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Regular Article

School connectedness as a protective factor between childhood adversity and adolescent mental health outcomes

Devin Diggs, Emre Deniz and Umar Toseeb
Department of Education, University of York, York, UK

Abstract

School connectedness may offset mental health risks associated with childhood adversity. The present study examined the potential protective effects of school connectedness against childhood adversity when predicting adolescent mental health outcomes in 9,964 individuals (51% female, 81% white) from the Millennium Cohort Study. Structural equation models were fitted to examine the longitudinal relationships between childhood adversity, school connectedness, and adolescent mental health. Childhood adversity was a risk factor, predicting greater internalizing and externalizing problems and lower levels of positive mental health. School connectedness was a promotive factor as it predicted fewer mental health problems and greater positive mental health. Furthermore, school connectedness at age 11 was protective against childhood adversity when predicting internalizing and externalizing problems at age 14. That is, students with a history of adversity who felt more connected to school were less likely to exhibit internalizing and externalizing symptoms than those who felt less connected to school. Only school connectedness at age 11 was protective against childhood adversity, indicating that feeling connected to school at younger ages may disrupt processes linking childhood adversity to adolescent mental health. Schools should foster students' feelings of connectedness to protect vulnerable individuals and benefit all pupils' mental health.

Keywords: adolescent mental health; childhood adversity; externalizing problems; internalizing problems; school connectedness

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Introduction

Childhood adversity is a common risk factor associated with adolescent mental health difficulties, with one in two individuals experiencing abuse, neglect, our household dysfunction in the UK (Bellis et al., 2014). There is increasing interest in identifying childhood experiences that may be protective against mental health difficulties following childhood adversity. School connectedness has been suggested as a potential target for interventions to promote adolescent mental health and protect against childhood adversity. However, the potential protective effects of school connectedness against childhood adversity remain unclear, specifically if feeling connected to school at certain ages is critical, how long protective effects last, and if the relationship only pertains to specific mental health outcomes (i.e. externalizing problems, internalizing problems, or positive mental health). To further understand the protective effects of school connectedness and inform future interventions, the current study explored the longitudinal relationships among childhood adversity, school connectedness, and adolescent mental health outcomes through a secondary data analysis of the United Kingdom Millennium Cohort Study.

Corresponding author: Umar Toseeb; Email: umar.toseeb@york.ac.uk
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Adverse childhood experiences

Adverse childhood experiences (ACEs) are events in childhood that are strongly associated with poor adolescent mental health, including physical, emotional, and sexual abuse; physical and emotional neglect; parental mental illness, domestic violence, divorce, having an incarcerated relative, and parental substance abuse. Felitti et al. (1998) first discovered a dose-response relationship between ACEs and health risk behavior and disease among over 13,000 adults, which has been replicated among more diverse samples (Burke et al., 2011; McLaughlin et al., 2012). The number of ACEs one has experienced is often calculated as an individual's ACE score, representing their cumulative exposure to childhood adversity. While the cumulative risk approach fails to recognize the differential effects of specific forms of adversity, it is helpful in identifying children in most need of interventions (McLaughlin & Sheridan, 2016). ACE scores shed important light on the profound impact early adversity has on subsequent mental health and are standardly deployed as measures of childhood adversity in research (Hamby et al., 2021; Hughes et al., 2017; Lacey & Minnis, 2020).

Mental health

Mental health is multidimensional, characterized by the lack of mental illness and presence of positive affect i.e., pleasurable experiences and positive moods such as joy and interest (Miller, 2011). The World Health Organization (2022) recognizes this dual-factor model of mental health, stating that mental health

enables individuals to cope with life stressors and function well in society. In the context of this study, mental health is more than the absence of mental illness and includes positive functioning and well-being; specifically, three constructs comprise mental health: externalizing problems, internalizing problems, and positive mental health.

Mental health difficulties often are conceptualized as externalizing or internalizing problems (Achenbach, 1978). Externalizing problems are negative behaviors acted out on an individual's environment (Campbell et al., 2000). In children and adolescents, these manifest as aggression, delinquency, or hyperactivity (Liu, 2004), and predict adult crime, violence, and substance use (Brook et al., 2011; Gornik et al., 2023; Miettunen et al., 2014). Internalizing problems reflect individuals' emotional and psychological states, including depressive symptoms, anxiety, and suicidal ideation (Liu et al., 2011). Internalizing problems are associated with negative consequences such as academic struggles, school dropout, suicide, and juvenile delinquency (Liu et al., 2011). Such externalizing and internalizing problems often co-occur within children (Bird et al., 1993; Caron & Rutter, 1991; Copeland et al., 2013; Willner et al., 2016).

Positive mental health consists of affective and psychological components. The affective component reflects an individual's subjective feelings of satisfaction with life and themselves, while the psychological element focuses on cognitive and emotional functioning (Clarke et al., 2011; Tennant et al., 2007). Put simply, positive mental health entails feeling good and functioning well and is often used interchangeably with mental well-being. In this study, "mental health" collectively refers to externalizing problems, internalizing problems, and positive mental health.

Mental health difficulties are common among adolescents in the UK. In 2022, 18% of children between the ages of 7–16 had a probable mental disorder (Newlove-Delgado et al., 2022). Adolescence is the peak age of onset for most mental health problems, suggesting interventions at or before this period are necessary to prevent mental health difficulties (Paus et al., 2008). The brain is most plastic during childhood and adolescence, further highlighting the importance of early interventions to mitigate risk factors and promote protective experiences (Lee et al., 2014; Romeo, 2013).

Adverse childhood experiences and mental health

ACEs are associated with an increased risk of mental health problems across the life course. On a social level, ACEs are associated with loneliness, social isolation, and feeling less close to others in adulthood (Hanlon et al., 2020; Hughes et al., 2016; Nurius et al., 2015). Notably, these social factors coincide with psychiatric risk. Childhood adversity is associated with an increased risk of depression and anxiety (Gomis-Pomares &Villanueva, 2022; Li et al., 2016; Yap et al., 2014), substance use disorders (Syer et al., 2021), and mental health diagnoses (McKay et al., 2022). Nearly 50% of mental health problems emerge before the age of 14 (Kessler et al., 2005), suggesting the risk associated with ACEs begins in childhood or adolescence. Indeed, childhood adversities are associated with an increased risk of mental health difficulties (Green et al., 2010).

Beyond predicting adult mental health difficulties, ACEs are associated with negative mental health in youth, ranging from psychiatric diagnoses to behavior problems (Scully et al., 2020). Specifically, childhood adversity is associated with greater externalizing and internalizing problems in adolescence (Balistreri & Alvira-Hammond, 2016; Healy et al., 2022; James et al., 2021; Schilling et al., 2007; Van Loon et al., 2015; Wan & Leung, 2010). Longitudinal studies demonstrate that childhood and adolescent mental health problems associated with ACEs arise in early childhood (Bevilacqua et al., 2021, Choi et al., 2019, Green et al., 2010; Stein et al., 2022). Research on the developmental timing of childhood adversity has yielded mixed results (Schaefer et al., 2022), but prospective studies have found that adversity before the age of 5 years is more strongly associated with risk of mental health problems (Duprey et al., 2017; Kaplow & Widom, 2007; Keiley et al., 2001). The brain undergoes rapid structural changes associated with higher cognitive function during the first years of life, leading to heightened sensitivity to stressors, which could explain the greater risk of psychopathology associated with adversity before the age of 5 (Nelson, 2000). Additionally, researchers have hypothesized that if early developmental disturbances are not resolved, there is increased risk of failure to achieve subsequent developmental milestones, which may ultimately lead to psychopathology (Aber et al., 1989; Cicchetti, 1989). While the relationship between early childhood adversity and mental health is clearly established, not all children who experience early adversity develop mental health difficulties, sparking exploration into protective factors.

Resilience and childhood adversity

Decades of developmental psychology research have consistently identified childhood experiences that independently promote positive mental health and counteract the risk of childhood adversity (Masten, 2001, 2007, 2014). The Resiliency Theory framework (Masten & Cicchetti, 2016) contextualizes how positive childhood experiences may be protective against childhood adversity. Resilience is the ability of children to successfully adapt to stressors that threaten positive development (Masten & Cicchetti, 2016). From a developmental systems perspective, children grow up in complex, interconnected, and interactive systems, ranging from proximal influences including families and schools, and more distal systems such as culture and governments. These overlapping contexts shape children's development and are foundational to one's mental health and resilience (Hyde et al., 2020).

The Compensatory and Protective Factors Models of Resiliency Theory classify factors associated with resilience. The Compensatory Model states that promotive factors have a direct and independent effect on the outcome of interest, in the opposite direction of risk factors (Zimmerman et al., 2013). Furthermore, these promotive factors may mitigate the negative effects of risk factors. Additionally, the Protective Factors Model of Resiliency postulates that positive experiences moderate the relationship between risk factors and the outcome (Zimmerman et al., 2013). In the context of ACEs, protective factors are those that weaken the relationship between ACEs and mental health difficulties.

