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## Exploring the health burden of cumulative and specific adverse childhood experiences in New Zealand: Results from a population-based study

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### ABSTRACT

**Background:** Adverse childhood experiences (ACEs) can influence later health, but there are gaps in understanding how ACEs may interact with Positive Childhood Experiences (PCEs). Additionally, there are gaps in understanding how ACEs impact on positive markers of health.

**Objectives:** To explore associations of ACEs with both negative and positive markers of physical and mental health in adulthood and to examine whether positive childhood experiences (PCEs) can mitigate the negative effects of ACEs on health.

**Participants and setting:** 2887 participants (1464 female, 1423 male) from the 2019 New Zealand Family Violence Survey, a population-based study conducted in New Zealand between March 2017–March 2019.

**Methods:** Multivariable logistic regressions were conducted to ascertain how both ACE score and ACE subtypes influenced the odds of experiencing adverse and positive mental and physical health after adjusting for socio-demographic predictors. A combined ACE-PCE variable was created and included in the multivariable logistic regression models to examine whether PCEs can mitigate the negative effects of ACEs.

**Results:** Findings indicated that respondents with higher ACE scores had an increased likelihood of reporting each adverse outcome. Higher ACE scores had the strongest association with poor mental health followed by disability and chronic physical health conditions. Respondents with higher ACE scores had a decreased likelihood of reporting each positive health outcome. Exposure to ACEs was detrimental to health even in the presence of PCEs, with minimal effects observed from PCEs given the limited variance observed from its assessment.

**Conclusion:** This study documents the deleterious impacts of ACEs on a wide range of health outcomes and demonstrates that these effects are persistent. Findings should provide the impetus for widespread prevention and intervention initiatives that seek to address ACEs. Further

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exploration of PCEs with a more complete assessment is needed to determine if they can mitigate the detrimental consequences of ACEs.

## 1. Introduction

Originally examined through the Adverse Childhood Experiences (ACE) study by Kaiser Permanente (Felitti et al., 1998), there is growing evidence that childhood adversities including exposure to various type of maltreatment (e.g., physical, sexual, and psychological abuse), and exposure to broader household dysfunction (e.g., substance abuse, mental illness, incarceration, divorce and violence) during childhood are associated with an extensive array of adverse physical health outcomes such as early adult mortality and morbidity (Bellis et al., 2019; Brown et al., 2009; Danese et al., 2009; Felitti et al., 1998; Godoy et al., 2021). ACEs are also associated with increased odds of experiencing mental health problems such as stress, depression, and anxiety (Bellis et al., 2019; Danese et al., 2009; De Venter et al., 2013). A dose–response relationship between the number of reported ACEs and health conditions has also been found, with those reporting exposure to a higher numbers of ACEs having a greater risk of developing mental and physical health comorbidities (Merrick et al., 2018). In addition to exploring the cumulative effect of ACEs on health outcomes, others have recommended that the contribution of individual ACE types be explored, in order to determine if particular ACE types are driving associations between ACE score and health outcomes. This would also provide the opportunity and to determine if different ACE types are associated with different health outcomes (Houtepen et al., 2020).

Previous studies have provided useful insights on the association between ACEs and later mental health, but most studies have defined mental health as “fewer problems” or “the absence of mental illness”. An alternative way of assessing mental health, distinct from measuring the absence of mental illness, has been developed which focuses on measuring mental health as a ‘positive state’ defined as optimal psychological functioning and a general feeling of well-being (Keyes, 2002). In this conceptualisation positive mental health operates and can be measured independently from mental ill-health (Keyes, 2002). Measuring mental health as a ‘positive state’ strengthens opportunities to move beyond a deficit model, as positive mental health is associated with a range of health benefits (Keyes, 2002, 2007). Including indicators of both mental ill-health and positive mental health holds potential to help us develop a more complete understanding of the impact of ACEs.

Recognition of the adverse health and social impacts associated with ACEs means that they have gained traction on political and policy agendas. As a result, there has been a drive within public health to prevent ACEs, mitigate their adverse effects and to promote ACE-aware services (Bethell et al., 2017; Houtepen et al., 2020). Nevertheless, some have criticized the focus on ACEs as over-emphasizing risks and not adequately addressing resilience and protective factors (Crandall et al., 2019). To address these criticisms, recent research has focused on exploring advantageous/positive childhood experiences (PCEs) which may have potential to protect against poor health and which may mitigate or outweigh long-term effects of early adversity (Bethell et al., 2019; Crandall et al., 2019).

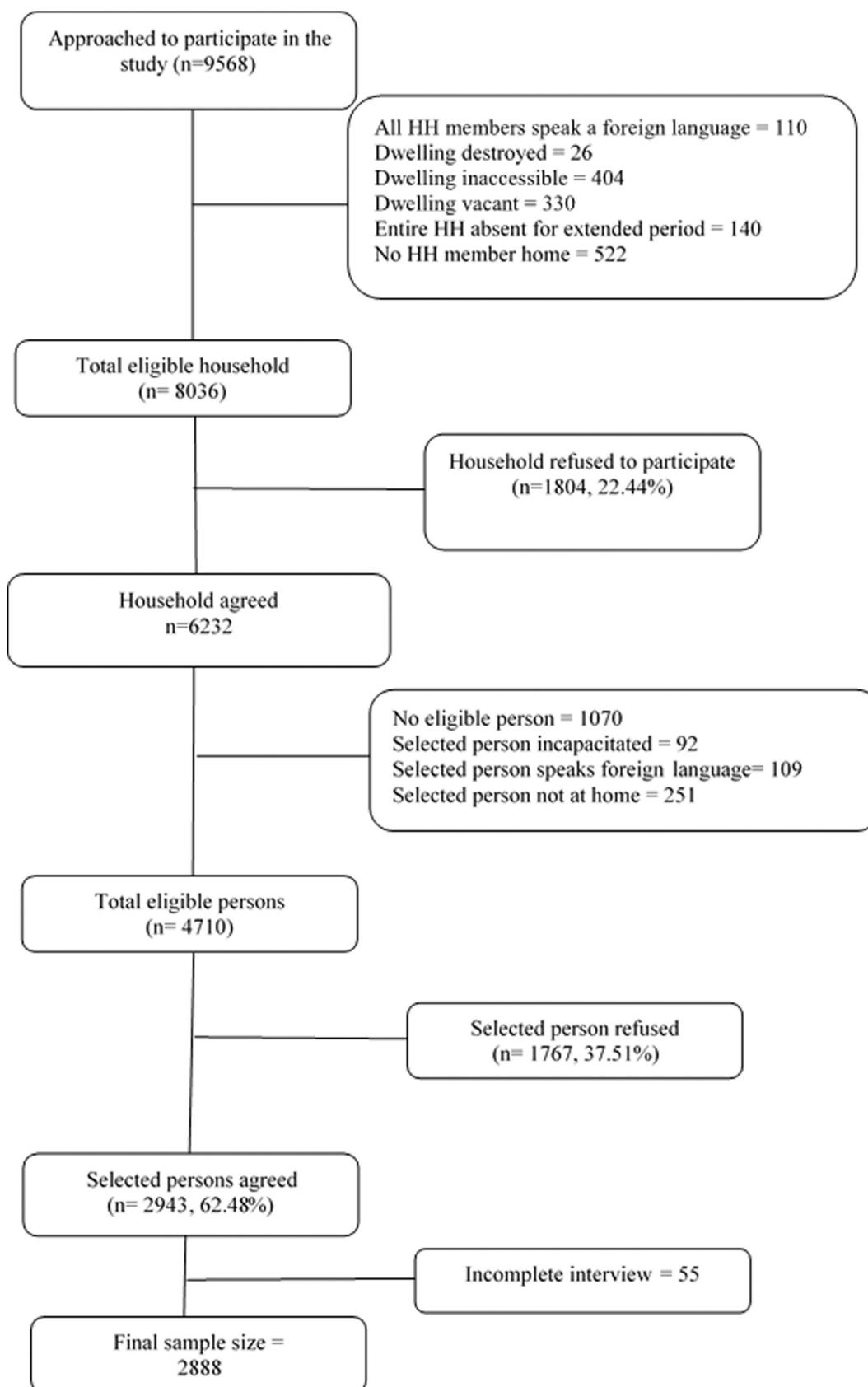
Although there is no consensus about the definition of PCEs, key favourable early experiences have been identified. These include a range of positive interactions with individuals, peers, family, as well as community and cultural influences. However, these have mostly been assessed using data from small or nonrepresentative samples (Bethell et al., 2019; Ketu-McKenzie, 2019). Adult support for children is one PCE that has been identified as an important factor in building resilience and in protecting against poor outcomes commonly attributed to ACEs (Bellis et al., 2017). Studies of the intergenerational transmission of child physical abuse have suggested that even the perception of support from significant adults during childhood may reduce the likelihood of subsequently maltreating one's child (Berlin et al., 2011). However, at present, the nature of the adult support provided is seldom articulated. Given that support can include multiple dimensions, such as financial support, emotional support (e.g., being loved) or being recognised as an individual it is important to empirically test whether different types of support have the potential to interrupt the detrimental impacts of ACEs on health.

