

Regular Article

Cumulative risk and adolescent emotional distress: A longitudinal moderated mediation analysis focusing on perceived stress and social support

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Abstract

This study provides insights into the roles played by perceived stress and social support in the relationship between cumulative risk exposure (CRE) and adolescent emotional distress. Preregistered longitudinal moderated mediation analyses were used to test hypotheses relating to the association between CRE and later emotional distress; the mediating role of perceived stress in the relationship between CRE and later emotional distress; and, the moderating effects of peer and adult-level family support on the relationship between CRE and later perceived stress, among $N = 19,159$ adolescents over three annual waves (at ages 11/12, 12/13, 13/14). Analyses revealed that CRE significantly predicted later adolescent emotional distress. This relationship was partially mediated by perceived stress. Both peer and adult-level family support significantly moderated the impact of CRE on later perceived stress (i.e., adolescents reporting higher levels of support perceived significantly lower levels of stress resulting from CRE compared to those reporting lower levels of support). These findings provide critical empirical evidence of the roles played by perceived stress and social support in the relationship between CRE and adolescent emotional distress, with consequent implications for intervention.

Keywords: Adolescence; cumulative risk exposure; emotional distress; perceived stress; social support

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Approximately one in five 11-to-16-year-olds have a probable mental health disorder (Newlove-Delgado et al., 2022), with those reflecting emotional distress (e.g., anxiety, depression) being the most prevalent in this period (NHS Digital, 2018). Half of all lifetime cases begin in adolescence, with a peak age of onset of 14.5 years (Solmi et al., 2021). Mental health disorders impair quality of life and are concurrently and prospectively associated with a range of maladaptive outcomes (e.g., lower academic attainment) (Humphrey, 2018). There is therefore an urgent need to better understand the processes and mechanisms that underpin or counteract their development. Drawing on a very large longitudinal dataset (“HeadStart”) with three annual datapoints that span the transition from early- to mid-adolescence (T1, age 11/12; T2, age 12/13; T3, aged 13/14), this paper makes a significant contribution to knowledge by testing a series of propositions that underpin cumulative risk theory, before drawing upon resilience theory to examine the extent to which access to putative protective factors pertaining to social support can disrupt the process through which cumulative risk impacts later emotional distress.

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Cumulative risk theory: the whole is greater than the sum of its parts

Risk factors are measurable characteristics (e.g., socioeconomic disadvantage) that are associated with a negative outcome (e.g., mental health difficulties). Since Rutter’s pioneering Isle of Wight studies (Rutter et al., 1976), significant attention has been paid to the impact of exposure to multiple risk factors situated across different levels of the developmental ecosystem (e.g., individual, family, peer group, and community). In the current study, we draw on two key tenets of cumulative risk theory. First, the accumulation principle states that the more risk factors to which an individual is exposed, the greater the probability of maladaptive outcomes. Second, the number-over-nature principle states that it is the *number* of risk factors, as opposed to their *nature*, which is the central driver of said outcomes (Evans et al., 2013). Drawing these two tenets together, we hypothesize that cumulative risk exposure (CRE) at T1 will predict increased emotional distress at T3, above and beyond each individual risk factor (Hypothesis 1). The evidence base to support these predictions is substantial, though there is a need for more longitudinal work (to establish temporal precedence), and in particular, research that can elucidate the proposed mechanisms and processes that underpin the relationship between CRE and maladaptive outcomes (Evans et al., 2013).

Another key tenet of cumulative risk theory is the hypothesis that risk factors interact and potentiate one another to impact on

allostatic load, which is a marker of “wear and tear” on the body, produced by the mobilization of physiological systems in response to environmental stressors. Increased and recurrent exposure to stressors results in sustained production of the stress hormone, cortisol, which in turn shifts operating parameters of immune, neurological, metabolic, and endocrine biomarkers outside of their optimal range, leading to dysfunction (Evans et al., 2013). These changes are proposed to alter neurological activity, underpinning the onset of disorder (Evans et al., 2007). However, despite growing support for the theory that stress has a key role in how risk factors influence outcomes, our understanding of such mechanisms is still developing, particularly with regard to CRE. Existing evidence is often reliant on physiological biomarkers of stress and allostatic load (e.g., blood pressure, neuroendocrine stress activity) (Guidi et al., 2020). Such studies have not investigated mediation pathways in youth mental health and tend to have small sample sizes, given the high time and resource demand of measuring biomarkers. Further, through a focus on physiological data, they overlook the largely subjective nature of stress, as captured in the transactional model, wherein there are substantive individual differences in the extent to which people appraise an event, or their lives more generally, to be stressful (Cohen, 1986; Lazarus & Folkman, 1984). Thus, there is considerable value in further investigation of the role of *perceived* stress in the relationship between CRE and adolescent mental health outcomes. Promisingly, our initial evidence examining baseline data from the HeadStart dataset – albeit cross-sectional and focusing only on early adolescent girls – indicates that perceived stress may mediate this relationship (Demkowicz, 2019).

Based on the above, and building on Hypothesis 1, we make a further prediction, namely that increased levels of perceived stress at T2 will significantly mediate the association between CRE at T1 and emotional distress at T3, even after controlling for prior (T1) levels of emotional distress and co-variables (Hypothesis 2).