Protective factors may function by disrupting negative developmental cascades. The developmental cascade framework suggests that events and characteristics of early development can "snowball" or cause cumulative consequences in greater magnitude or different domains later in development (Masten & Cicchetti, 2010). Due to varying contexts among individuals, generalizing protective effects is a difficult task; however, emotional security and strong relationships consistently facilitate adaptation among at-risk individuals, highlighting the role of social support in resilience (Bethell et al., 2019; Brinker & Cheruvu, 2016; Rutter, 1987; Schofield et al., 2013; van Harmelen et al, 2016).

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Positive parent-child relationships have been found to buffer the risk of internalizing and externalizing problems associated with adverse life events in the MCS dataset (Flouri et al., 2015), which raises the question if support outside the home could lead to similar protective effects.

The neurocognitive social transactional model is an example of a negative developmental cascade in which school connectedness could function as a protective factor (McCrory et al., 2022). The model posits that childhood adversity causes neurobiological changes including altered threat processing, atypical processing of social reward, and difficulties with autobiographical memory (McCrory et al., 2022; Teicher et al., 2016). These altered behaviors can lead to "social thinning," the decrease in quality and number of supportive relationships, and stress generation, an increased likelihood to experience stressors (McCrory et al., 2022). This lack of social support and increased stress can cause and exacerbate mental health problems that are associated with childhood adversity. Empirical evidence supports this theory, as individuals with a history of ACEs typically have impoverished social networks with fewer friends of the same age and classmates (Negriff et al., 2015; Nevard et al., 2021; Salzinger et al., 1993) and are more likely to experience stressful life events (Gerin et al., 2019; Harkness et al., 2008; Uhrlass & Gibb, 2007). In turn, low levels of social support have been found to predict mental health difficulties (Brugha et al., 2005; Matthews et al., 2019; McLafferty et al., 2018; Nevard et al., 2021), and chronic stress is a well-regarded risk factor for mental health (Grant et al., 2004; Turner & Lloyd, 2004). Studies have also identified that childhood adversity affects subsequent mental health problems through its intermediary influence on social support (Hyman et al., 2003; Lagdon et al., 2021; McLafferty et al., 2018; Owen et al., 2008; Powers et al., 2009; Salazar et al., 2011; Sheikh et al., 2016; Sperry & Widom, 2013; Stevens et al., 2013; Vranceanu et al., 2007). Resilience interventions often target promotive and protective processes to disrupt negative developmental cascades (Cicchetti & Hinshaw, 2002; Masten & Cicchetti, 2016), and under the neurocognitive social transactional model, increased social support and stress-buffering systems could counteract social thinning and stress generation and explain how strong relationships mitigate the negative mental health effects associated with childhood adversity.

Schools are a prime setting for interventions aimed to protect against childhood adversity. Often distal influences affect children more directly through proximal systems (Bronfenbrenner, 1977), drawing attention to how systems youth interact with frequently can change for their benefit. Outside of the family, schools are the most organized system in which children spend most of their time and are home to successful interventions aimed at nurturing childhood resilience (Eccles and Roeser, 2012; Masten, 2014). Furthermore, individuals begin to rely more on their peers relative to family as they enter adolescence, suggesting the school setting may be particularly useful in bolstering adolescents' social support and relationships (Goodenow, 1993; Nelson et al., 2016). Due to the strong ecological force of education systems in adolescence and the potential role of social support via classmates and teachers, school connectedness – feelings of belonging and social support at school – is a potentially promotive and protective factor against childhood adversity (Libbey, 2007; McNeely et al., 2002).

School connectedness

School connectedness benefits adolescent mental health and may mitigate the consequences of childhood adversity. The construct captures how positively students think, feel, and engage with the school environment and those within it (Hodges et al., 2018; Libbey, 2004). This definition spans three domains: (1) cognition: the perception of support and peer and teacher relationships (2) affect: ranging from acceptance and respect to valuing and enjoying school, and (3) behavior: active engagement in school, both academically and socially. School connectedness is of particular interest to interventionists due to its modifiable nature and ability to promote mental well-being.

School connectedness is a malleable factor that schools can cultivate. McNeely et al. (2002) found that positive classroom climates, extracurricular participation, tolerant disciplinary procedures, and small school size promote school connectedness. Whole school approaches designed to increase students' feelings of school connectedness are also effective (Chapman et al., 2013), in addition to students feeling like their school counselor effectively responds to their problems (Martin & Sorensen, 2020), the integration of relevant content into classrooms (Kim & Cappella, 2016), and classroom management strategies that cultivate autonomy, care, and connection (Acosta et al., 2019; Kiefer & Pennington, 2016). The modifiable nature of school connectedness suggests it may be an opportunity to improve young people's mental health.

School connectedness as a promotive and protective factor

Given school connectedness's relation to social support and stress-buffering capacity, it is a potentially protective factor against childhood adversity (Libbey, 2007; McNeely et al., 2002). In fact, school connectedness may promote mental health and well-being and mitigates the risk associated with childhood adversity.

School connectedness is a promotive factor for externalizing behaviors and has been found to be protective against childhood adversity. Studies have identified school connectedness as a strong predictor for externalizing behaviors, including substance use, violence, and risky behavior (Blum et al., 2002; Goetschius et al., 2021; Hardaway et al., 2012; Resnick et al., 1993, 1997). Furthermore, school connectedness has found to be protective against the ACEs of negative family relations, peer victimization, violence exposure, and social deprivation (Goetschius et al., 2021; Hardaway et al., 2012; Loukas et al., 2010; Loukas & Pasch, 2013). The promotive and protective effects of school connectedness also extend to internalizing problems.

School connectedness is associated with fewer depressive and anxiety symptoms in adolescents, even among individuals who have experienced childhood adversity (Huang & Baxter, 2021; Lester et al., 2013; Markowitz, 2017; Raniti et al., 2022; Schwerdtfeger et al., 2015). Feeling connected to school has also been found to be protective against childhood adversity and cyberbullying when predicting suicidal ideation and attempts (Kim et al., 2020; Lensch et al., 2021). Adding to this, some researchers have reported that school connectedness mediates the relationship between stressful life events and depression in adolescence (Huang & Baxter, 2021). Despite this, the moderator role of school connectedness in the potential direct associations between ACEs and mental health difficulties have remained questionable as findings from previous studies are not consistent (e.g., Schwerdtfeger et al., 2015; Shochet et al., 2006). While researchers have replicated the promotional effects of school, the protective effects of school connectedness for internalizing symptoms are less clear, meaning it is unknown whether or not school connectedness weakens the direct relationship between childhood adversity and adolescent mental health difficulties.

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Fewer studies have examined promotional and protective effects of school connectedness on positive mental health. School connectedness is positively correlated with emotional well-being among secondary school students, a promotional effect (Arif et al., 2019; Frydenberg et al., 2009). Goetschius et al. (2021) found that school connectedness at age nine significantly moderates the relationship between childhood social deprivation and positive functioning at age 15, demonstrating the potential protective benefits of school connectedness. However, they did not find the same protective effect in the interaction between violence exposure and school connectedness, suggesting school connectedness may interact differently with specific forms of adversity.

The present study

The present study aims to strengthen previous research through exploring how school connectedness at ages 11 and 14 moderates the relationship between childhood adversity before age five and adolescent mental health outcomes (externalizing and internalizing problems at ages 14 and 17 and positive mental health at age 17). Modeling these variables simultaneously via structural equation modeling provides a more detailed picture of the relationships between predictors, moderators, and outcomes. This study will extend the work by Goetschius et al. (2021) by examining mental health outcomes at age 17, allowing the investigation of more distal effects of school connectedness.

We were interested in addressing several research questions. First, what is the relationship between childhood adversity before age five and mental health outcomes at ages 14 and 17? (Research Question 1). We expected childhood adversity to predict higher levels of externalizing and internalizing problems and lower levels of positive mental health. Second, what is the relationship between school connectedness and mental health outcomes at ages 14 and 17? (Research Question 2a) and how does the timing of school connectedness (age 11 vs. age 14) affect this relationship? (Research Question 2b). We expected school connectedness to predict lower levels of externalizing and internalizing problems and higher levels of positive mental health. Additionally, we expected that age 14 school connectedness will exhibit greater promotive effects on mental health outcomes relative to age 11 school connectedness due to closer proximity to the measured outcomes. Finally, does school connectedness serve as a protective factor between early life adversity and mental health outcomes at ages 14 and 17 (Research Question 3a) and how does the timing of school connectedness (age 11 vs age 14) affect this relationship? (Research Question 3b). We made no predictions for these questions given the inconsistency in the literature (RQ 3 & RQ 3a).

Method

Sample

The study was a secondary analysis of existing data from the Millennium Cohort Study (MCS). The MCS is a longitudinal cohort study that has followed approximately 19,000 individuals born in the United Kingdom (UK) between 2000 and 2002 (Connelly & Platt, 2014). MCS families were first interviewed when the cohort member was nine months old, with follow-up data collection at ages three, five, seven, 11, 14, and 17 years. The MCS intentionally oversampled families living in poverty and ethnic minorities through stratified cluster sampling (Plewis et al., 2007). The data includes information about participants' physical and mental health, relationships and family, school, and demographic backgrounds. Data collection methods include cognitive assessments, physical measurements, parent and cohort member interviews, and questionnaires. The National Health Service Research Ethics Committee system approved all waves of data collection for the MCS (Shepherd & Gilbert, 2019). Ethical approval for secondary analysis of the data was sought from the Department of Education Ethics Committee at the University of York.