ACEs are prevalent and co-occurring in New Zealand (NZ) and occur at a rate comparable with other high-income countries, with one in two adults (55%) reporting experience of at least one ACE and more than one-third reporting multiple exposures (Fanslow, Hashemi, et al., 2021). Despite the high prevalence of ACEs there is limited NZ research providing evidence of their long-term consequences. The research that does exist focuses mostly on the impact of a single ACE (Bell et al., 2019; Danese et al., 2009; Duncan et al., 2019). A better understanding of both the cumulative and differential impact of individual ACEs on health outcomes is needed to guide development of future interventions (Merrick et al., 2018). In addition, knowledge of whether or how PCEs interact with ACEs to effect adult mental and physical health is needed. This would inform the nation's growing policy focus on fostering well-being in early life and addressing the social determinants of healthy development and lifelong health (Department of the Prime Minister and Cabinet, (DPMC), 2019; Government of New Zealand (The Treasury), 2020).

In this paper we use data from a large population-based New Zealand survey to examine: the association of ACEs (individually and cumulatively) and later markers of negative and positive physical and mental health; to assess the degree to which these associations are robust after adjustment for a wide range of sociodemographic characteristics, and to examine whether positive childhood experiences can mitigate the negative effects of ACEs.

## 2. Methods

Data was obtained from a population based cross-sectional retrospective survey, the 2019 New Zealand Family Violence Survey/He Kōiora Matapopore. This survey was conducted between March 2017–March 2019 in three regions (Waikato, Northland, and



(caption on next page)

← Fig. 1. 2019 New Zealand Family Violence Survey: Flowchart of household and individual recruitment outcomes.

**Table 1**

Definitions of socioeconomic status, ACE types measured, outcome variables (physical and mental health, and disability), and positive childhood experiences, the 2019 New Zealand Family Violence Survey

Variable	Definition
<b>Demographic characteristics</b>	
Food security status	Respondents were asked whether they have ever been worried about not having enough money to buy food. We scored responses of “never” as 0 and all other responses (Occasionally/Sometimes/Often/All the time) as 1.
Area-level deprivation (Indices of Multiple Deprivation (IMD))	Taken from NZ index of multiple deprivation (IMD) (Exeter et al., 2017) which used a combination of routinely collected data from government departments and census data in seven domains (i.e. employment, income, crime, housing, health, education, and access to services) to develop a measure of deprivation at the neighborhood level. Participants were classified in three groups: living in low, moderate and high deprived area.
<b>ACE: Abuse</b>	
Emotional abuse	Respondents were asked whether while they were growing up:
Physical abuse	Before age 18, a parent or adult in their home ever swore at them, insulted them, or put them down? Yes/no
	Before age 18, a parent or adult in their home ever hit, beat, kicked, or physically hurt them in any way? (Not including smacking) yes/no
Sexual abuse	Before the age of 15, they remember if anyone ever touched them sexually, or made them do something sexual that they didn't want to do? Yes/no
<b>ACE Household dysfunction</b>	
Intimate partner violence witnessing	Respondents were asked whether while they were growing up, in their first 18 years of life:
Household substance abuse	Their mother or stepmother was ever slapped, hit, kicked, punched or beaten up? Yes/no
	They lived with anyone who was a problem drinker or alcoholic? Or they lived with anyone who used illegal street drugs or who abused prescription medications? Yes/no
Household mental illness	They lived with anyone who was depressed, mentally ill, or suicidal? Yes/no
Parental separation or divorce	Their parents were separated or divorced? Yes/no
Incarcerated household member	They lived with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility? Yes/no
<b>Physical health</b>	
General health	Respondents were asked whether, in general, they describe their overall health as excellent, good, fair, poor, or very poor? Responses were categorised as poor (Fair, poor, or very poor) or good (good or excellent).
Chronic health condition	Respondents were asked whether they have ever been told by their doctor that they have any of the following long-term health conditions? a) Heart disease including heart attack, angina, or heart failure, b) Cancer, c) Stroke, d) Diabetes (not including gestational diabetes), e) Asthma, f) Arthritis, including gout, lupus, and psoriatic arthritis, g) others including Endocrine disease, Musculoskeletal disease, ENT (Ear, Nose & Throat) disease, Ophthalmology Eye disease, Neurological disease, Gastrointestinal disease, Genitourinary Disorder, Respiratory disease, Metabolic disease. A binary variable was also created for reporting any (at least one) physical health condition versus none.
<b>Disability</b>	
	A binary variable was created for reporting at least one type of disability versus none.
	Respondents were asked whether they had a long-term health problem or a condition (lasted 6 months or longer) that caused them difficulty with, or stopped them from:
Physical disability	Seeing, hearing, walking, lifting or bending, using their hands to hold, grasp, or use objects
Psychological disability	Communicating, mixing with others or socializing
Cognitive disability	Learning, concentrating, or memorizing
<b>Mental health</b>	
Mental health condition	Respondents were asked whether they have been ever told by their doctor that they have any of the following long-term mental health conditions? a) Depression, b) Anxiety, c) Substance abuse disorder including alcohol abuse, d) Other (including PTSD, OCD (Obsessive-Compulsive Disorder), Insomnia, Schizophrenia, etc.). In addition to individual mental health conditions, a binary variable was also created for reporting any (at least one) mental health condition versus none.
Taking antidepressant medication	Respondents were asked whether in the past four weeks, they had taken medication to help them not feel sad or depressed? Response options were yes/no.
Taking sleep medication	Respondents were asked whether in the past four weeks, they had taken medication to help them calm down or sleep? Response options were yes/no.
Poor mental health	Respondents were classified as having low mental health if they had received a diagnosis of aforementioned mental health conditions or reported taking sleep or antidepressant medication in the past four weeks.
Positive mental health	Keyes' Mental Health Continuum Short Form (MHC-SF) was used to measure positive mental health. The MHC-SF groups 13 dimensions of mental health under three categories: Positive Emotions (including positive affect and avowed quality of life), Positive Psychological Functioning (including self-acceptance, personal growth, purpose in life, environmental mastery, autonomy and positive relations with others), and Positive Social Functioning (including social acceptance, social actualisation, social contribution, social coherence and social integration) (Keyes, 2007). Participants rated the frequency with which they experienced each of these items in the past month on a 6-point Likert scale, where never = 1, every day = 6. Positive mental health was defined as having a score of 5 or 6 on one of two measures of emotional well-being, and a score of 5 or 6 on six of the eleven items of psychological and social wellbeing.
<b>Positive childhood experiences</b>	
	Respondents were asked when they were growing up, in their first 18 years of life, did they live with anyone who .....?
	Response options were no one, mother/stepmother, father/step-father, siblings, other relatives, close friend of the family, others.
Strengths were recognised	Recognised and encouraged their strengths?
Being loved	Loved them and who was on their side?

Auckland, which contained 40% of the New Zealand population). The survey collected data from individuals aged 16 and over who were able to speak English. Questions assessed their exposure to violence, childhood experiences, and physical and mental health outcomes. Full details of the study methods are published elsewhere but are summarized briefly here (Fanslow, Gulliver, et al., 2021).

### 2.1. Data collection and sampling method

Primary sampling units (PSU) based on meshblock boundaries were used to conduct random sampling. These units are the smallest geographical units used by Statistics New Zealand. Within each meshblock a random starting point was identified, and every second and sixth house within the meshblock was selected. Non-residential and short-term residential properties, rest homes and retirement villages were excluded. Specific meshblocks were allocated to each gender for safety reasons. As part of the door-knocking protocol, only one randomly selected person per household could participate in the study.

Comprehensive training of all interviewers was conducted to ensure valid data collection and the safety of interviewers and respondents. Face-to-face interviews were conducted privately in the home or other private location, with no one aged 2 years or over present. All respondents provided written consent prior to interview. Ethics approval was received from The University of Auckland Human Participants Ethics Committee (reference number 2015/018244).

### 2.2. Study sample

Of 9568 households approached, 1532 were ineligible to participate. Of 8036 eligible households, 1804 (22.4%) refused to participate. Of 6232 households who agreed to participate, 1271 participants were ineligible (mainly due to not speaking English or being incapacitated). A further 251 were not at home after several attempts. Of the remaining 4710 eligible participants, 1767 (37.5%) refused to participate. After excluding incomplete interviews ( $n = 55$ ), 2888 participants remained in the study (1464 female and 1423 male, 1 other [excluded from further analyses]), yielding an overall response rate of 63.7% of the remaining eligible individuals (Fig. 1). Socio-demographics characteristics of the study sample are presented in Table 2.

