



Association of positive and adverse childhood experiences with risky behaviours and mental health indicators among Chinese university students in Hong Kong: an exploratory study

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ABSTRACT

Background: Different childhood experiences may affect adult health differently.

Objective: To explore the association of different types of positive childhood experiences (PCEs) and adverse childhood experiences (ACEs) with risky behaviours and mental health indicators, and how PCEs and ACEs are associated with health outcomes in the context of each other.

Method: This was an exploratory cross-sectional online survey including 332 university students in Hong Kong. ACEs (abuse and household challenges), PCEs (perceived safety, positive quality of life, and interpersonal support), risky behaviours (smoking, binge drinking, and sexual initiation), and mental health indicators (depression, anxiety, loneliness, self-rated health, multimorbidity, meaning in life, and life satisfaction) were measured.

Results: The multivariable logistic regression analysis indicated cumulative effects of PCEs in lowered risks of depression, anxiety, loneliness, as well as better self-rated health, life satisfaction, and meaning in life ($p < .05$), after adjusting for ACEs. Results also indicated that ACEs had an increasing relationship with poorer mental health indicators, such as anxiety, loneliness, and life satisfaction ($p < .05$), after adjusting for PCEs. There was also an adverse association between having ≥ 4 ACEs with smoking and binge drinking. In addition, each type of PCE and ACE was significantly associated with one or more risky behaviours and mental health indicators. Stratified results showed that PCEs had stronger associations with mental health indicators in participants with fewer ACEs. Furthermore, ACEs had stronger associations with mental health indicators in participants with more PCEs than in those with fewer PCEs.

Conclusions: In this study, PCE was proven to be an independent protective factor against poor mental health after accounting for ACE. ACE was also proven to be an independent risk factor for poor mental health and risky behaviours. These findings suggest a crucial need for the active promotion of PCEs and the prevention of child maltreatment. The results of subtypes and stratifications can be taken into consideration when developing targeted interventions in the future.

Asociación de experiencias infantiles positivas y adversas con conductas de riesgo e indicadores de salud mental entre estudiantes universitarios chinos en Hong Kong: un estudio exploratorio

Antecedentes: Las diferentes experiencias de la infancia pueden afectar la salud de los adultos de manera diferente.

Objetivo: Explorar la asociación de diferentes tipos de experiencias infantiles positivas (EIP) y experiencias infantiles adversas (EIA) con conductas de riesgo e indicadores de salud mental, y cómo las EIP y las EIA se asocian con resultados de salud en el contexto de cada uno.

Método: Esta fue una encuesta transversal exploratoria en línea que incluyó a 332 estudiantes universitarios en Hong Kong. EIA (abuso y desafíos domésticos), EIP (seguridad percibida, calidad de vida positiva y apoyo interpersonal), comportamientos de riesgo (fumar, beber en exceso e iniciación sexual) e indicadores de salud mental (depresión, ansiedad, soledad, salud autoevaluada, multimorbilidad, sentido de la vida y satisfacción con la vida) fueron medidos.

Resultados: El análisis de regresión logística multivariable indicó efectos acumulativos de EIP en disminuir el riesgo de depresión, ansiedad, soledad, así como mejor autoevaluación de la salud, satisfacción con la vida y sentido de la vida ($p < 0,05$), después de ajustar por EIA. Los resultados también indicaron que EIA tuvo una relación de incremento con indicadores de salud mental más deficientes, como ansiedad, soledad y satisfacción con la vida ($p < 0,05$), después de ajustar por EIP. También hubo una asociación adversa entre tener ≥ 4 EIA con fumar y beber en exceso. Además, cada tipo de EIP y EIA se asoció significativamente con

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PALABRAS CLAVE

Experiencia infantil positiva; experiencia infantil adversa; salud mental; conducta de riesgo; factor de riesgo; factor protector

关键词

积极童年经历; 不良童年经历; 心理健康; 冒险行为; 风险因素; 保护因素

HIGHLIGHTS

- PCE is an independent protective factor against poor mental health after accounting for ACE. ACE is an independent risk factor for poor mental health and risky behaviours.
- PCEs and ACEs have different associations with health outcomes in the context of one another.

uno o más comportamientos de riesgo e indicadores de salud mental. Los resultados estratificados mostraron que EIP tuvo asociaciones más fuertes con indicadores de salud mental en participantes con menos EIA. Además, EIA tuvo asociaciones más fuertes con indicadores de salud mental en participantes con más EIA que en aquellos con menos EIP.

Conclusiones: En este estudio, se demostró que EIP es un factor protector independiente contra una pobre salud mental después de tomar en cuenta EIA. También se demostró que EIA es un factor de riesgo independiente para una pobre salud mental y comportamientos de riesgo. Estos hallazgos sugieren una necesidad crucial para la promoción activa de EIPs y la prevención del maltrato infantil. Los resultados de los subtipos y estratificaciones se pueden tener en cuenta al desarrollar intervenciones focalizadas en el futuro.

香港中国大学生中积极和消极童年经历与冒险行为和心理健康指标的关联：一项探索性研究

背景: 不同的童年经历可能对成年后的健康有不同的影响。

目的: 为了探索在香港的大学生中不同类型的积极童年经历和不良童年经历与成年后危险行为和健康的关联，以及积极和不良童年经历如何在彼此存在的情况下与行为和健康的关联。

方法: 本探索性研究在2020年10月至12月对香港332名大学生进行了横断面调查，并测量了不良童年经历（虐待和家庭难题）、积极童年经历（安全感、积极的生活质量和人际支持）、危险行为（吸烟、酗酒和性启蒙）和健康相关结果指标（抑郁、焦虑、孤独、自评健康、共病、人生意义和生活满意度）。

结果: 在多变量逻辑回归中调整了不良童年经历和人口特征后，积极童年经历与低风险的抑郁、焦虑和孤独以及较好的自评健康、生活满意度和人生意义之间存在累积效应（ $p < 0.05$ ）。在调整了积极童年经历和人口特征后，不良童年经历与较差的健康（焦虑、孤独和生活满意度）之间存在累积效应（ $p < 0.05$ ），并且有四种及以上不良童年经历与吸烟和酗酒呈负相关。每种类型的积极和不良童年经历与至少一种危险行为和与健康结果显著相关。分层结果显示，在不良童年经历较少的参与者中，积极童年经历与健康结果的关联性更强。与积极童年经历较少的参与者相比，在积极童年经历较多的参与者中，不良童年经历与各种健康结果的关联性更强。