Fostering resilience: social support as ordinary magic

A key tenet of cumulative risk theory is that exposure increases the *probability* of disorder but does not guarantee it (Evans et al., 2013). Thus, some adolescents will demonstrate positive adaptation despite being exposed to multiple risk factors. This brings us to the concept of resilience, defined as, “the capacity of a dynamic system to adapt successfully to disturbances that threaten system function, viability, or development” (Masten, 2014, p. 10). Various models have been proposed to explain the process(es) through which healthy development can occur in the face of risk (e.g., compensatory, protective, inoculation; Fergus & Zimmerman, 2005). In the current study, we draw directly on the *protective* model, in which access to putative protective factors is theorized to moderate the impact of CRE on later emotional distress (Masten, 2014). More specifically, we anticipate a protective-reactive effect, in which a given protective factor diminishes, but does not completely eradicate, the expected association between risk exposure and a given negative outcome (Fergus & Zimmerman, 2005). This assumption is based on the principle of equifinality (i.e., multiple routes to the same outcome, meaning no single protective factor in isolation can completely suppress the impact of risk exposure; Cicchetti & Rogosch, 1996) and the related proposition that protective factors can operate in tandem to disrupt the risk-outcome relationship (Leffert et al., 1998).

In her seminal work, Masten (2014) argues that resilience occurs through ordinary rather than extraordinary processes

(i.e., “ordinary magic”). Using this as our starting point, we focus on a very ordinary process, social support, by which we mean, “the social resources that persons perceive to be available or that are actually provided to them by non-professionals in the context of both formal support groups and informal helping relationships” (Gottlieb & Bergen, 2010, p. 512). More specifically, we examine the protective effects of *peer* and *adult-level family support*. Our rationale for this focus is threefold. First, heightened sensitivity to social stimuli is recognized as a characteristic feature of adolescence (Orben et al., 2020); consequently, social support may have particular utility during this period. Second, with specific reference to early adolescence, family adult and peer support are both highly salient; the former is seen as a critical source of interpersonal connection in the transition from childhood, with the latter becoming increasingly important over time as the social world is reoriented in service of development towards independence (Orben et al., 2020; Umberson et al., 2010). Third, our work reflects a broader effort in resilience research to shift the onus away from internal factors (which arguably place the onus on the individual to be responsible for their own resilience) onto external factors within the developmental ecosystem (Demkowicz, 2019; Ungar et al., 2013).

In thinking about how these two putative protective factors may modify the effects of CRE on later emotional distress, we draw on Cohen and Wills’ stress buffering hypothesis (1985), in which it is argued that social support functions to improve wellbeing by lessening the extent to which significant life challenges are experienced as stressful. As above, our initial evidence – albeit cross-sectional and focusing only on early adolescent girls – provides support for this proposition (Demkowicz, 2019). Based on the above, and building on Hypotheses 1 and 2, we make two final predictions. First, peer support at T2 will significantly moderate the effects of CRE at T1 on perceived stress at T2 (Hypothesis 3). Second, adult-level family support at T2 will significantly moderate the effects of CRE at T1 on perceived stress at T2 (Hypothesis 4).

The current study

In the current study, our aim is to provide much needed insights into the processes and mechanisms underpinning the relationship between CRE and adolescent emotional distress via a preregistered longitudinal moderated mediation analysis focusing on perceived stress and social support. To reiterate and summarize, our hypotheses are as follows (see also conceptual diagram, Figure 1):

- H1: CRE at T1 will predict increased emotional distress at T3 above and beyond each significant individual risk factor;
- H2: Perceived stress at T2 will significantly mediate the association between CRE at T1 and emotional distress at T3, even after controlling for prior (T1) levels of emotional distress and co-variables;
- H3: Peer support at T2 will significantly moderate the effects of CRE at T1 on perceived stress at T2;
- H4: Adult-level family support at T2 will significantly moderate the effects of CRE at T1 on perceived stress at T2.

Note: H3 and H4 are tested through simultaneous interaction (i.e., both protective factors operating at once to moderate the effects of CRE at T1 on perceived stress at T2).

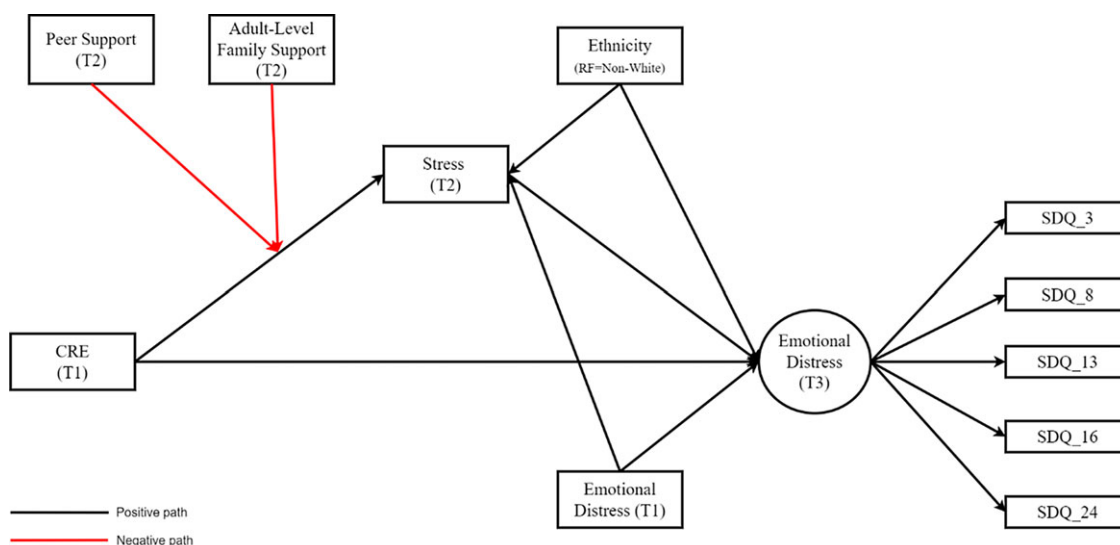


Figure 1. Proposed moderated mediation model.