Analyses for the present study used data from the age three, five, seven, 11, 14, and 17 data sweeps. Only the oldest children in each family were included in the analysis, and each data sweep was merged to produce a maximum sample of 17,343 individuals. The main predictor variable (childhood adversity) was assessed at ages three and five, moderators (school connectedness) at ages 11 and 14, and mental health outcomes at ages 14 and 17. Data at ages three and five were collected via interviews with cohort members' parents. The main interview was most often completed by the mother, and the partner interview was completed by the father. The young people completed questionnaires regarding school at the ages of 11 and 14. The self-complete questionnaire at age 11 was only administered to young people in England and Wales, restricting the age 11 sample to young people living in these countries. A majority of cohort members in the age 11 data sweep were in primary school at the time of the survey (96%), while the remaining cohort members were already in secondary school. Mental health data at age 14 were collected by parent report, and at age 17, cohort members completed mental health questionnaires.

Individuals were excluded from the analyses if all outcome data at the age of 17 were missing ($n = 7{,}347$) or if each of the variables from the data sweeps at ages three, five, 11, and 14 were missing ($n = 69$), resulting in a final sample size of 9,964 young people.

Measures

Adverse childhood experiences (ACEs)

Based on the original ACEs study by Felitti et al. (1998), seven ACEs were included in ACE scores for individuals: parental divorce, parental mental illness, parental alcohol consumption, domestic violence, parental drug use, physical punishment, and verbal maltreatment. These experiences are commonly used in other studies, facilitating comparison (Houtepen et al., 2020; Hughes et al., 2017; Straatmann et al., 2020; Walsh et al., 2019). Each ACE was assessed for both parents at ages three and five and was dichotomized (1 or 0) so that 1 refers to a positive case at either age or for either parent (see Table 1, Appendix). We utilized both parents reports of ACEs to comprehensively capture exposure to adversity. Scoring procedures for each ACE were adopted from a previous study of adverse childhood experiences using the MCS data (Straatmann et al., 2020). Data were classified as missing if there was no information from both parents at both time points. ACE scores were calculated for individuals by summing the occurrence of each ACE, ranging from 0 to 7. The percentage of participants exposed to greater than 3 ACEs was low (e.g., approximately 3%). Similar to prior studies (Demkowicz et al., 2021; Deniz et al., 2023; Panayiotou & Humphrey, 2018), the low frequency high exposure ACE scores of 4 and greater were collapsed to a category of 3 or more ACEs which has a proportionally higher power of representation. Therefore, ACE scores were grouped into categories of 0 ACEs, 1 ACE, 2 ACEs, and 3 or more ACEs and were treated as count variables in the main effects and moderation models.

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School connectedness

School connectedness was measured at ages 11 and 14 based on self-report questions related to school. We selected items previously used to measure school connectedness and satisfaction from the MCS dataset (Arciuli & Emerson, 2020; Patalay & Fitzsimons, 2018). These questions also overlap with validated school connectedness measures such as the Student Engagement in Schools Questionnaire (Hart et al., 2011) and the school connectedness subscale of the School Climate Survey (Zullig et al., 2010; 2014). At both ages, students were asked the following questions related to school engagement: (1) How often do you try your best at school?, (2) How often do you find school interesting?, (3) How often do you feel unhappy at school?, (4) How often do you get tired at school?, and (5) How often do you feel school is a waste of time? Individuals responded to these questions on a 4-point scale ranging from 1 ("all of the time") to 4 ("never").

Cohort members answered how happy they were with their school at 11 and 14 (1 = "completely happy" to 7 = "not at all happy," rescaled to 1 to 4 for consistency with remaining items). They were also asked about their friendships at school. At ages 11 and 14, they answered how many of their friends go to the same school as them (1 = "all of them" to 4 = "none of them"). All items were scored so that higher scores indicate positive associations with school.

Positive mental health

The Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS; Tennant et al., 2007) was used to measure positive mental health at age 17. The WEMWBS has shown good content validity, test-retest reliability, and high correlations with other well-being scales (Tennant et al., 2007). Adolescents completed the short 7-item scale and rated how often they felt certain experiences over the past two weeks (felt optimistic about the future, felt useful, felt relaxed, dealt with problems well, been thinking clearly, felt close to other people, and been able to make up their mind about things), ranging from 1 ("none of the time") to 5 ("all of the time"). The items were summed to create a composite score, ranging from 7 to 35. The raw score was then transformed into a metric score using the short WEMWBS conversion table (Table 2 in the Appendix; Stewart-Brown et al., 2009).

Internalizing symptoms

Adolescent (age 14 and 17) internalizing symptoms were measured using the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997; Goodman et al., 1998). The SDQ has good internal consistency (Goodman, 2001; Yao et al., 2009), moderate test-retest reliability (Yao et al., 2009), concurrent validity (Muris et al., 2003), and discriminant validity (Lundh et al., 2008).

At age 14, parents completed the SDQ regarding their children's behaviors, and at age 17, young people self-completed the questionnaires. The questions are the same for the parent-report and self-report SDQ. Self-report SDQ data was not recorded at age 14, and Booth et al. (2023) identified that parents reported lower levels of emotion symptoms, peer problems, and conduct problems than adolescents themselves on the SDQ within the MCS dataset. Parents or young people rated statements regarding adolescents' feelings and behaviors in the past six months on a scale ranging from 1 ("not true") to 3 ("certainly true"). Responses were recoded to a scale of 0–2 to align with standard SDQ scoring procedures. The internalizing score is composed of two subscales: emotional problems (i.e. "worries a lot") and peer problems (i.e. "generally plays alone"). The total internalizing score ranges from 0 to 20, with higher scores indicating greater severity of internalizing problems.

Externalizing symptoms

Adolescent (age 14–17) externalizing symptoms were also measured using the SDQ (Goodman, 1997; Goodman et al., 1998). Parents or young people rated statements regarding adolescents' feelings and behaviors in the past six months ranging from 1 ("not true") to 3 ("certainly true"). Responses were recoded to a scale ranging from 0 to 2 to follow standard SDQ scoring procedures. The externalizing score is the sum of five items from the conduct subscale (i.e. "often lies or cheats") and five items from the hyperactivity scale (i.e. "constantly fidgeting or squirming"). The total externalizing score ranges from 0 to 20, with higher scores indicating greater severity of externalizing problems.

Covariates

Sex, ethnicity, and poverty were covariates in the analyses. These variables have previously been demonstrated to have significant associations with adolescent mental health outcomes (Ahmad et al., 2022; Lai et al., 2019; Yoon et al., 2023). Sex was dummy-coded so that 1 indicated male and 0 indicated female. Racial and ethnic minority was dummy-coded so that 1 indicated a racial or ethnic minority (mixed ethnicity, Indian, Pakistani and Bangladeshi, Black or Black British, and other ethnic groups), and 0 indicated white. Poverty was measured at ages three and five using equivalised income data. Families earning less than the 60% median income at either age were coded as a positive case of poverty (1), while families earning more were coded as 0.

Statistical analysis

Statistical analyses for the present study were structural equation models (SEMs), which allows the analysis of complex behavioral relationships through measurement models and structural models (Hair et al., 1998). SEM is advantageous to multiple regression due to its ability to analyze all variables in the model simultaneously and reduce measurement error (Nusair & Hua, 2010; Ullman & Bentler, 2012).

Data was cleaned and analyzed using R version 4.2.1. Confirmatory factor analysis (CFA) and main effects models were performed using the lavaan package in R (v0.6-13; Rosseel, 2012). The semTools package (v0.5-6; Jorgensen et al., 2022) was used for simple slopes analysis and the latent interaction model according to the product indicator and residual centering method (Little et al., 2006; Schoemann and Jorgensen, 2021).

The robust variant of Maximum Likelihood (MLR) estimation was used to perform CFA, the main effects model, and the moderation model. Rhemtulla et al. (2012) found that MLR estimation yields useful test statistics to judge model fit and unbiased estimates of factor correlations when analyzing categorical variables. The non-normal distribution of product indicators used in the moderation model also calls for the use of the MLR estimator (Schoemann & Jorgensen, 2021).