结论: 在考虑不良童年经历后，积极童年经历似乎是不良健康的独立保护因素；而不良童年经历也是不良健康和危险行为的独立风险因素。这些发现表明有必要促进积极的童年经历和防止儿童虐待。亚型和分层的结果有助于设计有针对性的干预措施。

关键词: 积极童年经历；不良童年经历；心理健康；冒险行为；风险因素；保护因素

1. Background

Adverse childhood experiences (ACEs) refer to the events causing actual or potential damage to health, survival, growth, psychology, or physiology before the age of 18, such as physical/emotional abuse and household challenges (Felitti et al., 1998). It received continuous attention globally as a public health concern over the last two decades (Butchart et al., 2006). Exposure to four or more ACEs increased the risk of problematic substance use, sexually transmitted infections, and interpersonal and self-directed violence by at least 5 times (Hughes et al., 2017). Furthermore, numbers of ACEs correlate positively with an increased risk of adverse health behaviours and outcomes such as risky sexual behaviours, mental disorders, and low life satisfaction (Chartier, Walker, & Naimark, 2010; Dube, Felitti, Dong, Giles, & Anda, 2003; Felitti et al., 1998; Hughes et al., 2017). ACEs can lead to undesirable health conditions and behaviours which could in turn contribute to the great burden of disease and death in China and globally (Benziger, Roth, & Moran, 2016; Lim et al., 2012; Lozano et al., 2012; Peterson, Florence, & Klevens, 2018; Yang et al., 2013; Zhou et al., 2016).

As supported by the resilience framework and the positive youth development framework, children's strengths, as well as their living environments (e.g. schools, families, and neighbourhoods), can protect them from risks and help them adjust to adversity

(Wang, Jiang, Yang, & Choi, 2021). In contrary to ACEs, positive childhood experiences (PCEs), referred to as favourable experiences such as perceived safety and interpersonal support before the age of 18 years, were shown to reduce psychopathology and stress in adults with ACEs (Gunay-Oge, Pehlivan, & Isikli, 2020; Narayan, Rivera, Bernstein, Harris, & Lieberman, 2018). PCEs were further associated with a lower risk of depressive symptoms and a reduced risk of midlife cardiovascular diseases (Bethell, Jones, Gombojav, Linkenbach, & Sege, 2019; Chung, Mathew, Elo, Coyne, & Culhane, 2008; Slopen, Chen, Guida, Albert, & Williams, 2017). PCEs may have a great impact on different aspects of adult health in the context of ACEs (Merrick & Narayan, 2020). Therefore, it is worthy to actively assess the independent effect of PCEs to provide a direction for future interventions.

Most of the current studies of childhood experiences are conducted in Western countries while their culture is different from that in the Chinese population. It is common in Chinese culture that parents seldom express their love for their children and tend to use scolding or intimidation to show their authority in educating and responding to their children's unsatisfactory performances (Evans, 2012; Qiao & Chan, 2005). Yet, childhood experiences, especially PCEs, are seldom studied in the Chinese

population. Globally, the research gaps also consist of a lack of consideration for the effects of PCEs and ACEs in the context of each other. For instance, it is unclear whether ACEs have different associations with health outcomes in the context of PCE existence vs. PCE non-existence, and vice versa. There is also a lack of exploration in the specific effects of different types of ACEs and PCEs after adjusting for each other. These could provide critical information for designing targeted interventions. Furthermore, current studies of childhood experiences, especially those of PCEs, seldom focused on important adult mental health indicators such as loneliness, life satisfaction, and meaning in life, which are all important predictors of mortality (Cohen, Bavishi, & Rozanski, 2016; Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015).

Based on the research gaps mentioned above, we conducted this exploratory study to explore the association of PCEs, ACEs (e.g. abuse and household challenges for ACEs; perceived safety, positive quality of life, interpersonal support for PCEs) with adult risky behaviours and mental health indicators among university students in Hong Kong. In addition, we explored how PCEs and ACEs associate with health outcomes in the context of one another.

2. Methods

2.1. Study design and participants

An exploratory cross-sectional study was conducted among students in the Chinese University of Hong Kong from October to December 2020, when there were less than 50 local COVID-19 cases daily in Hong Kong (School of Public Health, the University of Hong Kong, 2022). The university students had just reached adulthood. Hence, this may have reduced the recall bias for childhood experiences. The inclusion criteria included 1) ≥ 18 years of age, 2) ability to understand Chinese, and 3) ability to give informed consent. The participants were asked to complete an online survey and were recruited on the university's online mass email platform. All participation was voluntary, anonymous, and confidential. Informed consent was obtained at the beginning of the survey. The whole survey would take about 5–10 min to complete. Two quality-check questions that required specified answers were added to the survey to check if participants answered the questions diligently (e.g. Please choose 'not sure' for this question). After completing the survey, all participants received a report on their physical and mental health with about 1000 words in Chinese. Information on hotlines and services for help was also provided. This study was approved by the Survey and Behavioural Research Ethics Committee (SBRE-20-074).

2.2. Instrument

2.2.1. Benevolent childhood experiences scale

The PCEs were measured using the Chinese validated 10-item Benevolent Childhood Experiences Scale (Narayan et al., 2018); Merrick, Narayan, DePasquale, & Masten, 2019); Zhan, Xie, Zou, Wang, & Geng, 2021). The scale consists of items pertained to perceived internal and external safety and security (e.g. presence of beliefs that gave comfort, at least one safe caregiver), positive and predictive quality of life (e.g. enjoyment of school, predictable home routine), and interpersonal support (e.g. a teacher who cared, a supportive non-caregiver adult). Responses were dichotomized, and the total score ranged from 0 to 10. The PCE score was categorized into 0-4, 5-6, 7-8, or 9–10 exposures according to the median and quartile score to ensure sufficient statistical power for detecting meaningful correlations (Bethell et al., 2019).