Method

Design

Secondary data analysis of the longitudinal cohort from the HeadStart study was undertaken, using the first three annual data points (T1, T2, and T3) and linked administrative data. HeadStart was a six-year project that aimed to explore and test new ways to improve the mental health and wellbeing of adolescents aged 10–16 years (for further details, see Evidence-Based Practice Unit, 2023). Ethical approval for HeadStart data collection was granted by University College London’s ethics committee (reference 8097/003). The design and analysis plan for this study was preregistered prior to the lead analyst begin granted access to the data (Deniz et al. 2023).

Sample

The study sample comprised $N = 19,159$ adolescents (Mean age at T1 = 12.22, $SD = .30$), drawn from 113 secondary schools in six Local Authorities across England. Of these, 77% were White; 52% were girls; 14% had at least one special educational need (SEN); 37% were eligible for free school meals (FSM); 27% were living in a socioeconomically deprived neighborhood; 26% were summer born; and 6% were currently or had previously been classified as a child in need (i.e., they had been referred to social services). Selection of Local Authorities in the HeadStart project was purposive and not designed to be representative. Accordingly, the study sample were subject to somewhat higher levels of socioeconomic disadvantage than is seen nationally across England.

Measures

Cumulative risk exposure

Pragmatic selection of candidate risk factors that were available in the HeadStart survey data or linked administrative data was undertaken, informed by the extant evidence base (e.g., Evans et al., 2013), and using the aforementioned definition (i.e., a measurable characteristic that is associated with a negative outcome). We also drew on the work of the World Health Organization (2012) and others (e.g., Furber et al., 2017), in which risk factors can include individual attributes and characteristics, not just exposures.

A CRE index was derived from the following candidate risk factor (RF) variables: gender (RF = girl); relative age (RF = summer born); bullying victimization (RF = bullied by other adolescents); academic attainment (RF = lowest quartile in prior attainment); SEN (RF = identified as having SEN); familial socioeconomic deprivation (RF = currently or previously eligible for FSM in the last 6 years); caregiving responsibilities (RF = has caregiving responsibilities); child in need status (RF = current or previous social services referral); neighborhood socioeconomic disadvantage (RF = resident in Index of Multiple Deprivation Quintile 1 neighborhood). Further articulation of these risk factors is presented in Table 1, including indicative evidence and theorization.

Peer and adult-level family support

The Student Resilience Survey (SRS; Lereya et al., 2016) was used to assess peer (13 items) and adult-level family support (4 items). Respondents read statements (e.g., “At home there is an adult who listens to me when I have something to say”; “Are there students at your school who would make you feel better if something is bothering you”) and endorse them on a 5-point scale (1 = never to 5 = always). In each subscale, a sum score is calculated, with higher scores indicating greater social support.

Perceived stress

Following guidance by Demkowicz et al. (2020), we used the two stress-focused items from the four-item Perceived Stress Scale (PSS-4; Cohen et al., 1983) in recognition that the full measure does not function well as a unidimensional construct, and that a two-factor structure is supported (one of which being perceived stress, used in the current study). Respondents read statements (e.g., “In the last month, how often have you felt that you were unable to control the important things in your life”) and endorse them on a five-point scale (never, almost never, sometimes, often, very often). As above, a sum score is calculated, with higher scores indicating higher levels of perceived stress.

Emotional distress

The emotional symptoms subscale (5 items) of the Strength and Difficulties Questionnaire (Goodman, 1997) was used to assess

Table 1. Candidate risk factors: indicative evidence and theorization

Construct	Risk factor	Indicative evidence	Theorization
Gender	Girl	Campbell <i>et al.</i> (2021) reported gender disparities in adolescent emotional symptoms, with girls reporting significantly worse mental health than boys.	Multiple theorized sociocultural, psychological, and biological factors operate in parallel to create chronic stress for girls. Gender norms in adolescence are proposed to reflect and reinforce inequitable hierarchies, with consequent effects on girls' health outcomes via differential exposure to other risk factors, health-related behaviors, and access to care (Marquez <i>et al.</i> , 2023).
Relative age	Relatively young in the school year (i.e., summer born in the UK)	Patalay <i>et al.</i> (2015) found that relatively younger UK adolescents (i.e., those summer-born) had significantly more emotional symptoms and peer problems compared with relatively older individuals (i.e. those autumn-born) in a year group.	Development of spoken language, social interaction, and cognition progresses with chronological age. Being relatively young in the school year (i.e., summer born in the UK, in which the school year begins in September) confers disadvantage across a range of domains due to a mismatch between normative expectations and developmental functioning that can cascade and have lifelong consequences (Squires <i>et al.</i> , 2012).
Bullying victimization	Bullied by other adolescents	Zwierzynska <i>et al.</i> (2013) found that peer victimization in childhood predicted internalizing symptoms in adolescence.	Being exposed to repeated and intentional harm doing by peers is a significant life stressor and influences emotional distress via mechanisms including cognitive predisposition to interpret stressful events in a global and self-critical manner, lowered self-esteem, increased unwanted feelings (e.g., fear, shame), and/or sleep and other somatic difficulties (Christina <i>et al.</i> , 2021).
Academic attainment	Lowest quartile in prior attainment	Deighton <i>et al.</i> (2018) found that low academic attainment predicted later internalizing symptoms in childhood and adolescence.	Low academic attainment is theorized to trigger later emotional distress due to experiences of frustration, disaffection, and social stigma (Panayiotou & Humphrey, 2018).
Special educational needs (SEN)	Identified as having SEN	Newlove-Delgado <i>et al.</i> (2022) found that students with SEN were significantly more likely to have a diagnosable mental health difficulty than their peers without SEN	Stress caused by challenges in navigating education and peer relationships experienced by those with SEN is proposed to predict later emotional distress (Demkowicz <i>et al.</i> , 2021).
Familial socioeconomic deprivation	Currently or previously eligible for free school meals (FSM) in the last 6 years	Deighton <i>et al.</i> (2019) reported that adolescents eligible for FSM were significantly more likely to experience elevated emotional symptoms than their peers who were not eligible for FSM.	Lower household income reduces access to resources including healthcare, food, and housing. Stress emanating from exposure to these adversities are theorized to underpin greater risk for emotional distress (Hazell <i>et al.</i> , 2022).
Caregiving responsibilities	Cares for a family member who has an illness, disability, mental health condition, or drug/alcohol dependency	A systematic review by Lacey <i>et al.</i> (2022) reported that young carers experienced significantly worse mental health outcome than their peers.	Unmet needs and/or the stress caused by having to provide emotional and/or physical caregiving typically performed by an adult places the young person at increased risk of developing mental health difficulties (Kavanaugh <i>et al.</i> , 2016).
Child in need status	Current or previous social services referral (e.g., for potential exposure to abuse, neglect, and/or household dysfunction)	Hughes <i>et al.</i> (2017) meta-analysis found that adverse experiences such as abuse or neglect were strongly associated with negative mental health outcomes.	Exposure to abuse, neglect, and/or household dysfunction and related adversities causes chronic stress, leading to emotional distress (Demkowicz <i>et al.</i> , 2021)
Neighborhood socioeconomic disadvantage	Resident in Index of Multiple Deprivation Quintile 1 neighborhood	Hazell <i>et al.</i> (2022) reported that relative neighborhood disadvantage was associated with greater adolescent internalizing symptoms.	Lower perceived safety (and/or increased likelihood of exposure to violence), reduced levels of neighborhood cohesion, and decreased access to resource/support/assets in more deprived neighborhoods may contribute to higher levels of stress, increasing susceptibility to emotional distress (Visser <i>et al.</i> , 2021)