Missingness was evaluated to determine if missing data were missing at random (MAR) or missing completely at random. The missingness pattern determined what techniques were appropriate to handle missing data (Rubin, 2004). A binary missingness variable was created so that 1 indicates that there was at least one missing focal variable (those measuring mental health at ages 14 and 17) and 0 indicating an observation with no missing data in the focal variables. A binomial regression was then run to test whether

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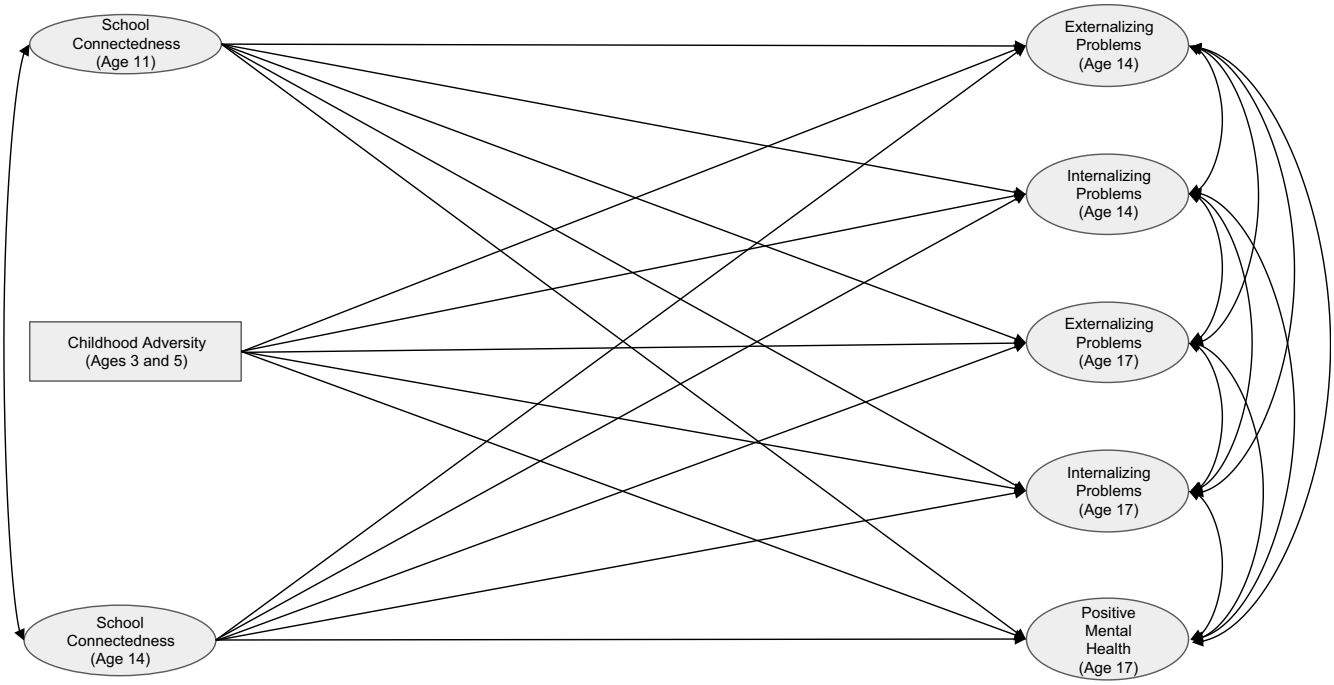

Figure 1. Conceptual diagram of the main effects model. Childhood adversity at ages three and five, school connectedness at age 11, and school connectedness at age 14 were used as predictor variables for the outcomes of externalizing and internalizing problems at ages 14 and 17 and positive mental health at the age of 17. Racial and ethnic minority status, poverty, and sex were included as covariates but are not depicted in the figure for readability.

other variables (childhood adversity, poverty, and racial/ethnic minority status) predicted missingness. Significant associations between these predictor variables and missingness would indicate that the missing data were associated with observed variables and missing at random (MAR). If the data were MAR, missing data would be estimated using full information maximum likelihood (FIML) estimation (Kline, 2016). FIML estimation is appropriate for data MAR and produces unbiased parameter estimates and standard errors when used for missing data estimation in SEM (Enders & Bandalos, 2001; Lee & Shi, 2021). Correlated error terms that improved model fit and were theoretically reasonable were included in the models (see Figures 1 & 2, Appendix).

The indices used to assess model fit for CFA and main effects models were robust *RMSEA*, robust *CFI*, robust *TLI*, and *SRMR* (Hu & Bentler, 1999). The standardized X^2 statistics were reported but are not used to judge model fit as the value is likely inflated due to the large sample size, resulting in the p-value not being an adequate measure of model fitness (Schermelleh-Engel et al., 2003). The following cutoffs were used to judge strong model fit: $RMSEA < 0.05$, $CFI > 0.9$, $TLI > 0.9$, and $SRMR < 0.8$ (Awang, 2012; Forza & Filippini, 1998; Hair et al., 2010; Hu & Bentler, 1999). These model fit indices were not used for the moderation model because they do not account for the dependence among observed variables from the product-indicator method and provide incorrect estimates of model fit (Schoemann & Jorgensen, 2021). Instead, model fit for the moderation models was assessed by utilizing the fit indices of the main effects models as a lower bound for the fit of its corresponding latent interaction model (Schoemann & Jorgensen, 2021).

Measurement models

Latent variables were created to measure school connectedness at age 11 and 14, externalizing and internalizing problems at age 14 and 17, and positive mental health at age 17. The latent variables included in the analysis were tested in one measurement model using CFA. Items were excluded from the latent variable factor structure if they had standardized loadings less than 0.4 (Kline, 2016), indicating the item was not accurately measuring the construct. All reported factor loadings are standardized.

Main effects models

A main effects model was fit to examine the association between childhood adversity before the age of five and school connectedness at the ages of 11 and 14 as predictor variables and internalizing and externalizing problems at ages 14 and 17 and positive mental health at age 17 years as outcomes (Figure 1). All path estimates are standard YX loadings, meaning a 1 standard deviation change in the predictor results in some standard deviation change in Y. This model was designed to test if the predictor variables of childhood adversity and school connectedness at ages 11 and 14 years were significantly associated with the mental health outcomes measured at ages 14 and 17 years (RQs 1, 2a and 2b). The size and significance of coefficients representing the relationship between the predictor and dependent variables were used to evaluate support of the hypotheses.

Moderation models

A latent interaction model was run to test whether school connectedness at ages 11 and 14 influenced the relationships between childhood adversity before the age of five and externalizing and internalizing problems (ages 14–17) and positive mental health (age 17). The moderation model was created using residual centering, a method that produces stable and interpretable model estimates by deriving the latent variable interaction from the observed covariation pattern among all indicators of the interaction, or product-indicators (Little et al., 2006). Both

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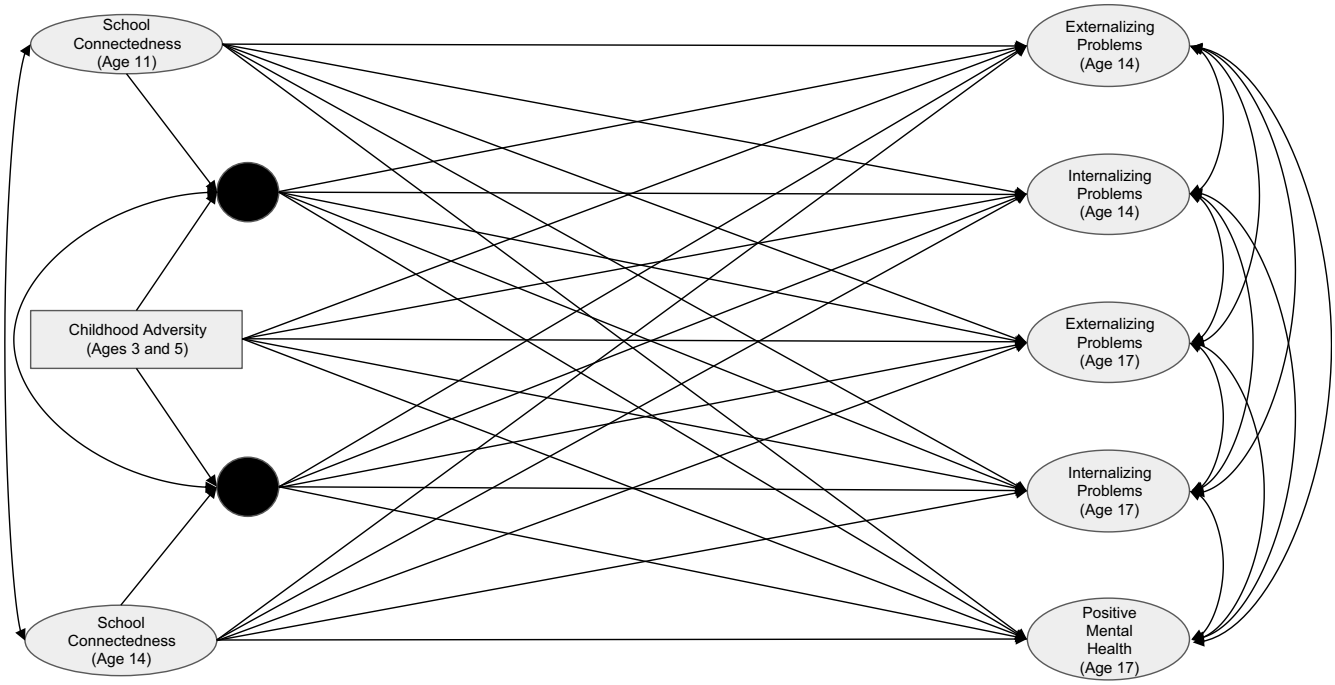

Figure 2. Conceptual diagram of the moderation model. School connectedness at age 11 and age 14 were examined as moderators to the relationship between childhood adversity and internalizing and externalizing problems at ages 14 and 17 and positive mental health at age 17. Black circles represent the interaction between school connectedness and childhood adversity. Racial and ethnic minority status, poverty, and sex were included as covariates but are not depicted in the figure for readability.

moderators (school connectedness at age 11 and 14) were included in the model to account for interrelationships among the moderators and childhood adversity (Figure 2). All path estimates are standard YX loadings. The size and significance of coefficients representing the relationship between the interaction terms and dependent variables were used to evaluate whether school connectedness was a significant moderator (RQs 3a and 3b). If a significant moderation effect was found, it was probed using simple slopes analysis.