2.2.2. Adverse childhood experience questionnaire

The Behavioral Risk Factor Surveillance System (BRFSS) ACE questionnaire is an 11-item questionnaire that measures ACEs in the respondent's first 18 years of life (Centers for Disease Control and Prevention). Five questions are categorized as polar questions with 'yes' and 'no' responses. The other six questions included the following responses: 'never', 'once', and 'more than once'. All 11 questions consist of extra response options (i.e. 'don't know / not sure' and 'refused'). The definition of qualified responses was developed based on other national ACE studies (Bellis, Hughes, Leckenby, Perkins, & Lowey, 2014; Bynum et al., 2010), and each qualified response was recorded as an ACE. The questionnaire is categorized into two main categories as recommended by the Centers for Disease Control and Prevention: abuse and family/household challenges (Centers for Disease Control and Prevention). Abuse includes emotional abuse, physical abuse, and sexual abuse (3 items). Household challenges contain the following contents: household intimate partner violence, household substance abuse (2 items), household mental illness, parental separation or divorce, and incarcerated household member. The maximum possible ACE score was eight. The ACE score was categorized into 0, 1, 2-3, or ≥ 4 exposures (Hughes et al., 2017).

2.2.3. Mental health indicators

The selection of mental health indicators was based on a previous meta-analysis on ACEs (Hughes et al., 2017), using both well-examined instruments and self-constructed questions. Self-rated overall health was measured on a 5-point Likert scale ranging from 1 (poor) to 5 (excellent) (Chandola & Jenkinson,

2000). A total of 18 common chronic diseases were measured using self-report, including but not limited to hypertension, heart diseases, diabetes, and cancer (Zhang et al., 2014). Multimorbidity was defined as having ≥ 2 chronic conditions (Xu, Mishra, & Jones, 2017). Life satisfaction was assessed using a 7-point Likert scale ranging from 1 (very dissatisfied) to 7 (very satisfied) (i.e. 'Are you satisfied with your life?'). One item is extracted from the validated Chinese Purpose in Life test (CPIL) to measure participant's meaning in life (Zhang et al., 2018), in which the participants were asked to rate their personal existence on a 7-point scale from 1 (utterly meaningless and without purpose) to 7 (very purposeful and meaningful). Depressive symptoms were measured using the 9-item Patient Health Questionnaire (PHQ-9), which was also validated in Chinese. Anxiety symptoms were assessed using a 7-item Chinese Generalized Anxiety Disorder Questionnaire (GAD-7). A 3-item Chinese validated UCLA Loneliness Scale (UCLA-3) was used to measure loneliness, the total scores range from 3 to 9 (Russell, 1996). Higher scores on the PHQ-9, the GAD-7, and the UCLA-3 indicated more severe respective symptoms.

2.2.4. Risky behaviours

The selection of risky behaviours was based on a previous meta-analysis on ACEs (Hughes et al., 2017). The assessed risky behaviours included smoking, drinking, and early sexual initiation. Smoking habit responses were dichotomized as 'have' or 'have never' smoked. Drinking was measured using a question in the AUDIT-3, which assessed the frequency of binge drinking (Tuunanen, Aalto, & Seppä, 2007). Early sexual initiation was measured by asking participants the following question: 'Did you have your first sexual intercourse before the age of 16?' (Bellis et al., 2014).

2.2.5. Demographic characteristics

Information on age, gender, marital status, education level, and living place before the age of 18 were also collected.

2.3. Data analysis

The participants who did not pass the two check questions were excluded. The participant demographics were compared between people with 0-4, 5-6, 7-8, 9-10 PCEs and between people with 0, 1, 2-3, ≥ 4 ACEs. The number of categorical variables and mean values of continuous variables were compared using Pearson's Chi-Square test and one-way ANOVA, respectively. Univariable and multivariable logistic regressions were used to assess the association between the number of PCEs, ACEs, and the outcomes including mental health indicators and risky behaviours. The association of multiple types of PCEs

and ACEs with mental health indicators and risky behaviours was also analyzed. Logistic regressions were also used to investigate the association of PCEs and ACEs with health outcomes in the context of one another by assessing the stratified associations between PCEs and outcomes among participants with high (≥ 2) and low (0-1) levels of ACEs, as well as the stratified associations between ACEs and outcomes among participants with high (7-10) and low (0-6) levels of PCEs, which was determined by the median score in the study sample. Age, gender, marital status, education, and childhood living place were adjusted in the multivariable logistic regressions. The results were summarized as crude odds ratios (COR), adjusted odds ratios (AOR), and their corresponding 95% confidence intervals (CIs). The statistical analyses were conducted using the Stata version 16.0. The level of significance was set at 0.05 throughout the study (two-tailed).

3. Results

A total of 341 students were recruited, with 9 failing to pass the check questions. Therefore, 332 participants were included in the analysis. Table 1 summarized their demographic characteristics. Their mean age was 21.9 ± 4.2 years old and 258 (77.7%) were female. Of the 332 students, 319 (96.1%) were single; 244 (73.5%) were undergraduate students; 263 (79.2%) spent their childhood in Hong Kong. The mean counts of PCEs and ACEs were 7.06 ± 1.87 and 1.72 ± 1.55 , respectively. A total of 42 (12.7%), 71 (21.4%), 139 (41.9%), and 80 (24.1%) of the participants reported 0-4, 5-6, 7-8, and 9-10 PCEs, respectively. And 95 (28.6%), 67 (20.2%), 130 (39.2%), and 40 (12.0%) of them reported 0, 1, 2-3, and at least 4 ACEs, respectively. The Chi-square test found that the distribution of age, education, and ACEs were significantly different from participants with different PCE levels ($p < .05$) (Table 1). There was no significant difference in demographic characteristics between participants with different ACE exposures ($p > .05$).

3.1. Cumulative relationships of ACEs and PCEs with risky behaviours and mental health indicators

The results of CORs in the univariable logistic regression were summarized in Table 2. In the multivariable logistic regression accounting for exposure to ACEs and other demographic characteristics (Table 3), when compared with 0-4 PCEs, cumulative relationships were found for lower risks of depression, anxiety, loneliness, poor or fair self-rated health, low life satisfaction, and low meaning in life ($p < .05$). The counts of PCEs were not significantly associated with multimorbidity, ever smoking, ever binge drinking, and early sexual initiation ($p > .05$).

Table 1. Demographic characteristics of the participants and comparison between participants with different PCEs and ACEs.