### 2.3. Representativeness

The ethnicity, marital status, average income and deprivation level distribution of the sample were closely comparable to the general population, however the sample was under-represented for younger participants (ages 16–29) and slightly over-represented for those over 60 years of age (Fanslow, Gulliver, et al., 2021).

### 2.4. Measures

#### 2.4.1. Exposure of interest: ACEs

The main exposure variable for the current study was the ACE scale, adapted from the US ACE Study (Merrick et al., 2018). The ACE scale consists of 11 questions collapsed into 8 dichotomously coded ACE categories: physical abuse, emotional abuse, sexual abuse, IPV witnessing, household substance use, household mental illness, parental separation or divorce, and incarcerated household member (Table 1). Respondents were asked if they were impacted by these adverse experiences prior to age 18. The only exception was sexual abuse which was asked for the period before age 15.

We created an “ACE Score” variable by adding the dichotomous scores of each ACE type to calculate an overall ACE Score for each respondent (range: 0 to 8). The scores were grouped into four categories: 0, 1, 2 to 3, and 4 or more ACEs. We use four as our threshold as the original ACEs study found that risk of experiencing adult health problems dramatically increased with exposure to four or more ACEs (Felitti et al., 1998).

#### 2.4.2. Positive childhood experiences

PCE was assessed using two questions related to the respondent's perception that: an adult loved them, and an adult recognised their childhood strengths (Table 1). Responses to these questions were dichotomized (yes/no).

#### 2.4.3. Sociodemographic characteristics

Sociodemographic variables were used to explore the prevalence rates of reported health outcomes among sub-groups of the population and as potential confounders in multivariable analyses. Variables included gender, age (16–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, and 65 and over years), ethnicity (European, Māori, Pacific, Asian, MELAA [Middle East, Latin American, African]), personal income (\$0–\$49K, \$50K–\$74K, \$75K–100K, >\$100K), education (primary/secondary, tertiary), employment status (unemployed, student, and employed [currently working or retired]), area-level deprivation (taken from the NZ index of multiple deprivation (IMD) (Exeter et al., 2017)), and food security status (Table 1).

#### 2.4.4. Outcomes of interest: health status as an adult

Adverse health outcomes were measured through self-reports of clinically diagnosed chronic physical health conditions, poor mental health and disability. A binary variable was created for reporting any (at least one) physical health condition versus none and a binary variable was created for reporting at least one type of disability versus none. Poor mental health was also dichotomized for reporting any (at least one) mental health condition versus none.

**Table 2**

Distribution of socio-demographic characteristics, ACE score and Positive Childhood Experiences (PCE) for the sample and their relationship with health outcomes, the 2019 New Zealand Family Violence Study.

	Unweighted n (W%)	Adverse health outcomes			Positive health outcomes	
		Chronic health conditions W%	Poor mental health W%	Disability W%	Good general health W%	Positive mental health W%
All	2888	42.4	25.2	18.0	77.7	73.8
Gender						
Male	1423 (50.2)	38.4	18.2	15.1	78.1	73.7
Female	1464 (49.8)	46.4	32.2	21.0	77.2	73.7
$\chi^2$ (p-value)		12.7 (0.001)	54.5 (0.0001)	12.7 (0.0004)	0.31 (0.57)	0.0003 (0.98)
Age group, years						
16–24	228 (12.8)	21.9	17.1	11.3	76.7	63.3
25–34	355 (13.5)	21.6	23.3	11.8	81.4	68.9
35–44	507 (16.0)	25.0	25.0	11.0	78.8	75.2
45–54	548 (19.7)	38.5	27.0	18.0	79.3	76.6
55–64	508 (16.3)	57.5	28.9	22.9	72.6	71.9
≥65	738 (21.7)	72.4	27.1	27.2	77.3	80.7
$\chi^2$ (p-value)		67.3 (0.0001)	3.0 (0.01)	11.9 (0.0001)	1.75 (0.12)	6.5 (0.0001)
Ethnicity						
European	1984 (63.0)	47.3	28.9	20.3	80.4	74.7
Māori	318 (12.0)	47.6	33.6	25.2	66.2	75.4
Pacific	159 (7.9)	45.4	11.5	10.6	66.4	75.2
Asian	378 (15.6)	18.6	10.6	7.0	80.6	69.5
MELAA	45 (1.5)	22.6	26.4	15.7	84.6	56.6
$\chi^2$ (p-value)		18.5 (0.0001)	19.1 (0.0001)	12 (0.0001)	9.91 (0.0001)	2.01 (0.09)
Personal income, \$						
0–\$49K	1504 (57.0)	44.4	28.8	22.0	74.1	72.0
\$50–\$74K	509 (18.9)	39.1	20.8	12.3	80.5	75.8
\$75–\$100K	338 (11.4)	37.7	21.0	13.1	84.6	78.7
>\$100K	383 (12.6)	38.8	21.1	11.7	85.1	77.7
$\chi^2$ (p-value)		2.3 (0.08)	6.7 (0.0002)	12.3 (0.0001)	8.7 (0.0001)	2.90 (0.03)
Educational attainment						
Primary or secondary	1230 (44.0)	49.6	27.1	22.8	72.6	71.6
Tertiary	1649 (56.0)	41.1	27.0	16.1	81.1	75.9
$\chi^2$ (p-value)		20.5 (0.001)	0.1 (0.7)	20.6 (0.001)	29.7 (0.001)	6.6 (0.01)
Area deprivation level						
Low	789 (25.7)	44.4	24.9	17.2	83.0	73.7
Moderate	1244 (41.8)	41.2	26.8	18.4	79.3	75.5
High	852 (32.4)	42.2	23.5	18.1	71.3	71.6
$\chi^2$ (p-value)		0.6 (0.5)	1.1 (0.3)	0.17 (0.8)	14.7 (0.0001)	1.4 (0.2)
Food security						
Secure	2352 (81.1)	41.2	22.4	15.2	81.9	75.7
Insecure	520 (18.9)	47.5	37.5	30.2	60.1	65.9
$\chi^2$ (p-value)		5.6 (0.02)	37.3 (0.0001)	59.8 (0.0001)	87.0 (0.0001)	16.4 (0.0001)
Employment status						
Not working/housework	331 (12.0)	45.6	33.2	28.6	63.7	0.68
Student	161 (8.7)	20.5	17.4	13.3	80.5	0.63
Employed/retired	2393 (79.2)	46.2	26.9	18.1	79.3	0.75
$\chi^2$ (p-value)		40.5 (0.001)	14 (0.001)	24.1 (0.001)	41.1 (0.001)	18.2 (0.001)
ACE score						
0	1300 (45.1)	42.3	17.3	13.6	82.1	78.6
1	628 (21.7)	39.8	25.7	17.0	80.1	76.9
2–3	626 (21.9)	42.6	29.9	22.1	72.2	66.7
4 or more	334 (11.2)	47.3	47.0	30.0	65.9	62.1
$\chi^2$ (p-value)		1.28 (0.2)	36.9 (0.0001)	16.9 (0.0001)	14.4 (0.0001)	15.7 (0.0001)
PCE						
Strengths were recognised						
Yes	2500 (87.7)	40.9	24.4	16.8	79.0	74.9
No	388 (12.3)	53.0	31.2	26.7	68.1	65.6
$\chi^2$ (p-value)		17.5 (0.001)	6.4 (0.01)	20.7 (0.0001)	18.8 (0.0001)	12.4 (0.0004)
Being loved						
Yes	2765 (96.1)	41.9	24.7	17.3	78.3	74.3

(continued on next page)

Table 2 (continued)

	Unweighted n (W%)	Adverse health outcomes			Positive health outcomes	
		Chronic health conditions W%	Poor mental health W%	Disability W%	Good general health W%	Positive mental health W%
No	123 (3.9)	54.7	37.4	35.3	61.3	61.1
$\chi^2$ (p-value)		7.2 (0.007)	10.4 (0.001)	22 (0.00001)	19.0 (0.0001)	8.86 (0.003)

Note. W%: Weighted percentages.

Table 3

Multivariable logistic regression models for association between ACE score and adverse and positive health outcomes controlling for socio-demographic characteristics, the 2019 New Zealand Family Violence Study.

