The impact of adverse childhood experiences on psychosocial functioning.

George K Hales

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Department of Psychology

University of Sheffield

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Abstract

Decades of research have established that adverse childhood experiences (ACEs) are associated with psychological wellbeing. There is a need to understand the underlying mechanisms that link ACEs to outcomes years later. However, much of the understanding garnered from research has relied on retrospective data. In Study One (Chapter Two), a systematic review was conducted which focuses on longitudinal research investigating mediating and moderating pathways explaining the relationship between ACEs and psychosocial outcomes. While a general picture of underlying mechanisms was not forthcoming, several methodological issues in the literature were found. First, wide heterogeneity in how multiple ACEs were operationalised made generalisations difficult. Second, the paucity of longitudinal studies that satisfactorily assess important temporal concepts such as stationarity (i.e. the stability of effects over time) precludes understanding of the nature of the relationship between ACEs and psychosocial functioning over time.

Study Two (Chapter Three) and Study Three (Chapter Four) sought to address these limitations using the Understanding Society dataset. In Study Two, two conceptually different operationalisation of multiple ACEs were modelled. The cumulative risk approach and person-centred approach were compared. Findings showed that the cumulative risk approach explained more variance for most outcomes, but the person-centred approach showed the potential of ACE typologies to find highly specified relationships. In Study Three, a series of longitudinal models found that many of the relationships between ACEs and psychosocial outcomes were bidirectional. Additionally, when ACE risks were partitioned by ecology, community risks had a specific effect on internalising problems, whereas household risks affected internalising problems, externalising problems, delinquency, and life satisfaction. Together, these studies shed light on how ACEs are related to psychosocial outcomes.

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Chapter One: Introduction

The lottery of birth continues to be kinder today on a whole host of measures than previous centuries (Pinker, 2019). Progress notwithstanding, no corner of the world is without stressors, and early life stressors including childhood maltreatment and other types of adversity place a heavy burden on children's development. Many theorists and researchers have pontificated about the pivotal set of experiences in childhood that set the tone for life prospects, and how adversities create an environment for children that deviates from the 'expected' rearing environment (McLaughlin & Sheridan, 2016). Indeed, many contend that the effects of exposure to severe stress and adversity in childhood endure throughout the lifespan. It remains unclear how ACEs have such an enduring effect.

1.1 What do we mean by Adverse Childhood Experiences anyway?

Adversities are thought to influence development in such a way that can result in negative adult outcomes such as criminal behaviour and mental illness (Schaefer et al., 2018), and impact educational and socioeconomic prospects (Jaffee et al., 2018). Although, this seems a somewhat circular definition to suggest that adversities are defined by their associated outcomes. Most definitions of ACEs rely – implicitly if not explicitly – on the work of Felitti et al. (1998) and their original scale which categorised ACEs as a combination of child maltreatment and household dysfunction items. The included maltreatment items were psychological abuse (now more commonly, emotional abuse), physical abuse, sexual abuse, and the included household dysfunction items were substance abuse, mental illness, domestic violence (against mother only), and incarceration. Subsequently, many researchers have used the concept of ACEs and inserted other severe adversities such as neglect, divorce, and poverty. Recently, Finkelhor et al. (2015) suggest the inclusion of several additional adversities such as low socioeconomic status, peer victimisation, social isolation, and exposure to community violence. No matter the included risks items, ACEs typically refer to a collection of adverse risks to development experienced in childhood.

Prior research has often focused on the effects of a single category of adversity, the concept of ACEs is useful and informative to approximating the collective risk associated with the exposure of multiple categories of adversities. This is an important distinction, because adversities are well-documented to co-occur (see Finkelhor et al., 2009). Estimating the impact of adversities alone does not control for the confounding of co-occurring

adversities that might contribute to an additive burden of risk. Indeed, ACEs are usually categorised as present or absent, and summarised by a total score. Sum scores are typically further categorised into distinct groups to compare a low risk (exposed to none) to a high risk (exposed to four or more, see Hughes et al., 2017). To clarify, the information regarding those exposed to one, two, and three ACEs is retained but the target comparison is often those who have experienced no ACEs to those who have experienced four or more. In sum, the concept of ACEs refers to the cumulative risk of multiple categories of ACEs which commonly include maltreatment, household dysfunction, and some other types of risk factor.

1.2 General context

Studies using retrospective self-report data have documented a relationship between the cumulative risk of ACEs and several potent causes of death (e.g. suicidal behaviours, smoking, substance use, and sexually transmitted disease), with odds ratios of a cumulative score of ACEs ranging from 1.3 for sedentary behaviour to 12.2 for suicide attempts (Felitti et al., 1998). This is supported by a recently published epidemiological study of adversity-related psychopathology, which found that traumatised children were twice as likely to develop various psychopathological disorders, and up to five times as likely to engage in self-harm behaviours (Lewis et al., 2019). The economic burden of childhood maltreatment, too, is substantial (Fang et al., 2015). Specifically, the lifetime economic burden of non-fatal maltreatment in the UK has been estimated to be between £44,896 to £145,508 per victim, based on costs such as mental and physical health, social care, criminal justice system involvement, and unemployment (Conti et al., 2017). It is therefore of high global and domestic importance to generate a good understanding of how stressors in childhood are linked to a wide array of negative outcomes.

1.3 Prevalence

The concept of ACEs is relatively new, meaning that it is difficult to establish trends in prevalence in the short- or long-term. To obtain a rough picture of prevalence, a necessary starting point is to assess the prevalence of documented harms against children. Although, it is likely that this is merely the tip of the iceberg because many ACEs often go unreported. Studies that examine longitudinal trends in the UK demonstrate that child mortality by homicide and child cruelty or neglect offences have decreased substantially between 1893 and 2016 (Degli Esposti et al., 2019). The same study identifies a mixed picture, that child sex offences have fallen and risen over time indicating no linear pattern of improvement;

there have been substantial rises in children entering into care, and registrations on the child protection register this millennium (the main contributors to this rise being emotional abuse and neglect). It is unclear whether these trends are due to genuine increases in child maltreatment, an improvement in child protection services over time, or a broadening of what actions are considered to be child maltreatment. The gradual broadening of the definition of harm has been described elsewhere as concept creep (see Haslam, 2016). This is reflected in the evolution of the agenda of combating harms against children in the UK, where the agenda has adapted from preventing non-accidental injury against children to child protection which concerns the identification of at-risk children and production of child protection plans to prevent harms (Bunting et al., 2018). Furthermore, ACEs are defined differently between cultures as some practices such as child marriage or physical discipline would constitute abuse and be a criminal act in some countries but are relatively normal in others. Cross-cultural extrapolations are difficult to make, so the best way to estimate the scale of the problem is to focus on multiple sources primarily from the country or culture of interest. To provide best estimates for prevalence in the UK, it is best to use evidence from other high-income countries or those with similar cultures to the UK.

One study sought to estimate the prevalence of child maltreatment in the UK, using a combination of combined parent-report and self-report data across children, adolescents, and young adults. In the UK, 24.5% of young adults experienced at least one type of maltreatment during childhood (Radford et al., 2013). This figure is drastically higher (around 17 times higher) than officially recorded rates of child maltreatment in the UK. However, this study is limited in that it only asked participants about their experiences of maltreatment, meaning that many ACEs of interest to this thesis were not measured. Hence, it is likely that in relation to ACEs this is an underestimate of prevalence. A meta-analysis of ACEs in Europe and North America found that prevalence rates differed by region. In Europe, there was a pooled prevalence of 23.5% who experienced at least one ACE and 18.7% who experienced two or more ACEs; in North America 23.4% experienced one ACE and 35% experienced two or more (Bellis et al., 2019), although there was large heterogeneity in these estimates. These estimates are supported by a more recent prevalence estimate in Europe (Hughes et al., 2021) which found that 22.6% experienced one ACE, and 15.2% experienced two or more ACEs. The same study estimated that in the UK, 53.9% experienced no ACEs, 23% experienced one ACE, and 23% experienced two or more ACEs. These studies indicate that ACEs are common, but do not indicate which categories of ACEs are common.

Finkelhor et al. (2015) examined the prevalence of ACEs using a stratified USA sample of 11-17 year-olds. Household dysfunction items were generally more prevalent than child maltreatment items; 21.3% of parents were divorced or separated, 13.7% reported knowledge of domestic abuse against the mother, 9.2% reported a familial substance abuse or alcohol problem, 32.5% reported familial mental illness, and 7.2% reported parental incarceration. Incidentally, Finkelhor et al. (2015) also attempted to validate the inclusion of additional variables into a measure of ACEs, such as low socioeconomic status, peer victimisation, social isolation, and exposure to community violence. These additions broaden ACEs outside of the home environment, emphasising the importance of the wider community and peers as a potential source of adversity (Finkelhor et al., 2005). Radford et al. (2011) indicate that exposure to community violence (66%) and peer victimisation (63%) are considerably higher in their sample of young people in the UK, indicating that these additional adversities are fairly common.

In summary, we can observe from the triangulation of different sources that some serious maltreatment types are relatively prevalent in the UK and similar countries. This is worrying in the context that living in a single parenthood home or witnessing domestic violence is fairly common, which could result in limiting the protective influence that parents have over offspring in vulnerable conditions. It is difficult to know the full extent of the scale because of a lack of representative data concerning ACEs in the UK outside of maltreatment items. However, in relation to the rest of Europe, children in the UK experienced similar numbers of ACEs, and fewer experienced multiple ACEs compared to North America.

1.4 The burden of ACEs

The first findings using the designation of ACEs found a dose-response risk of retrospectively reported ACEs on a broad range of adult outcomes, including suicide attempts, alcoholism, substance abuse, sexually transmitted diseases, severe obesity, smoking, heart disease, and strokes (Felitti et al., 1998). A recent meta-analysis of studies that adopted Felitti et al.'s (1998) scale found a dose-response relationship between ACEs and several psychological and behavioural outcomes including suicidal ideation, hallucinations, panic/anxiety, and depression; a dose-response relationship was found for medical outcomes including heart disease, somatic pain, and respiratory distress (Petruccelli et al., 2019). The findings suggested that the effect of ACEs was more potent for psychological and behavioural problems than medical outcomes. However, not all studies of

the effects of ACEs use Felitti et al.'s (1998) measure. Another review examined studies that used Juvenile Victimization Questionnaire, which assesses multiple types of victimization, found that the concept of polyvictimisation (similar to a cumulative measure of ACEs) was a stronger predictor of psychopathology outcomes than individual types of victimisation (Haahr-Pedersen et al., 2020a). As mentioned above, many studies incorporate additional ACEs into the cumulative risk, and some datasets may lack satisfactory measures of ACE categories.

The subject matter of ACEs and maltreatment also places a burden on optimising study design for causal inference, most notably because ethical considerations preclude experimental manipulation. Much of the research undertaken regarding ACEs relies on retrospective data (see Petruccelli et al., 2019). However, because causal inference assumes an effect of time (especially in the relationship between childhood experiences problems across the lifespan), using retrospective data raises concerns for validity due to issues such as recall biases, sampling biases, and that inferring causation from retrospective data is fundamentally flawed (see Widom et al., 2004 for a discussion). Additionally, research indicates that retrospective reports of maltreatment are discordant with prospective measures of maltreatment. For example, self-report accounts of physical abuse measured concurrently in adolescence and at age 30 only produced 'fair' agreement, and there was evidence that factors of life circumstances in adulthood (e.g. life dissatisfaction) confounded retrospective reports of abusive experiences (White et al., 2007). Findings such as these are supported by meta-analyses (Baldwin et al., 2019). This substantially undermines research reliant on retrospective data, as retrospective accounts cannot be trusted to approximate prevalence of ACEs. Further, cross-sectional analysis is limited in the insight it can produce compared with longitudinal analysis. Cross-sectional studies cannot elucidate causal pathways through which ACEs may lead to negative outcomes, such as mediation or moderation (Preacher, 2015). There is also reason to believe that reverse causation could be important in the relationship between ACEs and outcomes, so bidirectionality should be assessed (Jaffee et al., 2012), and that pre-existing vulnerabilities could cause increased adversity (Danese, 2020). Cohort studies are well-suited to attenuate these limitations because data can be collected at multiple timepoints and used to assess bidirectionality, stability of effects, and account for pre-existing variance.

In recent years, numerous systematic reviews have synthesised findings regarding the effect of ACEs on developmental and adult outcomes. One such systematic review

interrogated the relationship between multiple adversities on health outcomes in adulthood (Kalmakis & Chandler, 2015). It was found that ACEs were related to increased healthcare use, physical conditions, health-risk behaviours (e.g. binge drinking), developmental disruptions (e.g. homelessness), and mental illness. However, the vast majority of studies in this review used retrospective self-report data which provides a limited insight into temporal relationships. The broad results of this review are supported by a more recent review of health consequences, which found that ACEs are a risk factor to many public health threats such as drug use, anxiety, depression, respiratory disease, problematic alcohol use, cardiovascular disease, and cancer; the estimated effect of ACEs on these outcomes contributes to a substantive loss of disability-adjusted life years (Bellis et al., 2019). This systematic review also suffers from a reliance on studies using retrospective self-report measures of ACEs, as well as heterogeneous categorisations of ACEs. Another meta-analysis found that multiple ACEs were related to an increased risk of several outcomes, with large pooled odds ratios for suicide attempts, drug use, violence perpetration, and violence victimisation, and problematic alcohol use but reported large heterogeneity for most outcomes (Hughes et al., 2017). This meta-analysis focused only on adult outcomes, but included a relative balance between cohort and cross-sectional studies.

There have been several systematic reviews that have examined the relationship between ACEs and psychological or behavioural problems. There are some outcomes such as obesity and sleep problems which can be categorised as health or psychological problems, or indeed a compound of the two. One systematic review examined the relationship between ACEs and obesity in children and found a relationship between ACEs and obesity, but this was not found in every included study (Schroeder et al., 2021). Notably, this review included studies that only measured one ACE, and around half of included studies were longitudinal which might explain the inconsistent findings. In terms of adult obesity, a meta-analysis of cross-sectional studies found a substantial increase in odds for people who reported multiple ACEs (Wiss & Brewerton, 2020). A systematic review of the effects of ACEs on sleep problems and disorders found that ACEs were related to many outcomes including subjective sleep disturbances, dream disturbances, and worse experiences of insomnia compared to those with low or no ACEs (Kajeepeta et al., 2015). This review also heavily relied on retrospective self-report of ACEs, although a more recent meta-analysis of cohort studies corroborates these findings (Yu et al., 2022). Pooled odds ratios showed that multiple ACEs were a particular risk, with family dysfunction, sexual abuse, physical abuse, and emotional

abuse also contributing large individual risks. Finally, a meta-analysis synthesised the effect of ACEs on anxiety and depression in mothers (Racine et al., 2021). Pooled effect sizes showed a modest but consistent effect of ACEs on prenatal depression and anxiety, and postpartum depression. Similar to many review papers, this study is limited by a reliance on retrospective self-report of ACEs.

Externalising outcomes, particularly regarding criminal justice outcomes, have also received considerable research attention summarised in systematic reviews. A systematic review examining associations between ACEs and criminal involvement in young people found that justice-involved young people were substantially more likely to have experienced at least one ACE compared to those not involved in the justice system and increasing numbers of ACEs were associated with PTSD symptoms (Malvaso et al., 2021). Although, the authors concluded that overall study quality was poor and could not provide insight beyond an association. Another review found a modest but consistent increase in odds of justice system contact related to increased ACEs (Graf et al., 2021). Although this review only included studies conducted in USA which limits generalisability to Europe, where prevalence of ACEs is lower (Bellis et al., 2019). One way in which ACEs might be related to criminality is through increasing risks associated with crime. A recent review found that individuals with psychopathy – who are overrepresented in the criminal justice system – have substantially elevated rates of ACEs (Moreira et al., 2020). However, much like previous reviews this study relies substantially on retrospective data and cross-sectional studies.

A handful of systematic reviews have sought to find mediational relationships that explain the relationship between ACEs and future psychological problems. Mediational relationships are indirect relationships where the independent variable is related to the dependent variable through the effect of a mediator (e.g. Baron & Kenny, 1986). One review found that ACEs were related to several maladaptive cognitive schemas, which could pre-empt psychological problems (Pilkington et al., 2021). An additional review went one step further and assessed cognitive mediators of the relationship between ACEs and psychopathology in adulthood (Aafjes-van Doorn et al., 2020). Despite heterogeneity in study design, ACEs, cognitive mediators, and psychopathology, significant mediators were found consistently. However, both these reviews rely on an overwhelming majority of cross-sectional studies and therefore retrospective recall of ACEs in adulthood. Meanwhile, a review of the effect of ACEs on executive function in children (e.g. working memory) found a strong effect of ACEs on executive function deficits (Lund et al., 2020). All three reviews

examining cognitive domains included studies that only measured one ACE, which provides some general insight but may not suitably account for co-occurrence. Further, reviews investigating mediational mechanisms seem to focus largely on cognitive outcomes.

From the evidence synthesised above, a few general conclusions can be made. First, ACEs are related to a wide array of outcomes from medical health to psychological and behavioural problems, to justice system involvement even in studies where the original ACE scales are not used. Most reviews claim that the strength of these relationships increase in a dose-response fashion, such that children exposed to more ACEs are at greater risk of substantive problems. Second, while there have been some syntheses of potential mechanisms that explain these multiple outcomes, this is an area which has not been synthesised thoroughly. It is important to understand potential mechanisms in these relationships which might bear fruit for prevention and intervention efforts. Third, there is heterogeneity in terms of how ACEs are operationalised which makes it difficult to compare between studies. Most reviews only included studies which reported on multiple ACEs, whereas others (e.g. Kajeepeta et al., 2015) also included studies that reported on a single ACE. Further still, some ACEs were not investigated regarding some outcomes (see Lund et al., 2020). Fourth, our understanding of these temporal relationships relies heavily on cross-sectional analysis of retrospective data, with very few longitudinal studies. While the reviews demonstrably highlight potentially important correlations, conclusions must be measured with a degree of uncertainty. While the subject of ACEs has amassed an impressive body of research, there are clearly a number of issues in the literature that require more attention.

1.5 General limitations

A recent review paper highlighted some key weaknesses of research concerned with ACEs and other related phenomena (see Danese, 2020). One crucial weakness of this research area is that much of the research used to support the putative longitudinal relationship between ACEs and adult outcomes has been cross-sectional or relied on retrospective data. Cross-sectional and retrospective studies have several problems, discussed in more detail above. These include reliability, the inability to assess temporal relations, lack of control over pre-existing variance, and the neglect of reverse causation. Longitudinal methods such as cross-lagged panel modelling (CLPM, see Kenny, 1975; Preacher, 2015) which model for change over time with repeated measures are well-suited to testing temporal relations, reverse causation, and controlling for pre-existing variance. Furthermore, most

research uses data sampled in USA, relatively few studies use data collected in the UK (e.g. Bellis et al., 2013). However, parenting practices construed as abusive in one country might be acceptable in another; various other geographical variations such as the rates of violent crime, poverty, and the presence of weapons are presumably important to consider in relation to the occurrence of ACEs. While it is valuable to learn from research conducted in culturally similar countries, it is perhaps wise to study the nature of ACEs in the UK because some ACEs might vary in prevalence depending on the country.

1.6 Rationale and research aims

This thesis has three main aims and objectives:

1. To synthesise contemporary evidence of mediating and moderating mechanisms underlying the relationship between ACEs and psychosocial outcomes, which uses longitudinal data.
2. To explore two competing operationalisations of ACEs, and formally compare them (namely, cumulative risk approach and person-centred approach) in regards to their explanatory value of psychosocial outcomes.
3. To examine longitudinal relationship between ACEs and psychosocial outcomes based upon the superior operationalisation (if there is one).

The following three chapters address each of the research aims in turn. Chapter Two reports a systematic review of longitudinal research which assesses mediators and moderators of the relationship between ACEs and psychosocial functioning. The systematic review is supplemented by a commentary to contextualise the published manuscript in this thesis. Chapter Two contributes an important synthesis of temporally sensitive research that brings insight to the causal structures underlying the relationship between ACEs and enduring outcomes. Chapter Three reports a formal comparison of the cumulative risk approach and person-centred approach to operationalising ACE risks. The two approaches are used to estimate the relationship between ACEs and externalising and internalising problems, which addresses the limitation of heterogeneous operationalisations of ACEs by comparing two contrasting approaches. Chapter Four reports a series of longitudinal analyses which estimate the relationship between ACEs and psychosocial functioning and three timepoints. Models are estimated for externalising and internalising problems, in addition to delinquency and life satisfaction. This chapter addresses the limitation of a reliance on cross-sectional studies to examine the relationship between ACEs and psychosocial outcomes. Chapter Five provides a

general discussion of findings from Chapters Two, Three, and Four, and considers findings in the broader context of research literature in which the results are situated.

Chapter Two: Links of adversity in childhood with mental and physical health outcomes: A systematic review of longitudinal mediating and moderating mechanisms.

2.1 Commentary on Systematic Review

The following is a commentary on Chapter Two of this thesis, which is a reproduction of a published study, reference below:

Hales, G. K., Saribaz, Z. E., Debowska, A., & Rowe, R. (2022). Links of adversity in childhood with mental and physical health outcomes: A systematic review of longitudinal mediating and moderating mechanisms. *Trauma, Violence, & Abuse*. https://doi.org/10.1177/15248380221075087

The systematic review was designed to address research aim one which was to synthesise contemporary evidence of mediating and moderating mechanisms in the relationship between ACEs and psychosocial functioning using longitudinal data. The focus on prospective study designs was to eschew the limitations of previous systematic reviews that have been associated with retrospective data and cross-sectional designs. This sets the systematic review apart from other systematic reviews of ACEs research, which are highly reliant on studies using cross-sectional analysis of retrospective data to form conclusions. Furthermore, the focus on mediating and moderating mechanisms addresses the interplay of ACEs and other factors in leading to physical and mental outcomes. This is important for theory-building and study design because if a general picture of underlying mechanisms can be garnered, it would impact the datasets that we chose to use for studies two and three. Additionally, the review may identify opportunities to break causal chains between ACEs and negative outcomes, which would be useful for policymakers. Finally, we focused on self- and informant-report studies, because of the findings from Radford et al. (2013) that self- and informant-reported experiences of maltreatment found much higher rates of maltreatment than substantiated cases would. The findings that retrospective and prospective self-report are largely discordant was further motivation to prioritise prospective self-report. To accommodate a broad collection of studies for review, studies that assessed at least two ACEs were included.

The main findings of the systematic review (as are clarified in more detail in the reproduced paper), is that included studies demonstrate a clear relationship between ACEs and an array of outcomes, such as psychopathology, delinquent and problem behaviours, poor physical health, and poor socioeconomic outcomes. Mediating and moderating mechanisms

varied for each category of outcome. One of the observations made in the systematic review was that there was large heterogeneity in the adversity categories, number of adversities, putative mechanisms, and outcomes measured in the included studies. There was also a lack of consistency regarding the mechanisms, and we did not come to a general conclusion about the primary indirect influences in the relationship between ACEs and psychosocial functioning. There was a distinct lack of CLPMs used by studies included in the review. The systematic review had two main implications for the remainder of the thesis. First, the large heterogeneity in how ACEs was researched in terms of adversity categories, number of adversities, and outcomes associated informed the approach to operationalisation of ACEs. This eventually led to the study design in Chapter Three, where we investigate the cumulative risk and person-centred approaches to ACEs. Second, the lack of cross-lagged panel models used in this review led to the study design in Chapter Four, where we utilised repeated measures data to estimate a series of CLPMs.