Characteristics	Total sample (n = 332)	0–4 PCEs (n = 42)	5–6 PCEs (n = 71)	7–8 PCEs (n = 139)	9–10 PCEs (n = 80)	p	0 ACE (n = 95)	1ACE (n = 67)	2–3 ACEs (n = 130)	≥4 ACEs (n = 40)	p
Age						.027					.458
18–20	152 (45.8)	12 (28.6)	43 (60.6)	65 (46.8)	32 (40.0)		44 (46.3)	28 (41.8)	66 (50.8)	14 (35.0)	
21–25	138 (41.6)	23 (54.8)	21 (29.6)	60 (43.2)	34 (42.5)		42 (44.2)	29 (43.3)	46 (35.4)	21 (52.5)	
>25	42 (12.7)	7 (16.7)	7 (9.9)	14 (10.1)	14 (17.5)		9 (9.5)	10 (14.9)	18 (13.8)	5 (12.5)	
Gender						.702					.357
Male	74 (22.3)	11 (26.2)	18 (25.4)	27 (19.4)	18 (22.5)		20 (21.1)	19 (28.4)	24 (18.5)	11 (27.5)	
Female	258 (77.7)	31 (73.8)	53 (74.6)	112 (80.6)	62 (77.5)		75 (78.9)	48 (71.6)	106 (81.5)	29 (72.5)	
Marriage						.690					.900
Single	319 (96.1)	41 (97.6)	67 (94.4)	135 (97.1)	76 (95)		92 (96.8)	64 (95.5)	124 (95.4)	39 (97.5)	
Married	13 (3.9)	1 (2.4)	4 (5.6)	4 (2.9)	4 (5.0)		3 (3.2)	3 (4.5)	6 (4.6)	1 (2.5)	
Education						.012					.192
Undergraduate	244 (73.5)	26 (61.9)	58 (81.7)	109 (78.4)	51 (63.8)		63 (66.3)	49 (73.1)	103 (79.2)	29 (72.5)	
Postgraduate	88 (26.5)	16 (38.1)	13 (18.3)	30 (21.6)	29 (36.3)		32 (33.7)	18 (26.9)	27 (20.8)	11 (27.5)	
Childhood living place						.863					.890
Hong Kong	263 (79.2)	33 (78.6)	59 (83.1)	108 (77.7)	63 (78.8)		73 (76.8)	53 (79.1)	106 (81.5)	31 (77.5)	
Mainland	68 (20.5)	9 (21.4)	12 (16.9)	30 (21.6)	17 (21.3)		21 (22.1)	14 (20.9)	24 (18.5)	9 (22.5)	
ACEs						.004					
0 ACE	95 (28.6)	9 (21.4)	14 (19.7)	49 (35.3)	23 (28.8)						
1 ACE	67 (20.2)	4 (9.5)	14 (19.7)	27 (19.4)	22 (27.5)						
2–3 ACEs	130 (39.2)	17 (40.5)	32 (45.1)	51 (36.7)	30 (37.5)						
≥4 ACEs	40 (12.0)	12 (28.6)	11 (15.5)	12 (8.6)	5 (6.3)						

Data were presented as number (%). ACE: Adverse childhood experience; PCE: Positive childhood experience.

Table 2. The cumulative association of PCEs and ACEs with risky behaviours and mental health indicators before adjustment (n = 332).

Outcomes	Number of PCEs (reference category 0–4 PCEs)			Number of ACEs (reference category 0 ACE)		
	5–6 COR (95% CI)	7–8 COR (95% CI)	9–10 COR (95% CI)	1 COR (95% CI)	2–3 COR (95% CI)	≥4 COR (95% CI)
<i>Mental health indicators</i>						
Depression	0.21 (0.06, 0.76)*	0.17 (0.05, 0.57)*	0.14 (0.04, 0.48)*	0.91 (0.47, 1.75)	1.62 (0.90, 2.92)	2.03 (0.84, 4.92)
Anxiety	0.25 (0.09, 0.71)*	0.26 (0.09, 0.69)**	0.13 (0.05, 0.36)***	1.58 (0.83, 2.99)	2.11 (1.22, 3.65)**	3.76 (1.57, 8.99)**
Loneliness	0.88 (0.39, 1.99)	0.30 (0.14, 0.63)**	0.15 (0.07, 0.34)***	0.82 (0.42, 1.59)	2.03 (1.18, 3.49)*	4.19 (1.89, 9.28)***
Poor or fair self-rated health	0.53 (0.22, 1.30)	0.22 (0.10, 0.49)***	0.08 (0.03, 0.21)***	2.13 (1.12, 4.05)*	2.48 (1.43, 4.31)**	3.44 (1.59, 7.44)**
Multimorbidity	0.88 (0.23, 3.31)	0.50 (0.14, 1.81)	0.63 (0.16, 2.50)	2.47 (0.57, 10.73)	2.83 (0.77, 10.46)	2.49 (0.48, 12.88)
Low life satisfaction	0.37 (0.17, 0.82)*	0.07 (0.03, 0.17)***	0.04 (0.01, 0.14)***	1.24 (0.40, 3.86)	3.77 (1.58, 9.01)**	9.29 (3.44, 25.07)***
Low meaning in life	0.56 (0.26, 1.21)	0.21 (0.10, 0.44)***	0.06 (0.02, 0.16)***	0.78 (0.37, 1.65)	1.41 (0.78, 2.55)	1.97 (0.90, 4.32)
<i>Risky behaviours</i>						
Ever smoking	0.58 (0.08, 4.28)	0.44 (0.07, 2.73)	0.25 (0.02, 2.88)	2.89 (0.26, 32.57)	0.73 (0.05, 11.8)	10.44 (1.13, 96.62)*
Ever binge drinking	1.79 (0.71, 4.49)	1.12 (0.47, 2.68)	0.75 (0.28, 2.01)	1.39 (0.61, 3.19)	1.66 (0.82, 3.35)	3.12 (1.31, 7.38)*
Early sexual initiation	1.19 (0.21, 6.82)	0.60 (0.11, 3.38)	0.53 (0.07, 3.93)	0.47 (0.05, 4.59)	1.22 (0.28, 5.25)	2.53 (0.49, 13.11)

Anxiety: General Anxiety Disorder-7 (GAD7) ≥ 10, moderate to severe anxiety disorder; COR: Crude odds ratio; Depression: Patient Health Questionnaire-9 (PHQ-9) ≥ 10, moderate to severe depression; Loneliness: UCLA-3 ≥ 4; Low life satisfaction: Dissatisfied (1-3) in a 7-point Likert question; Low meaning in life: meaningless and without purpose (1-3) in a 7-point Likert question; Multimorbidity: At least two chronic conditions.