		Adverse health outcomes			Positive health outcomes	
		Physical health condition AOR (95%CI)	Poor mental health AOR (95%CI)	Disability AOR (95%CI)	Good general health AOR (95%CI)	Positive mental health AOR (95%CI)
ACE score	0	Ref	Ref	Ref	Ref	Ref
	1	0.99 (0.77–1.27)	<b>1.52 (1.16–1.99)</b>	1.32 (0.98–1.79)	0.94 (0.70–1.27)	0.94 (0.71–1.23)
	2–3	1.22 (0.95–1.55)	<b>1.87 (1.46–2.40)</b>	<b>1.83 (1.38–2.42)</b>	<b>0.61 (0.47–0.79)</b>	<b>0.55 (0.42–0.71)</b>
	4+	<b>1.45 (1.05–2.00)</b>	<b>3.03 (2.22–4.14)</b>	<b>2.41 (1.72–3.40)</b>	<b>0.50 (0.36–0.70)</b>	<b>0.47 (0.34–0.65)</b>
Gender	Female	1.20 (0.96–1.50)	<b>1.81 (1.44–2.26)</b>	1.12 (0.87–1.43)	1.12 (0.90–1.41)	1.09 (0.87–1.37)
Age	16–24	Ref	Ref	Ref	Ref	Ref
	25–34	1.10 (0.69–1.76)	1.22 (0.73–2.05)	0.95 (0.51–1.74)	1.53 (0.90–2.60)	1.34 (0.81–2.20)
	35–44	1.26 (0.77–2.05)	1.25 (0.75–2.08)	0.92 (0.50–1.68)	1.03 (0.61–1.73)	1.50 (0.94–2.40)
	45–54	<b>2.24 (1.37–3.65)</b>	1.28 (0.77–2.13)	1.60 (0.87–2.95)	1.02 (0.60–1.74)	<b>1.67 (1.03–2.70)</b>
	55–64	<b>4.95 (3.08–7.93)</b>	1.36 (0.82–2.26)	<b>2.17 (1.21–3.88)</b>	0.68 (0.41–1.13)	1.39 (0.88–2.20)
	≥65	<b>10.2 (6.27–16.52)</b>	1.30 (0.80–2.12)	<b>3.05 (1.73–5.39)</b>	0.66 (0.40–1.08)	<b>2.09 (1.30–3.34)</b>
Education (ref = primary/secondary)	Tertiary	0.96 (0.77–1.19)	1.12 (0.90–1.39)	0.96 (0.76–1.22)	1.11 (0.87–1.41)	1.18 (0.95–1.47)
Ethnicity	European	Ref	Ref	Ref	Ref	Ref
	Māori	1.26 (0.93–1.72)	0.83 (0.59–1.18)	1.01 (0.69–1.48)	<b>0.70 (0.50–0.98)</b>	<b>1.69 (1.17–2.43)</b>
	Pacific	1.39 (0.76–2.54)	<b>0.29 (0.16–0.50)</b>	<b>0.40 (0.22–0.73)</b>	0.72 (0.45–1.15)	1.53 (0.94–2.49)
	Asian	<b>0.57 (0.41–0.79)</b>	<b>0.35 (0.23–0.51)</b>	<b>0.49 (0.31–0.78)</b>	0.72 (0.50–1.02)	0.81 (0.58–1.13)
	MELAA	0.64 (0.28–1.45)	0.93 (0.39–2.21)	0.89 (0.33–2.40)	1.04 (0.43–2.50)	0.70 (0.34–1.45)
Area-deprivation level	Low	Ref	Ref	Ref	Ref	Ref
	Moderate	0.97 (0.76–1.23)	1.14 (0.89–1.46)	1.09 (0.82–1.45)	0.92 (0.70–1.21)	1.15 (0.89–1.49)
	High	1.02 (0.76–1.37)	0.94 (0.70–1.25)	0.94 (0.68–1.31)	0.81 (0.60–1.09)	1.08 (0.82–1.44)
Food security (ref = secure)	Insecure	<b>1.43 (1.08–1.89)</b>	<b>2.36 (1.80–3.11)</b>	<b>2.53 (1.92–3.32)</b>	<b>0.42 (0.32–0.55)</b>	<b>0.69 (0.53–0.90)</b>
Employment status	Not employed	Ref	Ref	Ref	Ref	Ref
	Students	0.83 (0.47–1.47)	0.53 (0.28–1.02)	0.60 (0.29–1.24)	<b>2.40 (1.29–4.47)</b>	1.15 (0.63–2.07)
Personal income	Retired/employed	0.86 (0.62–1.19)	1.04 (0.74–1.48)	<b>0.62 (0.44–0.86)</b>	<b>1.74 (1.25–2.42)</b>	1.14 (0.81–1.61)
	0–\$49K	Ref	Ref	Ref	Ref	Ref
	\$50–\$74K	1.00 (0.74–1.34)	<b>0.69 (0.52–0.92)</b>	<b>0.66 (0.47–0.94)</b>	1.11 (0.81–1.53)	1.09 (0.81–1.45)
	\$75–\$100K	0.94 (0.68–1.31)	0.70 (0.49–1.00)	0.71 (0.46–1.11)	1.49 (0.98–2.27)	1.28 (0.90–1.82)
>\$100K	1.04 (0.74–1.46)	0.77 (0.56–1.06)	0.65 (0.41–1.03)	1.32 (0.88–1.98)	1.19 (0.84–1.68)	

Note. AOR: Adjusted odds ratio: adjusted for gender, age, education, ethnicity, area deprivation, food security status, employment status, and personal income. The significant AORs are in bold font.

Positive health outcomes were measured through self-perceived ratings of positive mental health using Keyes' Mental Health Continuum Short Form (MHC-SF) (Keyes, 2007) and good general health. These two outcome variables were also dichotomized. For outcome variables which had multiple components, specific health outcomes were also included in the analyses (Table 1).

## 2.5. Analytic procedures

All analyses were conducted using Stata 14.2 (StataCorp, 2015) survey commands to allow for stratification by sample location (three regions), clustering by primary sampling units (PSU), and weighting of data to account for the number of eligible participants in each household. Problems with missingness were minor, around 1% for ACE variables, except for sexual abuse for which 5% of cases were missing.

Descriptive statistics (percentages) were used to describe the prevalence of each socio-demographic characteristic, ACE score, and PCEs for the overall sample and by each outcome variable (Table 2). Chi-square tests were used to examine whether outcome variables differed by these variables. Multivariable logistic regressions were run to calculate the odds of experiencing adverse and positive mental and physical health by ACE score, adjusted for established socio-demographic predictors of health outcome and with significant associations at  $p < 0.05$  in the bivariate analysis (i.e., gender, age, education, ethnicity, area deprivation, food security status, employment status, personal income). Results are reported as adjusted odds ratios (AORs) with 95% CIs (Table 3). Confidence intervals that do not cross 1.00 indicate significant results. The same analyses were repeated for ACE score, each individual ACE, and each component of adverse health outcome variables (Tables 4 and 5).

To examine whether PCEs can mitigate the negative effects of ACEs, a combined ACE-PCE variable was created for each individual PCE and included in the multivariable logistic regression models as a single variable (Tables 6 and 7). This was done as there was a strong relationship between ACE score and PCEs ( $r_{\text{Spearman}} = 0.27, p < 0.001$ ). This analytic procedure has also been used in other studies (Bellis et al., 2017; Bellis et al., 2018). For the purpose of these analyses, sample size and statistical power analysis findings required combining ACE categories into two categories (0–1 ACE vs  $\geq 2$  ACEs). This ensured adequate sample sizes in each group while maintaining differentiation between individuals who experienced a high or low number of ACEs. The combined ACE-PCE variable was categorised into all possible combinations of ACE category (0–1 and  $\geq 2$  ACEs), and PCE score (yes or no).

## 3. Results

### 3.1. Sample characteristics and prevalence of health outcomes by ACEs and PCEs

Of 2887 respondents, half (49.8%) were female, those who identified as European comprised 63% of the sample, 12% identified as Māori, 32.4% reported living in high deprivation areas, and 18.9% were classified as food insecure. Overall, less than half (45.1%, 95% CI: 42.9–47.3) reported zero ACEs, 21.7% (95%CI: 20.1–23.6) reported one ACE, and one in three (33.1%) reported multiple ACEs.

**Table 4**

Multivariable logistic regression models for association between ACE score and specific health outcomes, the 2019 New Zealand Family Violence Study.