emotional distress. Respondents read statements (e.g., “I worry a lot”) and endorse them on a three-point scale (not true, somewhat true, certainly true). As above, a sum score is calculated, with higher scores indicating higher levels of emotional distress.

Ethnicity

A binary ethnicity variable (White; minority ethnicity), derived from linked administrative data, was controlled as a covariate of both perceived stress (T2) and emotional distress (T3). Our intention here was to partial out variance accounted for by ethnicity, given the well-established evidence which indicates that it co-varies with our response variable (see for example Ahmad et al., 2022; Bains & Gutman, 2021; Goodman et al., 2008).

Analytic strategy

All analyses were performed following the aforementioned preregistered statistical analysis plan and conducted in R version 4.2.1 (R Core Team, 2023). First, we performed point biserial correlations to report the zero-order correlations between the candidate risk factors (binary) and emotional distress at T3 (continuous). This step was taken so that each candidate risk factor could be coded in the same direction (i.e., for each, 0=absent, 1=present). Second, we constructed the CRE index by summing all candidate risk factors such that increased scores reflected increased CRE. Third, we fitted a structural equation model (SEM) to test the mediating role of stress (T2) in the association between CRE and later emotional distress (T3), controlling for ethnicity and prior levels of emotional distress (T1). Finally, we included adult-level family support and peer support as moderators of the associations between CRE and perceived stress to test the hypothesized moderated mediation model. Model fit indices such as the root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker–Lewis index (TLI) were inspected and documented. The model was considered a good fit to the data if CFI and TLI $\geq .90$ and RMSEA $\leq .08$ (Hu & Bentler, 1999).

Missing data

In order to check that the missing at random (MAR) assumption was met, we generated a binary *missingness* variable which indicated whether an observation had any missing values in the focal variables. We then fitted a multiple logistic regression model to test whether missingness was conditional on observed variables in the dataset. This was found to be the case for several variables (i.e., ethnicity, FSM, SEN, academic attainment, and perceived stress), indicating that the MAR assumption was met. More information regarding the missingness pattern in the dataset can be found in Table S1 (Supplementary materials).

Given the above, multiple imputations by chained equations (MICE) and full information maximum likelihood (FIML) were used to handle missing data. MICE was used to report descriptive and regression analyses, while FIML was used to report SEM path coefficients.

Deviations from the analysis plan

As outlined earlier, the design and reporting of the current study followed a preregistered analysis plan. However, there was an unprecedented deviation from the registered analysis plan. More specifically, we initially hypothesized that stress at T2 would significantly mediate the associations between CRE at T1 and emotional distress at T3. However, in the main analysis, the proposed model did not fit the data well. Therefore, unpredictable

model modification indices were applied to improve the model fit. This is a common practice in the SEM literature (MacCallum et al., 1992) and is acceptable as far as the undertaken modifications are theoretically or empirically meaningful (Wang & Wang, 2019). The first undertaken modification indices, suggested by R package *modindices* (R Core Team, 2023), was to add a path between emotional distress at T1 and stress at T2. This aligns well with the existing literature as previous researchers have suggested that emotional distress predicts later stress (Kim et al., 2003; Phillips et al., 2015). Additionally, emotional distress at T1, which was a control covariate, was transformed to an observed variable (as opposed to latent), to reduce model complexity and improve fit. Arguably, treating the emotional distress subscale of the SDQ as an observed variable is acceptable in the sense that it has a well-constructed and repeatedly confirmed factor structure in this population (e.g., He et al., 2013; Van Roy et al., 2008). Upon the application of these modifications, a good model fit was established.

Finally, two further substantive changes to our analyses were undertaken on the basis of peer review recommendations. First, we reconstructed our CRE index, which originally included only those candidate risk factors that were significantly associated (in the direction anticipated) with emotional distress at T3, to include them *all* irrespective of their association with the outcome variable. Second, we had originally included a series of predictions and preliminary analyses based on the classic mediation approach (i.e., testing individual paths prior to undertaking formal mediation analysis); these were excised following advice that they were no longer commonly applied in the contemporary literature.