*p < .05, **p < .01, ***p < .001.

Table 3. The cumulative association of PCEs and ACEs with risky behaviours and mental health outcomes after adjustment (n = 332).

Outcomes	Number of PCEs (reference category 0–4 PCEs)			Number of ACEs (reference category 0 ACE)		
	5–6 AOR (95% CI)	7–8 AOR (95% CI)	9–10 AOR (95% CI)	1 AOR (95% CI)	2–3 AOR (95% CI)	≥4 AOR (95% CI)
<i>Mental health indicators</i>						
Depression	0.22 (0.06, 0.81)*	0.18 (0.05, 0.62)**	0.15 (0.04, 0.54)**	0.88 (0.44, 1.76)	1.47 (0.79, 2.73)	1.43 (0.56, 3.67)
Anxiety	0.23 (0.08, 0.68)**	0.28 (0.10, 0.79)*	0.14 (0.05, 0.40)***	1.76 (0.90, 3.46)	2.11 (1.17, 3.79)**	3.13 (1.23, 7.95)**
Loneliness	1.01 (0.42, 2.39)	0.39 (0.18, 0.85)*	0.18 (0.07, 0.42)***	0.73 (0.35, 1.50)	1.82 (1.01, 3.30)*	2.98 (1.26, 7.03)**
Poor or fair self-rated health	0.41 (0.16, 1.07)	0.19 (0.08, 0.46)***	0.07 (0.03, 0.19)***	2.39 (1.17, 4.90)*	2.16 (1.17, 3.99)*	2.16 (0.90, 5.20)
Multimorbidity	0.95 (0.23, 3.92)	0.49 (0.13, 1.89)	0.63 (0.15, 2.68)	2.51 (0.55, 11.36)	2.55 (0.67, 9.72)	2.01 (0.37, 10.93)
Low life satisfaction	0.29 (0.11, 0.72)**	0.07 (0.02, 0.17)***	0.05 (0.01, 0.16)***	1.34 (0.39, 4.63)	3.35 (1.26, 8.87)*	5.91 (1.91, 18.34)**
Low meaning in life	0.45 (0.19, 1.06)	0.17 (0.08, 0.38)***	0.05 (0.02, 0.14)***	0.79 (0.35, 1.82)	1.01 (0.52, 1.97)	1.05 (0.43, 2.60)
<i>Risky behaviours</i>						
Ever smoking	1.11 (0.11, 10.95)	1.06 (0.13, 8.43)	0.46 (0.03, 7.27)	2.66 (0.22, 32.63)	0.97 (0.05, 17.78)	11.81 (1.08, 128.94)*
Ever binge drinking	2.29 (0.85, 6.16)	1.57 (0.62, 4.01)	0.95 (0.33, 2.71)	1.24 (0.53, 2.93)	1.50 (0.72, 3.13)	2.82 (1.13, 7.04)*
Early sexual initiation	1.73 (0.27, 11.22)	0.88 (0.14, 5.58)	0.81 (0.09, 7.00)	0.43 (0.04, 4.32)	1.20 (0.26, 5.60)	2.12 (0.37, 12.32)

Anxiety: General Anxiety Disorder-7 (GAD7) ≥ 10, moderate to severe anxiety disorder; AOR: Adjusted odds ratio; Depression: Patient Health Questionnaire-9 (PHQ-9) ≥ 10, moderate to severe depression; Loneliness: UCLA-3 ≥ 4; Low life satisfaction: Dissatisfied (1-3) in a 7-point Likert question; Low meaning in life: meaningless and without purpose (1-3) in a 7-point Likert question; Multimorbidity: At least two chronic conditions.

Regression adjusted for age, gender, marriage, education, childhood living place, and ACEs. *p < .05, **p < .01, ***p < .001.

After adjusting for PCEs, when compared with 0 ACE, a cumulative relationship was found for higher risks of anxiety, loneliness, and low life satisfaction ($p < .05$) (Table 3). Exposure to four or more ACEs remained to be a risk factor for ever smoking, and ever binge drinking compared with none ACE exposure ($p > .05$) (Table 3).

3.2. Association of PCEs and ACEs with health outcomes in the context of one another

For the association of PCEs and ACEs with health outcomes in the context of each other, Supplemental Table 1 first summarized the stratified results of the four groups with different levels of PCEs and ACEs. Table 4 summarizes the stratified COR before adjustment. After adjusting for demographics (Table 5), among participants with more ACEs, more PCEs were significantly associated

with lower risks of depression, loneliness, poor or fair self-rated health, low life satisfaction, and low meaning in life ($p < .05$). Among participants with fewer ACEs, more PCEs were associated with lower risks of anxiety, loneliness, multimorbidity, low life satisfaction, and low meaning in life ($p < .05$). For those with more PCEs, more ACEs were associated with higher risks of anxiety, loneliness, multimorbidity, and low life satisfaction ($p < .05$). Among people with fewer PCEs, more ACEs were only significantly related to a higher risk of low life satisfaction ($p < .05$).

3.3. Individual association of multiple types of ACEs and PCEs with risky behaviours and mental health indicators

For the multiple types of PCEs and ACEs (Figure 1), perceived internal and external safety and security

Table 4. The association of PCEs and ACEs with health outcomes in the context of one another before adjustment.