Outcome	ACE score		
	Score: 1 AOR (95%CI)	Score: 2 to 3 AOR (95%CI)	Score: 4 or more AOR (95%CI)
Chronic physical health conditions			
Heart disease	1.32 (0.88–1.98)	1.34 (0.89–2.02)	<b>1.78 (1.05–3.02)</b>
Cancer	0.80 (0.52–1.24)	1.05 (0.67–1.66)	1.17 (0.63–2.18)
Stroke	1.32 (0.57–3.09)	1.48 (0.60–3.62)	2.49 (0.94–6.58)
Diabetes	0.78 (0.50–1.23)	0.94 (0.59–1.50)	1.09 (0.60–1.95)
Asthma	1.23 (0.85–1.78)	1.34 (0.96–1.88)	<b>1.63 (1.01–2.41)</b>
Arthritis	0.94 (0.69–1.28)	<b>1.40 (1.04–1.89)</b>	<b>1.71 (1.12–2.61)</b>
Other health conditions	1.24 (0.76–2.00)	1.05 (0.64–1.72)	1.12 (0.60–2.12)
Disability			
Physical disability	<b>1.38 (1.02–1.87)</b>	<b>1.74 (1.29–2.35)</b>	<b>2.12 (1.49–3.02)</b>
Psychological disability	0.99 (0.47–2.12)	<b>1.89 (1.08–3.31)</b>	<b>3.74 (2.13–6.59)</b>
Cognitive disability	1.15 (0.67–1.97)	<b>1.86 (1.20–2.88)</b>	<b>2.45 (1.49–4.03)</b>
Mental health condition			
Depression	<b>2.07 (1.40–3.05)</b>	<b>2.53 (1.76–3.66)</b>	<b>4.00 (2.66–6.04)</b>
Anxiety	<b>1.67 (1.13–2.48)</b>	<b>2.01 (1.41–2.87)</b>	<b>3.19 (2.11–4.80)</b>
Substance abuse disorder	<b>9.88 (1.75–55.64)</b>	<b>7.85 (1.68–36.8)</b>	<b>20.36 (4.46–92.87)</b>
Other mental health conditions	3.25 (0.63–16.69)	<b>5.12 (1.37–19.07)</b>	<b>7.77 (1.68–35.84)</b>
At least one mental health condition	<b>1.89 (1.35–2.65)</b>	<b>2.42 (1.78–3.29)</b>	<b>4.11 (2.93–5.77)</b>
Sleep medication	1.05 (0.75–1.44)	<b>1.42 (1.08–1.86)</b>	<b>2.11 (1.49–2.99)</b>
Depression medication	1.20 (0.79–1.82)	<b>1.84 (1.25–2.69)</b>	<b>2.44 (1.52–3.92)</b>

Notes. AOR: Adjusted odds ratio: adjusted for gender, age, ethnicity, area deprivation level, food security status, education, employment status, and personal income. The significant AORs are in bold font.

Reference group: those with ACE score = 0.

**Table 5**

Multivariable logistic regression models for association between individual ACEs and specific health outcomes, the 2019 New Zealand Family Violence Study.

	Emotional abuse AOR (95% CI)	Physical abuse AOR (95% CI)	Sexual abuse AOR (95% CI)	IPV witnessing AOR (95% CI)	Household substance abuse AOR (95%CI)	Household mental illness AOR (95%CI)	Parental separation/divorce AOR (95%CI)	Incarcerated household member AOR (95%CI)
Chronic physical health condition								
Heart disease	<b>1.49</b> (1.05–2.12)	1.27 (0.86–1.88)	<b>1.91</b> (1.32–2.77)	<b>1.61</b> (1.07–2.40)	<b>1.53</b> (1.03–2.27)	0.86 (0.55–1.33)	1.05 (0.70–1.59)	1.60 (0.57–4.42)
Cancer	1.32 (0.91–1.92)	0.88 (0.55–1.42)	1.32 (0.83–2.09)	0.75 (0.46–1.20)	1.27 (0.84–1.90)	1.04 (0.66–1.63)	1.39 (0.88–2.21)	1.44 (0.48–4.26)
Stroke	1.02 (0.51–2.07)	<b>2.27</b> (1.20–4.30)	1.06 (0.45–2.46)	<b>2.19</b> (1.03–4.65)	<b>2.66</b> (1.40–5.08)	1.54 (0.73–3.25)	1.20 (0.56–2.56)	<b>4.81</b> (1.48–15.57)
Diabetes	1.19 (0.83–1.71)	1.05 (0.68–1.63)	1.16 (0.73–1.85)	0.95 (0.59–1.51)	1.03 (0.67–1.61)	0.90 (0.53–1.51)	0.90 (0.55–1.43)	1.54 (0.57–4.20)
Asthma	1.08 (0.81–1.43)	1.00 (0.73–1.38)	1.37 (0.98–1.92)	1.28 (0.93–1.74)	<b>1.37</b> (1.01–1.86)	<b>1.54</b> (1.15–2.06)	<b>1.47</b> (1.08–2.00)	1.13 (0.62–2.07)
Arthritis	<b>1.35</b> (1.04–1.75)	<b>1.60</b> (1.21–2.12)	<b>1.44</b> (1.10–1.88)	<b>1.40</b> (1.01–1.94)	1.18 (0.88–1.58)	1.30 (0.96–1.75)	1.08 (0.80–1.46)	1.35 (0.72–2.51)
Other physical health conditions	1.10 (0.74–1.63)	1.19 (0.77–1.84)	1.14 (0.73–1.80)	0.90 (0.56–1.44)	1.31 (0.89–1.93)	1.31 (0.88–1.95)	<b>0.60</b> (0.39–0.94)	0.67 (0.24–1.84)
Disability								
Physical disability	<b>1.75</b> (1.36–2.24)	<b>1.74</b> (1.33–2.27)	<b>1.32</b> (1.00–1.75)	1.23 (0.93–1.62)	<b>1.33</b> (1.01–1.75)	<b>1.66</b> (1.26–2.19)	<b>1.37</b> (1.01–1.85)	1.20 (0.67–2.12)
Psychological disability	<b>2.95</b> (1.93–4.51)	<b>2.03</b> (1.29–3.17)	<b>2.41</b> (1.44–4.04)	<b>1.90</b> (1.11–3.25)	<b>1.57</b> (1.01–2.44)	<b>2.94</b> (1.85–4.65)	1.42 (0.88–2.28)	1.67 (0.79–3.55)
Cognitive disability	<b>2.22</b> (1.55–3.16)	<b>2.11</b> (1.41–3.17)	1.41 (0.91–2.17)	1.28 (0.82–2.00)	1.21 (0.81–1.80)	<b>1.73</b> (1.18–2.54)	<b>1.66</b> (1.05–2.61)	1.36 (0.65–2.82)
Mental health condition								
Depression	<b>2.08</b> (1.57–2.75)	<b>2.32</b> (1.72–3.11)	<b>2.31</b> (1.70–3.14)	<b>1.58</b> (1.15–2.17)	<b>1.70</b> (1.25–2.30)	<b>2.93</b> (2.23–3.86)	1.33 (0.97–1.82)	1.00 (0.51–1.96)
Anxiety	<b>1.84</b> (1.39–2.43)	<b>1.80</b> (1.32–2.44)	<b>2.03</b> (1.47–2.80)	<b>1.88</b> (1.33–2.66)	<b>1.88</b> (1.36–2.60)	<b>2.43</b> (1.82–3.23)	1.06 (0.76–1.49)	1.31 (0.69–2.48)
Substance abuse disorder	1.98 (0.81–4.85)	<b>3.59</b> (1.54–8.37)	1.94 (0.85–4.44)	1.92 (0.83–4.43)	<b>4.64</b> (1.82–11.84)	1.86 (0.82–4.20)	<b>4.45</b> (2.02–9.79)	<b>6.35</b> (2.07–19.4)
Other mental health conditions	<b>4.69</b> (1.85–11.9)	<b>3.47</b> (1.43–8.40)	1.37 (0.49–3.83)	2.36 (0.87–6.40)	2.00 (0.74–5.38)	0.87 (0.35–2.14)	1.09 (0.39–3.09)	1.67 (0.23–12.07)
At least one mental health condition	<b>2.11</b> (1.67–2.68)	<b>2.09</b> (1.61–2.72)	<b>2.19</b> (1.66–2.89)	<b>1.75</b> (1.32–2.32)	<b>2.03</b> (1.57–2.62)	<b>2.74</b> (2.15–3.50)	<b>1.45</b> (1.11–1.89)	1.18 (0.67–2.07)
Sleep medication	<b>1.40</b> (1.10–1.79)	<b>1.47</b> (1.10–1.94)	<b>1.51</b> (1.14–1.99)	1.27 (0.94–1.72)	<b>1.49</b> (1.12–1.96)	<b>1.64</b> (1.28–2.11)	<b>1.53</b> (1.16–2.00)	0.97 (0.52–1.82)
Depression medication	<b>1.55</b> (1.11–2.16)	<b>1.57</b> (1.10–2.24)	1.33 (0.93–1.90)	1.21 (0.79–1.86)	<b>1.67</b> (1.17–2.38)	<b>2.51</b> (1.80–3.50)	<b>1.39</b> (1.00–1.95)	1.27 (0.62–2.61)
Good general health	<b>0.62</b> (0.50–0.78)	<b>0.71</b> (0.55–0.91)	0.81 (0.61–1.06)	<b>0.74</b> (0.58–0.96)	<b>0.66</b> (0.51–0.85)	<b>0.72</b> (0.56–0.93)	<b>0.64</b> (0.50–0.82)	<b>0.49</b> (0.29–0.81)
Positive mental health	<b>0.68</b> (0.55–0.84)	<b>0.65</b> (0.52–0.82)	<b>0.55</b> (0.43–0.70)	<b>0.76</b> (0.59–0.98)	<b>0.74</b> (0.59–0.93)	<b>0.55</b> (0.43–0.68)	0.85 (0.66–1.08)	<b>0.62</b> (0.39–0.98)

Note. AOR: Adjusted odds ratio, adjusted for gender, age, ethnicity, area deprivation level, food security status, education, employment status, and personal income. The significant AORs are in bold font.