Results

Constructing the CRE index

Prior to constructing the CRE index, we tested the zero-order correlations between candidate risk factors and emotional distress at T3. Zero order correlations showed that being a girl ($\text{corr} = .34, p < .001$) and being a victim of bullying ($\text{corr} = .19, p < .001$) were the two strongest correlates of T3 emotional distress amongst all candidate risk factors. Additionally, relative age, familial socioeconomic deprivation, caregiving responsibilities, and child in need status were other significant correlates of emotional distress at T3. Interestingly, and unexpectedly, low academic attainment was *negatively* correlated with emotional distress at T3. For this variable to be coded in line with other risk factors, we therefore changed the risk factor designation from poor to high academic attainment (i.e., 0 = risk absent, low academic attainment; 1 = risk present, high academic attainment). Details can be found in Table 2.

The CRE index score originally ranged from 0 to 8 (i.e., no participants exposed to all nine candidate risk factors), with higher scores indicating higher risk exposure (N at each level of CRE: 0 = 1386; 1 = 4247; 2 = 5477; 3 = 4371; 4 = 2353; 5 = 1014; 6 = 255; 7 = 50; 8 = 6). Since the two highest levels (7 and 8) had very low power (N < 1%), we rescaled the CRE index to combine them with the next highest level (i.e., 0 = 1386; 1 = 4247; 2 = 5477; 3 = 4371; 4 = 2353; 5 = 1014; 6+ = 311), in line with both the preregistered analysis plan and standard practice in the cumulative risk literature (Appleyard et al., 2005). We then fitted separate linear regression models to determine whether increased levels of CRE at T1 predicted increased emotional distress at T3, above and beyond each significant individual risk factor (see Table 3). As above, each regression model controlled for emotional distress and ethnicity at T1. In all cases, higher CRE scores significantly predicted increased levels of emotional distress at T3

Table 2. Point biserial correlations (zero-order correlations) between the individual risk factors and emotional distress at T3

	Emotional Distress T3
Gender	.34***
Relative age	.03***
Bullying victimization	.19***
Familial socioeconomic deprivation	.04***
SEN	.01
Caregiving responsibilities	.04***
Child in need status	.02*
Neighborhood socioeconomic disadvantage	.01
Academic attainment	-.01

Note. a: All regression coefficients are reported on the multiply imputed dataset. Risk factor designation: gender (RF = girl); relative age (RF = summer born); bullying victimization (RF = bullied by other adolescents); academic attainment (RF = lowest quartile in prior attainment); SEN (RF = identified as having SEN); familial socioeconomic deprivation (RF = currently or previously eligible for FSM in the last 6 years); caregiving responsibilities (RF = has caregiving responsibilities); child in need status (RF = current or previous social services referral); neighborhood socioeconomic disadvantage (RF = resident in Index of Multiple Deprivation Quintile 1 neighborhood).

above and beyond each candidate risk factor in question and covariates, confirming Hypothesis 1.

Cumulative risk exposure, perceived stress, and emotional distress (hypothesis 2)

To test Hypothesis 2, we fitted the hypothesized mediation model. As noted earlier, the preregistered model did not fit well to the data

(Goodness of Fit: $\chi^2(p) < .001$, RMSEA = .16, CFI = .15, TLI = .10, SRMR = .56), so a number of modifications were undertaken (see “Deviations From The Analysis Plan”). The modified model (see Table 4) showed a good fit to the data ($\chi^2(p) < .001$, $df = 33$, RMSEA = .040, CFI = .97, TLI = .95, SRMR = .021). In support of Hypothesis 2, we found that perceived stress at T2 significantly mediated the association between CRE at T1 and emotional distress at T3. More specifically, our model suggested that CRE at T1 significantly predicted stress at T2 ($\beta = .17$, $p < .001$) which, in turn, significantly predicted emotional distress at T3 ($\beta = .17$, $p < .001$). The direct effects of CRE at T1 ($\beta = .10$, $p < .001$) appeared to be significantly higher than its indirect effects through perceived stress ($\beta = .03$, $p < .001$). Hence, our mediation analysis confirmed Hypothesis 2, indicating that stress is a significant mediator in the association between CRE at T1 and emotional distress at T3.

Peer and adult-level family support as moderators of the impact of cumulative risk exposure on perceived stress (hypotheses 6 and 7)

Our final model, moderated mediation model (Table 5 and Figure 2), fit the data well ($\chi^2(p) < .001$, $df = 45$, RMSEA = .039, CFI = .96, TLI = .94, SRMR = .019). The model revealed that relations between CRE at T1 and perceived stress at T2 were significantly moderated by both peer ($\beta = -.01$, $p < .001$) and adult-level family support ($\beta = -.03$, $p < .001$) at T2. That is, confirming Hypotheses 3 and 4, adolescents reporting higher levels of peer and adult-level family support at T2 perceived significantly lower levels of stress resulting from CRE at T1 compared to those reporting lower levels of peer and adult-level family support at T2.

Table 3. Regression of emotional distress at T3 on to the cumulative risk exposure index, controlling for all individual risk factors and covariates ($N = 19,159^a$)

	Coeff.	Std. error	t	p	CI [95%]
Emotional Distress T3 ~					
Gender	1.34	.03	39.10	< .001	1.28, 1.39
CRE	.08	.01	6.83	< .001	.06, .10
Relative age	-.19	.04	-4.74	< .001	-.26, -.13
CRE	.25	.01	18.53	< .001	.23, .27
Bullying victimization	-.17	.04	-4.28	< .001	-.24, -.11
CRE	.25	.01	18.30	< .001	.23, .27
Familial socioeconomic deprivation	-.36	.04	-8.81	< .001	-.43, -.29
CRE	.30	.01	19.96	< .001	.27, .33
SEN	-.51	.05	-10.09	< .001	-.60, -.43
CRE	.27	.01	20.29	< .001	.25, .29
Caregiving responsibilities	-.41	.04	-9.11	< .001	-.49, -.34
CRE	.28	.01	20.16	< .001	.25, .30
Child in need status	-.36	.07	-4.86	< .001	-.49, -.24
CRE	.25	.01	18.61	< .001	.23, .27
Neighborhood socioeconomic disadvantage	-.42	.04	-9.81	< .001	-.49, -.35
CRE	.30	.01	20.54	< .01	.27, .32
Academic attainment	.11	.04	2.61	< .001	.04, .18
CRE	.23	.01	17.47	< .001	.20, .25