Simple slopes analysis

Significant interactions were investigated further and plotted using simple slopes analysis. The independent and dependent variables were plotted at values of the moderator (mean, one standard deviation [SD] above the mean, and one SD below the mean) to see how the moderator influences the slope. Simple slopes analysis facilitated an interpretation of the interaction between the predictor and moderating variables. If school connectedness was a protective factor, the slope between childhood adversity and mental health problems would decrease as school connectedness increased.

Results

Demographic information

After applying the exclusion criteria, 9,964 cohort members were included in the analysis (Table 1). Most cohort members experienced at least one ACE, with 35% experiencing two or more ACEs by the age of 5. The sample was nearly half male, majority white, and 38% of cohort members experienced childhood poverty. Bivariate correlations between study variables are shown in Table 2. Binomial regression testing the missingness variable found significant associations with predictor variables, indicating that the data were MAR. Therefore, missing data were handled using FIML.

Measurement model

The measurement model for the latent variables showed strong model fit (*RMSEA* = .038, *RMSEA* 90% CI [.036, .039], *CFI* = .948, *TLI* = .934, *SRMR* = .036, $X^2(276) = 3422.706$). The strong model fit indicates that the latent variables' constituent items accurately measured their respective constructs. However, for school connectedness at ages 11 and 14, the items asking about cohort members' close friends attending the same school did not load well with the rest of the items (YX loadings < .4), indicating it was not related to the rest of the school connectedness items. These items were therefore removed from the model. The latent variables, indicators, and respective YX loadings of the final measurement model are summarized in Table 3.

Main effects model

The main effects model testing childhood adversity and school connectedness at ages 11 and 14 as predictors of adolescent mental health outcomes showed strong model fit (Figure 3). All effect sizes, standard errors, and significance test results for the main effects model are shown in Table 4.

Childhood adversity was associated with increased mental health risks throughout adolescence. Specifically, childhood adversity predicted both greater externalizing and internalizing problems at age 14 and greater externalizing problems and poorer positive mental health at age 17. Childhood adversity was not associated with internalizing problems at age 17 years.

School connectedness at ages 11 and 14 were promotive factors, significantly associated with all mental health outcomes. Age 11

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Table 1. Demographic information of cohort members

Variable	$N = 9{,}964^1$
ACE score count	
0	2,027 (25%)
1	3,243 (40%)
2	1,972 (24%)
≥3	890 (11%)
Unknown	1,832
Sex	
Female	5,088 (51%)
Male	4,876 (49%)
Poverty status	
>60% median income	6,122 (62%)
Poverty (<60% median income)	3,676 (38%)
Unknown	166
Race/ethnicity	
White	7,976 (81%)
Racial/ethnic minority	1,842 (19%)
Unknown	146
Age 11 school connectedness	22.8 (3.4)
Age 14 school connectedness	20.8 (3.4)
Age 14 externalizing problems	4.1 (3.4)
Age 14 internalizing problems	3.7 (3.4)
Age 17 externalizing problems	5.6 (3.3)
Age 17 internalizing problems	5.6 (3.5)
Age 17 positive mental health	24.6 (4.8)

[1]*n* (%); mean (SD).

school connectedness predicted fewer externalizing and internalizing problems at ages 14 and 17 and greater levels of positive mental health at age 17. Similarly, age 14 school connectedness was associated with benefits for all mental health outcomes but appeared to exhibit greater effect size estimates than age 11 school connectedness. These greater effect sizes suggest school connectedness at age 14 may be more strongly associated with mental health at ages 14 and 17.

The covariates of sex, childhood poverty, and racial/ethnic minority status showed significant relationships with the measured outcomes. Males were more likely to experience externalizing problems and have higher levels of positive mental health, while females were more likely to experience internalizing problems. Childhood poverty predicted greater externalizing and internalizing problems at age 14 and 17 but did not predict positive mental health at age 17. At age 14, racial and ethnic minorities were more likely to experience externalizing and internalizing problems. However, at age 17, racial and ethnic minority status predicted fewer externalizing and internalizing problems and did not predict positive mental health.

Moderation model

The moderation model showed strong model fit based on the fit indices of the main effects model (Figure 4). Although not used to assess model fit, the fit indices for the moderation model are reported in Table 4 along with the effect sizes and standard errors for each of the predictor variables.

Age 14 school connectedness was not a protective factor against childhood adversity. In the moderation model, there were no significant interactions between age 14 school connectedness and childhood adversity for any mental health outcomes, indicating that school connectedness at this age did not influence the relationship between ACEs and mental health outcomes. School connectedness at age 11 significantly influenced the relationship between childhood adversity and externalizing and internalizing problems at age 14. The interaction between age 11 school connectedness and childhood adversity was significant for the outcome of externalizing problems at age 14 ($\beta = -.082$, $SE = .025$, $p = .001$), which indicates school connectedness moderated the relationship between childhood adversity and externalizing problems.

The simple slopes analysis revealed that age 11 school connectedness was a protective factor against childhood adversity for externalizing problems at age 14 (Figure 5). At each level of age 11 school connectedness tested (−1 SD, mean, +1 SD), the relationship between childhood adversity and externalizing

Table 2. Zero order correlations of variables of interest

Variable	1	2	3	4	5	6	7	8	9	10
1. ACE score										
2. Age 11 school connectedness	−.12***									
3. Age 14 school connectedness	−.09***	.33***								
4. Age 14 externalizing problems	.16***	−.23***	−.25***							
5. Age 14 internalizing problems	.10***	−.16***	−.21***	.47***						
6. Age 17 externalizing problems	.09***	−.24***	−.35***	.36***	.15***					
7. Age 17 internalizing problems	.04***	−.13***	−.28***	.13***	.34***	.36***				
8. Age 17 positive mental health	−.05***	−.13***	.29***	−.13***	−.20***	−.40***	−.57***			
9. Sex	.07***	−.18***	.06***	.14***	−.06***	.07***	−.25***	.17***		
10. Minority status	−.12***	.07***	.07***	.05***	.06***	−.05***	−.08***	.03**	0	
11. Poverty	0	−.05***	−.07***	.19***	.20***	.05***	.07***	−.04***	−.02	.28***

Note. *$p < .05$. **$p < .01$. ***$p < .001$.

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Table 3. Factor loadings of the measurement model

Latent Variable	Item	Standard YX Loading
School connectedness (Age 11)	How often do you try your best at school?	.468
	How often do you find school interesting?	.661
	How often do you feel unhappy at school?	.451
	How often do you get tired at school?	.556
	How often do you feel school is a waste of time?	.710
	How do you feel about the school you go to?	.480
School connectedness (Age 14)	How often do you try your best at school?	.465
	How often do you find school interesting?	.586
	How often do you feel school is a waste of time?	.647
	How do you feel about the school you go to?	.572
	How often do you feel unhappy at school?	.524
	How often do you get tired at school?	.563
Externalizing problems (Age 14)	Conduct problems	.706
	Hyperactivity	.751
Internalizing problems (Age 14)	Emotional problems	.753
	Peer problems	.637
Externalizing problems (Age 17)	Conduct problems	.619
	Hyperactivity	.735
Internalizing problems (Age 17)	Emotional problems	.768
	Peer problems	.493
Positive mental health (Age 17)	I've been feeling optimistic about the future	.477
	I've been feeling useful	.616
	I've been feeling relaxed	.663
	I've been dealing with problems well	.785
	I've been thinking clearly	.796
	I've been feeling close to other people	.525
	I've been able to make up my own mind about things	.577

problems was positive. However, the slope of the line was less steep when age 11 school connectedness was high (+1 SD; $\beta = .102$, $SE = .037$, $p = .005$) compared to when age 11 school connectedness was at its mean ($\beta = .184$, $SE = .022$, $p < .001$) or −1 SD ($\beta = .266$, $SE = .033$, $p < .001$). Greater levels of school connectedness at age 11 were associated with a weakened relationship between childhood adversity and externalizing problems at age 14. In other words, children with high ACE scores were less likely to exhibit externalizing problems when they felt strongly connected to school, suggesting that age 11 school connectedness is a protective factor.