Regarding PCEs, 87.7% reported living with someone who recognised their strengths, 96.1% reported being loved during childhood. One in four (25%) reported poor mental health, 42.4% reported at least one clinically diagnosed chronic health condition, 18% reported at least one disability. Positive health outcomes were reported by the majority, with almost 75% of the sample reporting good general health and positive mental health. Female, Māori, those with lower personal income, those with secondary or primary education, those classified as food insecure, and those with higher ACE scores and without PCEs (not being loved or not having childhood strengths recognised) reported more adverse health outcomes and less positive health outcomes (Table 2).

### 3.2. Association between ACEs and adverse health outcomes

At the bivariate level, there were strong associations between ACE score and adverse health outcomes. The prevalence of poor mental health outcomes almost tripled from 17.3% in those with zero ACEs to 47% in those with 4+ ACEs, while the prevalence of reporting any disability more than doubled from 13.6% to 30% respectively. The only exception was for chronic physical health

**Table 6**

Multivariable logistic regression models for association between combined ACEs and PCE (being loved as a child) and adverse and positive health outcomes in adulthood, the 2019 New Zealand Family Violence Study.

		Adverse health outcomes			Positive health outcomes	
		Physical Health condition AOR (95%CI)	Poor mental Health AOR (95%CI)	Disability AOR (95%CI)	Good general health AOR (95%CI)	Positive mental health AOR (95%CI)
PCE*ACE	ACE					
Being loved Yes	0–1	Ref	Ref	Ref	Ref	Ref
	≥2	<b>1.29 (1.04–1.59)</b>	<b>1.88 (1.53–2.30)</b>	<b>1.80 (1.41–2.30)</b>	<b>0.59 (0.47–0.74)</b>	<b>0.54 (0.44–0.67)</b>
No	0–1	1.54 (0.63–3.78)	<b>3.09 (1.35–7.07)</b>	<b>2.50 (1.02–6.12)</b>	0.42 (0.15–1.17)	0.48 (0.20–1.15)
	≥2	1.49 (0.81–2.75)	<b>2.60 (1.49–4.53)</b>	<b>2.45 (1.35–4.43)</b>	<b>0.38 (0.22–0.66)</b>	<b>0.36 (0.20–0.65)</b>
Gender	Female	1.21 (0.97–1.50)	<b>1.81 (1.45–2.27)</b>	1.11 (0.86–1.43)	1.11 (0.89–1.40)	1.09 (0.87–1.37)
Age	16–24	Ref	Ref	Ref	Ref	Ref
	25–34	1.11 (0.69–1.78)	1.22 (0.72–2.06)	0.94 (0.51–1.74)	1.50 (0.88–2.57)	1.33 (0.80–2.20)
	35–44	1.27 (0.77–2.08)	1.24 (0.74–2.09)	0.91 (0.49–1.67)	1.02 (0.60–1.73)	1.50 (0.94–2.40)
	45–54	<b>2.24 (1.36–3.68)</b>	1.24 (0.74–2.08)	1.55 (0.83–2.88)	1.04 (0.60–1.78)	<b>1.71 (1.05–2.77)</b>
	55–64	<b>4.95 (3.07–7.97)</b>	1.30 (0.77–2.18)	<b>2.08 (1.15–3.75)</b>	0.69 (0.41–1.16)	1.41 (0.89–2.24)
	≥65	<b>10.13 (6.20–16.5)</b>	1.18 (0.72–1.94)	<b>2.84 (1.60–5.06)</b>	0.68 (0.41–1.12)	<b>2.15 (1.34–3.44)</b>
Education (ref = primary/ secondary)	Tertiary	0.96 (0.77–1.19)	1.13 (0.91–1.41)	0.97 (0.76–1.23)	1.10 (0.87–1.40)	1.18 (0.95–1.47)
Ethnicity	European	Ref	Ref	Ref	Ref	Ref
	Māori	1.27 (0.93–1.73)	0.86 (0.60–1.21)	1.02 (0.70–1.49)	<b>0.70 (0.50–0.98)</b>	<b>1.70 (1.17–2.45)</b>
	Pacific	1.39 (0.75–2.55)	<b>0.27 (0.16–0.48)</b>	<b>0.38 (0.21–0.70)</b>	0.72 (0.45–1.14)	1.54 (0.94–2.53)
	Asian	<b>0.56 (0.41–0.78)</b>	<b>0.32 (0.21–0.47)</b>	<b>0.47 (0.29–0.75)</b>	0.73 (0.51–1.04)	0.82 (0.60–1.15)
	MELAA	0.64 (0.28–1.45)	0.88 (0.40–1.97)	0.86 (0.32–2.29)	1.04 (0.43–2.50)	0.71 (0.35–1.44)
Area deprivation level	Low	Ref	Ref	Ref	Ref	Ref
	Moderate	0.97 (0.76–1.23)	1.15 (0.90–1.48)	1.10 (0.83–1.46)	0.91 (0.70–1.20)	1.14 (0.89–1.48)
	High	1.02 (0.75–1.37)	0.93 (0.70–1.25)	0.93 (0.67–1.30)	0.82 (0.60–1.10)	1.09 (0.82–1.45)
Food security (ref = food secure)	Insecure	<b>1.43 (1.08–1.90)</b>	<b>2.41 (1.83–3.18)</b>	<b>2.55 (1.95–3.35)</b>	<b>0.42 (0.32–0.55)</b>	<b>0.69 (0.53–0.90)</b>
Employment status	Unemployed	Ref	Ref	Ref	Ref	Ref
	Student	0.82 (0.46–1.46)	0.52 (0.27–1.01)	0.58 (0.28–1.21)	<b>2.43 (1.30–4.53)</b>	1.16 (0.64–2.10)
	Employed/ retired	0.86 (0.62–1.19)	1.04 (0.73–1.48)	<b>0.61 (0.44–0.85)</b>	<b>1.76 (1.27–2.45)</b>	1.15 (0.81–1.63)
Personal income	0–\$49K	Ref	Ref	Ref	Ref	Ref
	\$50–\$74K	0.99 (0.73–1.33)	<b>0.68 (0.51–0.90)</b>	<b>0.65 (0.46–0.93)</b>	1.11 (0.81–1.52)	1.10 (0.81–1.45)
	\$75–\$100K	0.93 (0.67–1.30)	<b>0.68 (0.47–0.96)</b>	0.70 (0.45–1.09)	1.50 (0.99–2.27)	1.29 (0.91–1.83)
	>\$100K	1.04 (0.74–1.46)	0.75 (0.54–1.03)	0.64 (0.40–1.02)	1.32 (0.88–1.98)	1.19 (0.84–1.68)

Note. AOR: Adjusted odds ratio, adjusted for gender, age, ethnicity, area deprivation level, food security status, education, employment status, and personal income. The significant AORs are in bold font.

conditions which did not have a significant association with ACE score at the bivariate level.

Using multivariable logistic regression analysis (Table 3) to account for all socio-demographic characteristics, ACEs remained strongly related to all three adverse health outcomes; i.e., respondents with higher ACE scores had an increased likelihood of reporting each adverse outcome. For chronic physical health conditions, the differences were significant comparing 4+ ACEs vs 0 ACEs (AOR:1.45, 95%CI: 1.05–2.00). The risk of poor mental health increased significantly even between those with 1 compared with 0 ACEs (AOR: 1.52, 95%CI: 1.16–1.99), while those with 4+ ACEs had a 3-fold increased risk of reporting poor mental health (AOR 3.03, 95%CI: 2.22–4.14). Similarly, a significant dose-response effect was observed for disability, with those who had experienced 2–3

**Table 7**

Multivariable logistic regression models for association between combined ACEs and PCE (childhood strengths recognised) and adverse and positive health outcomes in adulthood, the 2019 New Zealand Family Violence Study.

