratified the sample into two groups ( $< 4$  ACEs and  $\geq 4$  ACEs), found that PCEs were associated with depression in both groups, but the association was weaker for those exposed to  $\geq 4$  ACEs, the results of the study by Bethell et al. (2019), similar to ours, showed that PCEs were associated with depression and/or poor mental health in adults who reported  $\geq 1$  ACEs, whereas the associations were insignificant for those who reported 0 ACEs. The nonsignificant results in their study and in our study could also be due to the small sample sizes for those with 0–1 ACEs (see Table S4 in Supplementary Materials). Regarding anxiety, our results showed a negative association with PCEs that was weak and significant only for participants exposed to exactly 1 ACE, suggesting that PCEs may be more protective against depression than anxiety when there is a history of ACEs. Previous research has shown that depression and anxiety are both centred around negative emotional states, but they have very different associations with positive emotional states – while depressed mood is negatively associated with positive affect, anxiety symptomatology is largely unrelated to it (Watson & Tellegen, 1985), suggesting that the absence of positive experiences is particularly critical for the development of depression. Finally, while Crandall et al. (2019) found that PCEs only predicted vigorous physical activity among individuals exposed to  $< 4$  ACEs, PCEs in our sample had the strongest negative association with insufficient physical activity among individuals exposed to 0 ACEs, whereas the association was insignificant among individuals with a history of 1 ACE and marginally significant among individuals exposed to  $\geq 2$  ACEs, suggesting that PCEs provide only weak protection against physical inactivity among individuals with a history of ACEs exposure.

#### 4.1. Practice implications

Our results support the existing literature by emphasizing the importance of interventions for the prevention of ACEs and at the same time for the promotion of PCEs (e.g. Crouch et al., 2019; Racine, Eiricha, Dimitropoulos, Hartwick, & Madigan, 2020; Sege & Harper Browne, 2017). Micro-level evidence-based interventions should focus on strengthening supportive family relationships by helping parents and caregivers to develop self-regulatory, emotional, and social competencies that promote secure attachment in their children and strong social bonds both within and outside the family and also contribute to broader social and cultural environments that enable safe, predictable and nurturing caregiving (Bethell, Gombojav, & Whitaker, 2019; Bethell, Jones, Gombojav, Solloway, & Wissow, 2016; Bethell, Newacheck, Hawes, & Halfon, 2014; Cheung et al., 2017; Schofield, Lee, & Merrick, 2013). A particular attention should be given to economically and socially vulnerable families facing risk factors such as domestic violence, parent or caregiver's mental illness, and adverse experiences in parent or caregiver's childhood. As PCEs are not only negatively associated with childhood trauma, but also significantly attenuate the negative association between ACEs and self-rated health and mental health outcomes, it is particularly important from a broader perspective that macro-level approaches involve institutions of health care, education, and human services and the community context in order to maximize the individual's potential for resilient functioning (Bethell et al., 2014). Our findings provide additional arguments for the systematic implementation of preventive activities in kindergartens and schools (i.e. trauma-sensitive kindergartens and schools; Overstreet & Chafouleas, 2016) and the strengthening of supportive communities (Sege & Harper Browne, 2017). Schools and communities have an empirically proven role in creating positive experiences for children affected by ACEs to develop personal and relational skills and positive relationships through engagement in encouraging and supporting networks and activities (Cheung et al., 2017). Furthermore, similarly to Karatzias et al. (2020), our findings suggests that trauma-focused therapeutic interventions for mental health diseases could be enhanced by drawing on material from positive experiences in childhood.

#### 4.2. Limitations and future directions

The current study used non-probability quota sampling and an online research panel to collect data. This implies that the sample is not completely representative of the Slovenian population despite the use of weights. For example, only individuals using Internet could be reached, leading to a potential self-selection of

participants, especially among older adults. In addition, only individuals who agreed to join the panel could be included in the study and not all who were invited to participate responded (see also Callegaro et al., 2014). Furthermore, because we do not have data on non-respondents, we could not compare the characteristics of the respondents with those of the non-respondents. Although it is known that non-respondents and respondents may differ in their socio-economic, demographic, and health characteristics (e.g. Groves & Couper, 1992; Jackson et al., 1996), these differences may not necessarily predict differences in substantive variables (Peytcheva & Groves, 2009).