2.2 Links of adversity in childhood with mental and physical health outcomes: A systematic review of longitudinal mediating and moderating mechanisms.

2.21 Abstract

Adverse childhood experiences (ACEs) have been associated with causes of early death, addiction, mental illness, and poor health. However, studies investigating underlying mechanisms often rely on cross-sectional data or inappropriate study designs. To prevent the negative sequelae associated with ACEs, it is imperative to understand the mechanisms underlying the prospective relationship. The aim of this present review was to provide a synthesis and critical evaluation of the literature regarding the mechanisms underlying this relationship. A search in SCOPUS, MedLine via Ovid, PsycINFO via Ovid, and Web of Science was performed. Studies that utilised a prospective design assessing ACEs in childhood or adolescence, outcomes in adulthood, and analysed either a mediating or moderating relationship were included, unless the study relied on informant report or official records to assess childhood maltreatment types of ACEs. Twenty-two studies examining a longitudinal mediation or moderation were included in a systematic review. A review of the studies found links to psychopathology, delinquent and problem behaviours, poor physical health, and poor socioeconomic outcomes. A clear image of underlying mechanisms is not forthcoming due to (a) poor study design in relation to assessing longitudinal mechanisms, and (b) heterogeneity in the adversities, mechanisms, and outcomes assessed. Based on the review, several gaps and limitations are highlighted and discussed.

2.22 Introduction

Adverse childhood experiences (ACEs) are the focus of much research. Consistently ACEs have been found to impact childhood development and psychosocial functioning. Efforts to understand this relationship are marred by methodological difficulties and inadequacies such as an overreliance on officially documented cases of abuse, and cross-sectional study design. Officially documented cases of abuse only scratch the surface of the true prevalence of abuse and might be prone to biases. Cross-sectional study design is a sub-optimal methodology when used to investigate underlying mechanisms in a longitudinal relationship. To better understand what drives the purported relationship between ACEs and psychosocial functioning, this review will focus on studies that utilise prospective self-report designs to explore mediating and moderating variables.

ACEs involve a wide range of inter-correlated factors including child maltreatment (e.g., physical abuse, sexual abuse, emotional abuse, neglect), and household dysfunction (e.g., parent divorce, parental mental illness, parental substance abuse) (Felitti et al., 1998). Some studies have used factor analysis to formally examine the underlying structure. While ACEs broadly lead to similar outcomes, there are a number of different ways ACEs can be conceptualised. There is some empirical evidence that child maltreatment and household dysfunction variables can be separated although findings are mixed. For instance, an exploratory analysis found that a 3-factor solution (household dysfunction, physical/emotional abuse, and sexual abuse) best fit the data collected using the Behavioural Risk Factor Surveillance System survey (Ford et al., 2014). Notably, the three factors correlated highly with one another, possibly indicating a higher order factor of ACEs. Another analysis found that a 2-factor solution best fit 10 ACEs among a low-income sample of women who received home visiting services, but when 6 additional adversities were added a 4-factor solution provided a better fit, although, the eigenvalue for the fourth factor was lower than 1 which might indicate limited variance is explained by this factor (Mersky et al., 2017). The four factors corresponded to interpersonal victimisation (including maltreatment and household dysfunction items), emotional and physical neglect, extreme poverty, and family loss or separation. A similar study found that a 2-factor solution was the best fit even where additional adversities were included, wherein peer victimisation experiences were grouped with child maltreatment items (Afifi et al., 2020). It may be that child maltreatment

and household dysfunction are distinct subtypes of ACEs in conventional models, but additional ACEs might lead to different patterns.

There is a large evidence base showing that child abuse and neglect predict numerous negative adult outcomes including poor mental health, substance abuse, risky sexual behaviour, obesity, and delinquency (see Gilbert et al., 2009 for a review). A range of evidence shows that specific household dysfunction variables such as parental incarceration are related to negative effects in childhood including antisocial behaviour (e.g. Murray et al., 2012). Broadly defined household dysfunction is associated with a range of negative outcomes (Andersen, 2021). However, some household dysfunction items such as familial financial problems, death of a parent/close relative, and separation from family have received less research attention regarding adult outcomes (see Hughes et al., 2017). Comparative research has demonstrated that child maltreatment items are more salient than household dysfunction items at predicting mental health issues in early adulthood (Negriff, 2020). Child maltreatment is common in the UK; 24.5% of young adults retrospectively report being a victim of at least one type of maltreatment by their parents (Radford et al., 2011). A prevalence study in the USA found that household dysfunction is more prevalent than child maltreatment (Finkelhor et al., 2015). The same study also proposed adding other variables to measures of ACEs, including low socioeconomic status, high peer victimisation, high peer social isolation, and exposure to community violence which were purported to have improved the measure. There is appetite among researchers to iterate ACE measures by including more childhood adversities, and so this systematic review will use a broad definition of ACEs. Finkelhor et al. (2015) found that family mental illness (32.5%) was the most prevalent of the ACEs measured, with high peer social isolation (22.5%), parental divorce/separation (21.3%), and physical neglect (15.9%) also relatively prevalent; Radford et al., (2013) found that exposures to community violence (66.5%), peer victimisation (63.2%), and physical violence from a non-caregiver (55.5%) were the most commonly reported ACEs. Females reported an increased prevalence of lifetime sexual and intimate partner violence, whereas males reported an increased prevalence of lifetime violent victimisation.

It is thought that exposure to multiple types of adversity confers a more potent effect on the individual, resulting in a higher risk of outcomes, or worse outcomes (see Felitti et al., 1998; Finkelhor et al., 2011). Typically, studying ACEs takes the form of assessing the cumulative risk of ACEs, a putative relationship between a summed score of adversities and

subsequent outcomes. Indeed, the basis for this approach is that several research articles report co-occurrences between ACEs (see Cecil et al., 2017; Finkelhor et al., 2007, 2009) which confers a greater risk of negative sequelae (Cyr et al., 2014; Hunt et al., 2017; Merrick et al., 2017). Subsequent systematic reviews have generally concurred that exposure to four or more types of ACEs reflects a high risk of negative outcomes. For instance, one meta-analysis of studies that included a risk estimate for individuals exposed to four or more ACEs found that such exposure confers a high risk of several outcomes including suicide attempts, substance abuse or problematic alcohol use, and interpersonal violence (Hughes et al., 2017). Notably, these outcomes would constitute an adverse environment for rearing children, perhaps demonstrating evidence of a cycle of adversity. A systematic review of studies assessing risk factors for involvement in weapon-related crime in young people in the UK found that ACEs and prior victimisations were risk factors (Haylock et al., 2020). Further, a systematic review of studies relating ACEs to sleep disorders found that the strength of the putative association increased with the number and severity of ACEs (Kajeepeta et al., 2015). While these systematic reviews have outlined the magnitude of risk conferred by ACEs on negative outcomes in adolescence and adulthood, none reported on plausible mechanisms underlying the longitudinal relationship. One systematic review explored how aspects of the home environment and parenting behaviours might mediate the relationship between ACEs and cognitive development (Guinosso et al., 2016). However, this study focused on an outcome in childhood, thus limiting the scope of understanding longitudinal impacts. Another systematic review focused on mechanisms that explain the relationship between ACEs and obesity in adulthood, finding that commonly cited mechanisms included social disruption, health behaviours, and chronic stress response (Wiss & Brewerton, 2020). One weakness common to all these systematic reviews is that cross-sectional studies frequently accounted for a substantial proportion of included studies. Cross-sectional study design is a sub-optimal approach for studying time-dependent relationships, meaning that the current understanding of how ACEs affect longitudinal outcomes should be tempered.

Studying underlying mechanisms. There is growing interest in investigating the mechanisms underlying the relationship between childhood adversity and distal outcomes in adulthood. A number of theoretical frameworks invoke a role of intervening variables (e.g. Grych et al., 2015), which can be tested using mediation models. These models are most usefully applied where there are theoretical mechanisms linking ACEs to outcomes. There are also methodological obstacles to consider when investigating potential mechanisms

influencing the putative relationship. One such obstacle is that ideal study design must be balanced with ethical concerns about the welfare of children at risk; purposefully exposing children to ACEs as experimental manipulation would be unethical. Much knowledge regarding the impact of ACEs has relied on cross-sectional studies and retrospective recall. Indeed, the original ACEs dataset relied on cross-sectional design (see Felitti et al., 1998). When assessing mediation, temporal ordering of variance is an important consideration. A reliance on cross-sectional data to infer mediational processes could be highly misleading because mediational models imply change over time, but cross-sectional data obfuscates the time-lagged effects of a purported risk factor or mediator. Additionally, cross-sectional designs fail to consider whether the putative relationship between adversity and negative outcomes could be explained by confounding variables (see Jaffee et al., 2012). Collecting prospective data in a sequential design minimises uncertainty concerning temporal biases affecting observed results.

A key issue regarding data collection for childhood adversities is reliability. One way to test the reliability of different data collection methods is to compare agreement between methods. A recent meta-analysis tested the concordance between prospectively and retrospectively collected child maltreatment data (Baldwin et al., 2019). Agreement was poor for child maltreatment but substantially concordant for childhood separation from parents. Self-report in adolescence has been found to indicate the highest prevalence of ACEs when compared to caregiver reports and retrospective recall (Naicker et al., 2017); findings elsewhere indicate incongruence between reports of physical abuse collected concurrently during adolescence and retrospectively at age 30 (White et al., 2007). However, it should be noted that we do not know the extent to which individuals may overreport or misrepresent their experiences of adversity, especially when accounts rely on retrospective recall alone (see Widom et al., 2004).

Alternative methods include court-substantiated cases, or informant reports. Research in the UK has estimated that most child maltreatment victims are not officially documented, as rates of child maltreatment measured by a combination of self-report and parent informants are between 7-17 times more common than officially documented cases (Radford et al., 2013). A similar finding supports this general assertion with a Portuguese sample (Pinto & Maia, 2013). While substantiated child maltreatment data enables researchers to study verified cases, or the most severe cases (Shaffer et al., 2008), researchers interested in any occurrence of child maltreatment might favour prospective self-report or informant report

instead. Further, children from Black and Latin American populations in the USA are at an increased risk of involvement with child protection services and placement into foster care (Putnam-Hornstein et al., 2013). Findings from the UK indicate that the putative role of ethnicity in child protection services involvement may need to be considered in conjunction with neighbourhood deprivation (Bywaters et al., 2017). It is unclear why such biases might exist. One potential explanation is that social workers might expect more maltreatment to be present in troubled homes and formally report more alleged cases that meet their expectations (Debowska et al., 2020). Nevertheless, it is anticipated that while not immune to biases, self- or informant-report in representative samples might assuage some of these weaknesses of substantiated child maltreatment data.

Informants such as parents and teachers may provide reliable data regarding ACEs in young children. There are some concerns regarding underreporting of child maltreatment when using informant-report (Fisher et al., 2011). Additionally, insights from the E-Risk longitudinal dataset found that the agreement between retrospective self-report and prospective informant report of child maltreatment is only slight (Newbury et al., 2018). The World Health Organisation (Meinck et al., 2016) recommends that children and young people aged 10-17 should be the target sample to collect self-reported child maltreatment data. Several self-report measures have been designed specifically for this age range, such as the Juvenile Victimisation Questionnaire (JVQ), which demonstrates adequate psychometric properties (see Finkelhor et al., 2005). It is assumed that children who can self-report child maltreatment are of appropriate maturity to also report household dysfunction and other adversities such as bullying, although household dysfunction may just as easily be reported by informants. Clinical interviews can be used to improve accessibility for younger children or participants with impairments (Finkelhor et al., 2005), which broadens the reach of self-report data. Despite adequate measures being available to collect self-report data, data may still be unreliable due to the immaturity or cognitive impairments of participants, erroneous memories, or refusal to report adverse experiences to research teams. Therefore, informant report is a useful component of ACEs research.

Mediation is an important component for inferring the role of indirect relationships (Kenny, 2008), especially in the absence of randomised controlled trials. Moderation is also an important tool, particularly to identify if the relationship between ACEs and varies according to the level of a third variable (Baron & Kenny, 1986) such as sex, ethnicity, genetic polymorphisms, or socioeconomic status. Both analytic methods are important and

will be reviewed in tandem. For the purposes of this review, a cross-lagged panel model (CLPM) is highlighted as a minimally appropriate way to study putative longitudinal mediation. CLPM involves deliberately staggering measurements of independent variable, mediator, and dependent variable (X, M, and Y) through sequential design (see Preacher, 2015 for a discussion of mediation models using longitudinal data). This requires at least three time-points, corresponding to time lags in which the independent variable and mediator can affect the dependent variable. This is important because mediation is essentially a longitudinal process, so estimating mediation using cross-sectional data can be misleading (see Maxwell & Cole, 2007). Reducing this model to two phases introduces greater uncertainty as to the impact of the mediator on the direct relationship because only a partial effect of time can be observed (Mitchell & Maxwell, 2013). Additionally, deliberately staggering measurements raises an issue regarding the extent to which a variable is stable over time. If an outcome variable is relatively stable over the time of measurement, direct or indirect relationships could be an artefact of pre-existing variance. Indeed, other authors have suggested different models such as random intercepts cross-lagged panel model (RI-CLPM), autoregressive latent trajectory model with structured residuals, or dual change score model as more appropriate when a variable is time-invariant (see Hamaker et al., 2015; Mund & Nestler, 2019). Using the correct model to test the putative mechanism is of utmost importance to ensure claims being made are accurate (Orth et al., 2021).

It seems likely from the evidence laid out above that each method of data collection has different advantages and disadvantages, and often data from different sources identify different groups of individuals (Baldwin et al., 2019). In addition, prospective self- or informant-report data collection methods among a representative sample eschews potential biases associated with court substantiated or child protection services data. Prospective self- or informant-report data relies less on life scripts and memory biases than retrospective data (see Widom et al., 2004). Moreover, a CLPM model is coherent with repeated measures self- or informant-report designs. To allow for meaningful comparisons between the studies, this present review will test the distal effects of ACEs using prospective self-report data collected among children and adolescents to assess ACEs where feasible but will allow household dysfunction variables to be measured by caregiver reports and other informants. From the discussion above, it seems that child maltreatment data varies substantially based on data collection method, whereas there is less evidence that household dysfunction variables will vary based on the method of data collection.

The current study. This present systematic review aims to synthesise research using longitudinal designs to examine the impact of mediators and moderators in the relationship between ACEs and negative outcomes. The present systematic review will include studies using prospective self-report data of ACEs and informant report of household dysfunction variables. This approach has been taken because of the underreporting of child maltreatment by official records (Radford et al., 2013; Shaffer et al., 2008) and reliability concerns of retrospective data (Widom et al., 2004). Additionally, the use of substantiated cases of child maltreatment does not conform with the purpose of assessing prospective studies in this review. The inclusion of studies that use informant report for household dysfunction variables is made on the assumption that such biases do not affect judgments regarding household dysfunction variables and the lack of evidence to contradict this assumption. Anticipating a low number of studies, the systematic review will have a broad focus of outcomes including mental health, physical health, and life adjustment outcomes. This present systematic review is distinguished by primarily focusing on mediation and moderation analyses which use prospective data, which is of fundamental importance to investigating time-dependent relationships.

2.23 Method

Search strategy

The systematic review protocol was registered on PROSPERO CRD42020169259.

Empirical research included in this review used prospective data to examine mediating or moderating pathways between adversities experienced in childhood and outcomes in adulthood. Studies included must have collected data on multiple ACEs prior to the age of 19, and followed participants into adulthood to assess physical, mental, social, behavioural, cognitive, or economic outcomes. ACEs was defined as the measurement of two or more exposures to ACEs previously defined by Felitti et al., 1998 and revised by Finkelhor et al., 2015. Using these definitions, several ACEs were focused on in this review (see Table 2.1). Studies that enquired about ACEs exposure ever during childhood or in a temporally specified time (e.g., in the last 12 months) were included. There must have been a minimum

Table 2.1

Sub-categories of Adverse Childhood Experiences used in this review.

Childhood maltreatment	Household dysfunction	Other
Physical abuse	Household mental illness	Peer victimisation/bullying
Sexual abuse	Household criminality	Peer rejection
Emotional abuse	Household alcohol abuse	Community violence
Neglect	Household substance use	Witnessing crime
Harsh punishment	Domestic violence/abuse	Criminal victimisation
Low caregiver warmth	Financial hardship	Multiple hospitalisations
	Parental divorce/separation	Chronic illness
	Death of family member	Care placement
		Exposure to war/conflict
		Natural disasters
		Societal insecurity
		Sexually Transmitted Disease
		Homelessness

of two data collection time points for a study to be included, where ACEs and outcome variables were measured in temporal order. Studies that relied on court-substantiated cases of child maltreatment or caregiver reports of child maltreatment were excluded. Informant reports of household dysfunction variables were included.

Selection criteria

This review was conducted following PRISMA guidelines (Moher et al., 2009). A systematic database search was carried out on 16th March 2020 covering studies published up to the beginning of March 2020. Subsequently, another search was carried out on 6th October 2020 to capture additional studies released between the original search and completion of the original search while synthesis was ongoing. The databases searched were SCOPUS, MedLine via Ovid, PsycINFO via Ovid, and Web of Science (Core Collection). Strings were devised thematically based on adversity, study design, and the mediating or moderating relationships using BOOLEAN search terms (see Table 2.2); each conceptual string was combined with OR and separate strings combined with AND. These strings were modified into Medical Subject Headings (MeSH) when searching in Ovid databases (see Appendix A

for detailed search strategies). In April 2020, the websites of the following cohort studies were directly searched for relevant studies: Longitudinal Study of Child Abuse and Neglect (LONGSCAN), The Dunedin Multidisciplinary Health and Development Study, E-Risk Longitudinal Twin Study, Avon Longitudinal Study of Parents and Children, 1958 National Child Development Study, British Cohort 1970, Context of Violence in Adolescence Cohort, Growing Up in Scotland, National Survey on Child and Adolescent Well-being, National Survey of Children's Exposure to Violence, CDC-Kaiser Permanente Adverse Childhood Experiences Study, Christchurch Health and Development Study, National Epidemiologic Survey on Alcohol and Related Conditions, and the Longitudinal Study of Australian Children.

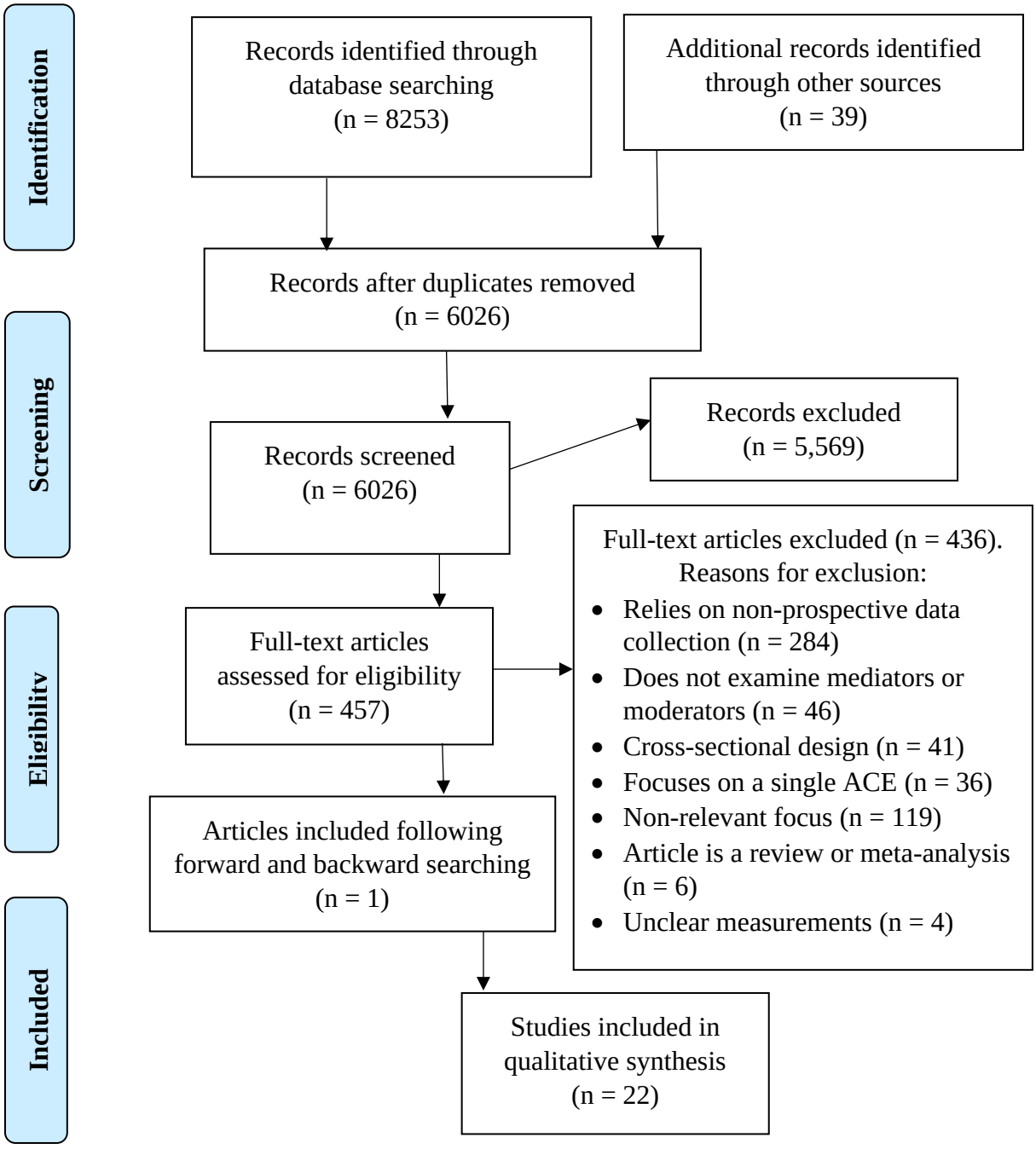
Table 2.2

Boolean search terms used in systematic review.

Concept	Terms used
Adversity/ACEs	child* adversity*, "adverse childhood experienc*", child* trauma*, child* maltreat*, child* victimi*, child* abus*, "cumulative risk"
Study design	longitud*, prospect*, "cohort study"
Mechanism	moderat*, mediat*, mechanism*, pathway*, indirec*, interact*, resilien*

Titles and abstracts of each article were screened, and those that seemed relevant were retrieved so the full-text article could be screened. Reference lists of included studies and studies that cited included studies were assessed for inclusion. Variables relating to study design, sample populations, and findings were extracted. The process of the search strategy is displayed in Figure 2.1. The criteria that were used to include studies for the systematic review are found below. Based on the criteria, two raters (GH & ZES) assessed a random sample of 10% (45) full-text articles to represent the number of articles included. These 45 articles were sampled from the 457 full-text articles using a random number generator to represent the number of articles assessed for inclusion in the final review. There was a raw agreement of 91% between raters. Disagreements were ultimately settled to arrive at unanimous decisions, indicating good reliability of inclusion criteria.

Figure 2.1



PRISMA diagram adapted from Moher et al., (2009).