		Adverse health outcomes			Positive health outcomes	
		Physical Health condition AOR (95%CI)	Poor mental Health AOR (95%CI)	Disability AOR (95%CI)	Good general health AOR (95%CI)	Positive mental health AOR (95%CI)
PCE*ACE						
Strengths were recognised	ACE					
	Yes					
	0–1	Ref	Ref	Ref	Ref	Ref
	≥2	<b>1.34 (1.07–1.69)</b>	<b>1.83 (1.47–2.27)</b>	<b>1.79 (1.38–2.30)</b>	<b>0.64 (0.50–0.83)</b>	<b>0.56 (0.45–0.71)</b>
No	0–1	1.27 (0.83–1.94)	1.15 (0.74–1.81)	1.17 (0.72–1.92)	0.88 (0.55–1.39)	0.67 (0.44–1.01)
	≥2	1.21 (0.86–1.71)	<b>2.19 (1.57–3.05)</b>	<b>2.00 (1.35–2.97)</b>	<b>0.39 (0.28–0.56)</b>	<b>0.37 (0.26–0.53)</b>
Gender	Female	1.21 (0.97–1.50)	<b>1.81 (1.45–2.25)</b>	1.11 (0.86–1.43)	1.13 (0.90–1.41)	1.10 (0.88–1.38)
Age	16–24	Ref	Ref	Ref	Ref	Ref
	25–34	1.12 (0.70–1.79)	1.20 (0.71–2.01)	0.93 (0.51–1.71)	1.55 (0.91–2.64)	1.35 (0.82–2.22)
	35–44	1.28 (0.78–2.09)	1.23 (0.73–2.05)	0.90 (0.49–1.65)	1.06 (0.63–1.79)	1.54 (0.96–2.46)
	45–54	<b>2.27 (1.38–3.73)</b>	1.23 (0.74–2.05)	1.55 (0.84–2.87)	1.08 (0.63–1.84)	<b>1.76 (1.09–2.85)</b>
	55–64	<b>4.98 (3.10–8.00)</b>	1.28 (0.76–2.14)	<b>2.06 (1.14–3.73)</b>	0.73 (0.43–1.22)	1.48 (0.93–2.36)
	≥65	<b>10.12 (6.20–16.5)</b>	1.17 (0.71–1.92)	<b>2.82 (1.57–5.05)</b>	0.72 (0.44–1.19)	<b>2.30 (1.43–3.69)</b>
Education (ref = Primary/secondary)	Tertiary	0.96 (0.78–1.20)	1.14 (0.92–1.41)	0.97 (0.77–1.24)	1.10 (0.87–1.40)	1.17 (0.94–1.46)
Ethnicity	European	Ref	Ref	Ref	Ref	Ref
	Māori	1.26 (0.93–1.72)	0.88 (0.62–1.24)	1.04 (0.71–1.52)	<b>0.68 (0.49–0.95)</b>	<b>1.66 (1.16–2.39)</b>
	Pacific	1.39 (0.75–2.57)	<b>0.28 (0.16–0.49)</b>	<b>0.39 (0.21–0.71)</b>	0.72 (0.45–1.14)	1.53 (0.94–2.49)
	Asian	<b>0.56 (0.40–0.77)</b>	<b>0.32 (0.22–0.48)</b>	<b>0.47 (0.30–0.75)</b>	0.73 (0.51–1.05)	0.84 (0.60–1.16)
	MELAA	0.65 (0.28–1.46)	0.89 (0.40–1.98)	0.86 (0.32–2.29)	1.06 (0.44–2.57)	0.72 (0.36–1.45)
Area-level deprivation	Low	Ref	Ref	Ref	Ref	Ref
	Moderate	0.97 (0.76–1.24)	1.14 (0.90–1.47)	1.10 (0.82–1.45)	0.92 (0.71–1.21)	1.16 (0.64–2.08)
	High	1.02 (0.76–1.37)	0.94 (0.70–1.25)	0.94 (0.68–1.30)	0.82 (0.61–1.10)	1.13 (0.80–1.59)
Food security (ref = secure)	Insecure	<b>1.45 (1.09–1.91)</b>	<b>2.43 (1.85–3.20)</b>	<b>2.58 (1.97–3.38)</b>	<b>0.41 (0.31–0.54)</b>	<b>0.69 (0.53–0.90)</b>
Employment status	Unemployed	Ref	Ref	Ref	Ref	Ref
	Student	0.84 (0.47–1.49)	0.52 (0.27–1.00)	0.59 (0.28–1.20)	<b>2.47 (1.33–4.57)</b>	1.16 (0.64–2.08)
Personal income	Employed/retired	0.87 (0.63–1.20)	1.05 (0.74–1.49)	<b>0.62 (0.45–0.86)</b>	<b>1.75 (1.26–2.42)</b>	1.13 (0.80–1.59)
	0–\$49K	Ref	Ref	Ref	Ref	Ref
	\$50–\$74K	0.99 (0.73–1.33)	<b>0.67 (0.51–0.89)</b>	<b>0.65 (0.46–0.93)</b>	1.12 (0.82–1.54)	1.10 (0.82–1.47)
	\$75–\$100K	0.94 (0.68–1.32)	<b>0.68 (0.48–0.98)</b>	0.70 (0.45–1.09)	1.48 (0.98–2.25)	1.27 (0.90–1.81)
	>\$100K	1.04 (0.75–1.46)	0.76 (0.55–1.04)	0.65 (0.41–1.03)	1.32 (0.88–1.97)	1.18 (0.84–1.67)

Note. AOR: Adjusted odds ratio, adjusted for gender, age, ethnicity, area deprivation level, food security status, education, employment status, and personal income. The significant AORs are in bold font.

or more ACEs more likely to report having a disability (AOR: 2.41, 95%CI: 1.72–3.40 for those with 4+ ACEs).

Table 4 presents a breakdown of ACE Scores and specific adverse health outcomes. As ACE score increased there were increased odds of reporting specific physical health conditions. However, the results were only significant for the association between exposure to 4+ ACEs and reporting heart disease (AOR = 1.78, 95%CI: 1.05–3.02) and reporting asthma (AOR = 1.63, 95%CI 1.01–2.41). There was also a significant association between exposure to 2+ ACEs and reporting arthritis (AOR 1.40, 95%CI: 1.04–1.89). Regarding disability, those with exposure to four or more ACEs were at increased odds of reporting physical (AOR = 2.12, 95%CI 1.49–3.02), psychological (AOR = 3.74, 95%CI 2.13–6.59), and cognitive (AOR = 2.45, 95%CI 1.49–4.03) disability. Regarding poor mental

health, exposure to four or more ACEs was associated with four times the odds of reporting diagnosed depression (AOR = 4.0, 95%CI 2.66–6.04) and almost three times the odds of reporting diagnosed anxiety (AOR = 3.19, 95%CI 2.11–4.80). An ACE score of 4+ was also associated with almost two times the odds of taking sleep medication (AOR = 2.11, 95%CI: 1.49–2.99) or antidepressant medication (AOR = 2.44, 95%CI: 1.52–3.92). Exposure to even one ACE was significantly associated with reporting diagnosed substance abuse (AOR = 9.88, 95% CI 1.75–55.64).

Different types of ACEs were associated with different chronic health conditions (Table 5). Increased odds of heart disease were associated with emotional abuse (AOR = 1.49, 95%CI: 1.05–2.12), sexual abuse (AOR = 1.91, 95%CI: 1.32–2.77), IPV witnessing (AOR = 1.61, 95%CI: 1.07–2.40) and household substance abuse (AOR = 1.53, 95%CI: 1.03–2.27). Increased odds of asthma were associated with household substance abuse (AOR = 1.37, 95%CI: 1.01–1.86), household mental illness (AOR = 1.54, 95%CI: 1.15–2.06), and parental divorce (AOR = 1.47, 95%CI: 1.08–2.00). Individual ACE types also showed significant associations with each mental health condition assessed and with use of psychotropic medication. Individual ACE types were also strongly associated with each type of disability.

### 3.3. Association between ACEs and positive health outcomes

At the bivariate level, there were negative associations between ACE score and positive health outcomes. The prevalence of positive mental health decreased from 78.6% reported by those with zero ACEs to 62.1% among those with 4+ ACEs, while the prevalence of reporting good general health decreased from 82.1% to 65.9% respectively.

Using multivariable logistic regression analysis (Table 3) to account for all socio-demographics, an inverse dose-response effect was observed for each positive health outcome. Differences were significant at the 2–3 ACE level and above. Those with 4+ ACEs were less likely to report good general health (AOR = 0.50, 95%CI: 0.36–0.70) and less likely to report positive mental health (AOR = 0.47, 95% CI: 0.34–0.65).

### 3.4. Exploring the mitigating effect of PCEs on association between ACEs and health outcomes

Those with higher ACE scores (2+) were more likely to report poor mental health and disability regardless of if they felt they had been loved or not as a child, after adjustment for socio-demographics (Table 6). Those who had 2+ ACEs were also more likely to report chronic physical health conditions, but this association only reached significance for those who also reported being loved as a child. This finding could be the result of the small sample size for those who did not report being loved as a child. Individuals with zero or one ACE who felt that no one loved them as a child had higher odds of reporting poor mental health (AOR = 3.09, 95%CI: 1.35–7.07), and disability (AOR: 2.50, 95%CI: 1.02–6.12) compared to those who felt they had been loved as a child (Table 6).