A similar protective effect was exhibited between school connectedness at age 11 and internalizing problems at age 14. The interaction between age 11 school connectedness and childhood adversity was significant ($\beta = -.049$, $SE = .024$, $p = .039$), indicating school connectedness significantly influenced the relationship between childhood adversity and internalizing problems at age 14. The relationship between childhood adversity and internalizing problems was positive at each level of age 11 school connectedness tested (−1 SD, mean, +1 SD). However, the slope of the line decreased at higher levels school connectedness, demonstrating how school connectedness weakened the relationship between childhood adversity and age 14 internalizing problems (+1 SD: $\beta = .065$, $SE = .036$, $p = .068$; mean: $\beta = .114$, $SE = .022$, $p < .001$; −1 SD: $\beta = .162$, $SE = .032$, $p < 0.001$). In fact, the slope of the line was not significantly different from 0 when school connectedness was 1 standard deviation greater than the mean, meaning high levels of school connectedness could neutralize the risk of developing internalizing problems associated with childhood adversity.

There was no significant interaction between age 11 school connectedness and childhood adversity for positive mental health, meaning school connectedness was not a protective factor for this outcome.

Discussion

Summary of key findings

In the current study, we examined the relationships between childhood adversity, school connectedness, and adolescent mental health outcomes. The key findings are that (a) childhood adversity was associated with increased risk for mental health problems at ages 14 and 17 years, (b) school connectedness is associated with better mental health outcomes across adolescence, (c) age 14 school connectedness appeared to have a stronger relationship with adolescent mental health outcomes compared to age 11 school connectedness, and (d) age 11 school connectedness was a protective factor against childhood adversity for age 14 externalizing and internalizing problems. These findings replicate previous studies that have identified childhood adversity and school connectedness as risk and promotive factors, respectively, for adolescent mental health (Arif et al., 2019; Bevilacqua et al., 2021; Blum et al., 2002; Choi et al., 2019; Frydenberg et al., 2009; Goetschius et al., 2021; Hardaway et al., 2012; Healy et al., 2022; Huang & Baxter, 2021; James et al., 2021; Kim, 2013; Lensch et al., 2021; Loukas et al., 2010; Loukas & Pasch, 2013; Markowitz, 2017; Raniti et al., 2022; Resnick et al., 1993, 1997; Schwerdtfeger et al., 2015). The study makes a unique contribution to the literature as we find that age 11 school connectedness, but not age 14 school connectedness, moderates the relationship between childhood adversity and adolescent mental health, demonstrating a potential time-sensitivity to the protective nature of school connectedness. The subsequent sections discuss and compare these findings with previous literature.

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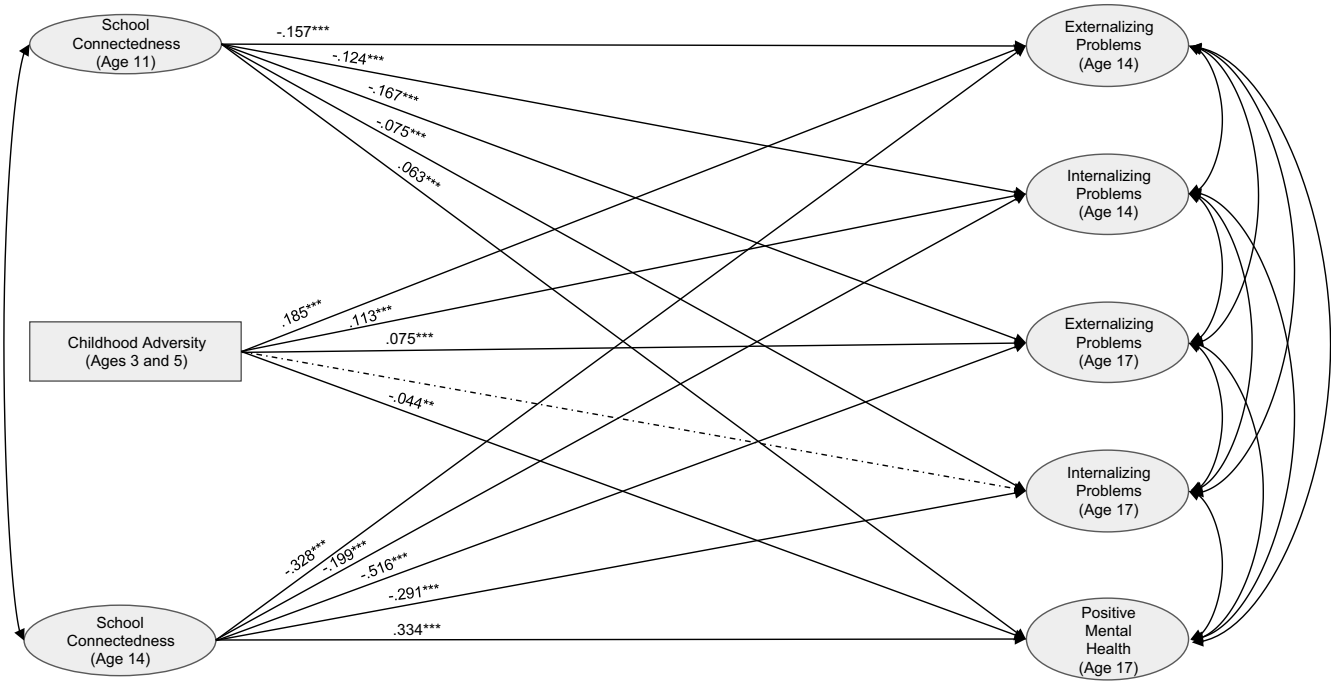

Figure 3. Path diagram of main effects model. The path diagram shows associations between predictors of childhood adversity and school connectedness at ages 11 and 14 and adolescent mental health outcomes (externalizing problems, internalizing problems, and positive mental health). Racial and ethnic minority status, poverty, and sex were included as covariates but are not depicted in the figure for readability. Correlated error terms among the indicators of latent variables were also not depicted for readability but can be found in the appendix. *solid lines indicate significance at $p < .05$. Dashed lines represent non-significant relationships at $p > .05$. Coefficients of significant relationships are listed with the following significance levels: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Childhood adversity and adolescent mental health

Childhood adversity predicted greater externalizing problems at ages 14 and 17 and greater internalizing problems at age 14, in line with the hypotheses. These results are consistent with literature that have identified childhood adversity as a risk factor for adolescent mental health problems (Bevilacqua et al., 2021; Choi et al., 2019; Healy et al., 2022; James et al., 2021). Childhood adversity also predicted worse positive mental health at 17. Consistent with the present findings, Goetschius et al. (2021) found that childhood violence and social deprivation each predicted lower positive functioning at age 15. This study is the only one of which we are aware that examines positive mental health as an outcome related to early life adversity. Our study extends these results by demonstrating the distal effects of ACEs through a significant negative association with positive functioning at age 17.

Contrary to the hypothesis, childhood adversity did not predict greater internalizing problems at age 17. Anderson et al. (2022) also found higher ACE exposure was not related to adolescent internalizing symptoms, although the participants were 10–15 years old rather than 17. These findings could be explained by the exclusion of sexual abuse and neglect in our measure of childhood adversity, as they are strong predictors of internalizing problems (Giano et al., 2021; Goetschius et al., 2021). Conversely, it is possible that the risk of internalizing problems associated with ACEs decreases over time. Studies have identified that childhood adversities are stronger predictors of internalizing problems at earlier ages of adolescence relative to subsequent years (Gilman et al., 2003; Jaffee et al., 2002; Nweze et al., 2023; Oldehinkel & Ormel, 2015). This pattern of decreased risk of internalizing symptoms in late adolescence from childhood adversity could explain these findings. Lastly, internalizing problems were measured using the parent-report SDQ at age 14 and self-report SDQ at age 17. Adolescents from the MCS dataset have been found to report more mental health difficulties than their parents on the SDQ (Booth et al., 2023), indicating that it is likely the different informant structures measured different aspects of cohort members' internalizing behaviors, which could explain these findings.

School connectedness as a promotive factor

School connectedness is a promotive factor of adolescent mental health. Both age 11 and age 14 school connectedness predicted all mental health outcomes with the expected directionality: a negative relationship with externalizing and internalizing problems at ages 14 and 17 and a positive relationship with positive mental health at age 17. These results replicate prior findings that show school connectedness benefits adolescent externalizing problems (Blum et al., 2002; Goetschius et al., 2021; Hardaway et al., 2012; Loukas et al., 2010; Loukas & Pasch, 2013; Resnick et al., 1993, 1997), internalizing problems (Huang & Baxter, 2021; Kim, 2013; Lensch et al., 2021, Markowitz, 2017, Raniti et al., 2022; Schwerdtfeger et al., 2015), and positive mental health (Arif et al., 2019; Frydenberg et al., 2009; Goetschius et al., 2021). Overall, these findings suggest that school connectedness promotes adolescent mental health without respect to risk status.