Additional factors in childhood that were not examined in this study, such as the severity of the adversity and the developmental period during which the adversity occurred, may influence the development of unfavourable health outcomes later in life. In addition, the present study did not specifically examine PCEs in early versus middle or late childhood. Furthermore, by using the above/below median PCEs score, we could not assess whether increasing PCEs at any level would attenuate the negative association between ACEs and specific health outcomes in adulthood. Given a dynamic interplay between adverse and positive experiences in childhood and adolescence (Heller, Larrieu, D'Imperio, & Boris, 1999; Khanlou & Wray, 2014), longitudinal studies would provide more nuanced insight into their role in health and well-being in adulthood. Future studies should also assess the severity of different physical health conditions, which could provide a different insight into the relationship between physical health conditions and ACEs and PCEs.

Furthermore, the measures used to operationalize ACEs were not exhaustive and could be extended in future research. For example, previous research has shown a negative association between peer victimization and poverty and different outcomes in childhood and later life (Cronholm et al., 2015; Finkelhor, Shattuck, Turner, & Hamby, 2015). This study did not include lifetime trauma exposure (comp. Karatzias et al., 2020). An additional limitation is that although RQ has a strong face validity and has been used in some previous research (Hiles Howard et al., 2015; Sciola et al., 2019), it has been primarily developed for use in practice (Rains & McClinn, 2013). Future studies should confirm our findings with other validated measures of PCEs, for example with Narayan et al.'s (2018) BCEs scale. Furthermore, similar to how ACEs are not an exhaustive list of adverse experiences in childhood, several authors consider various factors that exist at multiple, interdependent levels of the child's ecology (the individual child level, the family level, and the broader community level) to be PCEs (Cicchetti & Toth, 2016; Gartland et al., 2019; Masten & Cicchetti, 2016). There is a need in the field to develop and test additional measures of PCEs 'that both reflect and

generate resilience within children, families, and communities' (Bethell et al., 2019, p. E6).

Finally, future research in this area would benefit from a more detailed analysis of the relationship between ACEs, PCEs, and health outcomes, stratified by socio-demographic variables such as age, gender, socio-economic status, ethnicity/race, and chronic conditions/special needs (e.g. Bethell et al., 2014; Crouch et al., 2019; Heller et al., 1999). Analyses by age should be particularly relevant given the different levels of health problems and health-risk behaviours between younger and older people and possible cohort effects due to different circumstances that have shaped the development of individuals. In addition, analyses to determine whether the mitigating effects of PCEs differ by the individual type of adversity experienced (e.g. abuse, neglect, and household dysfunctions) would also make a valuable contribution to this field (comp. Racine et al., 2020).

## 5. Conclusion

In summary, our results showed that ACEs were negatively associated with self-rated physical and mental health, 6 physical health outcomes, 3 mental health outcomes, and 5 health-risk behaviours evaluated in this study. After controlling for ACEs, the PCEs were associated with self-rated physical and mental health, mental health outcomes (i.e. depression, anxiety, and suicide attempt), and one health-risk behaviour (i.e. physical inactivity). The association between PCEs and self-rated health were stable across all ACEs exposure levels, while the association between PCEs and mental health outcomes and physical inactivity varied across ACEs exposure levels. The hypothesized associations of PCEs with physical health outcomes and most health behaviours were not observed, and further research overcoming the shortcomings of the present study is needed to gain a better understanding of these associations. From a public health perspective, interventions addressing PCEs can prevent or at least mitigate the development of unfavourable long-term health outcomes following childhood adversity by promoting parental skills and strengthening supportive schools and communities.

## Note

1. Educational categories in Slovenia reflect to a certain extent the different socio-economic strata. The Slovenian education system has so far been without tuition fees, so that people with poorer material starting conditions can also receive a relatively high level of education. However, for reasons of cultural capital, the education system has been a sphere of reproduction of social inequalities, especially until the end of the 1980s (Flere & Lavrič, 2005), when enrolment in tertiary education increased from about 20% of the generation to about 70% within a decade and



remained at that level. On the other hand, drop-out rates are significant (about one third) and the educational level achieved is not automatically reflected in employment opportunities and income categories (Kuhar & Reiter, 2014).

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Data availability statement

The data supporting the results presented in this paper will be publicly available at Social Science Data Archive Slovenia from May 2022 <https://www.adp.fdv.uni-lj.si/eng/>.

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