Note. a: CRE is tested as predictor of emotional distress at T3 alongside each significant individual risk factor and controlling for covariates (emotional distress T1 and ethnicity), separately. These covariates are not shown in the table in the interest of brevity and clarity. All regression coefficients are reported on the multiply imputed dataset. CRE = Cumulative Risk Exposure.

Table 4. The mediating role of perceived stress at T2 between cumulative risk exposure at T1 and emotional distress at T3 ($N = 19,159$)

	Estimate	Std. error	Z	p
Mediation Paths				
CRE → ED (T3) (path c)	.10	.01	11.94	< .001
Stress (T2) → ED (T3) (path b)	.17	.01	28.14	< .001
CRE → Stress (T2) (path a)	.17	.01	13.32	< .001
Covariates				
ED (T1) → ED (T3)	.19	.01	35.95	< .001
ED (T1) → Stress (T2)	.29	.01	38.93	< .001
Ethnicity → ED (T3)	.24	.03	8.75	< .001
Ethnicity → Stress (T2)	.10	.04	2.40	.02
Factor Loadings				
SDQ_3 (T3) → ED (T3)	.30	.01	56.13	< .001
SDQ_8 (T3) → ED (T3)	.45	.01	81.11	< .001
SDQ_13 (T3) → ED (T3)	.38	.01	75.18	< .001
SDQ_16 (T3) → ED (T3)	.37	.01	68.83	< .001
SDQ_24 (T3) → ED (T3)	.33	.01	64.79	< .001
Direct – Indirect – Total Effect				
Direct effect	.10	.01	11.94	< .001
Indirect effect (ab)	.03	.01	12.00	< .001
Total effect	.13	.01	15.13	< .001

Note. Model Fit: RMSEA = .040, CFI = .97, TLI = .95, SRMR = .021, $df = 33$, $\chi^2(p) < .001$. ED = Emotional Distress, CRE = Cumulative Risk Exposure. Estimator: Full information maximum likelihood.

Discussion

In the current study, preregistered longitudinal moderated mediation analyses were used to test a series of hypotheses relating to the association between CRE and later emotional distress; the mediating role of perceived stress in the relationship between CRE and later emotional distress; and, the moderating effects of peer and adult-level family support on the relationship between CRE and later perceived stress. Data were drawn from the HeadStart study longitudinal cohort ($N = 19,159$ adolescents; mean age = 12.22 at T1). Analyses revealed that CRE significantly predicted later adolescent emotional distress; this relationship was partially mediated by perceived stress; and, both peer and adult-level family support significantly moderated the impact of CRE on later perceived stress.

Cumulative risk exposure, perceived stress, and emotional distress (hypotheses 1 to 3)

Consistent with Hypothesis 1, our analyses demonstrated that CRE at T1 significantly predicted later emotional distress at T3, above and beyond each significant individual risk factor. Our findings thereby provide support for both the accumulation principle (i.e., the more risk factors to which an individual is exposed, the greater the probability of maladaptive outcomes) and the number-over-nature principle (i.e., it is the *number* of risk factors, as opposed to their *nature*, which is the central driver of maladaptive outcomes) in cumulative risk theory (Evans et al., 2013). The specific risk factors identified in our analysis are consistent with prior research that has identified being female (Campbell et al., 2021), exposure to

Table 5. Hypothesized moderated mediation ($N = 18,979$, missing not handled = 180)

	Estimate	Std. err.	Z	p
Mediation Paths				
CRE → ED (T3) (path c)	.10	.01	11.91	< .001
Stress (T2) → ED (T3) (path b)	.89	.04	23.13	< .001
CRE → Stress (T2) (path a)	.17	.01	13.32	< .001
Moderation Effect				
INTPS (CRE*PeerSupport) → Stress (T2)	-.01	.00	-7.13	< .001
INTFS (CRE*FamilySupport) → Stress (T2)	-.03	.00	-14.13	< .001
Covariates				
ED (T1) → ED (T3)	.20	.01	35.99	< .001
ED (T1) → Stress (T2)	.29	.01	38.93	< .001
Ethnicity → ED (T3)	.27	.01	36.17	< .001
Ethnicity → Stress (T2)	.06	.04	1.36	.06
Factor Loadings				
SDQ_3 (T3) → ED (T3)	.30	.01	56.13	< .001
SDQ_8 (T3) → ED (T3)	.45	.01	81.11	< .001
SDQ_13 (T3) → ED (T3)	.38	.01	75.18	< .001
SDQ_16 (T3) → ED (T3)	.37	.01	68.83	< .001
SDQ_24 (T3) → ED (T3)	.33	.01	64.79	< .001
Direct – Indirect – Total Effect				
Direct effect	.10	.01	11.91	< .001
Indirect effect (ab)	.15	.01	17.79	< .001
Total effect	.25	.01	21.72	< .001

Note. Model Fit: RMSEA = .039, CFI = .96, TLI = .94, SRMR = .019, $df = 45$, $\chi^2(p) < .001$. INTPS (mod1): Interaction Term Peer Support. INTFS (mod2): Interaction Term Family Support. ED = Emotional Distress, CRE = Cumulative Risk Exposure. Estimator: Full information maximum likelihood.