The present study demonstrates the potential long-term benefits of school connectedness while controlling for the effects of developmental timing. Age 14 school connectedness appeared to have stronger associations with all mental health outcomes

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Table 4. Results of main effects and moderation structural equation models

	Age 14 Externalizing		Age 14 Internalizing		Age 17 Externalizing		Age 17 Internalizing		Age 17 Positive MH	
Predictor Variables	β (*SE*)	95% CI	β (SE)	95% CI	β (*SE*)	95% CI	β (*SE*)	95% CI	β (*SE*)	95% CI
Main effects model										
ACE score	.185*** (.018)	[.150, .219]	.113*** (.017)	[.080, .146]	.075*** (.017)	[.042, .108]	.023 (.015)	[−.007 .053]	−.044** (.014)	[−.071, −.018]
Age 11 SC	−.157*** (.022)	[−.200, −.115]	−.124*** (.021)	[−.166, −.082]	−.167*** (.021)	[−.208, −.125]	−.075*** (.019)	[−.112, −.039]	.063*** (.017)	[.030, .096]
Age 14 SC	−.328*** (.022)	[−.372, −.284]	−.199*** (.022)	[−.241, −.156]	−.516*** (.024)	[−.563, −.468]	−.291*** (.022)	[−.334, −.248]	.334*** (.019)	[.298, .371]
Sex	.340*** (.031)	[.279, .400]	−.226*** (.031)	[−.287, −.166]	.173*** (.030)	[.115, .231]	−.783*** (.029)	[−.839, −.727]	.454*** (.024)	[.408, .501]
Racial minority	.159*** (.040)	[.079, .238]	.135*** (.039)	[.060, .221]	−.103** (.038)	[−.178, −.028]	−.305*** (.034)	[−.371, −.239]	.059 (.031)	[−.003, .120]
Poverty	.469*** (.034)	[.403, .535]	.445*** (.033)	[.380, .511]	.118*** (.031)	[.057, .179]	.133*** (.029)	[.076, .190]	−.024 (.025)	[−.074, .025]
Moderation model										
ACE score	.184*** (.018)	[.149, .219]	.114*** (.017)	[.081, .147]	.072*** (.017)	[.039, .105]	.021 (.015)	[−.009, .050]	−.042** (.014)	[−.068, −.015]
Age 11 SC	−.157*** (.022)	[−.199, −.114]	−.124*** (.022)	[−.166, −.082]	−.167*** (.021)	[−.208, −.125]	−.075*** (.019)	[−.112, −.039]	.063** (.017)	[.030, .096]
Age 14 SC	−.330*** (.023)	[−.374, −.285]	−.199*** (.022)	[−.242, −.156]	−.516*** (.024)	[−.564, −.468]	−.292*** (.022)	[−.335, −.248]	.335*** (.019)	[.298, .371]
ACE X Age 11 SC	−.082** (.025)	[−.130, −.033]	−.049** (.024)	[−.095, −.002]	−.007 (.023)	[−.038, .052]	−.001 (.020)	[−.039, .041]	−.007 (.018)	[−.043, .029]
ACE X Age 14 SC	.017 (.024)	[−.030, .064]	.023 (.023)	[−.021, .068]	−.003 (.023)	[−.047, .042]	−.001 (.021)	[−.042, .039]	−.002 (.019)	[−.040, .036]
Sex	.347*** (.031)	[.286, .407]	−.223*** (.031)	[−.284, −.162]	.175*** (.030)	[.117, .233]	−.782*** (.029)	[−.839, −.726]	.453*** (.024)	[.407, .500]
Racial minority	.138** (.040)	[.059, .217]	.124** (.038)	[.048, .199]	−.112** (.038)	[−.186, −.038]	−.308*** (.034)	[−.374, −.242]	.064** (.031)	[.003, .125]
Poverty	.472*** (.034)	[.406, .538]	.448*** (.034)	[.382, .513]	.119*** (.031)	[.058, .180]	.134*** (.029)	[.076, .191]	−.025 (.025)	[−.075, .024]
Fit indices	x^2	*df*	*RMSEA*	*RMSEA* 90% CI		*SRMR*	*CFI*	*TLI*		
Main effects	5359.272	364	.041	[.040, .042]		.044	.924	.904		
Moderation	6652.809	781	.034	[.033, .034]		.035	.915	.902		

Note. ACE = adverse childhood experience; MH = mental health; SC = school connectedness. *$p < .05$. **$p < .01$. ***$p < .001$.

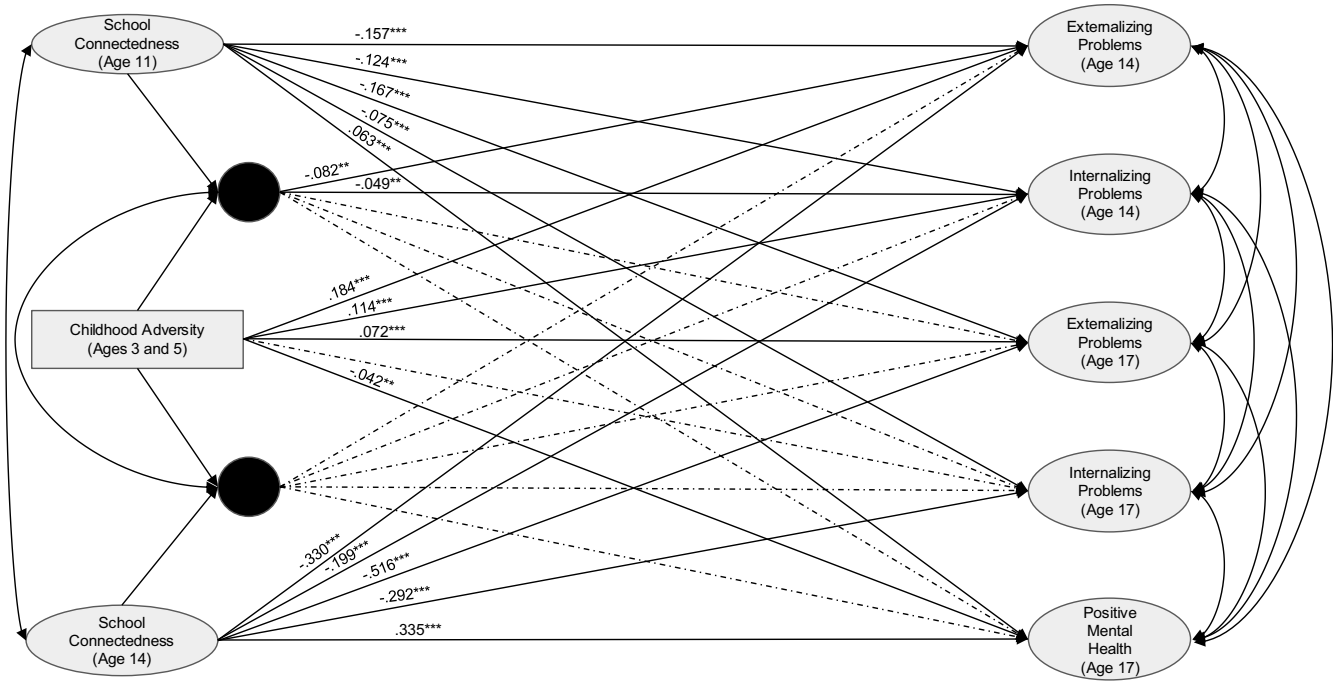

Figure 4. Path diagram of moderation model. The path diagram shows associations between the predictors of childhood adversity and school connectedness at ages 11 and 14 and adolescent mental health outcomes (externalizing problems, internalizing problems, and positive mental health). Interactions between school connectedness and childhood adversity are represented by the black circles. Racial/ethnic minority status, poverty, and sex were included as covariates but are not depicted in the figure for readability. Correlated error terms among the indicators of latent variables were also not depicted for readability but can be found in the appendix. *solid lines indicate significance at $p < .05$. Dashed lines represent non-significant relationships at $p > .05$. Coefficients of significant relationships are listed with the following significance levels: *p<0.05, **p<0.01, ***p<0.001.

measured at age 17 relative to age 11 school connectedness, revealing the importance of timing. While the closer proximity between age 14 and 17 likely contributes to the stronger effect sizes of age 14 school connectedness, it is also possible that the specific school environment and developmental differences at age 14 could contribute to these findings. At age 14, students in the UK begin to study for General Certificates of Secondary Education (GCSEs), important qualifications that are major stressors for students (Department for Education, 2023; National Education Union, 2019). Furthermore, individuals rely less on their family social networks as they transition to adolescence and are less likely to receive social support from teachers, which could increase the importance of school-related social support at age 14 (Eccles et al., 1993; Goodenow, 1993; Nelson et al., 2016; Oelsner et al., 2011). These differences between ages 11 and 14 may contribute to how school connectedness varies at these time points.

The long-lasting promotive effects of school connectedness are another novel finding from this study. Age 11 school connectedness predicted mental health outcomes at ages 14 and 17, even when controlling for age 14 school connectedness. These findings demonstrate that feeling connected to school at age 11 has positive benefits to mental health three and six years later, highlighting school connectedness's potential as a target to promote students' mental health in the long-term.

School connectedness as a protective factor

School connectedness at age 11 was found to be a protective factor against childhood adversity in relation to externalizing and internalizing problems at age 14. The moderation model and simple slopes analysis revealed that higher levels of school connectedness were associated with a weakened relationship between ACEs and externalizing and internalizing problems at age 14. Previous studies have also found a moderating effect of school connectedness and extracurricular participation on the relationship between childhood adversity and externalizing problems in adolescence (Goetschius et al., 2021; Hardaway et al., 2012; Loukas et al., 2010; Loukas & Pasch, 2013).