A. Published in English, undergone peer review.

B. Utilised quantitative, prospective design that assessed the effect of mediating and moderating variables on the relationship between childhood adversity and outcomes in adulthood. There must have been at least two time-points of data collection, where adversities were measured prior to outcomes.

C. Measured adversities including the following examples or related other adverse life circumstances: child abuse and neglect, witnessing domestic violence, witnessing crimes, criminal victimisation, exposure to community violence/war/terror, bullying, household dysfunction (e.g., substance use or mental illness in the household), parent factors (e.g., incarcerated, deceased, separated or divorced).

D. Measured multiple (at least two) self-reported ACEs experienced by children (i.e., age lower than 19 years of age), or household dysfunction adversities either self-reported or reported by informants. Studies that relied only on official records of child maltreatment, or retrospective measurement of adversities at age 19 and older were excluded.

E. Outcomes measured were related to adult mental health, physical health, or life adjustment. Only studies assessing outcomes of participants over the age of 18 were included. Where a study sample represented age groups crossing the age of 18 (e.g., 16-20), the study was excluded unless results were separated for adults and adolescents.

2.24 Results

Study characteristics

See Table 2.3 for an overview of the characteristics and results of the 22 reviewed studies. The articles under review were published between 2006 and 2020. Notably, all but one study, which was conducted in the Netherlands (Veldman et al., 2015), were conducted in English-speaking countries including USA (n = 7), the UK (n = 6), Canada (n = 3), New Zealand (n = 2), and Australia (n = 4). The type of sample used for analysis varied, with birth cohorts (n = 13), school-age community (n = 4), high-risk for ACEs (n = 3), and juvenile delinquent or problem behaviour (n = 2) samples were used. Two samples recruited based on sex, with one female only sample and one male only sample.

Table 2.3

Table of studies included in systematic review.

Authors and date	Dataset (Country)	Sample characteristics	Number of time-points	Number and type of ACEs	Mediators and moderators	Outcome	Findings
Bell et al., (2019).	Christchurch Health and Development Study (New Zealand).	A birth cohort of individuals born in the Christchurch region in 1977. N = 962.	8	2 – Child maltreatment	Major depression, anxiety disorder, nicotine dependence, other illicit substance dependence, life stress.	Psychotic experiences at age 30-35.	Partially mediated.
Byrd et al., (2019).	Pittsburgh Girls Study (USA).	Female sample of 5–8-year-olds in Pittsburgh, oversampled low-income households. N = 2004	16	4 – Child maltreatment 1 – Other	Emotional reactivity, MAOA genotype.	Antisocial Personality Disorder and Borderline Personality Disorder.	Partial mediation through emotional reactivity, moderation through MAOA.
Chen & Lacey (2018).	National Development Study (UK).	A birth cohort of individuals born in Great Britain during a 1-week period in 1958. N = 7464	9	1 – Child maltreatment 4 – Household dysfunction 1 – Other	Educational attainment, social class, emotional and somatic symptoms, problem alcohol use, smoking, physical exercise, BMI.	Inflammation (CRP, fibrinogen, and vWF) at age 44-45.	Partial mediation through socioeconomic and health factors, but not psychological distress factors.

Clark et al., (2010).	National Development Study (UK).	A birth cohort of individuals born in Great Britain during a 1-week period in 1958. N = 9377	9	3 – Child maltreatment 3 – Household dysfunction 1 – Other	Social class, Father's social class, housing tenure, sex, psychopathology[a].	Psychopathology at ages 23 and 45. (anxiety, affective, mood symptoms).	Mediation through early adult psychopathology.
Dion et al., (2019).	N/A (Canada).	Students recruited from high schools. N = 370	2	4 – Child maltreatment 1 – Household dysfunction	Attachment anxiety and attachment avoidance.	Psychological distress and self-esteem at age 24.	Mediation through attachment anxiety.
Dubowitz et al., (2020).	LONGSCAN (USA).	A consortium of five American prospective studies. N = 473	8	4 – Child maltreatment	Internalising or externalising problems.	Alcohol and marijuana use at age 18.	Mediation through internalizing problems.
Fergusson et al., (2011).	Christchurch Health and Development Study (New Zealand).	A birth cohort of individuals born in the Christchurch region in 1977. N = 398	8	2 – Child maltreatment 1 – Household dysfunction	MAOA (low-activity vs high-activity).	Hostility at ages 18, 21, and 25.	MAOA moderated
Heinze et al., (2018).	N/A (USA).	Ninth-grade students recruited from high schools in Michigan. N = 676	13	1 – Household dysfunction 2 – Other	Friendship attachment style (secure vs insecure).	Depression and anxiety growth trajectories between 19-32.	Secure attachment to friends moderated.

Huizinga et al., (2006).	National Youth Survey Family Study (USA).	Individuals aged 11-17 recruited to a national representative household study. Male sample. N = 1007	9	1 – Child maltreatment 1 – Other	MAOA (high risk vs low risk).	Arrest records as an adult, Antisocial Personality Disorder at ages 24-28.	No moderation.
Kelly-Irving et al., (2013a).	National Development Study (UK).	A birth cohort of individuals born in Great Britain during a 1-week period in 1958. N = 15221	9	1 – Child maltreatment 4 – Household Dysfunction 1 – Other	Educational attainment, social class, depression, alcohol consumption, smoking status, BMI.	All-cause mortality.	Partial mediation. More pronounced in male sub-sample than female sub-sample.
Kelly-Irving et al., (2013b).	National Development Study (UK).	A birth cohort of individuals born in Great Britain during a 1-week period in 1958. N = 6138	9	1 – Child maltreatment 4 – Household dysfunction 1 – Other	Educational attainment, social class, depression, alcohol consumption, smoking status, BMI. For women, there was an additional mediator of having a first pregnancy prior to age 33.	Cancer between ages 33-50.	Partial mediation in female sub-sample, but no relationship in male sample.
A. Miller et al., (2014).	LONGSCAN (USA).	A consortium of five American prospective studies.	8	3 – Child maltreatment	Quality of relationships with parents, quality of	Suicidal ideation at age 18.	Partial mediation through depression.

		N = 884			friendships, depression.		
K. Miller et al., (2018).	N/A (USA).	Two community samples of families with children aged 9-10. N = 82	6	4 – Child maltreatment 5 – Household dysfunction 1 – Other	Cortisol awakening response.	BMI at age 22.	Full mediation through cortisol awakening response.
Moretti & Craig, (2013).	N/A (Canada).	Youths with either serious behaviour problems or involved in justice system. N = 179	3	2 – Child maltreatment	Emotion dysregulation.	Depressive symptoms at age 19.	Partial mediation in male sample.
Raposa et al., (2014a).	Mater-University Queensland Study of Pregnancy (Australia).	A birth cohort study of mother-child dyads with depressed mother. N = 389	6	1 – Child maltreatment 4 – Household dysfunction	Smoking, alcohol use, BMI, depressive symptoms, chronic stress in adulthood.	Inflammation (CRP, sTNF-RII) between ages 22-25.	Partial mediation through smoking status, BMI, and chronic stress.
Raposa et al., (2014b).	Mater-University Queensland Study of Pregnancy (Australia).	A birth cohort study of mother-child dyads with depressed mother. N = 705	6	1 – Child maltreatment 4 – Household dysfunction	Social stress, non-social stress depressive symptoms.	Physical health (interviewer-rated, SF-16, chronic illnesses) at age 20.	Mediation through depression and non-social stress.

Raposa et al., (2015).	Mater-University Queensland Study of Pregnancy (Australia).	A birth cohort study of mother-child dyads with depressed mother. N = 175	6	1 – Child maltreatment 4 – Household dysfunction	Presence of psychopathology in close friend.	Depressive symptoms at ages 22-25.	Mediation through the presence of a close friend with psychopathology symptoms.
Schurer et al., (2019).	National Development Study (UK).	A birth cohort of individuals born in Great Britain during a 1-week period in 1958. N = 7450	9	1 – Child maltreatment 4 – Household dysfunction 1 – Other	Capital accumulated, cognitive skills, noncognitive skills, mental and physical health, education attainment, family formation, labour force attachment.	Economic outcomes (Net income, welfare dependence, subjective poverty) at age 55.	Mediation through education attainment, cognitive skills, non-cognitive skills, health, and family factors.
Solís et al., (2015).	National Development Study (UK).	A birth cohort of individuals born in Great Britain during a 1-week period in 1958. Sample split by sex. N = 3753 men, N = 3782 women.	9	1 – Child maltreatment 4 – Household dysfunction 1 – Other	Educational attainment, social class, socioeconomic status, marital status, physical activity, alcohol consumption, smoking, BMI, depressive symptoms.	Allostatic load at age 44.	Mediation through health factors, education level, and wealth male sub-sample. Mediation through by health factors and being a homeowner at age 33 in female sub-sample.

Starr et al., (2014).	Mater-University of Queensland Study of Pregnancy (Australia).	A birth cohort study of mother-child dyads with depressed mother. Sample split by available data for genotypic polymorphism. N = 705	6	3 – Household dysfunction 1 – Other	Chronic stress in early adulthood. CRHR1 (rs110402 SNP) and 5-HTTLPR genotype.	Depressive symptoms at age 20.	Moderation by chronic stress and CRHR1. Moderated by three-way interaction of chronic stress, CRHR1, and 5-HTTLPR.
Veldman et al., (2015).	Tracking Adolescents' Individuals Lives Study (Netherlands).	A cohort study of children from 5 municipalities. N = 1881	4	5 – Household dysfunction 3 – Other	Internalizing problems, externalizing problems, attention problems.	Educational attainment at age 19.	Partial mediation through externalising symptoms in male sub-sample.
Wojciechowski. (2020).	Pathways to Desistance (USA).	Juvenile offenders recently adjudicated for a serious offence. N = 261.	12	2 – Other	Anxiety trajectory (low, moderate, high).	Drug or alcohol dependence.	Partial mediation through high trajectories of anxiety.

Note.[a] = This is not strictly a mediator because it is the same variable as measured as the outcome.

Study designs

The age of participants at baseline ranged from at birth (n = 11, Bell et al., 2019; Chen & Lacey, 2018; Clark et al., 2010; Kelly-Irving et al., 2013a, 2013b; Fergusson et al., 2011; Raposa et al., 2014a, 2014b, 2015; Schurer et al., 2019; Solís et al., 2015; Starr et al., 2014), to age 11-17 (Huizinga et al., 2006). The age of participants at outcome measure ranged from 19 (Veldman et al., 2015) to 55 (Chen & Lacey, 2018; Clark et al., 2010; Kelly-Irving et al., 2013a, 2013b; Schurer et al., 2019; Solís et al., 2015). The length of follow-ups varied considerably from 5 years to 55 years (M = 26.23, SD = 15.68). None of the assessed study designs formulated a CLPM to test longitudinal mediation. Sample sizes ranged from 82 to 15,221 (M = 2924.36, SD = 4080.52), indicating varying levels of statistical power amongst included studies. Characteristics of samples also varied, with 59% using general population samples (n = 13), 31.8% using at-risk samples (n = 7), and 9% using forensic/juvenile justice samples (n = 2).

Most of the included articles used secondary data from established cohort studies (n = 18), whereas a minority collected primary data (n = 4). The cohort studies that were used by articles included in this review were Christchurch Health and Development Study (n = 2), Pittsburgh Girls Study (n = 1), National Development Study (n = 6), LONGSCAN (n = 2), National Youth Survey Family Study (n = 1), Mater-University of Queensland Study of Pregnancy (n = 4), Tracking Adolescents' Individuals Lives Study (n = 1), and Pathways to Desistance Study (n = 1). There was considerable overlap in the use of variables for studies using the National Development Study dataset, as well as studies that used the Mater-University of Queensland Study of Pregnancy dataset.

The combination of ACEs measured in included articles ranged from measuring two types of maltreatment and testing putative mediators separately (Bell et al., 2019) to measuring ten ACEs from both child maltreatment, household dysfunction, and other sub-categories, and testing the putative mediators underlying a dose-response relationship (K. Miller et al., 2018). Seven studies measured fewer than four ACEs, limiting the ability to assess mediators and moderators of a dose-response relationships with negative outcomes. The types of ACEs measured in included studies are shown in Table 2.1.

Throughout included studies, various terms are used to describe the general concept of ACEs, including child abuse, child maltreatment, abuse exposure, exposure to violence, childhood adversity, early life stress, early life adversity, and poly-victimisation. There was

much variation in how ACEs were measured from study to study, with most studies adopting a mixture of binary items that are either summed to create a composite, or entered as individual variables (n = 15, Chen & Lacey, 2018; Clark et al., 2010; Dion et al., 2019; Heinze et al., 2018; Huizinga et al., 2006; Kelly-Irving et al., 2013a, 2013b; A. Miller et al., 2014; Raposa et al., 2014a, 2014b, 2015; Schurer et al., 2019; Solís et al., 2015; Veldman et al., 2015; Wojciechowski, 2020). Some studies used validated scales for individual variables or the whole composite of ACEs, such as the Adverse Childhood Experiences Scale, the Conflict Tactics Scale, Parent-Child Relationships Scale, Abuse Questionnaire, Structured Clinical Interview, Dyadic Adjustment Scale (Byrd et al., 2019; K. Miller et al., 2018; Moretti & Craig; Starr et al., 2014). One study designed its own scales for each measure (Dubowitz et al., 2020). Two studies were unclear in how they measured ACEs, although from both it seemed as though single item measures were used (Bell et al., 2019; Fergusson et al., 2011).

Types of mediators/moderators. Mediators and moderators examined in this review are heterogeneous, capturing a wide variety of factors that can influence adult adjustment in the context of adversity. The most common types can be categorised as in different pathways, such as biological, psychological, additional stressors, health, personal assets, social, and family pathways. In most studies (n = 17) mediators or moderators were assessed before the outcome, in two studies at the same time as the outcome, in one study genetic polymorphisms were measured after the outcome, and in two studies it was unclear. Frequently examined mediators and moderators are shown in Table 2.4.

Table 2.4

Frequent mediators/moderators assessed and measured outcomes.

Mediators	**Studies (*n*)**	**Outcomes measured**
Depression symptoms	7	Psychotic experiences, all-cause mortality, cancer, suicidal ideation, inflammation, physical health, allostatic load.
Smoking status	5	Psychotic experiences, inflammation, all-cause mortality, cancer, allostatic load.
Alcohol consumption	5	Inflammation, all-cause mortality, cancer, allostatic load.
Body Mass Index	5	Cancer, inflammation, allostatic load.
Educational attainment	5	Inflammation, all-cause mortality, cancer, economic success, allostatic load.

Social class	5	Inflammation, psychopathology, all-cause mortality, cancer, allostatic load.
Moderators		
MAOA genotype	3	Antisocial Personality Disorder, Borderline Personality disorder, hostility, criminality

Note. Only mediators and moderators assessed in 3 or more studies are presented in this table. The remaining mediators and moderators are: sex, anxiety symptoms, anxiety growth trajectory, attachment type, emotional and somatic symptoms, psychopathology symptoms, internalising problems, externalising problems, attention problems, emotion regulation, emotional reactivity, presence of psychopathology in close friend, quality of friendships, quality of relationship with parents, life stress, social stress, non-social stress, chronic stress, mental and physical health, physical exercise, illicit substance use, cognitive skills, noncognitive skills, capital accumulated, first pregnancy prior to age 33, family formation, housing tenure, marital status, parent's social class, labour force attachment, cortisol awakening response, CRHR1 (rs110402 SNP) genotype, 5-HTTLPR genotype.

Psychopathology. Outcomes relevant to psychopathology include depression/mood symptoms (n = 5), anxiety symptoms (n = 2), antisocial personality disorder (n = 2), drug or alcohol dependence (n = 2) borderline personality disorder, psychotic experiences, suicidal ideation, self-esteem, and general psychological distress. Evidence for mediating and moderating effects is mixed as few mediators and moderators are examined for similar outcomes across multiple studies. Most pathways tested were statistically significant. There was evidence that variables relevant to psychological distress or other psychopathology symptoms play an important role in the relationship between ACEs and later psychopathology symptoms (Bell et al., 2019; Clark et al., 2010; Dubowitz et al., 2020; A. Miller et al., 2014; Moretti & Craig, 2013; Wojciechowski, 2020). Some studies found that this was mediation via a different type of psychopathology symptom (Bell et al., 2019; Dubowitz et al., 2020; Moretti & Craig, 2013; Wojciechowski, 2020), whereas others were more of a continuity of symptoms (Clark et al., 2010; A. Miller et al., 2014). Specifically, depression and emotion dysregulation were mediators of subsequent psychotic experiences and depression symptoms respectively (Bell et al., 2019; Moretti & Craig, 2013), and internalising problems including anxiety were mediators of drug or alcohol dependence (Dubowitz et al., 2020; Wojciechowski, 2020). There is also evidence that social factors (e.g., having a close friend with psychopathology symptoms) mediate the relationship between ACEs and mood disorder symptoms (Heinze et al., 2018; Raposa et al., 2015). Adolescent victimisation seemed to mediate between ACEs and antisocial personality disorder, but this

was not moderated by monoamine oxidase A (MAOA) genotype (Huizinga et al., 2006). However, no two studies examined the same mechanism, so converging evidence is scant. For a full description of summarised results, see Table 2.3.

Out of 12 studies that assess the mediating and moderating variables in the relationship between ACEs and psychopathology, none appropriately accounted for stability of variance by repeating measures of independent variables, mediators, and outcomes. Four out of 12 studies assessing psychopathology symptoms as an outcome accounted for *a priori* variance of similar symptoms at one of the previous time-points. One study repeated measures of putative mediating and outcome variables at three sequential time-points but did not do the same for ACEs (Moretti & Craig, 2013). One study controlled for substance use two years after baseline ACE measures and controlled for mediators at baseline (Dubowitz et al., 2020). Three studies controlled for the outcome measure at baseline (Clark et al., 2010; Dion et al., 2019; A. Miller et al., 2014), but one of these studies only employed a half-longitudinal design (Dion et al., 2019). Some studies utilised caregiver report when the participant was too young to self-report adversities (Raposa et al., 2015; Starr et al., 2014), or combined other methods of data collection alongside self-report (Bell et al., 2019; Clark et al., 2010; Dubowitz et al., 2020).

Several studies assessing psychopathology as an outcome studied sex differences, finding that some mechanisms may differ depending on sex. Two studies examined the interaction of MAOA genotype in the relationship between ACEs and personality disorders. Specifically, when male participants only were sampled, no moderation was found when the outcome was antisocial personality disorder (Huizinga et al., 2006). In a female only sample, high-activity MAOA genotype moderated the effect of ACEs on antisocial personality disorder and borderline personality disorder (Byrd et al., 2019). Specifically, high levels of ACEs and high-activity MAOA genotype increased the levels of emotion dysregulation, which subsequently predicted higher levels of personality disorder. Studies examining a sex interaction for psychological distress outcomes were mixed. When the outcome was suicidal ideation, one study found no sex interaction (Dion et al., 2010), whereas one study found that the mediation by social factors was stronger in a male sub-sample (A. Miller et al., 2014). When the outcome was depression symptoms, one study found no evidence of sex interaction (Raposa et al., 2015), another study found that sex was not a predictor of depression or anxiety growth trajectories (Heinze et al., 2018), and one study found that emotion dysregulation was a significant mediator only for the male sub-sample (Moretti & Craig,

2013). Finally, one study found no sex interaction in the relationship between ACEs and psychopathology symptoms (Clark et al., 2010). Taken together, these studies imply that sex is a moderator of the pathway between ACEs and personality disorders, but there is mixed evidence that sex differences are important for other psychopathological outcomes. Studies were limited in assessing differences based on ethnicity or socioeconomic status, although one study used an ethnically diverse sample (A. Miller et al., 2014).

Physical health. Of the studies that examining physical health outcomes, most found evidence for mechanistic pathways. Outcomes measuring mortality and physical health included inflammation (n = 2), mortality, cancer, body mass index, subjective physical health, chronic illness, and allostatic load. Several studies found that health behaviours such as smoking status, physical exercise, and body mass index were mediators of the relationship between ACEs and physical health outcomes (Chen & Lacey, 2018; Kelly-Irving et al., 2013a, 2013b; Raposa et al., 2014a; Solís et al., 2015). Further, mixed findings indicated a mediation through socioeconomic factors (i.e., educational attainment, occupational social class; Chen & Lacey, 2018; Solís et al., 2015), and two found no mediation (Kelly-Irving et al., 2013a, 2013b). However, all but two of these studies used the same dataset, the National Development Study. There is also tentative evidence that additional stressors contribute to health-related outcomes (Raposa et al., 2014a, 2014b), but these two studies used the same dataset. For a full description of summarised results, see Table 2.3.

Out of seven studies that studied outcomes corresponding to physical health, all seven utilised several time-points but none repeated measures corresponding to the CLPM. All studies used a mixture of self-report and informants. Notably, six of the seven studies utilise two secondary datasets, the National Development Study (Chen & Lacey, 2018; Kelly-Irving et al., 2013a, 2013b; Solís et al., 2015), Mater-University Queensland Study of Pregnancy (Raposa et al., 2014a, 2014b).

Several studies assessing physical health outcomes examined sex differences. Firstly, it was found that different mediators attenuated the relationship between ACEs and allostatic load (Solís et al., 2015). For men, health factors, education level, and accumulated wealth mediated the relationship, whereas for women health factors and being a homeowner at age 33 were mediators. Secondly, in the relationship between ACEs and mortality the mediation effect was stronger for males than for females, with psychological malaise remaining a strong predictor of mortality even when mediators were added to the model (Kelly-Irving et al.,

2013a). Thirdly, a study found no direct link between ACEs and cancer for males but did find a direct link for females (Kelly-Irving et al., 2013b). No sex interactions were found when the outcome was inflammation (Chen & Lacey, 2018). Studies were limited in assessing differences based on ethnicity.

Delinquency. Of the studies that examined delinquency as an outcome, both examined MAOA genotypes as moderators. Outcomes measured were hostility and arrest records. One study found that MAOA moderated the relationship between ACEs and hostility in early adulthood (Fergusson et al., 2011), whereas the other study found that MAOA did not moderate the relationship between ACEs and arrest records (Huizinga et al., 2006). This study also examined an interaction of sex, which was not significant (Huizinga et al., 2006). For a full description of summarised results, see Table 2.3. Both studies utilised several time-points. Studies were limited in assessing differences based on ethnicity, although Fergusson et al. (2011) reported analyses both with and without ethnic minorities. In these separated analyses, the interaction effect was strengthened when ethnic minority data were omitted.

Personal achievements. Two studies examined mediating and moderating mechanisms in the relationship between ACEs and personal achievement. Both studies found evidence for mediating mechanisms such as cognitive skills, family formation, educational attainment, and externalising problems (Schurer et al., 2019; Veldman et al., 2015). One study found that when stratified by sex, the model only remained significant for the male group (Veldman et al., 2015). For a full description of summarised results, see Table 2.3. Both studies utilised several time-points, but neither study repeated measures corresponding to a CLPM. Both studies used a mixture of self-report and informant report in prospective design.

2.25 Discussion

ACEs have been implicated in psychopathology, delinquency, poor physical health, and poor socioeconomic outcomes. However, the general image of mediating and moderating effects is unclear based on the reviewed research. The main objective of this systematic review was to provide a synthesis of evidence regarding mediating and moderating mechanisms underlying the relationship between ACEs and negative outcomes in adulthood. The current review focused on prospective studies that used either self-report or informant report data of two or more ACEs.