Outcomes	More ACEs ($n = 170$)#	Fewer ACEs ($n = 162$)#	More PCEs ($n = 219$)#	Fewer PCEs ($n = 113$)#
	More PCEs vs fewer PCEs COR (95% CI)	More PCEs vs fewer PCEs COR (95% CI)	More ACEs vs fewer ACEs COR (95% CI)	More ACEs vs fewer ACEs COR (95% CI)
<i>Mental health indicators</i>				
Depression	0.45 (0.21, 0.98)*	0.62 (0.28, 1.36)	1.48 (0.83, 2.62)	2.03 (0.79, 5.22)
Anxiety	0.85 (0.43, 1.68)	0.37 (0.17, 0.81)*	2.34 (1.33, 4.10)**	1.02 (0.43, 2.43)
Loneliness	0.41 (0.21, 0.77)**	0.18 (0.09, 0.39)***	2.92 (1.64, 5.20)***	1.31 (0.58, 2.95)
Poor or fair self-rated health	0.28 (0.15, 0.54)***	0.24 (0.11, 0.50)	1.71 (0.98, 2.97)	1.45 (0.63, 3.32)
Multimorbidity	1.36 (0.43, 4.23)	0.18 (0.04, 0.80)*	3.98 (1.05, 15.12)*	0.54 (0.15, 1.98)
Low life satisfaction	0.17 (0.08, 0.36)***	0.05 (0.01, 0.22)***	9.10 (2.00, 41.38)**	2.44 (1.06, 5.60)*
Low meaning in life	0.26 (0.13, 0.50)***	0.18 (0.08, 0.40)***	1.56 (0.78, 3.13)	1.11 (0.52, 2.39)
<i>Risky behaviours</i>				
Ever smoking	0.48 (0.08, 2.94)	0.67 (0.06, 7.61)	1.24 (0.17, 8.96)	1.74 (0.17, 17.28)
Ever binge drinking	0.90 (0.45, 1.82)	0.51 (0.21, 1.22)	1.98 (1.00, 3.95)	1.11 (0.46, 2.69)
Early sexual initiation	0.74 (0.18, 3.06)	0.33 (0.05, 2.45)	2.54 (0.46, 14.19)	1.15 (0.20, 6.55)

Anxiety: General Anxiety Disorder-7 (GAD7) ≥ 10 , moderate to severe anxiety disorder; COR: Crude odds ratio; Depression: Patient Health Questionnaire-9 (PHQ-9) ≥ 10 , moderate to severe depression; Loneliness: UCLA-3 ≥ 4 ; Low life satisfaction: Dissatisfied (1-3) in a 7-point Likert question; Low meaning in life: meaningless and without purpose (1-3) in a 7-point Likert question; Multimorbidity: At least two chronic conditions.

More PCEs: ≥ 7 PCEs; Fewer PCEs: 0-6 PCEs; More ACEs: ≥ 2 ACEs; Fewer ACEs: 0-1 ACE. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 5. The association of PCEs and ACEs with health outcomes in the context of one another after adjustment.

Outcomes	More ACEs ($n = 170$)#	Fewer ACEs ($n = 162$)#	More PCEs ($n = 219$)#	Fewer PCEs ($n = 113$)#
	More PCEs vs fewer PCEs AOR (95% CI)	More PCEs vs fewer PCEs AOR (95% CI)	More ACEs vs fewer ACEs AOR (95% CI)	More ACEs vs fewer ACEs AOR (95% CI)
<i>Mental health indicators</i>				
Depression	0.46 (0.21, 1.02)	0.67 (0.30, 1.51)	1.44 (0.80, 2.59)	2.17 (0.80, 5.88)
Anxiety	0.88 (0.44, 1.78)	0.39 (0.18, 0.86)*	2.40 (1.34, 4.29)**	1.05 (0.43, 2.61)
Loneliness	0.37 (0.18, 0.74)**	0.19 (0.09, 0.42)***	3.15 (1.71, 5.82)***	1.43 (0.61, 3.39)
Poor or fair self-rated health	0.26 (0.13, 0.53)***	0.25 (0.12, 0.55)**	1.63 (0.91, 2.92)	1.49 (0.61, 3.62)
Multimorbidity	1.17 (0.36, 3.82)	0.19 (0.04, 0.87)**	4.07 (1.02, 16.23)*	0.37 (0.09, 1.53)
Low life satisfaction	0.14 (0.06, 0.32)***	0.05 (0.01, 0.24)***	9.32 (1.97, 44.13)**	2.51 (1.05, 6.02)*
Low meaning in life	0.23 (0.11, 0.47)***	0.17 (0.07, 0.39)	1.56 (0.75, 3.21)	0.92 (0.40, 2.11)
<i>Risky behaviours</i>				
Ever smoking	0.44 (0.06, 2.99)	0.62 (0.04, 8.78)	1.30 (0.17, 9.85)	2.44 (0.17, 34.07)
Ever binge drinking	0.91 (0.45, 1.87)	0.57 (0.23, 1.40)	1.86 (0.90, 3.86)	1.16 (0.46, 2.89)
Early sexual initiation	0.56 (0.12, 2.70)	0.38 (0.05, 2.88)	2.19 (0.27, 18.08)	1.49 (0.23, 9.63)

Anxiety: General Anxiety Disorder-7 (GAD7) ≥ 10 , moderate to severe anxiety disorder; AOR: Adjusted odds ratio; Depression: Patient Health Questionnaire-9 (PHQ-9) ≥ 10 , moderate to severe depression; Loneliness: UCLA-3 ≥ 4 ; Low life satisfaction: Dissatisfied (1-3) in a 7-point Likert question; Low meaning in life: meaningless and without purpose (1-3) in a 7-point Likert question; Multimorbidity: At least two chronic conditions.

More PCEs: ≥ 7 PCEs; Fewer PCEs: 0-6 PCEs; More ACEs: ≥ 2 ACEs; Fewer ACEs: 0-1 ACE. Regression adjusted for age, gender, marriage, education, and childhood living place. * $p < .05$, ** $p < .01$, *** $p < .001$.