The protective effect of age 11 school connectedness against internalizing and externalizing problems is in line with the neurocognitive transactional model of childhood adversity. The model suggests that disrupting social thinning and stress generation would decrease the negative mental health outcomes associated with childhood adversity (McCrory et al., 2022). Given that school connectedness consists of feelings of belonging, social support, and positive engagement with the school environment (Hodges et al., 2018; Libbey, 2004), it is tenable that high levels of school connectedness would offset or disrupt the negative cascade by counteracting social thinning and stressful experiences, and in turn, reduce negative mental health consequences. The moderating effect of age 11 school connectedness between childhood adversity and internalizing and externalizing outcomes lends support to this theory.

Contrary to the hypothesis, age 14 school connectedness did not moderate the relationship between childhood adversity and mental health outcomes at ages 14 and 17. These results suggest that school connectedness may only be protective among younger students who have experienced adversity more recently.

Strengths and limitations

Strengths of this study include its large sample size, multiple validated measures of mental health, longitudinal design, and the use of SEM. SEM facilitated analysis of the relationships between all the variables in the model simultaneously rather than in

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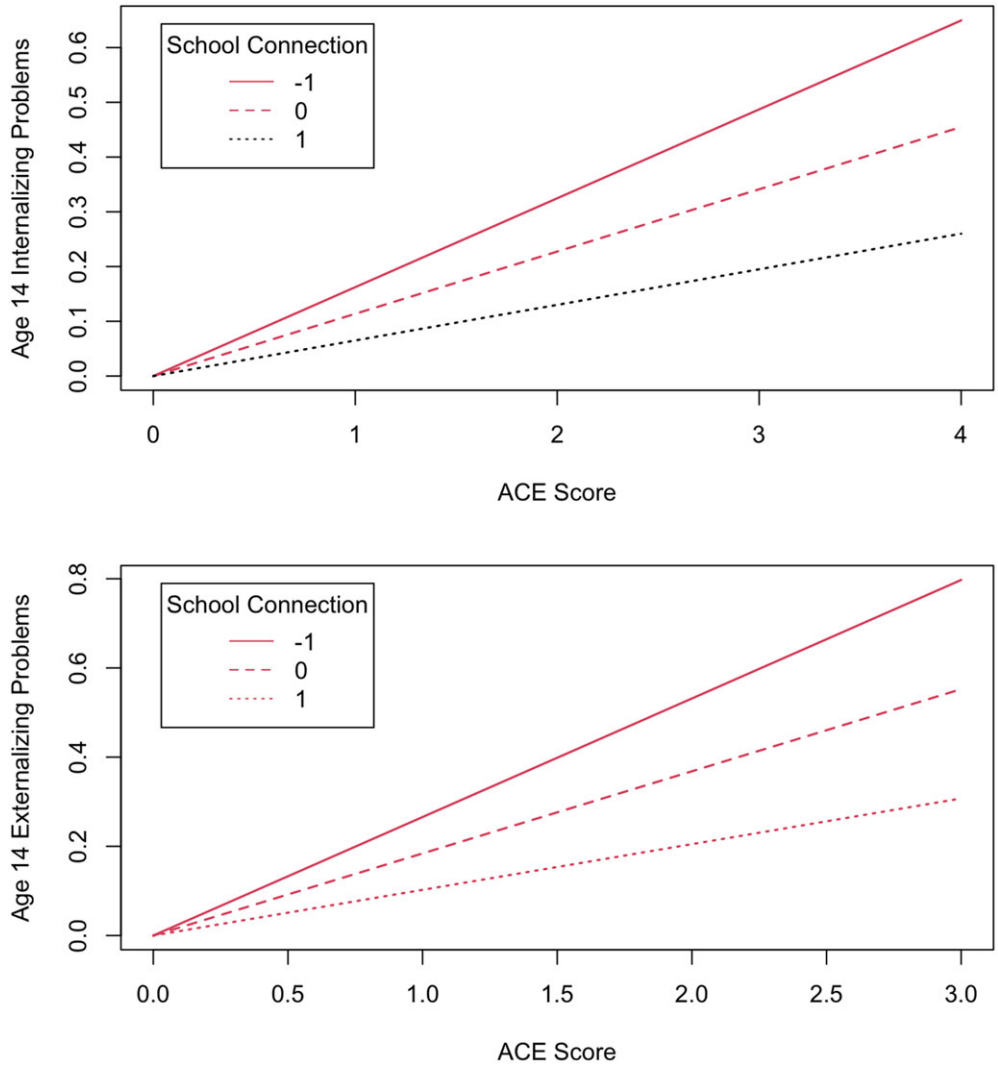

Figure 5. Simple slopes analysis for age 11 school connectedness. Age 11 school connectedness was plotted at its mean (0) and ± 1 SD. The slope between childhood adversity both age 14 externalizing problems and age 14 internalizing problems becomes less steep at higher levels of age 11 school connectedness, indicating that age 11 school connectedness is a protective factor. Abbreviations: ACE = adverse childhood experience.

succession, as would be the case in multiple regression analysis (Hair et al., 1998). This method, longitudinal data, and adequate statistical power from the large sample size facilitated a better understanding of the interrelationships between the variables of interest. A major strength of this study was the inclusion of moderators and mental health outcomes at multiple time points, facilitating the analysis of the proximal and distal effects of school connectedness, childhood adversity, and their interactions. Testing multiple moderators simultaneously contributes to a more parsimonious model and provides the most detailed analysis of how the moderators interact with each other and predictor variables (Montoya, 2019). Furthermore, there are distinct differences in development and school environments between the ages of 11 and 17, and the repeated-measures longitudinal approach helped elucidate how these differences may affect children's mental health.

A number of limitations should be borne in mind when interpreting the findings of this study. The study was limited by its correlational design and the measurement of childhood adversity and school connectedness. Although the longitudinal design limits the confounding of variables, the findings are correlational, meaning causal inferences cannot be drawn. At age 14, the directionality of the association between school connectedness and mental health outcomes cannot also be ascertained. ACE scores in the present study did not include physical or emotional neglect, sexual abuse, or having an incarcerated relative, each of which are associated with mental health problems in adolescence. Additionally, ACEs were measured as a cumulative exposure to childhood adversity, and there has been movement in the field to measure specific dimensions of adversity, such as deprivation and violence (Goetschius et al., 2021). More nuanced and comprehensive measurement of childhood adversity in future studies will facilitate a clearer understanding of its impact on adolescent mental health and interactions with school connectedness.

The school connectedness measure was also not comprehensive. Since the MCS dataset did not use a validated measure of school connectedness, relevant items in the questionnaire that overlapped with validated scales (Student Engagement in Schools Questionnaire [Hart et al., 2011] and the School Climate Survey [Zullig et al., 2010; 2014]) were selected for CFA. In this process, the items related to having friends at school did not load well with the rest of the questions and were removed. In doing so, the school connectedness measure centered around school satisfaction and engagement, important components of school connectedness, but

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was likely not fully representative of the construct. Specifically, the affective dimension of acceptance and the cognitive dimension of cohort members' perceptions of quality peer relationships were not captured. The school connectedness measure employed by Goetschius et al. (2021) comprised of questions centered on feelings of belongingness and also found that school connectedness was protective against externalizing problems. Future studies should aim to use a validated scale for school connectedness that fully captures the cognitive, affective, and behavioral domains of the construct.

Lastly, the parent- and self-report SDQ at ages 14 and 17, respectively, are likely to measure different aspects of young people's internalizing and externalizing problems. The measures at both time points are not assumed to be invariant, a limitation of this study. Booth et al. (2023) found that adolescents reported more negative outcomes on the SDQ relative to their parents, suggesting the informant discrepancy may be associated with measurement invariance. Future studies should aim to account for measurement invariance. However, previous work using the MCS dataset (Toseeb et al., 2022) demonstrates that the factor structure of parent-report SDQ is not the same at ages 14 and 17 years, indicating that parent-report SDQ is likely to be variant across these ages. Based on these findings, we chose to use parent-report SDQ at age 14 due to availability of data and self-report SDQ at age 17 years.

Conclusion

In summary, we found that childhood adversity and school connectedness were risk and protective factors, respectively, for adolescent mental health among UK youth. Moreover, we discovered that school connectedness at age 11 significantly moderated the relationship between childhood adversity and age 14 internalizing and externalizing problems, a novel finding demonstrating the protective effects of feeling connected to school. School connectedness at age 14 was not protective, suggesting that school connectedness at younger ages may disrupt processes that link childhood adversity to externalizing problems in adolescence. While promoting school connectedness throughout all levels of education is important, these differences can inform targeted interventions aimed at supporting children who have experienced adversity.

School connectedness is a malleable factor that schools should promote. Classroom content relevance, whole school approaches, strong school counselor relationships, and supportive classroom management strategies are linked to increased feelings of school connectedness (Acosta et al., 2019; Chapman et al., 2013; Kiefer & Pennington, 2016; Kim & Cappella, 2016; Martin & Sorensen, 2020). Based on the findings from the present study, these interventions may protect students against the negative effects of childhood adversity on internalizing and externalizing problems and benefit all students' mental health and well-being.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S0954579424001184.

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