bullying (Deniz & Toseeb, 2023; Moore et al., 2017), having special educational needs (Deighton et al., 2019), and experiencing familial socioeconomic deprivation (Verhulst & Tiemeier, 2020) as being predictive of emotional distress in children and adolescents. Interestingly, several previously established risk factors such as relative age (Patalay et al., 2015) were not confirmed in our analysis, and low prior academic attainment actually predicted *lower* levels of later emotional distress (hence the decision to recode the risk factor designation in our analyses – see *Constructing the CRE Index*). This surprising finding may reflect greater complexity in the relationship between attainment and emotional distress than has previously been assumed. While it has traditionally been proposed that low academic attainment would increase emotional distress because of self-perceived failure, there is evidence that this process may only (or particularly) apply to girls (Panayiotou & Humphrey, 2017; Verboom et al., 2014). Furthermore, although studies have often cited negative relationships between greater attainment and mental health difficulties, it has been suggested that perhaps high attainment and corresponding engagement in more challenging academic work could result in increased workload and pressure, thus heightening stress and the associated risk of difficulties. Patalay and Fizzimons (2018) reported that *higher* cognitive ability – typically predictive of greater academic

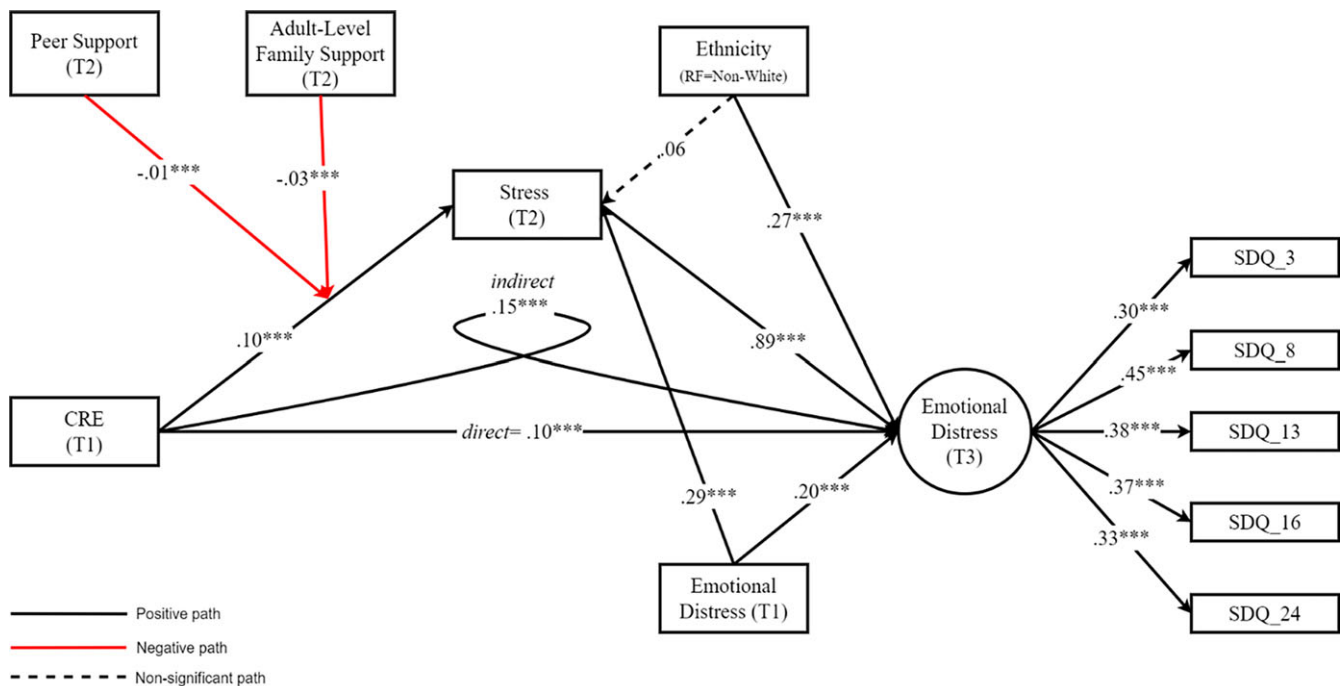


Figure 2. Reported moderated mediation model.

attainment (Peng & Kievit, 2020) - was associated with poorer self-reported mental health among a UK sample of adolescents. Other evidence has indicated that high-performing students may be more emotionally affected by academic-related pressures (D'agostino et al., 2022). Further research examining potential complexities in how attainment may operate as a risk factor beyond a binary function may be useful, particularly giving growing concerns about the extent of academic pressure experienced by adolescents (The Lancet Child & Adolescent Health, 2023).

In line with Hypothesis 2, we found that perceived stress significantly mediated the association between CRE at T1 and emotional distress at T3. These effects were evident even after controlling for prior (T1) levels of emotional distress and covariates. Our findings therefore offer clear support for the theorized role of stress in explaining how CRE impacts later physical and mental health outcomes (Evans et al., 2013; Guidi et al., 2020). In particular, they add new evidence highlighting the importance of *perceived* stress as a mediating variable in this process, aligning with the transactional model (Cohen, 1986; Lazarus & Folkman, 1984). However, it is noteworthy that we only found evidence of partial, as opposed to full mediation, prompting consideration of other factors and processes (e.g., disruption of proximal developmental processes; Evans et al., 2013) that have been proffered. Further investigation is required to confirm such processes, including how they may intersect with stress appraisal mechanisms.