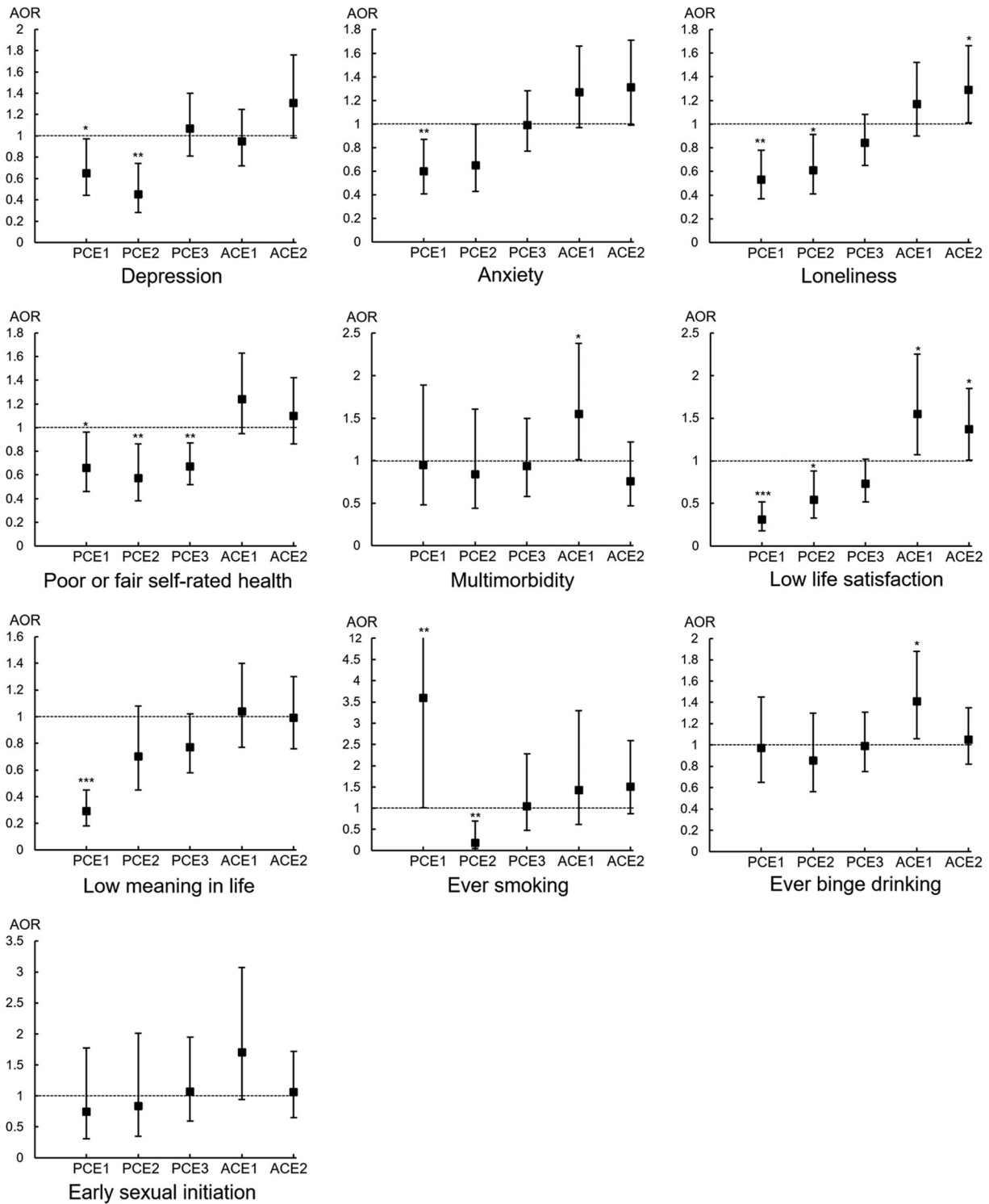


Figure 1. The association of multiple types of positive and adverse childhood experiences with risky behaviours and mental health indicators. AOR: Adjusted odds ratio; PCE1: Perceived internal and external safety and security; PCE2: Positive and predictable quality of life; PCE3: Interpersonal support; ACE1: Abuse; ACE2: Household Challenges. Adjusted for age, gender, marriage, education, and childhood living place. * $p < .05$, ** $p < .01$, *** $p < .001$.

was significantly associated with lower risks of depression (AOR = 0.65, 95% CI: 0.44-0.97), anxiety (AOR = 0.60, 95% CI: 0.41-0.87), loneliness (AOR = 0.53, 95% CI: 0.37-0.78), poor or fair self-rated health (AOR = 0.66, 95% CI: 0.46-0.96), low life satisfaction (AOR = 0.31, 95% CI: 0.18-0.52), low meaning in life (AOR = 0.29, 95% CI: 0.18-0.45), and a higher risk of smoking (AOR = 3.59, 95% CI: 1.01-12.72). Experiences on positive and predictable quality of life were

related to the lower risks of depression (AOR = 0.45, 95% CI: 0.28-0.74), loneliness (AOR = 0.61, 95% CI: 0.41-0.91), poor or fair self-rated health (AOR = 0.57, 95% CI: 0.38-0.86), low life satisfaction (AOR = 0.54, 95% CI: 0.33-0.88), and smoking (AOR = 0.18, 95% CI: 0.05-0.70). Interpersonal support was only associated with the decreased risk of poor or fair self-rated health (AOR = 0.67, 95% CI: 0.52-0.87). Abuse was associated with increased risks of multimorbidity

(AOR = 1.55, 95% CI: 1.01-2.38), low life satisfaction (AOR = 1.55, 95% CI: 1.07-2.25), and binge drinking (AOR = 1.41, 95% CI: 1.06-1.88). The number of household challenges was associated with higher risks of loneliness (AOR = 1.29, 95% CI: 1.01-1.66) and low life satisfaction (AOR = 1.37, 95% CI: 1.01-1.85).

4. Discussion

The PCEs appeared to be significantly associated with adult mental health indicators (depression, anxiety, loneliness, self-rated health, life satisfaction, and meaning in life) regardless of the count of ACEs. However, PCEs were not associated with less risky behaviours. ACEs appeared to be significantly associated with adult mental health indicators (anxiety, loneliness, and life satisfaction), and risky behaviours including smoking and binge drinking. In addition, PCEs and ACEs were also associated differently with health outcomes in the context of one another. Each type of PCEs and ACEs was also significantly associated with one or more risky behaviours and mental health indicators.