Regarding positive health outcomes, those with ACE scores of 2+, whether or not they felt loved as a child, were less likely to report having good general health or positive mental health after adjustment for socio-demographic characteristics (Table 6). A similar pattern was observed for individuals who reported that someone had recognised their childhood strengths. With or without strength recognition, those with ACE scores of 2+ were more likely to report having adverse health outcomes and less likely to report having good general health or positive mental health after adjustment for sociodemographic characteristics (Table 7).

## 4. Discussion

### 4.1. ACEs and health outcomes

In this population-based study, people who reported higher number of ACEs had higher risk of experiencing negative health outcomes and were less likely to report having positive health outcomes; these patterns were not fully explained by socioeconomic factors. Even one experience of adversity in childhood was associated with increased risk of poor mental health in later life. Experience of two or more ACEs contributed to increased risk of disability, while experience of four or more ACEs was associated with chronic physical health problems.

Individual ACE subtypes had different relationships with specific physical health conditions (i.e., heart disease, stroke, arthritis, and asthma), while all ACE subtypes had a relationship with almost all indicators of poor mental health and almost all types of disability. The strong association between ACEs and poor mental health and the mixed results for the association between ACEs and chronic physical health problems has been previously noted in systematic reviews (Hughes et al., 2017; Norman et al., 2012).

This study also found that experience of two or more ACEs reduced the likelihood of experiencing later positive physical and positive mental health outcomes. These findings contribute to the limited literature documenting a dose response effect between high number of ACEs and low positive mental well-being (Hughes et al., 2016).

These findings are consistent with the strengthening evidence base indicating that exposure to “toxic stressors” such as childhood adversity can affect a multitude of health outcomes across the lifespan (Hughes et al., 2017; Norman et al., 2012). Pathways for these associations have been documented elsewhere, and include direct damage to health via neurological, hormonal and chronic inflammation pathways (Danese et al., 2009; Ehlert, 2013; Kelly-Irving et al., 2012) or indirect damage to accumulation of human capital (a range of cognitive, social, and emotional competencies). These pathways have also been found to contribute to the adoption of high risk behaviours, such as smoking, substance abuse, obesity, and high risk sexual behaviours by people who experience ACEs (Felitti et al., 1998; Ramiro et al., 2010). These high-risk behaviours may account for nearly 50% of the increased risk of negative consequences associated with ACEs (Bellazaire, 2018). The enduring effects of ACEs on health found in the current study were independent

of SES factors and reinforce previous findings that ACEs are detrimental across all income groups (Houtepen et al., 2020). Policy and programmes to address child poverty are important in their own right, but will not fully mitigate the effect of ACEs.

#### 4.2. ACEs and PCEs

An important contribution of this study is the finding that exposure to ACEs is detrimental to health even in the presence of PCEs. People with 2+ ACEs had increased risk of reporting poor physical health conditions, poor mental health, or disability compared to those with 0–1 ACEs, regardless of if they also reported experience of PCEs such as feelings of being loved as a child. In addition, individuals with experience of 2+ ACEs were less likely to report positive mental or positive physical health in later life and the experience of individual PCEs did not mitigate these effects. For those with low ACEs (0–1), the absence of feeling loved as a child was as deleterious as experience of high ACEs.

Research on the mitigating effects of PCEs is relatively new, with mixed findings. Some research has reported that positive experiences in childhood are associated with improved adult health for those exposed to a high number of ACEs, e.g., six or more PCEs (Bethell et al., 2019), while others did not find mitigating effects for individual PCEs (Bellis et al., 2018). We did not find mitigating effects in the present study, but this may be because we only assessed two PCEs, and we only had a small number of individuals who reported not having experienced these PCEs. A more comprehensive assessment of a greater number of PCEs might help determine if PCEs can mitigate risk of adverse health outcomes. Others have found that cumulative but not singular exposure to PCEs may be required to enable mitigation of some of the detrimental effects of ACEs (Bellis et al., 2018; Bethell et al., 2019). Additional PCEs that could be considered include positive experiences with family, friends, and school/community (Bethell et al., 2019; Narayan et al., 2018). Cultural strengths may also be important resilience factors (Atwool, 2006; Hewlett, 2018; Penehira et al., 2014). Further more comprehensive exploration the quantity and intensity of exposure to PCEs is needed to determine what level of exposure to positive childhood experiences might mitigate adverse health outcomes or support development of positive health outcomes. If established, these findings could inform the range of policy and practice options available.

#### 4.3. Limitations

The cross-sectional nature of the study means a temporal relationship between exposure to ACEs and the onset of health outcomes cannot be inferred. However, the consistency of findings assessing ACEs and health outcomes, the dose response relationship observed, and the articulation of causal pathways by which ACEs can influence health that have been identified through other studies mitigates this concern (Danese et al., 2009; Ehlert, 2013; Kelly-Irving et al., 2012).

Selection bias may also have played a role in the non-significant results or the weaker associations between exposure to ACEs and chronic physical health conditions found in the present study. For example, those with high ACE scores and fewer PCEs may have been less likely to be included from our sample because they were too ill to participate, they needed institutional care, or they died at younger ages (Jia & Lubetkin, 2020).

Use of self-report measures for exposure and outcome variables also pose limitations, as they were not independently verified. The use of retrospective, self-reported information regarding ACEs and PCEs may also be subject to recall bias (Bellis et al., 2018). However, evidence suggests moderate to good consistency of ACE reports over time (Atwool, 2006), and prospective recording of ACEs has also confirmed the associations between childhood adversity and negative life outcomes (Bellis et al., 2018; Fergusson & Mullen, 2012). Social desirability may also have affected responses, as participants may be particularly disinclined to report ACEs to a live interviewer and more inclined to report experiencing PCEs in the context of a face-to-face interview.

The findings related to PCEs should be interpreted with caution, as the lack of variability in the PCEs assessed is likely to have restricted our ability to detect moderating or mediating effects of these childhood experiences. Future studies would benefit from undertaking a more comprehensive assessment of PCE exposure to determine the quantity and intensity of PCEs that might mitigate adverse health outcomes or support development of positive health outcomes.

Finally, the use of current socio-demographic characteristics may be a limitation because we explored the impact of childhood experiences on health in adulthood, but we did not have a measure of participant SES in childhood. However, other studies have shown a strong association between childhood and adulthood SES (Metzler et al., 2017). Longitudinal studies could be used to explore the association between childhood SES and health more directly.

#### 4.4. Strengths

To date, few NZ studies have explored the relationship between ACEs and adult health. This study extends previous work by assessing a full range of ACEs, and documents the association between ACE scores, individual ACE types and health outcomes. This study also extends previous work by looking at a comprehensive range of health outcomes, including poor physical and mental health, disability and indicators of positive health. This is unique internationally, as most previous studies have explored the effects of ACEs on limited types of health outcomes. Additionally, this study extends previous work by including assessment of PCEs in a large population-based sample. Future studies could extend this work by including a great range of PCEs.

#### 4.5. Implications

The prevalence of ACEs and their association with a wide range of negative outcomes means the costs of ACEs to the country are

high. The Every Child Counts Campaign (a New Zealand non-party political campaign to promote the interests of children and families) estimates that child abuse and neglect, which accounts for half of the original ACEs, costs New Zealand approximately \$NZ 2 billion annually [over 1% of the Gross Domestic Product] (Every Child Counts, 2008). This suggests that population-wide ACE-aware services, along with efforts to prevent ACEs are needed.

Findings of this study indicate that increased investment in prevention and treatment is needed to mitigate the deleterious effects of ACEs on health. ACEs screening during standard physical and mental health care for adults could help clinicians identify those at risk of physical and mental health problems who may need extra support or trauma-informed services. Our findings also suggest that the absence of PCEs may also have lifelong consequences for poor physical and mental health even for those who do not have exposure to a high number of adverse experiences in childhood. Extending the range of PCEs assessed, and including PCEs as well as ACEs measures in routine public health surveillance systems (e.g., B4 school checks (White, 2014), may advance knowledge of how PCEs contribute to improving health outcomes. It is also important to recognise that ACEs themselves may result from structural factors such as child poverty, discrimination, racism, and colonization; these are underlying issues that also need dismantling (Joy & Beddoe, 2019).

## 5. Conclusion

This study documents the deleterious impacts of ACEs on a wide range of health outcomes and demonstrates that these effects are persistent through the lifecourse. Findings should provide impetus to establish widespread prevention and intervention initiatives that seek to address ACEs. Strategies that address socioeconomic inequities are needed, but will not, of themselves, fully mitigate the consequences of adverse childhood experiences.

## Declaration of competing interest

None.

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