In line with prior reviews which included cross-sectional studies (e.g., Gilbert et al., 2009; Hughes et al., 2017), the present review supported the basic longitudinal relationship between ACEs and multiple negative outcomes, particularly psychopathology and poor physical health. This review highlights some trends regarding the mediators underlying the relationship between ACEs and psychological distress. For instance, mediators relevant to psychological distress were found to be important in the relationship between ACEs and adult psychopathology. For depression, psychotic experiences, alcohol or drug dependence, suicidal ideation, mid-life psychopathology, and self-esteem, at least one mediator was related to psychological distress (i.e., attachment anxiety, emotion dysregulation, sub-clinical distress), which might imply a predisposition, or an influence of stable environmental factors (see Hannigan et al., 2017). However, only one study investigated the influence of genotype on antisocial personality disorder and did not find evidence for moderation (Huizinga et al., 2006). Based on reviewed studies, earlier depression symptoms had the strongest evidence in several mediating psychological distress outcomes.

Regarding outcomes relevant to delinquency (such as hostility), genetic polymorphisms were assessed as moderators, but no mediators were assessed. Specifically, a high-activity MAOA genotype was found to moderate the relationships between ACEs and measures of hostility (Huizinga et al., 2006). A low-activity MAOA genotype was found to moderate the effect of ACEs on hostility, by increasing levels of hostility in early adulthood (Fergusson et al., 2011). There is relatively little to compare these findings to, as MAOA polymorphisms are most often assessed as risk factors for criminality (see Byrd & Manuck, 2014). For variables regarding physical health and early mortality, there was a trend for other health-related variables such as smoking status, body mass index, physical activity, and alcohol consumption to partially mediate outcomes. This supports the findings of previous systematic reviews that relied on cross-sectional studies (Wiss & Brewerton, 2020). It is difficult to comment on the relative importance of each mediator, as reviewed studies tended to assess these together as ‘health factors’. To a lesser degree, variables related to socioeconomic conditions such as social class and education level, as well as depression partially mediated health outcomes.

The systematic review identified 22 prospective studies, which suggests that while ACEs are a popular research concept, the use of prospective longitudinal data to investigate mediation or moderation is uncommon. Included studies all adopted good study design features, but none adopted a longitudinal model ideally suited to infer mediating mechanisms.

Crucially, most studies failed to repeat measures of independent, mediator, and dependent variables over the course of the study, meaning conclusions often rely on untested assumptions (Preacher, 2015). One study compared the use of prospective self-report and retrospective self-report of child maltreatment, and found considerable disagreement (Bell et al., 2019), emphasising the importance of deciding which data collection methods are most appropriate to measure ACEs. All included studies were published in the last 15 years, using data in English-speaking countries including USA, UK, Canada, New Zealand, and Australia, with one exception being the Netherlands. Most samples represented the general population, while some at-risk and forensic populations were represented. A wide range of outcomes were assessed in these studies, such as psychopathology, mortality, delinquency, physical health, and educational or economic achievements. Similarly, a wide range of mediators and moderators were assessed, such as genotypic moderation, psychopathological symptoms, health behaviours, and social conditions. Most studies tested several mediators or moderators simultaneously. However, because of the heterogeneity of mechanisms and outcomes addressed, a meta-analysis was not appropriate. Furthermore, the concept of ACEs was measured with great heterogeneity, with the range of ACEs studied being 2-10, and varying mixtures of child maltreatment, household dysfunction, and other types of adversities.

Limitations of the reviewed studies

The main limitation in reviewed studies is that the strength of study design was not ideally designed to test longitudinal mediation. Studies attempted to approximate a sequential design but were unable to account for potential longitudinal stability. Broadly, researchers should engage with literature regarding longitudinal panel modelling to use methods appropriate for testing underlying mechanisms, whether this be the CLPM or a different panel model (see Hamaker et al., 2015; Mund & Nestler, 2019). To increase certainty that outcome variance is due to a mediational mechanism observed in ACEs and the mediators in question, Preacher (2015) argues that there should be at least three time-points at which independent, dependent, and mediating variables are all measured. This allows researchers to control for *a priori* variance, which might confound the putative model. Only five studies attempted to control for prior variance of an outcome measure. For some outcomes, such as cancer and early mortality, controlling prior levels may not make conceptual sense, but controlling other well documented risk factors, such as family history may be worth consideration.

Another limitation of the present evidence base is that two large prospective studies account for 9 out of 22 (40.9%) of the reviewed papers: the National Development Study, and the Mater-University Queensland Study of Pregnancy. Indubitably, these studies are useful to research questions concerning the longitudinal effects of childhood adversity. However, an over-reliance on two datasets means that the results synthesised may be unduly influenced by idiosyncrasies attributable to these datasets. It is appreciably difficult to obtain high-quality longitudinal data which assesses relevant variables. But it is important to ensure that findings can be generalised beyond popular datasets. More high-quality datasets that can be used to study longitudinal mechanisms are required.

One clear gap observed from the included articles is that despite the broad range of outcomes, disproportionate research attention focused on psychopathology. Only five of the outcomes measured appeared in more than one research article (depression, anxiety, antisocial personality disorder, inflammation, and drug or alcohol dependence). To draw meaningful conclusions, the reviewed outcomes were subsumed into generic categories which may be arbitrary. Notably, while the original ACEs study found that ACEs were related to a plethora of leading causes of death (Felitti et al., 1998), none of the included studies assessed suicide attempts, sexually transmitted disease, diabetes, organ diseases, or strokes. This omission belies several strong limitations of ACEs research, the reliance on a small number of datasets for longitudinal research, and the general reliance on unreliable data collection methods (Widom et al., 2004). Specifically, many studies were excluded for relying solely on retrospective self-reports, or court-substantiated records of child maltreatment. Only a handful of studies assessed positive outcome variables, substantially limiting the capacity of this review to synthesise knowledge about other pathways. To fully understand developmental processes tying ACEs to negative outcomes, it is important not to overlook normal developmental outcomes (Sroufe, 2013).

Another notable weakness of included studies is that most studies were comprised of ethnically and socioeconomically homogeneous samples. Some studies did investigate socioeconomic factors as mediators, which is important because low socioeconomic status tends to increase the risk of ACEs child maltreatment (Bywaters et al., 2017). There is some evidence that some ethnic minorities are more likely to be involved in child protection services, which indicates that ethnicity should be considered as a moderator (Putnam-Hornstein et al., 2013). Additionally, few studies examined sex as a moderator which further limits the insight as to relationships and mediated relationships dependent on sex.

Considering that prevalence rates of ACEs seem to be influenced by the sex of the child (see Radford et al., 2011), it is also important to examine sex as a moderator.

Recommendations for future studies

One way that future studies can improve is to ensure that study design is informed by longitudinal panel modelling designs appropriate to test underlying mechanisms. As a minimum, where researchers are interested in a mediating mechanism, study designs should enable researchers to control for variance over at least three time-points. Failing to do so means that our conclusions rely on untested assumptions. Appropriate panel modelling techniques and suitable data will be most informative regarding developmental mechanisms (see Hamaker et al., 2015; Mund & Nestler, 2019; Preacher, 2015).

Secondly, research included in this systematic review tended to rely on a small number of prospective cohort studies. Equally, data assessed by studies included in this systematic review predominantly represented samples in USA, UK, and Australia. Expanding on these samples is important for generalisability of study results. Research would benefit from new longitudinal data, and perhaps an increased focus on countries unrepresented by reviewed studies.

Thirdly, outcomes of interest to ACEs research vary from psychopathology, delinquency, physical health problems, and economic output. However, research included in this review disproportionately studied psychopathological outcomes. Notably, none of the included studies investigated suicide attempts, sexually transmitted disease, diabetes, organ diseases, or strokes as outcomes despite these being key outcomes in the original ACEs study (Felitti et al., 1998). Further research should seek to study the longitudinal mechanisms underlying the link between ACEs and outcomes that were not presented in this systematic review, as well as other important outcomes such as sleep disorders, criminality, and positive outcomes such as marriage, and economic success.

Fourthly, this systematic review captured a broad range of ACEs to reflect child maltreatment and household dysfunction, but several adverse experiences were not represented at all in this review. For instance, no studies measured exposure to war/conflict, societal insecurity, homelessness, or natural disasters. This limits the research base of ACEs in representing adversity faced by children globally. Future studies could use data that measures such phenomena in a longitudinal manner alongside adversities such as child maltreatment or household dysfunction. The current global COVID-19 pandemic provides an

opportunity to assess ACEs related to extraneous adversities. Indeed, prospective studies assessing ACEs related to the current pandemic should be set up now to further knowledge about the effect of ACEs.

Finally, there is a need to standardise the way that ACEs are measured in longitudinal research. Studies in this systematic review were sometimes measuring similar or identical concepts such as child abuse, child maltreatment, abuse exposure, exposure to violence, childhood adversity, early life stress, early life adversity, and poly-victimisation. Arguably, these concepts encapsulate partial aspects of ACEs (Siddaway, 2020). There is a need to conceptually review ACEs with regards to assimilating similar or identical concepts into ACEs research to expand our understanding of how adversity affects outcomes in adulthood. Furthermore, there is a need for ACEs research to develop generalisable measures to enable better comparison between studies. From there, researchers can debate whether ACEs should be measured as individual variables, composite variables, or other variations.

Recommendations for practice, policy, and research are summarised in Table 2.5.

Table 2.5.

Implications for Practice, Policy, and Research.

Practice	• There is clear evidence of a relationship between ACEs and various negative outcomes in adulthood which supports previous cross-sectional data. • Early occurrences of psychological distress and unhealthy behaviours are important in the relationship between ACEs and later adult psychological distress and poor health outcomes, respectively. Preventing long-term negative sequelae might necessitate intervention in adolescence or early adulthood for those with known histories of ACEs.
Policy	• Develop programs to prevent the longevity of psychological distress and unhealthy behaviours. • Develop a commonly agreed upon definition of ACEs to improve comparison between studies and settings.
Research	• More research studying underlying mechanisms in relationship between ACEs and adult outcomes using prospective data needed. Theorised pathways should inform research design to aid the organisation of reviews and meta-analyses.

- Future study designs aiming to investigate mediating mechanisms should emulate a robust model that is able to account for stability of variance across multiple time-points.

Limitations of this review

The present study should be interpreted in light of several limitations. Firstly, the review was limited to studies assessing adult outcomes, which means that it may have missed important prospective research regarding child and adolescent outcomes that could have been insightful. Additionally, the search strategy may have omitted relevant terms such as 'potentially traumatic experiences'. This may mean that some relevant papers were missed in the search. We call on ACE researchers to converge on terminology to limit complexity in this research area. Secondly, this systematic review aimed to prioritise prospective self- and informant-report data which was justified by recent evidence that child maltreatment varies widely based on data collection method (see Baldwin et al., 2019; Newbury et al., 2018), and that prospective data has less reliance on life scripts and memory biases (see Widom et al., 2004). However, officially documented cases might be preferred due to greater certainty regarding the occurrence of ACEs. Our conclusions may differ due to our decision to focus on prospective self- or informant-report data, so it is imperative that future research investigates the effect of data collection methodology on putative mediation and moderation mechanisms underlying the relationship between ACEs and adult psychosocial functioning. Thirdly, only articles published in peer-reviewed journals were considered. Thus, the results synthesised are open to publication bias, especially in considering that most studies reported significant findings.

Chapter Three: Comparison of person-centred and cumulative risk approaches in explaining the relationship between adverse childhood experiences and behavioural and emotional problems.

3.1 Abstract

Adverse childhood experiences (ACEs) commonly co-occur, and researchers often estimate their impact using a cumulative risk approach. The person-centred approach offers another approach to operationalise the co-occurrence of ACEs. This study aims to estimate latent classes of ACEs in a sample of UK children, examine their relationship with emotional and behavioural problems, and compare the explanatory value of the latent classes to cumulative risk scores. Data were collected among a general population sample of British 10-year-old children extracted from the UK Household Longitudinal Study (N = 601). Seven items characterised ACEs, comprising parent-report physical discipline, emotional abuse, supervisory neglect, maternal psychological distress, and child-report parental educational disinterest, bullying victimisation, and adverse neighbourhood. Outcome measures were derived from the self-report Strengths and Difficulties Questionnaire including total difficulties, emotional symptoms, conduct problems, hyperactivity, peer problems, and prosocial behaviour. Latent class analysis resulted in a 3-class solution: *low ACEs*, *household challenges*, *community challenges*. Compared to the other classes, the *community challenges* class scored substantially worse on total difficulties, emotional symptoms, and peer subscales. The cumulative risk score was associated with all outcomes except prosocial behaviour. Cumulative risk models accounted for a larger proportion of variance compared with the latent class models, except for peer problems which the person-centred model explained better. This study confirms that ACEs are associated with impairment in child functioning, and that both person-centred and cumulative risk approaches can capture this relationship well. Specifically, the person-centred approach demonstrated how co-occurring risks factors in the *community challenges* class produced particularly poor internalising outcomes.

3.2 Introduction

Adverse childhood experiences (ACEs) have been linked to a multitude of negative outcomes, but as findings presented in the previous chapter show, underlying mechanisms remain elusive. Additionally, the way in which ACEs are operationalised varies from study to study. This illuminates the possibility that how ACEs are measured and operationalised may be a key driver in the relationship between ACEs and psychosocial functioning. Specifically, how multiple ACEs cluster together will be investigated in this present chapter.

The cumulative risk approach has been the dominant way of operationalising ACE risks. Several studies examined the relationship between a summed score of seven adversities (e.g. physical abuse, parental substance use), and outcomes including alcoholism, drug abuse, depression, suicide attempts, and smoking (e.g. Chapman et al., 2004; Edwards et al., 2003; Felitti et al., 1998). These studies concurred in finding a dose-response relationship between the number of ACEs and outcome severity. More recently, Hughes et al.'s (2017) meta-analysis of 137 studies found exposure to four or more ACEs (compared to no ACEs) substantially worsened outcomes, with particularly strong risks associated with problematic drug or alcohol use, self-directed or interpersonal violence, sexual risk taking, and mental ill health.

The predominant approach to operationalising ACEs has been the cumulative risk approach, which treats each categorical ACE as equally additive to an overarching effect. Consequently, the cumulative risk approach does not distinguish specific types of adversity and provides limited insight into the risks of exposure to specific ACEs. The discovery of homogeneous patterns of risk co-occurrence might be beneficial for practitioners, who might see the presence of one risk factor as a marker of the likely presence of other risks. Knowledge about patterns of co-occurrence and associated outcomes might also help to identify people who are particularly vulnerable to adversity. Models which can provide these unique insights might prove to be a valuable alternative to the cumulative risk approach.

One such method is the person-centred approach, which uses latent class analysis (LCA) with categorical data or latent profile analysis (LPA) with continuous data to identify unobserved groups defined by patterns of co-occurring items (Lanza & Rhoades, 2013). A key assumption of this approach is that the distribution of ACEs can be explained by groups of individuals who have experienced similar patterns of ACEs. Each group has an estimated likelihood of the presence of each item. Classes can be distinguished quantitatively (i.e.

high/low probability of all items) and qualitatively (i.e. high probability of some items, low probability of other items). Membership of computed latent classes can be used to estimate outcomes associated with that class, or to highlight groups at higher risk of class membership (e.g. Debowska et al., 2018). The effects of different combinations of ACEs and those who are at most risk of the worst outcomes can be ascertained through the person-centred approach, which might be informative for intervention and prevention strategies.

Qualitatively homogeneous groups can be difficult to summarise from study to study, perhaps due to the aforementioned differences in measuring ACEs. Alternatively, this might be due to the relatively recent adoption of LCA for ACE items. Further refinement of the person-centred approach to ACEs might elucidate general population-level trends, as has been done with child maltreatment. For instance, a systematic review of child maltreatment LCA studies found that a 3- or 4-class solution is fairly typical, quantitatively distinct classes (i.e. no/low abuse and poly-victimisation) were common, and while qualitative classes varied between studies a sexual abuse class was observed somewhat consistently (Debowska et al., 2017). Studies varied in using child, adolescent, and adult samples, and used a range of data collection methods such as self-report, parent-report, and child welfare records, all of which may have contributed to variation in class solutions.

Formal comparisons between cumulative risk and person-centred approaches

Studies utilising both cumulative risk and person-centred approaches tend to agree that greater numbers of ACEs are associated with worse outcomes, although some LCA studies have demonstrated that qualitative classes are also informative. One study using a community sample of children identified a 7-class model, (Lanier et al., 2018) where the classes with the strongest association to health outcomes were a high ACEs class, and a parental mental illness and poverty class. However, the 7-class solution in this study included small classes (< 5% membership) which could be regarded as spurious without theoretical justification (Hipp & Bauer, 2006). Another study sampled American undergraduate students and found a 4-class model comprising high ACEs, moderate risk of non-violent household dysfunction, emotional and physical abuse, and low ACEs (Merians et al., 2019). While the high ACEs group was associated with the most severe outcomes, the emotional and physical abuse class only differed slightly from the high ACEs class, which implies that this qualitative class is particularly potent.

The cumulative risk approach and the person-centred approach are both viable approaches to operationalising ACE co-occurrences among different age groups (Lian et al., 2022). Formal comparisons of explanatory utility approaches have so far produced inconclusive results. For instance, Merians et al. (2019) compared approaches using nine ACE items among a sample of undergraduate students, with the outcomes concerning mental health, physical health, alcohol use, and academic performance. A 4-class solution was compared to nominal groupings of 0, 1, 2, 3, 4, and 5 or more ACEs; both models explained similar magnitudes of variance. However, this could be an inappropriate comparison because the number of categorical groups in each model was unbalanced. Another study compared LCA and cumulative risk approaches in relation to chronic inflammation outcomes (Lacey et al., 2020). This study found a 4-class solution (low ACEs, polyadversity, parental mental illness and substance misuse, maltreatment and conflict). While the cumulative risk approach produced a dose-response relationship for three inflammation markers, the person-centred approach produced different outcomes for each class. The polyadversity and maltreatment and conflict classes were associated with the highest scores for different inflammation markers. This study presents subtle differences in outcomes by latent class typology, which suggests that the combination of maltreatment and familial conflict might pose a specific risk for chronic inflammation, which was not captured by the cumulative risk approach.

There are several limitations in the literature assessing the measurement of ACEs which could contribute to inconsistent findings. First, much research relies on retrospective data. A recent meta-analysis found poor agreement between prospective and retrospective measures of child maltreatment (Cohen's $k = 0.19$), so study design could impact results (Baldwin et al., 2019). The focus on adult retrospective data limits understanding of latent classes in children and how age of onset might modify the effect of ACE exposure (Debowska et al. 2017). Second, many studies using LCA/LPA utilise samples with a wide age range (e.g. Lanier et al., 2018). This can compromise validity because participants aged 11-18 have had more time to accumulate adversity than 10-year-olds, and developmental stages could modify the impact of ACEs based on sensitive periods of maturation. Third, many studies use American samples, which might limit the generalisability to other populations. Fourth, there is inconsistency in how ACEs are conceptualised. The original specification of ACEs included seven items (Felitti et al., 1998), but the number of adversities included in measurements varies, as was described in the previous chapter. A

recent study recommended the inclusion of variables such as bullying victimisation and social ostracism (Finkelhor et al., 2015).

The current study

The current study aims to a) identify latent classes of ACEs (physical discipline, emotional abuse, supervisory neglect, educational disinterest, maternal psychological distress, bullying victimisation, adverse neighbourhood) in a UK household sample of 10-year-old British children; b) explore relationships between identified classes and child behaviour and emotional problems; c) compare person-centred and cumulative risk approaches regarding explanatory validity of child behaviour and emotional problems. Given that prior research findings are inconsistent, no predictions are made regarding the latent classifications. This current study will address several limitations in the exploration of cumulative risk and person-centred approaches to ACEs, and their relation to emotion and behaviour outcomes in children. First, ACEs were measured concurrently during childhood, so the present study does not rely on retrospective self-report data. Second, the sample was restricted to children aged 10 years old which eschews the confounding effects of age. Third, the population sampled is a non-American community sample, which supplements the evidence base currently reliant on American samples. Fourth, the ACEs included were chosen to reflect the broadening concept of ACEs, which resulted in the inclusion of ACEs such as bullying victimisation, adverse neighbourhood, and (parental) educational disinterest. This study will contribute to the growing knowledge of how ACEs co-occur, and the explanatory value of person-centred and cumulative risk approaches to operationalising ACEs.

3.3 Method

Sample and Data

We used data from the general population youth sample at wave 3 of the UK Household Longitudinal Study (UKHLS) to perform cross-sectional analysis. This was collected 2011-2013, from approximately 24,000 households (University of Essex, 2020). We only used data collected concerning children aged 10 years old. Data were collected through paper self-completed and parent-reported questionnaires. Oral consent was given by participants at each wave. Adults were incentivised to participate with a £10 voucher, while

children received £3 vouchers. The University of Essex Ethics Committee approved data collection. All data were accessed after End User License approval from the UK Data Service (https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=6614" https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=6614) and a self-declaration was made to the University of Sheffield University Research Ethics Committee that the data is pre-existing, has been robustly anonymised, and would not likely cause offence to those who originally provided the data.

Only observations with complete ACEs data were included in analysis, which resulted in n = 119 observations being dropped. The final sample (after participants with missing ACE data had been removed) used for analysis is N = 601, with a balanced sample of males (48.8%, n = 293) and females (51.2%, n = 308). Most of the sample were White British or Irish (82.5%) and the remaining 17.5% were from Asian, Black, or mixed ethnic backgrounds, which closely represents the UK population (ONS, 2012).

Measures

Confidential computer-assisted self-report data from child participants and parent-report data were retrieved to create variables representing ACEs. In total, seven binary adversity indicators were created, see Table 3.1 for all contributing items.

Table 3.1

Adversities and their contributing items.

Adversities	Items
Physical discipline[a]	"I use physical punishment as a way of disciplining [child]"
	"I spank [child] when [he/she] is disobedient"
	"I explode in anger towards [child]"
	"I grab [child] when [he/she] is being disobedient"

	"I slap [child] when [he/she] misbehaves"
Emotional abuse[a]	"I scold and criticise to make [child] improve"
	"I scold or criticise when [child]'s behaviour doesn't meet my expectations"
Supervisory Neglect[a]	"I punish [child] by putting [him/her] somewhere alone with little or no explanation"
Maternal Psychological Distress[a]	Reported using the Short General Health Questionnaire (GHQ-12; Goldberg & Williams, 1988)
Educational disinterest[b]	"My parents are interested in how I do at school"
	"My parents come to school parents' evenings"
Bullying Victimisation[b]	"How often do you get physically bullied at school, for example getting hit, pushed around or threatened, or having belongings stolen?"
	"How often do you get bullied in other ways at school such as getting called names, getting left out of games, or having nasty stories spread about you on purpose?"

Adverse Neighbourhood[b]	"How much do you worry that you might be a victim of a crime?"
	"How safe would you feel walking alone in this area after dark?"

Note. [a] = parent-reported items, [b] = child-reported items.