Regarding the independent associations, the findings in this study were consistent with the evidence in previous studies, which supported PCEs as a protective factor for health which included self-rated physical health, self-rated mental health, depression, anxiety, post-traumatic stress disorder symptoms after accounting for ACEs (Bethell et al., 2019; Chung et al., 2008; Kuhar & Zager Kocjan, 2021; Narayan et al., 2018). This study further discovered the independent association of PCEs with the reduced risk of loneliness, low life satisfaction, and low meaning in life, which are all important predictors of health outcomes and mortality (Cohen et al., 2016; Holt-Lunstad et al., 2015). However, the count of PCEs was not an independent protective factor for risky behaviours such as smoking, binge drinking, and early sex initiation in this study. In Kuhar et al's study, PCEs were also not significantly associated with smoking and harmful alcohol use after adjusting for ACEs in a population with a mean age of 46.5 years old (Kuhar & Zager Kocjan, 2021). This may indicate that PCE is a stronger protective factor for mental health than health-risk behaviours. This weak protection for health-risk behaviours may be explained by the role of other social determinants of these risky behaviours, including networks, socio-economic, cultural, and environmental factors, which may influence the relationship between childhood experiences and risky behaviours (Kuhar & Zager Kocjan, 2021; Marmot & Wilkinson, 2005).

Regarding how PCEs and ACEs are associated with health outcomes in the context of one another, this study suggested that PCEs had stronger associations

with mental health indicators in participants with fewer ACEs, while ACEs had stronger associations with mental health indicators in those with more PCEs. This indicates the importance of promoting PCEs, eliminating ACEs, considering the association of PCEs and ACEs with health outcomes in the context of each other, and paying attention to people with a high level of PCEs who suffer from ACEs. Furthermore, it has been indicated that the lack of PCEs might be more harmful to lifelong health than the presence of ACEs (Crandall et al., 2019). People with fewer PCEs might have unfavourable mental health status already which might not be further influenced by ACEs and they are less likely to have post-trauma growth. On the other hand, people who had more PCEs may feel more shame when ACEs occur, which makes them less likely to discuss their problems with people and institutions who can offer help to them (Crandall et al., 2019). The number and duration within each type of ACE occurrence may also be different between people with high and low levels of PCEs, which can account for the interaction of PCEs and ACEs on health outcomes (Crandall et al., 2019).

Among multiple types of ACEs, reducing abuse or its subsequent impacts might help with promoting life satisfaction and preventing risky behaviours, while reducing household challenges or its subsequent impacts might help with fostering better mental health. Among the three types of PCEs, perceived safety and predictable quality of life were associated with most of the mental health indicators including depression, anxiety, loneliness, self-rated health, life satisfaction, and meaning in life. Therefore, promoting a safe environment and positive quality of life should be given special attention in order to promote long-term health. Although perceived safety was associated with the increased risk of smoking, it may be due to the low smoking rate in Hong Kong and the small sample size in this study. These findings might be beneficial for designing more targeted early interventions, such as providing support and a safe environment for children.

Compared to the difficulties in controlling ACEs, especially when ACEs have happened, there is much room for promoting positive aspects in life. Studies have explored some potential ways to create better childhoods, such as the Carolina Abecedarian Project that implemented social-cognitive stimulation, caregiving, supervised play, and customized learning activities, and the Perry Preschool Project that offered preschool education and home-based parenting guidance (Campbell et al., 2014; Muennig et al., 2011); Conti, Heckman, and Pinto (2016)). The two projects led to significant improvement in health and health behaviours in early adulthood. Other frameworks can also be referred to in future public health practice for school, family, and community, such as

the Health Outcomes From Positive Experiences (HOPE), which is designed for preventing ACEs and other risky environmental factors, and increasing positive childhood experiences in four categories: supportive relationships, safe and equitable environment, social engagement, and social and emotional competence (Sege & Harper Browne, 2017).

The current study has valuable research implications. First, potential mediators and pathways between childhood experiences and mental health indicators as well as risky behaviours can be measured in future large-scale population-based studies by using a longitudinal design. Second, other populations such as older adults should also be studied to assess the lifetime impact of ACEs and PCEs. Third, future studies are encouraged to further explore theoretical frameworks and to develop effective interventions, especially among Asian populations, to actively provide PCEs to children in the premise of avoiding ACEs, as well as effective interventions to prevent or to relieve the health problems of children or adults with ACEs. Generally, more studies are needed to help better understand the long-term impact of childhood experiences and to bring more attention to promoting PCEs and preventing ACEs in the early stage.

4.1. Strength and limitation

This study was the first study conducted in the Asian social-cultural environment to measure the association of PCEs and ACEs with risky behaviours and health outcomes simultaneously. Their association with loneliness, life satisfaction, and meaning in life were seldom studied before. This study also explored the association of PCEs and ACEs with health outcomes in the context of one another and the association of multiple types of PCEs and ACEs with mental health and behaviours. The results can provide evidence for public health practitioners, researchers, and policymakers to enhance the healthy growth and development of children by reducing the adverse effect of ACEs and adding the positive effect of PCEs.

This study also has several limitations to acknowledge. First, this was an exploratory cross-sectional study using convenience sampling in a single university with a limited sample size. Self-reported measures were used and the majority of the participants were female. The generalizability of our results to other populations was not known and further studies are needed. Second, recall bias could lead to inaccurate reporting of past childhood experiences, especially the sensitive ones (Prokopez et al., 2020; Rehkopf et al., 2016). Therefore, measures were taken during the data collection process to cope with the sensitive nature of the study. For instance, positive questions were measured first and missing responses were allowed. Additionally, the inclusion of the young

adult sample in our study may reduce the recall bias because they had just reached adulthood. Third, this study was conducted during the COVID-19 epidemic, which may have impacted the mental health of the participants, therefore confounding the results. Finally, only limited outcomes were included to measure mental health indicators and risky behaviours. Future studies can explore the association of childhood experiences with mental health indicators and risky behaviours more comprehensively.

4.2. Conclusions

In this study, PCE was proven to be an independent protective factor against poor mental health while ACE was proven to be an independent risk factor for both poor mental health and risky behaviours. Cumulative relationships were also found between the count of childhood experiences, depression, anxiety, loneliness, self-rated health, life satisfaction, and meaning in life. PCEs showed stronger protective associations with mental health indicators in participants with fewer ACEs. ACEs showed stronger risk associations with mental health indicators in participants with more PCEs, while ACEs had no association with mental health indicators in participants with fewer PCEs except for life satisfaction. This work suggests a need for programme and policy solutions to actively promote PCEs and prevent/treat ACEs at the same time. The results on significant associations of multiple types of PCEs and ACEs with risky behaviours and mental health indicators can be taken into consideration in the development of interventions in the future.

Data availability statement

The data that support the findings of this study are openly available in figshare at <http://doi.org/10.6084/m9.figshare.16802329>.

Disclosure statement

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

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