Parent-report adversities

Three parent-reported adversities, *physical discipline* (five items, e.g. "I use physical punishment as a way of disciplining [child's name]"), *emotional abuse* (two items, e.g. "I scold and criticise to make [child's name] improve"), and *supervisory neglect* (one item, "I punish [child's name] by putting him/her somewhere alone with little or no explanation"), were adapted from the parent-report parenting styles questionnaire (see Robinson et al., 1995). All item responses followed a five-point Likert scale: "never", "once in a while", "about half the time", "very often", and "always". Items were dichotomised for latent class analysis, defined as present for: "about half the time", "very often", or "always", and absent for "never" or "once in a while". "Once in a while" was treated as absent to follow the approach taken elsewhere (see Felitti et al., 1998) where psychological and physical abuse were only recorded as present if parents "often or very often" engaged in a behaviour.

Maternal psychological distress was self-reported by mothers using the Short General Health Questionnaire (GHQ-12; Goldberg & Williams, 1988). The summed caseness scale gives values between 0 (least distressed) and 12 (most distressed), an example item being: "Have you recently felt you couldn't overcome your difficulties?". Researchers have previously found that using 3 as a cut-off provides a good balance of sensitivity and specificity for screening mental illness diagnoses (Goldberg et al., 1998). For analysis, maternal psychological distress was dichotomised so that values between 3-12 were coded as present, values between 0-2 were coded as absent, which identified 26.3% of mothers to be experiencing psychological distress.

Child self-report adversities

Items adapted from child self-report questionnaires were dichotomised from five-point likert scales although the response items differ slightly. We identified three ACEs: *educational disinterest* (two items, e.g. "My parents are interested in how I do at school"), *bullying victimisation* (two items, e.g. "How often do you get physically bullied at school?"),

and *adverse neighbourhood* (two items, e.g. “How safe would you feel walking alone in this area after dark?”). For educational disinterest, responses of “hardly ever” or “never” were coded as present, and “always or nearly always”, “sometimes”, and “not sure” as absent; for bullying victimisation “a lot” or “quite a lot” were coded as present, and “not much or never” as absent; and for adverse neighbourhood “a bit unsafe” and “very unsafe” were coded as present, and “very safe” or “fairly safe” as absent for the question about safety, and “a bit of a worry” and “a big worry” coded as present, and “an occasional doubt” and “not a worry at all” as absent for the question about worrying about being a victim of crime.

Strengths and Difficulties Questionnaire

The self-report SDQ comprises five subscales each containing five items. The subscales measure “emotional symptoms” (e.g. “I am often unhappy, depressed or tearful”), “conduct problems” (e.g. “I get very angry and often lose my temper”), “hyperactivity” (e.g. “I am restless, I cannot stay still for long”), “peer problems” (e.g. “I would rather be alone than with people of my age”), and “prosocial behaviours” (e.g. “I try to be nice to other people. I care about their feelings”). Each item is scored from 0 to 2 as “not true”, “somewhat true”, or “certainly true”, making the total score for each subscale between 0 to 10. For analysis, derived SDQ subscale scores were used wherein observations were missing if two or more of five items were missing. A total difficulties score range from (0 to 40) was a sum of the emotional symptoms, conduct problems, hyperactivity, and peer problems scales. Internal consistency for each SDQ scale was estimated using Cronbach’s alpha: total difficulties ($\alpha = .81$), emotional problems ($\alpha = .64$), peer problems ($\alpha = .56$), conduct problems ($\alpha = .58$), hyperactivity ($\alpha = .64$), and prosocial behaviours ($\alpha = .69$). The SDQ is useful in screening for psychiatric problems in children (Goodman et al., 2000), and has shown good predictive validity in relation to child mental health outcomes (Goodman & Goodman, 2009). Other researchers have recommended caution in interpreting results regarding conduct problems and peer problems (see Sharratt et al., 2018).

Data analysis

Latent class analysis was utilised to explore the number and nature of qualitatively homogeneous patterns of ACE exposure (physical discipline, emotional abuse, supervisory neglect, maternal psychological distress, parental educational disinterest, bullying victimisation, and adverse neighbourhood). As latent class analysis is an exploratory process,

models of between 2 and 7 classes were specified. No single index distinguishes the best model. We tested relative model fit by comparing *k* class models to *k – 1* class models, using conventional indices such as Akaike Information Criteria (AIC; Akaike, 1974), Bayesian Information Criteria (BIC; Schwarz, 1978), sample-size adjusted BIC (SSABIC; Sclove, 1987), the Lo-Mendell-Rubin adjusted likelihood test (LMR-LRT; Lo et al., 2001), parametric bootstrapped likelihood ratio test (BLRT; Arminger et al., 1999), and entropy values (Ramaswamy et al., 1993). The AIC, BIC, and SSABIC are used similarly; lower values for model with *k* number of classes compared to *k - 1* indicate a model with better relative fit. LMR-LRT and BLRT test relative fitness through a significance test by comparing model *k* to *k – 1*. Larger entropy values indicate a larger proportion of correctly classified observations, where values approaching 1 indicate better classification of observations. Simulation studies found that the BLRT test performed best, followed by the BIC and SSABIC values (see Nylund et al., 2007), and that SSABIC improves on BIC when sample sizes are $N < 1000$ (Yang, 2006). For each model the AIC, BIC, SSABIC, LMR-LRT, BLRT, and entropy values are presented. As our sample size is relatively small, greater emphasis is placed on SSABIC than AIC and BIC, but the model with best fit should have high agreement between AIC, BIC, and SSABIC, and the LMR-LRT and BLRT significance tests. Entropy values will be used to judge whether the model solution categorises observations to an acceptable level (> .80; Ramaswamy et al., 1993).

To explore relationships between most likely class membership and child behaviour and emotional symptoms, ANOVAs were run with latent class membership as the predictor variable, and SDQ scales (total difficulties, emotional symptoms, conduct problems, hyperactivity, peer problems, prosocial behaviour) as the outcomes. Cohen's *d* values were estimated to compare the effect of belonging to each class. To compare person-centred and cumulative risk approaches, ANOVAs were repeated using the cumulative risk score (summed dummy indicators of exposure to adversity) with the same number of groups as the latent class groupings. All ANOVAs were repeated with sex and ethnicity included as covariates. Direct comparisons between person-centred and cumulative risk models were made by computing Hay's omega-squared (ω^2) for both sets of models by each outcome. Additionally, a regression was computed which included dummy coded latent class and cumulative risk groupings in the model. Latent class analyses were conducted using Mplus version 8.6 (Muthén & Muthén, 1998-2017), while data management and other analyses were conducted using Stata MP 16 (StataCorp, 2019).

3.4 Results

Descriptive information

Table 3.2 shows the least frequent ACE was supervisory neglect (3.5%), and the most frequent was adverse neighbourhood (34.6%). The average number of ACEs reported was 1.29 (*SD* = 1.11) (range of 0-6). The majority reported at least one ACE (74.9%) but only 4.2% reported four or more ACEs.

Table 3.2.

Observed proportions of adverse childhood experiences in whole sample and by sex and ethnicity.

Adversity	Whole sample	Male	Female	*t* sex diff.	White	Ethnic minority	*t* ethnic diff.
Physical discipline	6.5%	8.2%	4.9%	1.65	5%	13.3%	-3.15**
Emotional abuse	30.6%	35.8%	25.7%	2.72**	28.4%	41%	-2.54**
Supervisory neglect	3.5%	4.4%	2.6%	1.23	2.4%	8.6%	-3.14**
Maternal psychological distress	26.3%	28.7%	24%	1.29	24.6%	34.3%	-2.05*
Educational disinterest	12.8%	14.7%	11%	1.33	12.1%	16.2%	-1.14
Bullying victimisation	15.1%	19.8%	10.7%	3.12**	15.9%	11.4%	1.17
Adverse neighbourhood	34.6%	30%	39%	-2.31*	33.3%	41%	-1.5
ACEs score mean (*SD)*	1.29 (1.11)	1.42 (1.13)	1.18 (1.08)	2.64**	1.22 (1.04)	1.66 (1.32)	-3.73***

Note. Whole sample, *n* = 601; Male, *n* = 293, Female, *n* = 308, White, *n* = 496, Ethnic minority, *n* = 105. Comparisons of sex and ethnicity differences in ACEs based on two-tailed t-tests. *$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

Latent Class Model selection

Table 3.3 shows enumeration statistics for models specifying 2-7 latent classes. AIC and SSABIC values, as well as BLRT significance test favoured the 3-class model, whereas BIC values favoured the 2-class model. Entropy values for models of 3-7 classes indicated good classification of observations, but relative fit statistics for models of 4-7 were unfavourable. The 3-class solution was conceptually meaningful and selected for further analysis. Item endorsement probabilities for each class are presented graphically in Figure 3.1. For comparison, item endorsement probabilities are also presented for the 2-class model (see Figure 3.2).

Table 3.3.

Class enumeration statistics for latent class models of two to six classes of adverse childhood experiences.

No of classes	Log-likelihood	AIC	BIC	SSABIC	Entropy	LRT adjusted (*p*)	BLRT
2	-1797.12	**3524.24**	**3690.219**	3642.598	.736	**.003**	**<.001**
3	-1780.62	3607.249	3708.416	**3635.397**	**.876**	**.013**	**<.001**
4	-1773.03	3608.062	3744.418	3646.002	**.903**	**.047**	.2
5	-1767.25	3612.49	3784.035	3660.221	**.84**	.654	.6
6	-1762.27	3618.531	3825.265	3676.052	**.855**	**.022**	1
7	-1758.52	3627.035	3868.958	3694.347	**.863**	.285	.6

Boldface indicates acceptable values for each criterion (entropy is evaluated by a cut-off of .8; LRT adjusted and BLRT by an alpha value of .05, while AIC, BIC, and SSABIC are evaluated by comparison with *k - 1* models).

Class descriptions

Class 1 comprised the majority of the sample (*n* = 540, 89.9%) and was labelled "*low ACEs*" due to low endorsement probability of all items. Class 2 comprised a minority of the sample (*n* = 36, 6%) and was labelled "*household challenges*" due to the moderate to high probabilities of emotional abuse and physical discipline. The remaining items were of

comparable probability to the *low ACEs* class. Class 3 also comprised a minority of the sample (*n* = 25, 4.2%) and was labelled "*community challenges*". This class was characterised by high probabilities of bullying, adverse neighbourhood, and emotional abuse. Other items were of comparable probability to the *low ACEs* class.

Figure 3.1

Model-estimated class specific item-probability profile plot of 3-class model.

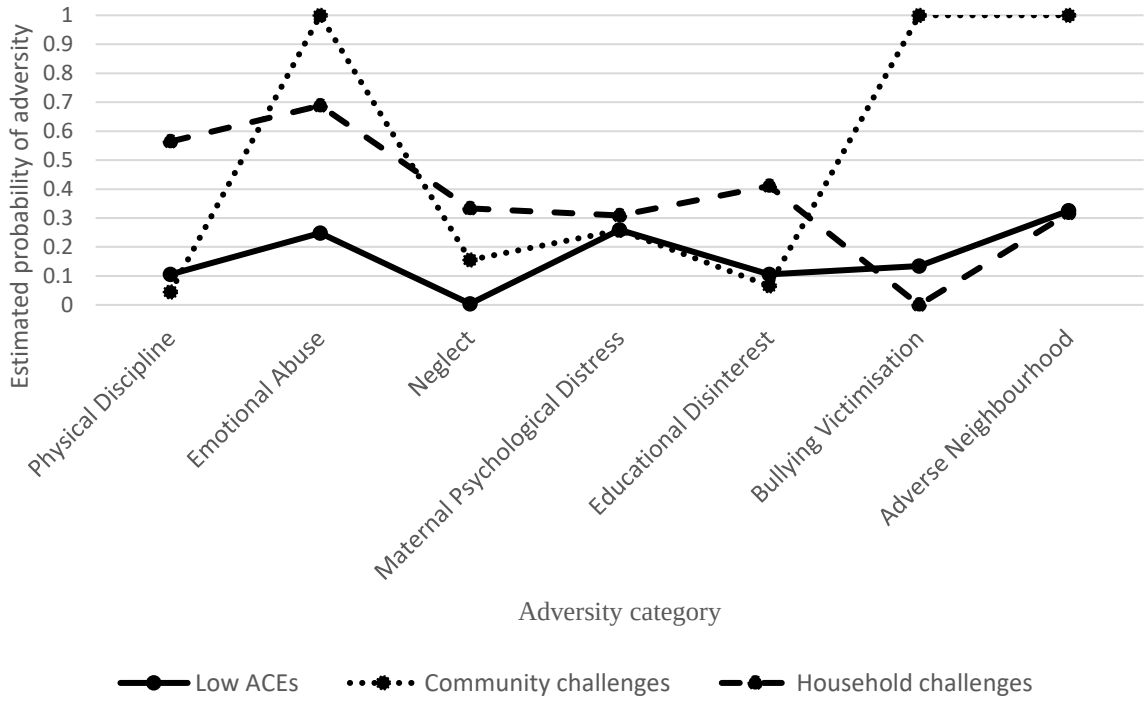
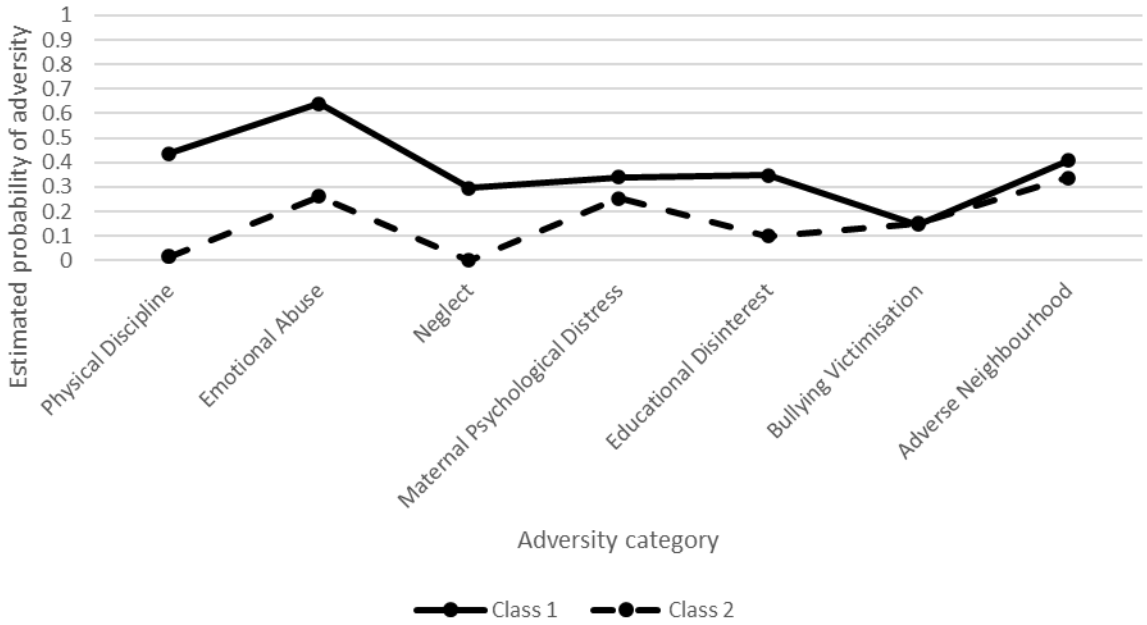


Figure 3.2

Model estimated class specific item-probability profile plot of 2-class model.



Differences between classes regarding emotional and behavioural outcomes.

Six one-way ANOVAs were computed using latent class groupings as the independent variables and the SDQ scales as outcome variables (see Table 3.4). For total difficulties, emotional symptoms, and peer problems, significant *F* values were observed (after Bonferroni correction). Additionally, ANOVAs repeated with sex and ethnicity included as covariates remained significant for total difficulties, emotional symptoms, and peer problems (see Table 3.5). Group comparisons were made through observation of the means and standardised effect sizes (Cohen's *d*). Effects of .2, .5, and .8 were treated as small, medium, and large respectively (Cohen, 1992).

The *community challenges* class had the highest score for each SDQ scale (excluding prosocial behaviour) compared to the *low ACEs* classes. Compared to the *household challenges* class, the *community challenges* class had a higher total difficulties, emotional problems, and peer problems. When comparing the *community challenges* class to the *low ACEs* class, we observed large effect sizes for total difficulties and peer problems, and medium effect sizes for emotional symptoms and conduct problems, all with the *community challenges* class scoring higher. Comparisons between *community challenges* and *household*

challenges classes indicate large differences in magnitude for the total difficulties and peer problems, and moderate differences in magnitude for emotional symptoms, again all with the *community challenges* class scoring higher. Differences between *household challenges* and *low ACEs* classes were all non-significant based on effect size confidence intervals.

Associations between cumulative risk of ACEs and SDQ outcomes

Table 3.5 presents the cumulative risk approach to assessing the relationship between adversities and SDQ scales. Groups were created to reflect the same number of groups as latent classes. Here, the groups have been formulated as 0-1 ACEs, 2-3 ACEs, and the widely adopted 4 or more ACEs group (e.g. Hughes et al., 2017). ANOVAs indicated the cumulative risk grouping of adversities was significantly (after Bonferroni correction) associated with all SDQ scales except prosocial behaviour. All ANOVAs were re-run with sex and ethnicity included in the model, which did not substantively alter the observed relationships (see Table 3.6). As expected, comparisons between the 4 or more ACEs group and 0-1 ACEs produced the largest effect sizes, specifically large for emotional symptoms and between 2-3 ACEs and 0-1 ACEs showed small differences for emotional problems, conduct problems, hyperactivity, peer problems, and a moderate difference for total difficulties. Only one significant difference was observed between 4 or more ACEs and 2-3 ACEs, which was a small difference in emotional problems.

Table 3.4

Person-centred models and comparison of Strengths and Difficulties subscale outcomes between identified latent classes.

Outcome	Outcome means per class (*SD*)			Cohen's *d* [95% CI]			*F*	*p*	ω^2
	Low ACEs	Household	Community	Community vs Low ACEs	Household vs Low ACEs	Community vs Household			
Total difficulties	9.91 (5.33)	10.29 (5)	15.28 (5.71)	**1.00 [.60, 1.41]**	.07 [-.27, .41]	**.94 [.40, 1.48]**	12.16	<.001	.036
Emotional problems	2.54 (2.04)	2.75 (1.95)	4.12 (2.11)	**.77 [.37]**	.1 [-.24, .44]	**.68 [.15, 1.2]**	7.22	<.001	.02
Conduct problems	1.98 (1.57)	2.44 (1.80)	2.76 (1.61)	**.50 [.10, .90]**	.30 [-.04, .63]	.18 [-.33, .69]	4.18	.016	.011
Hyperactivity	3.65 (2.15)	3.81 (2)	4.56 (1.80)	**.43 [.02, .83]**	.07 [-.27, .41]	.39 [-.12, .91]	2.22	.109	.004
Peer relationship	1.72 (1.64)	1.46 (1.56)	3.84 (1.77)	**1.29 [.88, 1.70]**	-.16 [-.51, .18]	**1.44 [.86, 2.01]**	20.71	<.001	.062
Prosocial behaviour	8.35 (1.61)	8.14 (1.76)	7.92 (1.80)	-.27 [-.67, .13]	-.13 [-.47, .21]	-.12 [-.63, .39]	1.09	.337	.0003

Note. *Low ACEs* class n = 540, *Household challenges* class n = 36, *Community challenges and emotional abuse* class n = 25. Sample size for each model varies between 595-598 dependent on occasional missing data. Extreme values were winsorised to the lower/upper extreme values. Boldface indicates significant group differences where confidence interval does not cross 0. Bonferroni corrected alpha, $\alpha = .003$.

Table 3.5.

Latent class and SDQ subscale ANOVAs re-run with sex and ethnicity in the model.

Outcome	Model		Latent Class		Sex		Ethnicity	
	F	*p*	*F*	*p*	*F*	*p*	*F*	*p*
Total difficulties	10.51	<.001	11.36	<.001	15.62	<.001	1.01	.316
Emotional problems	4.72	.001	7.63	.001	4.22	.04	.09	.76
Conduct problems	7.15	<.001	3.49	.031	18.55	<.001	.95	.331
Hyperactivity	11.84	<.001	1.77	.171	37.16	<.001	4.05	.045
Peer relationship problems	13.73	<.001	19.76	<.001	12.75	<.001	0	.975
Prosocial behaviour	7.37	<.001	.52	.595	27.17	<.001	.02	.901

Table 3.6

Comparison of Strengths and Difficulties subscale outcomes between cumulative risk groupings.

Outcome	Outcome means per class (*SD*)			Cohen's *d* [95% CI]			*F*	*p*	ω^2
	0-1 ACEs	2-3 ACEs	4 or more ACEs	4 or more vs 0-1	2-3 vs 0-1	4 or more vs 2-3			
Total difficulties	9.15 (5)	11.96 (5.72)	13.08 (5.46)	**.78 [.37, 1.20]**	**.54 [.36, .72]**	.20 [-.23, .62]	21.62	<.001	.065
Emotional problems	2.32 (1.96)	3.08 (2.12)	4.08 (2)	**.90 [.49, 1.31]**	**.38 [.20, .55]**	**.48 [.05, .90]**	15.66	<.001	.047
Conduct problems	1.86 (1.53)	2.35 (1.62)	2.52 (1.83)	**.42 [.02, .83]**	**.31 [.14, .49]**	.10 [-.32, .52]	7.26	<.001	.021
Hyperactivity	3.44 (2.07)	4.21 (2.23)	4.08 (1.73)	.31 [-.09, .72]	**.36 [.19, .54]**	-.06 [-.48, .36]	8.75	<.001	.025
Peer relationship problems	1.53 (1.49)	2.27 (1.90)	2.71 (2.05)	**.77 [.36, 1.19]**	**.45 [.28, .63]**	.23 [-.20, .66]	16.24	<.001	.049
Prosocial behaviour	8.38 (1.56)	8.24 (1.73)	7.96 (1.97)	-.27 [-.67, .14]	-.09 [-.26, .09]	-.16 [-.58, .26]	1.12	.328	.0004

Note. 0-1 ACEs group n = 393, 2-3 ACEs group n = 183, 4 or more ACEs group n = 25. Sample size for each model varies between 595-598 dependent on occasional missing data. Extreme values were winsorised to the lower/upper extreme values. Boldface indicates significant group differences where confidence interval does not cross 0. Bonferroni corrected alpha, α = .003.

Table 3.7.

Cumulative risk and SDQ subscale ANOVAs re-run with sex and ethnicity in the model.

Outcome	Model		Cumulative risk		Sex		Ethnicity	
	F	*p*	*F*	*p*	*F*	*p*	*F*	*p*
Total difficulties	15.76	<.001	21.54	<.001	15.75	<.001	2.24	.135
Emotional problems	9.04	<.001	16.21	<.001	4.67	.031	.04	.837
Conduct problems	8.88	<.001	6.82	.001	18.95	<.001	1.12	.29
Hyperactivity	15.56	<.001	8.71	<.001	36.78	<.001	5.37	.021
Peer relationship problems	11.52	<.001	15.43	<.001	12.54	<.001	.25	.621
Prosocial behaviour	7.47	<.001	.73	.484	27.53	<.001	0	.956

Comparison between latent class and cumulative risk models

Comparisons between person-centred and cumulative risk approaches were made using Hay's ω^2, presented in both Table 3.4 and 3.6. Statisticians have identified values of .01, .06, and .14 as estimates of small, medium, and large magnitudes respectively (Kirk, 1996). For total difficulties, emotional symptoms, conduct problems, and hyperactivity, the cumulative risk models accounted for more variance. For peer problems, the latent class model accounted for more variance. Both latent class and cumulative risk models accounted for small or medium magnitudes of variance for total difficulties, emotional symptoms, conduct problems, hyperactivity, and peer problems.

Regressions were run with dummy coded latent class and cumulative risk variables concurrently for SDQ scales, minus prosocial behaviour (see Table 3.8). At the Bonferroni corrected alpha level, the *community challenges* class significantly contributed to the model for the peer problems outcome alone. The 2-3 ACEs cumulative risk group was a significant contributor for total difficulties, emotional symptoms, hyperactivity, and peer problems, while the 4 or more ACEs group was significant for emotional symptoms.

Table 3.8.

Associations between latent class and cumulative risk groupings and outcomes.

Outcome	Community Challenges		Household Challenges		2-3 ACEs		4 + ACEs	
	β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Total difficulties	.115	.01	-.078	.077	**.239**	<.001	.12	.011
Emotional problems	.060	.189	-.074	.102	**.178**	<.001	**.172**	<.001
Conduct problems	.061	.191	.024	.599	.124	.005	.051	.303
Hyperactivity	.036	.428	-.043	.349	**.172**	<.001	.060	.219
Peer relationship problems	**.181**	<.001	-.116	.008	**.199**	<.001	.010	.034

Note. Regressions were not run for the prosocial behaviour outcome because neither latent class or cumulative risk models were significant in the first instance. Boldface indicates significant *β* value at the Bonferroni corrected α = .003

3.5 Discussion

The primary aim of this study was to compare two different approaches to operationalising the clustering of multiple ACEs in a UK household cohort, testing how latent classes of adversity related to domains of behavioural and emotional problems in childhood, and compared person-centred and cumulative risk approaches to operationalising ACEs. The findings add to the growing literature adopting LCA in the study of ACEs and offers insight into the explanatory value of the person-centred and cumulative risk approaches for behavioural and emotional outcomes in children.

Using latent class analysis, three homogeneous classes were extracted: *low ACEs*, *community challenges*, and *household challenges*. The *low ACEs* class had a low probability of all items, the *community challenges* class had a much larger probability of bullying,

adverse neighbourhood, and emotional abuse, while the *household challenges* class had a high probability of emotional abuse and physical discipline. The class solution implies that ACEs either co-occurred mostly within the household, or in the wider community (with the overlap of emotional abuse). This is an interesting notion for intervention and prevention, because clinicians might be concerned that the presence of bullying, or an adverse neighbourhood could be a marker for other adversities. The presence of a class characterised by little or no exposure to ACEs is in line with findings elsewhere, but the absence of a high ACEs class was unexpected. This may be due to the low sample size unable to capture the high ACEs group, or the absence of some ACEs observed in the dataset.

Comparison of means between classes found that the *community challenges* class had faced more adverse outcomes compared to both other classes, with moderate or large differences observed for total difficulties, peer problems, and emotional symptoms. The co-occurrence of emotional abuse in addition to adversities in the community might contribute to the potency of this co-occurrence. There is already strong evidence to link bullying victimisation to mental health problems (Moore et al., 2017), and a recent meta-analysis found that perceived neighbourhood crime was strongly associated with mental health outcomes (Baranyi et al., 2021). The large effects associated with the combination of these adversities is consistent with the literature elsewhere. Our findings could be of clinical interest to identifying children at high risk of emotional and behavioural problems in the community. Future studies might be well placed to test the impact of these co-occurrences.

It is perhaps counterintuitive that the *household challenges* class scored similarly to a class with low probabilities of all adversities, especially since the severe effects of child maltreatment have been widely documented (e.g. Gilbert et al., 2009). One potential explanation is that the emotional abuse and physical discipline items were adapted from a parent-report questionnaire about parenting styles (see Robinson et al., 1995) and therefore might not reflect abusive parenting practices as well as other measures. Alternatively, the questionnaire being parent-reported might have led to underreporting as parents have been found to underreport ACEs compared to their offspring (Fisher et al., 2011).

Comparison of means between cumulative risk groups (0-1 ACEs, 2-3 ACEs, 4 or more ACEs) found that the 2-3 ACEs and 4 or more ACEs groups had worse difficulties scores compared to the 0-1 ACEs group. Although notably there was only one significant difference between the 2-3 ACEs and 4 or more ACEs groups, which means the results do

not necessarily imply a linear effect. Observed differences were larger for internalising outcomes (emotional symptoms, peer problems) than externalising problems (hyperactivity, conduct problems), which was also observed in the latent class models. This could indicate that the adversities included in this study are more closely related to internalising problems than externalising problems. It has been found elsewhere that certain ACEs (e.g. physical abuse, sexual abuse, and physical neglect) predict externalising problems better than internalising problems (Petrenko et al., 2012), which supports the use of person-centred approaches to understand the relationship between co-occurrence profiles of ACEs and specific outcomes.

Formal comparisons between latent class and cumulative risk models were made by comparing Hay's ω^2 values, and by including both latent class and cumulative risk groupings in regression models. The latent class model explained more variance in the peer problems subscale. However, the cumulative risk model explained more variance for the remaining outcomes, excluding prosocial behaviour which neither model captured well. In regression models where dummy variables of both latent class and cumulative risk groupings were included, the *community challenges* group was a significant contributor to the peer problems outcome. The 2-3 ACEs group was a significant contributor to the total difficulties, emotional symptoms, hyperactivity, and peer problems, and the 4 or more ACEs group was a significant contributor to emotional symptoms. This suggests that even when accounting for the number of ACEs, the *community challenges* group provides unique insight to explaining peer problems. This further suggests that the person-centred approach may be a useful supplementary method of researching ACEs, specifically for the development of tailored intervention strategies.

These findings should be interpreted in the context of other published comparisons made between person-centred and cumulative risk approaches. Other studies (e.g. Merians et al., 2019) have examined ACEs using retrospective self-report in adulthood, which has been found to produce only modest overlap with concurrent self-report in identifying occurrence of abuse (Baldwin et al., 2019). Young adults retrospectively reporting on ACEs have reported experiencing more ACEs (Radford et al., 2013), so differences in results between our study and previous studies could be due to the disparate age of participants, or indeed the confounds associated with concurrent versus retrospective self-report such as memory. Indeed, Lacey et al. (2020) found different results based on prospectively and retrospectively reported ACEs in relation to inflammation. Additionally, our study measured outcomes in

childhood, whereas both Merians et al. (2019) and Lacey et al. (2020) measured adult outcomes. It is reasonable to expect different causal pathways or different magnitudes of effect between ACEs and outcomes in childhood compared to adulthood, even if outcomes are similar in valence. However, we cannot imply the development or persistence of these problems as our analyses are cross-sectional. Future research designs could benefit from comparing person-centred and cumulative risk models over multiple timepoints. This would enable researchers to better estimate the effect of developmental sensitivities (as recommended by Debowska et al., 2017), as well as examine reverse causation which cannot be examined in cross-sectional studies.

Limitations and future studies

The conclusions drawn in this study must be considered in the context of several limitations. First, class enumeration statistics did not unanimously support one solution in the latent class analysis. This might be explained by difficult modelling conditions such as low number of items and relatively small sample size which compromises the performance of AIC and BIC (Yang, 2006). However, our class solution was theoretically meaningful and demonstrated external validity through associations with relevant outcomes. Second, the ACE items were drawn from a mixture of self-report and parent-report, meaning that our results are vulnerable to underreporting from parents, or common-method variance bias from self-report. It is unclear to what extent these biases impact estimations, but the combination of two types of data collection likely reduces the effect of common method variance. Third, data regarding important ACEs such as sexual abuse, and information such as age at onset, chronicity, and severity of ACEs were not observed. However, several ACEs that are usually measured were included, as well as items not normally included such as bullying victimisation.

This study fits into the literature examining the operationalisation of ACEs, both items to be included and how to model the effect of multiple risks. Future studies should consider potential confounders of the relationship between ACEs and psychosocial outcomes, including age of onset, length of exposure, severity, socioeconomic status, genetic variation, and birth risks (Debowska et al., 2017; Hughes et al., 2017). Other studies have found different latent classes of adversity for at-risk boys and girls (Haahr-Pedersen et al., 2020b; Haahr-Pedersen et al., 2021). Based on the observed means, it might be worthwhile to investigate latent classes based on sex and ethnicity with a larger dataset. These could

highlight targets for intervention to reduce inequalities, which future studies should continue to explore. Further avenues of further investigation could be to examine predictors of different typologies of ACE co-occurrence, or to compare person-centred approaches with other approaches, such as network analysis (see de Vries et al., 2022). Research on ACEs should focus on adopting a validated measure of ACEs which includes additional adversities such as the revised inventory of ACEs (Finkelhor et al., 2015) to better estimate co-occurring risks.

Conclusions

The study reported in this chapter contributes to the ACEs literature by formulating latent classes in a UK sample of children and comparing person-centred and cumulative risk approaches to operationalising ACEs. Results suggest that the cumulative risk approach accounts for more variance in most regards, but that the person-centred approach generates unique insights. Both cumulative risk and person-centred approaches characterised ACEs well characterised, and specific latent classes conferred risk for specific problems in childhood. However, these analyses examined a cross-sectional relationship between ACEs and psychosocial functioning in 10-year-olds. While ACEs were concurrently reported, cross-sectional analysis is limited in estimating the temporally contingent relationship between ACEs and psychosocial functioning. Chapter 4 describes a longitudinal study, testing the relationship between ACEs and psychosocial functioning over time using the cumulative risk approach, and partitioned risk clusters emblematic of latent classes described in this chapter.

Chapter Four: Modelling the longitudinal relationship between ACEs and psychosocial functioning.

4.1 Abstract

Most research investigating the relationship between ACEs and psychosocial outcomes relies on cross-sectional analysis of retrospective data. This is a sub-optimal way of investigating temporal relationships. Indeed, there is a dearth of research on the subject of ACEs that utilises CLPM which limits insight into the bidirectionality and stationarity of the relationship between ACEs and psychosocial outcomes. This study aims to estimate the temporal relationship between ACEs and psychosocial outcomes (specifically internalising problems, externalising problems, delinquency, and life satisfaction), and generate insight into the bidirectionality and stationarity of the relationship while accounting for autoregressive effects. Data were extracted from the UK Household Longitudinal Study, which contained longitudinal data at three timepoints where children were aged 10-11 (T1), 12-13 (T2), and 14-15 (T3). The ACEs used in this study were repeated measures at each timepoint (bullying, adverse neighbourhood, few close friends, sibling victimisation, quarrelsome relationship with parents, bad relationship with stepparent, financial struggles, maternal psychological distress). Two sets of models were run, one in which all ACEs contribute to a single cumulative risk score, and one in which risk was partitioned into two scores, community risks and household risks. The cumulative risk score predicted delinquency at one cross-lagged path, and the remaining outcomes at both cross-lagged paths. The effects seemed stronger from T2 to T3 for internalising, externalising. The was evidence of bidirectional relationships between ACEs and both internalising and externalising problems. There was evidence of a bidirectional relationship between community risks and internalising problems. Meanwhile, household risks predicted all outcomes and there was evidence of bidirectionality with externalising, delinquency, and life satisfaction. These findings are an important contribution to the ACEs literature.

4.2 Introduction

There is a reliable dose-response relationship between ACEs and numerous psychosocial outcomes (Hughes et al., 2017), but as the findings in the previous chapter demonstrated, the way in which ACEs cluster could be important for outcomes. Most published studies address the role of cumulative ACEs by using cross-sectional analysis with retrospective data. To address these limitations in the published literature, we undertake cross-lagged panel analyses to examine the longitudinal relationship between ACEs and psychosocial outcomes.

As expounded in the previous chapter, the person-centred approach to childhood adversity has sought to illuminate how different patterns of adversity might be associated with specific outcomes (Lanza & Rhoades, 2013). The latent classes described in the previous chapter pertain to three typologies: *low ACEs*, *household challenges*, and *community challenges*. The household challenges class had a high probability of physical discipline use and emotional abuse (low probability of bullying victimisation), whereas the community challenges class had a high probability of bullying victimisation, adverse neighbourhood, and emotional abuse (low probability of physical discipline, neglect, maternal psychological distress, and educational disinterest). The community challenges class had substantially worse internalising and externalising difficulties compared to other classes. In the same study, the explanatory value of latent class models was compared to cumulative risk models. While the cumulative risk approach explained more variance in most outcomes, the latent class approach explained more variance in peer relationship problems. Our findings are consistent with findings from a recent study that categorised ACE risks into ecological domains, and used these domains to associate with outcomes while controlling for ACE risks from other domains. They found that family-related risks were better predictors of trauma symptoms for 2-9 year-old children, while peer and community risks were better predictors of symptoms for 10-17 year-olds (Turner et al., 2020). These findings would seem to imply that risks are developmentally sensitive, although the data that was used was cross-sectional and so cannot be informative for temporal sequencing. This is a problem with much ACEs research, as few studies use prospective data to gather repeated measures of ACE exposure (see Sahle et al., 2021).

Many studies have examined the relationship between ACEs and psychosocial outcomes using cross-sectional data, one such example being the analysis presented in the

previous chapter. While cross-sectional analyses are informative for assessing associations and relationships, longitudinal analyses are better suited to examine causal structures. As surmised by Preacher (2015), longitudinal models using repeated measures facilitate the investigation of the temporal sequencing within a putative causal structure while allowing for the observation of the stability of variance, or stationarity, at measured intervals. Indeed, the inclusion of both cross-lagged and autoregressive effects fosters particularly strong reasoning with regards to how much each variable is related to another because the cross-lagged effects represent the effect of one variable on another over time while accounting for stationarity. As causal hypotheses assume an effect over time, cross-lagged repeated measures study designs are well-placed to provide support to or challenge causal propositions. Additionally, cross-lagged repeated measures are able to examine reverse causation, which is particularly important in relation to externalising problems and the development of antisocial behaviour, as harsh parenting could conceivably be a response to problematic behaviour (Jaffee et al., 2012). Given that experimental methods are inappropriate for investigating causal sequelae of ACEs, CLPM provides an informative contribution to the literature beyond cross-sectional analysis of retrospective data.

A recently published paper utilised cross-lagged panel modelling using longitudinal data to examine the relationship between ACEs and child behavioural problems (Zhang & Mersky, 2022). In their study, they adopted the cumulative risk approach and found a bidirectional relationship between ACEs and internalising problems, and between ACEs and externalising problems. The authors note that these findings are in contrast to those of Font and Burger (2015) who used similar data and found that child maltreatment had a unidirectional effect on internalising and externalising problems. Zhang and Mersky (2022) claim that a difference in models was the primary reason for the disparity in findings, because while Zhang and Mersky (2022) modelled bidirectional effects using a random-intercepts cross-lagged panel model (RI-CLPM), Font and Burger (2015) used CLPM. The RI-CLPM includes random intercepts in the model, which controls for stable individual differences across lags. The way in which RI-CLPM models change means that a positive score indicates that a score above the expected value is followed a subsequent score being above the expected value (see Hamaker et al., 2015). Meanwhile, the way in which the CLPM models change means that a positive score indicates that rank-order increase in one construct is followed by a subsequent rank-order increase. Assuming that the reason for divergent results

is due to the chosen cross-lagged model, it is important to consider whether to adopt CLPMs or RI-CLPMs.

Much has been written about whether to use the CLPM or RI-CLPM (see Hamaker et al., 2015; Lüdtke & Robitzsch, 2021; Orth et al., 2021), with some claiming that the CLPM should be 'abandoned' (Lucas, 2022) because it does not demarcate between- and within-person effects. However, it is important to decide whether the RI-CLPM would offer an advantage for our putative hypotheses because utilising both CLPM and RI-CLPM would be beyond the scope of this study. One of the benefits of the RI-CLPM is the ability to disentangle within- and between-person effects through the use of random intercepts (Hamaker et al., 2015), which is of great use to researchers interested in within-person change over time. A recently published example highlights the usefulness of this type of analysis using daily observed data (Hamilton et al., 2022). Following the line of argument from Orth et al. (2021), because of the way that RI-CLPM models variance (deviation in trait level of X and Y) compared to how CLPM models variance (individual differences in X and Y), some research questions regarding the effects of adversity might be better suited to CLPM rather than RI-CLPM. For instance, this chapter is intended to estimate whether people high on ACEs at T1 have higher problems at T2 (and vice versa). In this sense, RI-CLPM might be better suited to examining ACEs in datasets with lagged measures in a short timeframe (e.g. daily or weekly measures) to understand the more immediate impacts of adversity or a particularly stressful period of time. For this present study the CLPM will be used because the relationships of interest concern between-person effects.

Present analysis

This chapter presents the effect of ACEs on four outcomes: externalising problems, internalising problems, delinquency, and life satisfaction outcomes using CLPM. Previous research on the relationship between ACEs and internalising and externalising problems is elucidated in detail in the previous chapter. It was concluded that ACEs (both cumulative risk and person-centred operationalisations) were related to both internalising (emotional and peer problems) and externalising (conduct and hyperactivity) subscales in 10-year-old children. Regarding the other outcomes of interest in this chapter, ACEs have been linked with the onset of serious offending in adolescents (see Fox et al., 2015), although longitudinal analysis of this relationship is scant. Modelling the relationship between ACEs and delinquency using

a cross-lagged design will be insightful to the causal structure of this relationship. Furthermore, ACE exposures have been linked to worse life satisfaction previously (Mosley-Johnson et al., 2019), but this has not been examined using cross-lagged panel modelling. It is important to understand the nature of this relationship because of the potential importance of life satisfaction as a resilience resource due to its implied representation of optimism and positivity about one's life (see Logan-Greene et al., 2014).

In the current analyses ACEs are modelled separately as cumulative risk and as partitioned risks. The cumulative risk models include a summary score of all risks as a single variable. The partitioned risk models include separate summary scores of household risks and community risks with these scales reflecting the qualitative clusters of ACEs found in Study Two. Household risks include sibling victimisations, poor relationship with parents/stepparents, low income, and maternal psychological distress. Community risks include bullying victimisation, adverse neighbourhood, and few close friends. These are a close approximation of household and community ACEs defined by the latent classes produced in the previous chapter, but do not include physical discipline, emotional abuse, or neglect from the previous chapter because they are not repeated measures, and so would not fit into a cross-lagged panel model. Recent findings suggest that family-related risks are more closely related to outcomes in younger children, whereas peer-related risks are more related to outcomes in older children (Turner et al., 2020) inform our hypothesis that the strength of the effect of household risks will become weaker over time whereas the effects of the community risks will become stronger. In total, eight models are presented, four of which estimate the longitudinal cumulative risk effect of ACEs on psychosocial outcomes, and four which estimate the longitudinal cumulative effect of household and community risks on psychosocial outcomes.

4.3 Research Questions and Hypotheses:

RQ1: To what extent are there independent effects from a cumulative measure of ACEs at T1 to outcomes at T2, and subsequently from T2 to T3?

H1: We expect that there will be independent longitudinal effects such that more ACEs predict worse internalising (SDQ emotion problems and peer relationship subscales), externalising (SDQ conduct problems and hyperactive subscales subscales delinquency acts), and lower life satisfaction outcomes. Specifically, a linear relationship between the number of ACEs present and the severity of negative outcomes is predicted.

RQ2: To what extent are there independent effects from two different clusters of risks (household risks and community risks) at T1 to outcomes at T2, and subsequently from T2 to T3?

H2: We expect that the community risk cluster will have stronger longitudinal effects on internalising (SDQ emotion problems and peer relationship subscales), externalising (SDQ conduct problems and hyperactive subscales subscales) delinquency acts, and life satisfaction outcomes than the household risk cluster.

4.4 Method

Protocol pre-registration

The rationale and procedure was pre-registered online on the Open Science Framework (https://osf.io/wrjaq). It is important to note some deviations to the pre-registered procedure. First, the way in which financial struggles, few close friends, and maternal psychological distress were coded from continuous responses to a scale of 0 to 3 was originally planned to be calculated using deciles, but was instead calculated using standard deviations from the mean value. Second, it was stated in the pre-registered procedure that all difficulty subscales in the SDQ would be modelled, but instead we calculated internalising problems and externalising problems using the SDQ subscales to reduce the number of models estimated. This is also a satisfactory way to model psychosocial problems using the SDQ (Goodman et al., 2010).

Data and sample

We used data from three waves in the UK Household Longitudinal Study (Understanding Society; University of Essex, 2020) dataset collected from children aged 10-15. The waves included were wave 3 (2011-2013, age 10-11), 5 (2013-2015, age 12-13), and 7 (2015-2017, age 14-15). From wave 3 to wave 5, there was a retention rate of 71.7%, and from wave 5 to wave 7, there was a 79.2% retention rate. More information about this can be found in the technical reports accessible via https://www.understandingsociety.ac.uk/documentation/mainstage/technical-reports. Data can be accessed via https://www.ukdataservice.ac.uk/ after End User License access is obtained. The data were accessed in November 2019. Codebook, sampling, and data collection procedures are available via https://www.understandingsociety.ac.uk/. The

University Research Ethics Committee approved a self-declaration to confirm the data are pre-existing, robustly anonymised, and the project is unlikely to cause offence to data providers.

To ensure that there was roughly equal time difference between observations, data were only included if they were collected at the correct ages targeted at each wave. Where demographic data was missing, it was assumed that the participant did not complete data collection for that timepoint.

The baseline demographics of the sample (Table 4.1) were broadly representative of the UK population. There was a balanced representation of male (49.5%) and female (50.5%) children, and participants were predominantly from a White British (76.2%) ethnic background, which is close to the proportion of white people living in England and Wales as reported in the 2011 census (80.5%; Office for National Statistics [ONS], 2011). The sample used for analysis was N = 646.

Measures

Understanding Society data were used to create eight types of ACEs: sibling victimisation, quarrelsome relationship with parents, bad relationship with stepparent, bullying victimisation, adverse neighbourhood, few close friends, maternal psychological distress, and financial struggles. The ACEs are described below.

Adverse childhood experiences

The ACEs constructed for this analysis were repeated measures at all three timepoints. Where ACEs had multiple contributing items, they were divided to create a mean score to avoid unbalanced contributions to the summed ACE variables (see below). ACEs are measured on a scale of 0 to 3 to retain more information about the burden of ACEs than is possible for latent class analysis, where dichotomisation is necessary.

Table 4.1.

Demographics and descriptive statistics.

	Time 1	Time 2	Time 3
	% or Mean (SD)		
Demographics			
Male	49.5%		
Female	50.5%		
White British	76.2%		
Asian (any)	11.9%		
Mixed	5.1%		
Other white background	3.3%		
Black (any)	3.3%		
Arab	.3%		
ACE			
Sibling victimisation	.82 (.76)	.77 (.78)	.66 (.76)
Quarrelsome relationship with parent(s)	.64 (.80)	.63 (.77)	.73 (.82)
Bad relationship with stepparent	.17 (.5)	.15 (.47)	.14 (.43)
Bullying victimisation	.41 (.65)	.33 (.6)	.28 (.53)
Adverse neighbourhood	1.17 (.69)	.94 (.67)	.83 (.66)
Few close friends	1.58 (.73)	1.54 (.71)	1.50 (.70)
Maternal psychological distress	1.34 (.89)	1.31 (.90)	1.28 (.88)
Financial struggles	1.58 (.92)	1.56 (.94)	1.54 (.93)
Risk			

Cumulative Risk	7.74 (2.59)	7.29 (2.51)	6.98 (2.57)
Peer Risk	3.17 (1.31)	2.82 (1.30)	2.60 (1.22)
Household Risk	4.56 (2.05)	4.44 (1.94)	4.36 (2.04)

Items were primarily adapted from child self-report measures. *Sibling victimisation* was measured from four items concerning sibling experiences, pertaining to how often siblings perpetrated physical violence, theft, name-calling, and teasing. Response options for all four items were "never", "not much (1-3 times in the last 6 months)", "quite a lot (more than 4 times in the last 6 months)", and "a lot (a few times every week)". Responses were coded from 0 to 3, summed and divided by four to arrive at a single score. If participants reported not having a sibling, the variable was coded as 0. *Quarrelsome relationship with parents* was adapted from two items pertaining to how frequently participants quarrelled with their mother and father. Response options were "hardly ever", "less than once a week", "more than once a week", and "most days". Items were coded from 0 to 3, summed and divided by 2 to arrive at a single score. Participants could also respond "don't have a [father/mother]", which was coded as 0. *Bad relationship with stepparent* was adapted from a single item which asked participants to judge their relationship with their stepparent, with response options ranging from "very poor", "poor", "fair/good", and "very good" on a 0-3 scale. If participants reported that they had no stepparent, the value was coded as 0. *Bullying victimisation* was adapted from two items concerning bullying experiences, pertaining to how often participants experienced physical bullying and bullying in other forms at school. Responses ranged from "never", "not much (1-3 times in the last 6 months)", "quite a lot (more than 4 times in the last 6 months)", "a lot (a few times a week)" on a 0-3 scale. Items were summed and divided by two to create a single score. *Adverse neighbourhood* was adapted from two items pertaining to how much the participant worried about being a victim of crime, and how safe they felt walking alone in the area after dark. Item responses ranged from "not a worry at all", "an occasional doubt", "a bit of a worry", "a big worry", and "very safe", "fairly safe", "a bit unsafe", "very unsafe" respectively, each on a 0-3 scale. Responses were summed and divided by two. The final self-report ACE was *few close friends*, which was adapted from a single item asking how many close friends the participant had, which was an open question where participants responded with an integer. At ages 10-11, responses

ranged from 0-82, so to fit the other variables these responses needed to be recoded. We used the mean ($\bar{x}$) and standard deviation (σ) to categorise responses into a 0-4 scale. Responses greater than $\bar{x} + \sigma$ were coded as 0, values greater than $\bar{x}$ but smaller than $\bar{x} + \sigma$ were coded as 1, values below $\bar{x}$ were coded as 2, and values below $\bar{x} - \sigma$ were coded as 3 (unless this went below 0 in which case values of 0 were coded as 3).

Two ACEs were observed via means other than child self-report. *Maternal psychological distress* was adapted from parent-reported General Health Questionnaire likert scales (GHQ; Goldberg & Williams, 1988) which ranged from 0-36. *Financial struggles* was adapted from the total gross household labour income (monthly), which was reported in the household survey. Both maternal psychological distress and financial struggles were re-coded following the same strategy as *few close friends* (see above) such that those with higher scores on the GHQ had a higher score of maternal psychological distress, and those with higher total gross household labour income had lower scores on financial struggles.

ACE risk scores

To approximate the cumulative impact of ACEs, we calculated three different summary scores. The first summary score was a cumulative risk score, which was a summary of all eight ACEs detailed above which had a possible range of 0-24.

We also calculated two partitioned risk scores, namely a community risk score and a household risk score. This partition was computed to approximate latent class analysis results from the previous chapter, and published results which found that family-related risks and community-related risks conferred increased risk for specified outcomes (Turner et al., 2020). The community risk score was computed by summing the scores of *bullying victimisation*, *adverse neighbourhood*, and *few close friends*. The household risk score was computed by summing *sibling victimisation*, *quarrelsome relationship with parents*, *bad relationship with stepparent*, *financial struggles*, and *maternal psychological distress*.

SDQ

Self-report scores from the Strengths & Difficulties Questionnaire (Goodman, 1997) were used to derive internalising problems and externalising problems at each of the three timepoints. The SDQ contains five subscales which measure emotional problems, peer problems, conduct problems, hyperactivity/inattention, and prosocial behaviours. The SDQ subscales are described in more detail in the previous chapter. Each item has response options

of “not true”, “somewhat true”, and “certainly true” regarding how the participant sees themselves as a person. Internalising and externalising subscales (0-20) were calculated as recommended by Goodman et al., (2010). The internalising problems score was calculated by adding together the derived emotional problems and peer problems subscales had a Cronbach’s α coefficient that over time ranged from .70-.74; while the externalising problems score was calculating by adding the derived conduct problems and hyperactivity/inattention subscales and had a Cronbach’s α coefficient that over time ranged from .75-.79. The prosocial subscale was omitted due to there being no relationship evident in the previous chapter.

Delinquency

A delinquency score was calculated to summarise self-reported acts of delinquent or illicit behaviours. Each item was measured using different response options, but were converted into a sum score to estimate general delinquency. These behaviours included vandalism, shoplifting, fighting, and bullying perpetration (both physical and other forms). For vandalism and shoplifting, responses ranged from “never”, “once or twice”, “several times”, “often”. For fighting, responses ranged from “none”, “once”, “2-5 times/6-9 times”, “10 or more times”. For bullying perpetration, both physical and other forms had response options ranging from “never”, “not much (1-3 times in the last 6 months)”, “quite a lot (more than 4 times in the last 6 months)”, “a lot (a few times every week)”. Responses were re-coded into 0-3 scales where 0 was never and 3 was the most frequent for that item which resulted in a possible range of 0-20. This computed scale had a Cronbach’s α that over time ranged from .65-.96.

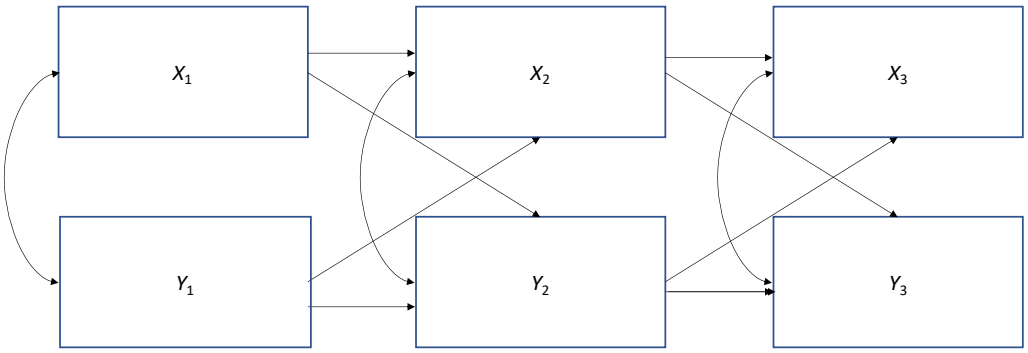
Life Satisfaction

We also calculated a life satisfaction score based on self-report responses to questions concerning life as a whole, family, friends, appearance, school, and schoolwork. Responses were reverse coded for ease of interpretation so that higher scores indicated greater life satisfaction. Item responses were on a scale from 1-7 (from “not at all happy” to “completely happy”), resulting in a possible range of 6-42. The life satisfaction scale had a Cronbach’s α ranging from .74-.79. The same scale has been used elsewhere to plot trajectories of adolescent life satisfaction (see Orben et al., 2022).

Analysis strategy

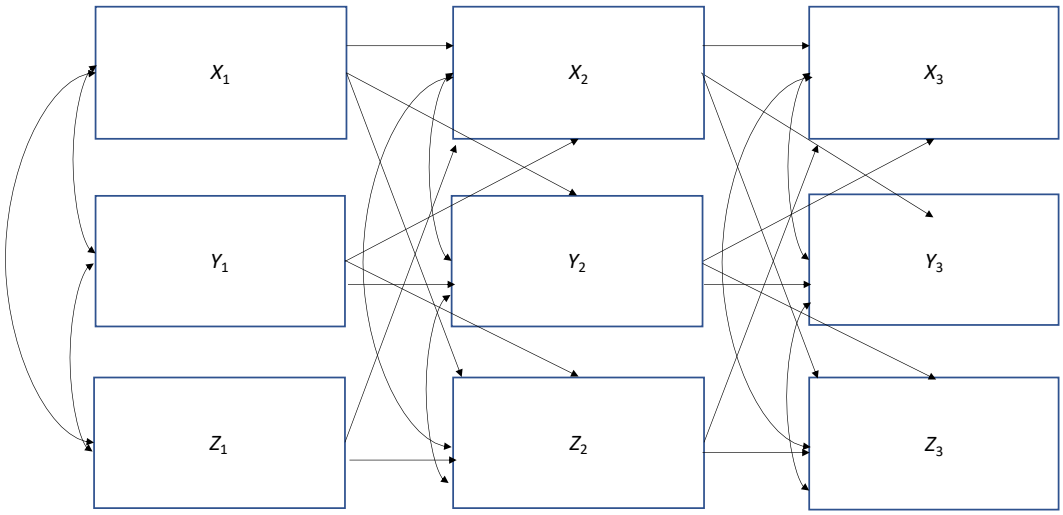
Data management was conducted in STATA MP 17 (StataCorp, 2021), while analysis was conducted in Mplus 8.6 (Muthén & Muthén, 1998-2017). A series of CLPMs were computed to assess bidirectional repeated measures relationships between ACE risk scores and psychosocial outcomes (i.e. SDQ scales, delinquency acts, and life satisfaction) across time. Specifically, CLPMs were run modelling cumulative risk scores and outcomes (see Figure 4.1 for conceptual model), and CLPMS were modelled including both partitioned risks (i.e. community risks, household risks) and outcomes (see Figure 4.2 for conceptual model). We used full information maximum likelihood estimation, via the robust Maximum Likelihood estimator, in Mplus to handle missing data. Extreme values (more than three standard deviations from the mean) were winsorised. For each model, fit indices were reported: Root Mean Square Error of Approximation (RMSEA) where values should be below .1 (Kenny et al., 2015), Comparative Fit Index (CFI) which should be above .95 (Hu & Bentler, 1999), Tucker Lewis Index (TLI) which should be above .9 (Bentler & Bonett, 1980), and Standardised Root Mean Square Residual (SRMR), which should be below .06 (Hu & Bentler, 1999).

Figure 4.1. *Cross-lagged panel model where X is cumulative risk and Y is the putative 'outcome'.*



Note. This figure denotes the elements of a cross-lagged panel model which includes autoregressive effects (e.g. from X_1 to X_2), cross-lagged paths (e.g. from X_1 to Y_2), and correlations (e.g from X_1 to Y_1).

Figure 4.2. *Cross-lagged panel model where X is community risk, Y is the household risk, and Z is the putative 'outcome'.*



Note. This figure denotes the elements of a cross-lagged panel model which includes autoregressive effects (e.g. from X_1 to X_2), cross-lagged paths (e.g. from X_1 to Y_2), and correlations (e.g from X_1 to Y_1).

4.5 Results

Models were run where the autoregressive paths were constrained to be equal across timepoints. These CLPM models fit the data at an acceptable level. Tables 4.2 and 4.3 show the model fit indices for the cumulative risk and partitioned risk models respectively. Chi-square values for every model were significant, although this might be due to the low degrees of freedom in the models (Kenny et al., 2015). Nested models were run where all paths were constrained to be equal across time to test whether effects from T1 to T2 and T2 to T3 were different in magnitude. Chi-square difference tests were computed to evaluate whether the models that allowed beta coefficients to vary over time fit better than the models that fixed beta coefficients over time (i.e. stationarity). The results of the chi-square difference tests

Table 4.2.

Fit of cross-lagged panel models for cumulative risk models by outcome.

	χ^2	RMSEA [95% CI]	CFI	TLI	SRMR
Internalising	38.073*	.091 [.065, .120]	.967	.923	.034

Externalising	48.952*	.105 [.079, .134]	.960	.906	.037
Delinquency	24.143*	.070 [.043, .100]	.967	.923	.037
Life Satisfaction	33.032*	.084 [.057, .112]	.970	.929	.038

Note. Autoregressive paths were constrained to be equal across time. Degrees of freedom = 6*. All Chi-square values significant at p <.001.

Table 4.3.

Fit of cross-lagged panel models for partitioned risk models by outcome.

	χ^2	RMSEA [95% CI]	CFI	TLI	SRMR
Internalising	53.801*	.073 [.054, .094]	.968	.912	.031
Externalising	65.583*	.083 [.064, .103]	.960	.889	.032
Delinquency	42.826*	.063 [.043, .084]	.965	.903	.032
Life Satisfaction	48.807*	.069 [.049, .090]	.970	.917	.032

Note. Autoregressive paths were constrained to be equal across time. Degrees of freedom = 12*. All Chi-square values significant at p <.001.

indicate that the models that fixed beta coefficients over time fit better for delinquency and life satisfaction, but not internalising and externalising problems (see Table 4.4). This provides evidence that the magnitude of the effect of ACEs on life satisfaction (and bidirectional effects) are stable over time, whereas for the magnitude of the effect of ACEs on internalising and externalising outcomes differed between T1 to T2 and T2 to T3.

Table 4.4

Chi-square difference tests results.

	Chi-square difference	df
Cumulative risk models		
Internalising	30.354	4
Externalising	24.791	4
Delinquency	7.92	4
Life satisfaction	5.688	4
Partitioned risk models		

Internalising	30.969	12
Externalising	30.079	12
Delinquency	20.994	12
Life Satisfaction	11.982	12

Note. The critical value for cumulative risk models was 9.488, chi-square difference values below this critical value indicate that the fully constrained model was a better fit. The critical value for partitioned risk models was 21.026, chi-square difference values below the critical value indicate that the fully constricted model was a better fit.

Table 4.5 presents the results of the cumulative risk CLPM analyses. For brevity, autoregressive coefficients were omitted. All autoregressive paths were large and significant, as expected (see Appendix 1).

Table 4.5.

Cross-lagged panel analyses coefficients for directional paths using cumulative risk summary score.

Path	Internalising		Externalising		Delinquency		Life Satisfaction	
	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*
T1 Outcome -> T2 ACEs	.076 (.034)	.025	.098 (.036)	.007	.046 (.037)	.217	-.092 (.038)	.015
T2 Outcome -> T3 ACEs	.059 (.034)	.086	.138 (.032)	<.001	.057 (.040)	.157	-.045 (.034)	.194
T1 ACEs -> T2 Outcome	.074 (.034)	.031	.083 (.035)	.017	.070 (.038)	.065	-.115 (.038)	.002
T2 ACEs -> T3 Outcome	.115 (.037)	.002	.136 (.034)	<.001	.156 (.046)	.001	-.091 (.041)	.025

Note. Standardised coefficients and standard errors are presented. In all models, autoregressive paths were constrained to be equal across time. Delinquency Acts and Life Satisfaction included winsorised values.

Table 4.6.

Cross-lagged panel analyses coefficients for directional paths using partitioned risk summary score.

Path	Internalising		Externalising		Delinquency		Life Satisfaction	
	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*
T1 Peer Risk -> T2 HH Risk	.012 (.038)	.744	.038 (.033)	.252	.041 (.033)	.210	.021 (.035)	.559
T2 Peer Risk -> T3 HH Risk	.060 (.041)	.145	.056 (.035)	.111	.072 (.034)	.040	.066 (.038)	.085
T1 HH Risk -> T2 Peer Risk	.063 (.037)	.089	.057 (.041)	.167	.086 (.040)	.033	.071 (.038)	.063
T2 HH Risk -> T3 Peer Risk	.068 (.041)	.094	.054 (.041)	.189	.079 (.040)	.048	.073 (.042)	.083
T1 Outcome -> T2 Peer Risk	.112 (.038)	.003	.074 (.041)	.071	.008 (.039)	.837	-.078 (.039)	.045
T2 Outcome -> T3 Peer Risk	.079 (.040)	.049	.068 (.041)	.102	-.011 (.046)	.817	-.026 (.042)	.527
T1 Outcome -> T2 HH Risk	.068 (.039)	.081	.068 (.035)	.055	.049 (.035)	.164	-.082 (.037)	.027
T2 Outcome -> T3 HH Risk	.043 (.040)	.276	.130 (.030)	<.001	.083 (.036)	.022	-.044 (.038)	.246
T1 Peer Risk -> T2 Outcome	.081 (.034)	.016	.027 (.036)	.456	.010 (.040)	.804	-.036 (.034)	.298
T2 Peer Risk -> T3 Outcome	.076 (.035)	.031	.024 (.033)	.459	.052 (.044)	.229	-.015 (.037)	.680
T1 HH Risk -> T2 Outcome	.021 (.034)	.541	.080 (.035)	.023	.078 (.038)	.043	-.097 (.038)	.010
T2 HH Risk -> T3 Outcome	.082 (.036)	.023	.138 (.036)	<.001	.151 (.051)	.003	-.089 (.036)	.012

Note. Standardised coefficients and standard errors are presented. In all models, autoregressive paths were constrained to be equal across time. Delinquency Acts and Life Satisfaction included winsorised

values. “Peer Risk” refers to the community risk cluster of ACEs; “HH Risk” refers to the household risk cluster of ACEs.

Regarding SDQ outcomes (internalising difficulties and externalising difficulties), all cross-lagged models found results suggestive of a bidirectional relationship between adversities and difficulties. From T1 to T2 ACEs were predictive of both SDQ outcomes, and vice versa. From T2 to T3, ACEs were predictive of both SDQ outcomes, but only SDQ externalising were predictive of ACE scores. For delinquency scores, only one path was significant which was ACE scores at T2 to delinquency at T3. There was evidence of a bidirectional relationship between ACEs and life satisfaction. From T1 to T2 ACE scores were predictive of life satisfaction and vice versa. However, from T2 to T3 ACE scores were predictive of life satisfaction, but not the reverse.

Table 4.6 presents the results of the partitioned risk CLPM analyses. To clarify, in this model both community and household risk variables were included in addition to the putative outcome. For brevity, autoregressive coefficients were omitted. Similar to the cumulative risk CLPM models, all autoregressive effects were large and significant (see Appendix 2). There was little evidence that risk clusters were predictive of one another. The only significant pathways were found in the delinquency model, where household risks predicted community risks at both cross-lagged paths and community risks predicted household risks from T2 to T3.

Community risks predicted SDQ internalising problems at both T1 to T2, and T2 to T3. There was evidence that this relationship was bidirectional, as SDQ internalising problems predicted community risks at both cross-lagged paths. Community risks did not significantly predict other outcomes. Household risks predicted all four outcomes to different degrees. Household risks predicted SDQ internalising problems at the T2 to T3 pathway, but was not suggestive of a bidirectional relationship. Household risks predicted SDQ externalising, delinquency, and life satisfaction at both cross-lagged pathways. For each of these models there was evidence of a bidirectional relationship, as SDQ externalising predicted household risk from T2 to T3, delinquency predicted household risk from T2 to T3, and life satisfaction predicted household risk from T1 to T2.

4.6 Discussion

This chapter described a series of CLPMs that examined the temporal role of ACEs on a wide range of psychosocial problems across childhood and adolescence, and the bidirectional relationships between ACEs and psychosocial problems (i.e. SDQ internalising and externalising problems, delinquency, and life satisfaction). Two sets of models were run. Based on the predominant approach to the study of ACEs, models were run with a cumulative risk summary score in which contributing items were summed to produce a total risk score. These models found that ACEs predicted each outcome for at least one cross-lagged pathway, where a larger risk score predicted worse outcomes. Based on the latent class findings in the previous chapter, rival models were run with risks partitioned by ecology. Specifically, risks were categorised as 'community' or 'household' risks and two summary risk scores were computed. Both risk scores were included simultaneously as putative predictors of psychosocial outcomes. In these models, the community risks variable predicted SDQ internalising problems, while the household risks variable predicted SDQ internalising problems, SDQ externalising problems, delinquency, and life satisfaction.

Independent effects of cumulative risk

Hypothesis one purported that there would be independent longitudinal effects of ACEs on psychosocial outcomes. This was supported to some extent. The models produced significant effects of ACEs on psychosocial outcomes while controlling for autoregressive effects. The effect of ACEs on the observed outcomes was significant at both lagged paths for SDQ internalising, SDQ externalising, and life satisfaction. This implies a stable effect of ACEs on psychosocial outcomes, although for SDQ internalising and externalising, the effect of ACEs is stronger from T2 to T3. For delinquency, the effect was significant only from T2 to T3. These findings seem to suggest that ACEs play a greater role in internalising and externalising outcomes in later childhood (i.e. age 14-15). Taken together, these results are indicative that the cumulative effect of ACEs is important for the development of a wide array of developmental psychosocial problems. This provides support above and beyond what could be inferred from cross-sectional analysis of retrospective data.

The models also suggest that the relationship between ACEs and psychosocial functioning is bidirectional. SDQ externalising problems were predictive of ACEs at both cross-lagged paths, while SDQ internalising problems predicted ACEs from T1 to T2, and life satisfaction predicted ACEs from T1 to T2. An observation of the coefficients shows that

for SDQ externalising problems the coefficient from T2 to T3 was larger than the coefficient from T1 to T2. One interpretation of this is that a mixture of conduct and hyperactivity behaviours at ages 12-13 increased the risk of exposure to stressors at ages 14-15. One could speculate about mechanisms such as these behaviours leading to more fractious relationships with parents and siblings at home, or indeed increased targeting from bullies in school. Future studies could test such a mechanism using mediation models (see Preacher, 2015).

Another observation from these CLPMs aside from the hypothesis is that for internalising and externalising outcomes, the magnitude of the effect of ACEs was slightly larger from T2 to T3 compared to T1 to T2. Any explanation offered for this would be purely speculative as we did not hypothesise about the magnitude of effects. As such, it is important to note that in studies using retrospective data, ACEs have been found to substantially contribute to mood disorders (e.g. Racine et al., 2021). This study adds weight to the claim that ACEs are related to the development of mood problems, but it is unclear why the relationship might be stronger from T2 to T3. Future studies should investigate how ACEs might be related to the age of onset, severity, and persistence of such problems. Indeed, future studies should investigate whether the effects of ACEs on internalising and externalising problems are particularly strong at ages 14-15 or if certain ACEs have an independent relationship with psychosocial functioning at this age.

Independent effects of partitioned risk categories

In line with recently published results from Turner et al. (2020), hypothesis two predicted that the community risk cluster would have stronger longitudinal effects on psychosocial outcomes compared to the household risk cluster at the later cross-lagged paths. Broadly, this hypothesis was not supported, as the reverse seemed to be closer to the observed outcomes in the models computed. The community risk score predicted worse SDQ internalising problems at both lagged paths in the context of autoregressive effects and the effect of household risks. This relationship seemed to be bidirectional. The effect also seemed relatively stable at both lagged paths, and so an increased effect of community risks over time was not supported by this study. One potential confounder of this relationship is that the adverse neighbourhood items included in the analyses presented in this chapter pertained to ‘worry about’ crime or being out at night. This might inflate the observed relationship between community risks and internalising problems due to the conflation of anxiety in both predictor and outcome. However, each of the items included in the community risks cluster

has been related to internalising problems in existing research. As discussed in the previous chapter, both bullying and perceived neighbourhood crime have both been associated with mental health problems (Baranyi et al., 2021; Moore et al., 2017). Social ostracism has also been experimentally linked to poorer emotional and esteem outcomes (Pharo et al., 2011). This analysis provides longitudinal support for this cluster of risks being related to internalising problems.

On the other hand, the household risk cluster unidirectionally predicted internalising problems from T2 to T3. There was evidence for bidirectional relationships between externalising problems, delinquency, and life satisfaction. Specifically, household risks predicted externalising problems, delinquency, and life satisfaction at both cross-lagged paths. Both externalising problems and delinquency predicted household risks from T2 to T3, and life satisfaction predicted household risks from T1 to T2. For SDQ internalising, SDQ externalising, and delinquency, these effects seemed stronger for the path from T2 to T3 compared to the path from T1 to T2. These results are in direct contrast to those published by Turner et al. (2020) who found that household risks had weaker effects on older children. This is perhaps surprising, because it has been hypothesised that as children grow older the influence of the family wanes, and the influence of peers grows (see Laursen & Veenstra, 2021 for a discussion). One potential explanation as to why we did not see a growing influence of the community risks and a shrinking influence of household risks is that at the latest timepoint children were 14-15 years old. The purported delayed timing of role transitions in contemporary society (Sawyer et al., 2018) might have resulted in an enduring influence of familial risk factors over community risk factors. Or, more simply, it could be that the household risks included in this analysis conferred a greater risk of psychosocial problems than the community risks. Other research has shown that community violence exposure confers a substantive risk to health problems (Finkelhor et al., 2015). Further research should examine this discrepancy.

Another observed pattern which was not hypothesised, but is otherwise worthy of note, is that in the CLPMs where risks were partitioned into community and household categories, the two risk variables were not predictive of each other. The risk clusters were correlated, but were not predictive of one another independent of autoregressive effects. The lack of a relationship observed in these models might indicate the need to understand how risks in different ecologies are related, and potentially the underlying causes of the risks themselves. The results of these longitudinal analyses indicate that risks clustered by ecology

do not predict each other. As such, future studies that examine the underlying causes of ACE exposure would be highly informative. One potential avenue would be to use intergenerational studies examining the role of parental stress exposure as an antecedent (Kretschmer, 2021).

In the partitioned models, we found evidence that household risks were more strongly predictive of outcomes from T2 to T3, whereas community risks were only predictive of internalising problems and the coefficients were stable at both cross-lagged paths. While the hypothesis regarding the temporal effects of the partitioned categories of risk were not supported, this does not indicate that there is no merit in categorising risk by ecology. One insight garnered from the partitioned risk models is the plausibility of a specific effect of risk according to the ecology in which that risk is experienced. Community risk scores were predictive of internalising problems at both cross-lagged paths, while household risk scores were predictive of the remaining psychosocial outcomes at both cross-lagged paths. This observation was not hypothesised. However, if we had merely run the models using the cumulative risk scores, we would not have been able to explore specified effects. The strong methodology of this analysis underlines that the specificity of these effects could be informative to contemporary theories around ACEs and intervention efforts.

Limitations

The analysis strategy used in this chapter, namely cross-lagged panel modelling, provides a strong basis from which to ascertain temporal associations among ACEs and psychosocial functioning. The ability to assess reverse causation, temporal sequencing, and autoregressive effects are rare in a literature dominated by cross-sectional analysis of retrospective data. Cross-lagged analyses are a particularly important method due to the undesirable ethics of experimentally controlling ACEs to test for causally related sequelae. However, the conclusions drawn from this study are limited by methodological considerations. For instance, while our analysis was chosen to account for temporal sequencing and reverse causation, observations begin at age 10. Naturally, this means that the models cannot account for ACEs experienced between birth and age 10, which could confound our sample or the results. The models do account for temporal relationships, but are restricted to the snapshot of 10-15 years of age. Relatedly, items contributing to ACEs in this study did not refer to the same amount of time. For instance, some responses to contributory items referred to ‘most days’, whereas others referred to ‘more than 4 times in the last 6

months'. Future research should use items that refer to a uniform period of time (e.g. during the last 6 months), collect data from an earlier age, including pre-conception stressors and intergenerational ACEs where possible. Nevertheless, this is a novel contribution to the literature and could be informative to researchers working on interventions in this population.

The analyses presented in this chapter do not include measures of parenting behaviours that amount to child maltreatment such as physical discipline practices by parents (which were included in the previous chapter). The principal reason for this decision was to maximise methodological rigour by only including variables that were repeated measures at each timepoint, so that cross-lagged paths could be assessed. If items that were only measured cross-sectionally were included in our models, we would not be able to assess the putative longitudinal relationships properly. Although, importantly, studies that investigate the role of individual ACEs find that physical abuse and other such omitted ACEs are strongly related to various internalising and externalising problems (see Merrick et al., 2017). Therefore, due to the omissions of some key ACEs, we might expect that our models do not fully account for the effect of ACEs on psychosocial problems. On the other hand, many studies of ACEs use cross-sectional studies to examine the relationship between ACEs and psychosocial outcomes, whereas the ACEs included in this study are repeated measures at three timepoints allowing for a closer examination of the prospective relationship and a rare observation of reverse causation.

Conclusions and future directions

The results from these CLPMs support the consensus garnered from the extant literature, that there is a relationship between the cumulative burden of ACEs and subsequent psychosocial outcomes such as internalising and externalising problems, delinquent behaviour, and life satisfaction. Categorising ACE items into 'community' or 'household' risks, produced specific outcomes were predicted by each category. Community risks predicted internalising problems, implying that children were more likely to struggle with emotional or social problems due to risks in the community. Household risks predicted externalising problems, delinquency, and life satisfaction at both cross-lagged paths but internalising problems only at one path. This implies that household risks had more of an impact on behavioural problems and life satisfaction. The models also revealed some evidence of bidirectional relationships between psychosocial functioning outcomes and ACEs. However, our findings are limited to describing the relationship between ACEs and

psychosocial functioning between the ages of 10 and 15, so we could not control for pre-existing variance prior to the age of 10. All in all, these results provide a much-needed insight to the longitudinal relationship between ACEs and psychosocial functioning in childhood.

Chapter Five: General discussion

This thesis had three primary aims: to synthesise contemporary evidence of mediating and moderating mechanisms underlying the relationship between ACEs and psychosocial functioning using longitudinal data, explore two competing operationalisations of ACEs and formally compare their predictive utility regarding psychosocial outcomes, and to examine the longitudinal relationship between ACEs and psychosocial outcomes. The previous three chapters sought to address these aims in turn.

5.1 Summary of main findings

The studies reported in this thesis provide strong support for the relationship between ACEs and psychosocial functioning, while examining how the putative relationship unfolds. Several studies have reported on the putative relationship between ACEs and psychosocial functioning outcomes. However, many systematic reviews of ACEs research rely on cross-sectional analysis of retrospective data, which substantially limits insight about the nature of the relationship between ACEs and many negative outcomes. Furthermore, in order to inform intervention and prevention efforts, it is important to learn about potential pathways to resilience via mediating or moderating mechanisms. The first study presented in Chapter Two aimed to address these two problems by synthesising longitudinal research that examined mediating or moderating mechanisms in the relationship between ACEs and a broad set of psychosocial outcomes such as psychopathology, physical health, delinquency, and personal achievements. However, from the studies reviewed, a clear picture regarding mediating and moderating mechanisms did not emerge. For psychopathology related outcomes, attachment anxiety, emotion regulation problems, sub-clinical distress, and earlier depression symptoms were all found to be mediators, which strongly implies that emotional problems have a role in the relationship between ACEs and subsequent psychopathology. For delinquency, only a moderating mechanism of the MAOA genotype was examined, for which findings were mixed. Regarding physical health outcomes, studies primarily found health-related behaviours as mediators (e.g. smoking, body mass index, physical activity, alcohol consumption) which provides strong evidence that the effect of ACEs on physical health outcomes operates indirectly via health-related behaviours. Finally, for personal achievements (i.e. economic and educational attainment), mediating mechanisms included

cognitive skills, family formation, educational attainment, and externalising problems. Together, these results do not imply a general mechanism linking ACEs with psychosocial functioning. The pathways from ACEs to different outcomes seem to diverge early on, most likely due to unidentified factors. In other words, the findings fitted the notion of multifinality (see Cicchetti & Rogosch, 1996), that the same putative cause have myriad plausible outcomes depending on the circumstances of the individual. For example, experiencing a burden of ACEs might lead to a greater likelihood of smoking or drinking frequently during adolescence to deal with the stress, and subsequently lead to worse health outcomes in adulthood. On the other hand, the burden of ACEs might lead a different individual to struggle with regulating their emotions, which consequently leads to psychopathological problems in adulthood. The scope of the review does not allow conclusions as to why the burden of ACEs would lead to different responses among individuals, but it does stress the importance of these branching paths, and perhaps takes a step towards clarifying why ACEs are associated with such a broad array of outcomes.

The question of what drives these different responses to ACEs was of pertinent interest following the findings of the systematic review outlined in Chapter Two. The avenue which we used to try to understand this was to investigate the heterogeneous operationalisations of ACEs. The second study in this thesis, presented in Chapter Three, examined this problem in detail. Specifically, this study compared the explanatory value of two approaches to operationalise ACEs in relation to psychosocial outcomes in children. The first approach was the cumulative risk approach, which assumes equivalent contribution of ACE to a summary score. The summary score was used to approximate a dose-response relationship with outcomes. The second approach was the person-centred approach, which assumes the presence of homogeneous latent classes characterised by patterns of co-occurring ACEs which can then be used to group participants by their most probable class. From this classification, group comparisons were made in relation to outcomes of interest, and conclusions can be drawn based upon the characteristics of each typology. Analyses of the UK Household Longitudinal Study (Understanding Society) dataset modelling both approaches produced mixed results. The cumulative risk approach explained more variance in most psychosocial outcomes (SDQ total difficulties, emotional problems, conduct problems, hyperactivity/inattention), and demonstrated that exposure to four or more ACEs had a substantial effect on such outcomes compared to exposure to zero ACEs. The person-centred approach explained more variance in one outcome – peer problems – and demonstrated that

participants classified by large probability of exposure to bullying, adverse neighbourhood, and emotional problems had worse outcomes compared to a group with high probability of exposure to physical discipline and emotional problems, and a group with low probability of exposure to ACEs. These results suggest that the cumulative risk is the strongest approximation of the relationship between ACEs and psychosocial functioning in children, but that latent classes of co-occurring risk could foster insight into how a specific cluster of risks is related to specific outcomes.

Building on the findings of Study Two (Chapter Three), Study Three (Chapter Four) aimed to examine the longitudinal relationship between ACEs and a slightly broader collection of psychosocial outcomes (the addition of life satisfaction scale and delinquency). Two sets of CLPMs were computed, one using the cumulative risk approach, and one where risks were partitioned into household and community risks. The cumulative risk CLPM models showed that ACEs predicted all outcomes in at least one cross-lagged path, which indicated strong evidence for the longitudinal effect of numerous ACEs. In the partitioned risk models, household risks predicted SDQ externalising problems, delinquency, and life satisfaction in at least one cross-lagged path; meanwhile community risks predicted SDQ internalising problems. In both sets of models, there was evidence of reverse causation, whereby putative outcomes were predictive of ACE scores. This indicated that the relationship between ACEs and psychosocial functioning is likely to be bidirectional. In other words, there was evidence that children exposed to adversity develop psychosocial problems, but also that children developing psychosocial problems become exposed to adversity. One potential explanation for this is that children with internalising or externalising problems might be more vulnerable (or indeed less resilient) to the accumulation of risk than children without such problems (see Goemans et al., 2021). This is a novel finding that could only be tested using prospective repeated measures data.

5.2 Theoretical and practical implications

One of the main issues with ACEs that has been addressed in this thesis is the operationalisation of multiple ACEs. Previous research largely investigated the burden of maltreatment in terms of maltreated children compared to non-maltreated children (see Fergusson et al., 2011), which might be problematic if indeed the effects of maltreatment and adversity mount with the additional exposure of different types. It is reasonable to expect that

children exposed to two types of adversity differ in outcomes compared to those who are exposed to one type. Indeed, given that adversities commonly co-occur (Finkelhor et al., 2009), operationalisations that account for co-occurrence have an advantage over those that model maltreated versus non-maltreated. Since the publication of the dose-response model of ACEs (Felitti et al., 1998), there has been an increasing trend of operationalising childhood adversities such that researchers model the presence of multiple ACEs using a cumulative risk approach, which was described in Chapter Three. This approach does account for an additive effect of different types of ACE, but assumes equivalent contributions from different ACEs to the overall burden which is reductive. There is perhaps cause for argument that some adversities contribute more to specific outcomes, or even contribute more to the overall burden (Finkelhor et al., 2009). Another approach to operationalising co-occurring ACEs is the person-centred approach, again outlined in detail in Chapter Three. This approach assumes that co-occurring exposures of ACEs are patterned, and latent class analysis can, in essence, find underlying typologies of ACE exposure. Study Two (Chapter Three) provided a novel contribution to the literature by formally comparing the cumulative risk and person-centred approaches, using a representative general population sample of British children. The analyses supported the presence of underlying typologies of ACEs and that one group of participants classified into the community challenges class had worse mean scores on SDQ subscales. The person-centred approach explained more variance in peer problems than the cumulative risk approach, but the cumulative risk approach also explained more variance on most other outcomes. This study shows the feasibility of using the person-centred approach in addition to the potential for unique findings which might otherwise be undiscovered by the cumulative risk approach. In practice, where ACEs are screened for, the cumulative risk method seems more beneficial for estimating general risk.

The findings of Study Two provided inspiration for partitioning risks into their ecological categories. Namely, because latent classes approximated household and community risks, these clusters were adopted as well as the cumulative risk approach in a longitudinal study design for Study Three. Again, there was support for specified risk, whereby the community risks predicted internalising problems, and the household risks predicted externalising problems, delinquency, and life satisfaction. Further research using the person-centred approach and partitioning risks by ecology would be informative to intervention efforts. Specifically, if the results from Study Three were replicated, child protection services could have a greater insight as to how household risks versus community

risks differentially effect psychosocial outcomes. This means that intervention efforts could be tailored to children facing these clusters of risks if findings are replicated elsewhere.

One collective conclusion to take from Studies Two and Three is that the predominant way of operationalising ACEs – the cumulative risk approach – could benefit from being supplemented by the person-centred approach in research. Specifically, the cumulative risk approach is not optimised for generating insight about how co-occurring risks affect outcomes beyond a simple dose-response finding. The advantages of this method are the simplicity, and the ability to estimate general risk associated with a large cluster of variables. However, to foster greater understanding regarding how different risks cluster together among people, and how these clusters differently impact outcomes the person-centred approach provides a suitable alternative. Alternative approaches not explored in this thesis have been used elsewhere, for instance single-adversity approaches (see Merrick et al., 2017), network analytic approaches (see de Vries, 2022), and dimensional approaches (see McLaughlin & Sheridan, 2016). Future research would do well to assess and make use of these several different approaches to operationalising ACEs.

A related theoretical consideration to be taken from this thesis is what kinds of stressor to include under the umbrella of ACEs. While there are some ACE scales, as described in Study One, there exists very little if any demarcation in the literature between what ought to be considered an ACE beyond those included in existing scales. This presented a quandary when designing the ACE scores using the UK Household Longitudinal Study, because while it contains information on stressors and parenting behaviours, items had to be selected from different scales to approximate ACEs. For example, we included items regarding parental disinterest in the child's education, and the quality of relationship with a stepparent as ACEs in studies two and three respectively. Educational disinterest, as it was called in Study Two, was included as a milder form of educational neglect, a lack of interest made by parents to support the education of their child. However, as this item did not seem important in the latent class analysis it was omitted in Study Three. In Study Three, a bad relationship with a stepparent was included due to the inflated risk of maltreatment associated with the presence of a stepparent (Daly & Wilson, 1985). While the mechanism of why the inflated risk is fairly speculative (see Debowska et al., 2020), it was assumed that a bad relationship with a stepparent might be a good approximation of this risk. Bullying was another risk factor we included as an ACE due to other research arguing for its inclusion (Finkelhor et al., 2015), but despite the well-known risks associated with bullying it is rarely

included in ACE scales elsewhere. The research presented in Chapters Three and Four challenge the conceptualisation of ACEs to a degree, and invites the questions of what constitutes an ACE. Specifically, in what circumstances should a stressful item be incorporated into an ACE score. An answer to this question would be invaluable to researchers working with datasets that do not use a specific ACE battery.

An extension of the above issue regarding the definition of ACEs and demarcation of ACEs is the investigation of protective factors. For instance, the quality of the relationship with parents could be coded as a protective variable depending on the context. An important avenue for future research might be to investigate how potentially protective variables operate. For instance, protective factors that enable children not to have poor outcomes in the context of ACEs, or characteristics of children who do not have problems following a particular risk (e.g. bullying). Resilience theorists have emphasised the importance of context, that depending on contextual factors a variable – such as the relationship with a stepparent – could be protective, harmful, or irrelevant to the effect on a person (see Rutter, 1987). For instance, children exposed to adversities such as bullying, sibling victimisation, and financial struggles might be protected from negative outcomes by having a strong relationship with their parents. However, the appraisal of such contexts is beyond the scope of an already large set of analyses in this thesis. Future studies should also seek to assess the contribution of protective factors.

5.3 Limitations and future work

Collectively, the work presented in this thesis must be interpreted in the context of limitations. First, leading on from the section above, the definition of ACEs is unclear in what kind of stressful experiences ought to be included in ACE scores. Outlined in more detail above, we included some items that are not typically included in ACE composite scores, although bullying victimisation in particular contributed substantially to one latent class in Study Two. While this is a weakness of the ACE literature in general, our decision to include these items without testing their inclusion with a comprehensive battery of ACEs could be interpreted as a weakness. However, the work and data required to conduct an analysis is beyond the scope of this thesis and should be a priority of future work. Indeed, the absence of some severe ACEs such as sexual abuse is a weakness of the studies presented herein. These limitations notwithstanding, the dataset we used in studies two and three has two key advantages over several studies published in the research literature. First, the UKHLS dataset

follows a representative general population sample of British children and contains a combination of self-reported and parent-reported experiences. Second, the UKHLS dataset contains repeated measures of most scales every two years, which enabled the opportunity to compute cross-lagged panel analyses which is a rare strength of such datasets as is demonstrated in Study One.

Relatedly, a weakness of our analyses is a lack of information regarding experiences between ages 0-10. Our analyses are based on experiences reported during ages 10-15, and so even though we included a longitudinal analysis, presents data from a relatively short timespan during child development. Pre-existing variance regarding the early years of life are not accounted for in the analyses presented in studies two and three. Indeed, other contributors to the development of psychosocial outcomes such as the intergenerational transmission of stress and genes could not be accounted for in our analyses. Nonetheless, the period of 10-15 years of age is an important period of development where individuals transition from childhood into adolescence and the influence of peers begins to compete with the influence of parents. In this sense, it is an ideal time to test the predictive value of household and community risks, as we did in Study Three.

Future studies

There is ample room for future work to expand and build upon the work presented in these three studies. First, there needs to be more research attention focused on indirect influences in the relationship between ACEs and psychosocial functioning using longitudinal data. The findings described in Study One demonstrate the need for studies that use comprehensive batteries of ACEs to investigate variables that mediate or moderate the relationship between ACEs and psychosocial outcomes. There is a particular lack of cross-lagged panel models that would be ideal for testing mediation mechanisms. Datasets that contain repeated measures of ACEs and outcome variables are rare, but are required to contribute to the understanding of how ACEs effect development over time, of bidirectional relationships, and the stationarity of these relationships (see Preacher et al., 2015). Such studies would also be invaluable to the field of resilience.

Further research should also continue to investigate the various operationalisations of multiple ACEs and consider the demarcations of what is and what is not regarded an ACE. This is important for a few reasons. First, as established in Study One, it is difficult to generalise between studies due to a different collection of adversities being used to form a

composite score between studies. Second, it is important for researchers and practitioners interested in the environmental contributors to negative outcomes to know with greater certainty what to take from ACEs research. It is difficult to draw conclusions from a collection of studies when the term 'ACEs' refers to a different set of risks from one study to the next.

Conclusions

This thesis set out to closely examine the relationship between ACEs and psychosocial outcomes, with particular attention paid to understanding the underlying mechanisms at play which drive the relationship between ACEs and later emotional and behavioural outcomes. Considered together, these studies show that while there is no singular mechanism underlying the relationship between ACEs and various psychosocial outcomes, synthesised longitudinal evidence suggests that mediators and moderators are highly specific to eventual outcomes (Study One), that the way in which ACEs are operationalised can guide insight, and specific clusters of ACEs are related to outcomes (Study Two), and that ACEs partitioned into ecological risk groups are specific predictors of outcomes longitudinally (Study Three). These studies provide a novel contribution to the ACEs literature, and underscore the challenge of researching the relationship between ACEs and psychosocial outcomes.

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Appendices

Appendix A

Autoregressive coefficients using cumulative risk summary score.

Path	Internalising		Externalising		Delinquency		Life Satisfaction	
	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*
T1 ACEs -> T2 ACEs	.576 (.029)	<.001	.566 (.028)	<.001	.596 (.026)	<.001	.580 (.030)	<.001
T2 ACEs -> T3 ACEs	.570 (.030)	<.001	.550 (.028)	<.001	.584 (.028)	<.001	.575 (.030)	<.001
T1 Outcome -> T2 Outcome	.454 (.029)	<.001	.511 (.026)	<.001	.361 (.044)	<.001	.432 (.029)	<.001
T2 Outcome -> T3 Outcome	.472 (.032)	<.001	.535 (.032)	<.001	.366 (.049)	<.001	.473 (.034)	<.001

Note. Standardised coefficients and standard errors are presented. In all models, autoregressive paths were constrained to be equal. Delinquency Acts and Life Satisfaction included winsorised values.

Appendix B

Autoregressive coefficients using partitioned risk summary score.

Path	Internalising		Externalising		Delinquency		Life Satisfaction	
	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*	β (S.E.)	*p*
T1 Peer Risk -> T2 Peer Risk	.349 (.031)	<.001	.385 (.029)	<.001	.394 (.029)	<.001	.377 (.030)	<.001
T2 Peer Risk -> T3 Peer Risk	.372 (.033)	<.001	.406 (.031)	<.001	.416 (.030)	<.001	.401 (.032)	<.001
T1 HH Risk -> T2 HH Risk	.601 (.026)	<.001	.583 (.028)	<.001	.597 (.026)	<.001	.598 (.026)	<.001
T2 HH Risk -> T3 HH Risk	.574 (.027)	<.001	.545 (.027)	<.001	.562 (.027)	<.001	.569 (.027)	<.001
T1 Outcome -> T2 Outcome	.444 (.030)	<.001	.508 (.027)	<.001	.356 (.044)	<.001	.438 (.029)	<.001
T2 Outcome -> T3 Outcome	.462 (.033)	<.001	.531 (.032)	<.001	.361 (.050)	<.001	.479 (.035)	<.001

Note. Standardised coefficients and standard errors are presented. In all models, autoregressive paths were constrained to be equal. Delinquency Acts and Life Satisfaction included winsorised values.