Peer and family adult social support as moderators of the impact of cumulative risk exposure on perceived stress (hypotheses 3 and 4)

In support of Hypotheses 3 and 4, we found that social support from both peers and parent/carers significantly moderated the impact of CRE on later perceived stress (i.e., adolescents reporting higher levels of support perceived significantly lower levels of stress

resulting from CRE compared to those reporting lower levels of support). These findings extend previous, cross-sectional evidence (e.g., Butler et al., 2022; Demkowicz, 2019) to show longitudinal effects, and offer support for the protective model, in which access to putative protective factors is theorized to moderate the impact of CRE on later emotional distress (Masten, 2014). As expected, protective-reactive effects were observed (i.e., each protective factor diminished, but did not completely eradicate, the expected association between CRE and later emotional distress; Fergus & Zimmerman, 2005).

These findings are important because though previous studies have found evidence that social connection moderates how negative life events influence mental health difficulties (e.g., Anderson et al., 2015; Ditzen & Heinrichs, 2014; Hazel et al., 2015), they have often focused on moderation of direct effects rather than underlying stress processes. Our findings therefore offer support for Cohen and Wills' (1985) stress buffering hypothesis, in which it is argued that social support functions to improve wellbeing by lessening the extent to which significant life challenges are experienced as stressful. Furthermore, they emphasize the importance of recognizing risk as non-deterministic and indeed socially embedded, whereby an adolescent's wider social context can influence the extent to which adversity is likely to lead to distress. Qualitative research has provided insight into the ways that social support processes can function as adolescents manage difficulties in their lives. For instance, Stapley et al. (2019) found that talking to trusted others and drawing on available social support can help individuals to cope with or resolve problems, navigate stressful situations, and cope with difficult feelings.

Strengths and limitations

The current study benefitted from a very large sample, longitudinal design, and use of robust, preregistered statistical modeling procedures to test theoretically informed hypotheses. Nonetheless,

there are numerous limitations that need to be borne in mind ahead of considering the implications of our findings. First, though our handling of candidate risk factors was in line with cumulative risk theory, it is important to acknowledge alternative models that would prompt different treatment of these data. For example, in the dimensional risk model, factors representing threat (i.e., the presence of harmful input, such as bullying victimization) and those representing deprivation (i.e., the absence of expected input, such as poverty) are differentiated, with distinct downstream consequences for later mental health outcomes (McLaughlin & Sheridan, 2019).

Second, as is the case with all secondary analyses, we were limited to those measures that were available in the dataset (in this case, the HeadStart longitudinal cohort). It is important to note, therefore, that our CRE index was not comprehensive (for example, established risk factors such as parental psychiatric symptoms (Wille et al., 2008) were not included). It should also be noted that the lack of a physiological stress measure in the dataset makes it challenging to differentiate the impact of perceived stress and physiological stress (i.e., does perceived stress simply act as a proxy for underpinning physiological stress, or does it yield distinct effects?). Furthermore, we acknowledge the concerns raised regarding the measures of perceived stress (Demkowicz et al., 2020) and emotional distress (Black et al., 2020) we used, while noting the steps taken to address these in the current study (e.g., modeling perceived stress as a two-item manifest variable).

Third, in focusing exclusively on the effects of peer and adult-level family support, we neglected internal protective factors, including for example self-efficacy (Klasen et al., 2014). Fourth, the purposive sampling of Local Authorities employed in the HeadStart study meant that it was not designed to be representative. Notably, the study sample were subject to somewhat higher levels of socioeconomic disadvantage than is seen nationally across England. Accordingly, caution is required in generalizing the findings of the current study to the broader adolescent population. Finally, the dataset used in the current study was generated prior to the onset of the COVID-19 pandemic. This is particularly important given its impact on adolescent mental health (Mansfield et al., 2022), and consequent implications for the nature and extent of risk factor exposure and access to protective factors (Kuhlman et al., 2021).

Implications

In demonstrating that CRE significantly predicts later adolescent emotional distress, that this relationship is partially mediated by perceived stress, and that both peer and adult-level family support significantly moderate the impact of CRE on later perceived stress, the current study provides support for both cumulative risk theory (Evans et al., 2013) and the protective model of adolescent resilience (Fergus & Zimmerman, 2005; Masten, 2014). This empirical delineation of the processes and mechanisms underpinning the development of emotional distress (and their moderation) also provides multiple practical implications. First and foremost, intervention to reduce risk factor exposure should be prioritized. Among the “variable” risk factors (i.e., those that can be changed; Furber et al., 2017) identified in the current study, some are reflective of broader structural inequalities (e.g., familial socioeconomic deprivation) that would require government action to remedy (Marmot, 2020), but others represent more immediately tractable issues (e.g., bullying victimization) that could feasibly be targeted through the implementation of school-based

interventions, for which there is a robust evidence base (Fraguas et al., 2021). For “fixed marker” risk factors (i.e. those that cannot be changed; Furber et al., 2017), notably gender, further research is required to better understand what factors place adolescent girls at significantly higher risk of experiencing emotional distress than boys, in order that opportunities to intervene to address or mitigate these factors can be identified (Patalay & Demkowicz, 2023).

The finding that perceived stress partially mediates the relationship between cumulative risk factor exposure and later emotional distress provides a second practical implication: intervention to modify stress appraisal processes. At the broadest level, aggregative reviews and meta-analytic evidence indicate that supporting and promoting relaxation, social problem solving and/or emotional regulation can be effective in helping adolescents to manage stress and increase coping skills (Kraag et al., 2006; Rew et al., 2014). However, our study also highlighted specific factors as being particularly important in modifying the effects of CRE on perceived stress, which brings us to our third practical implication: intervention to promote adult-level family and peer social support. With regard to the former, meta-analytic evidence indicates that intervening to improve parenting skills and/or the parent-child relationship can lead to small but meaningful reductions in emotional distress among children and adolescents, though targeted interventions yield stronger effects than universal, preventive programmes (Yap et al., 2016). In relation to the latter, a recent systematic review indicated that despite the widespread use of peer-led interventions (e.g., those involving peer mentoring, peer buddying, peer counselling and peer education), the evidence base for mental health outcomes is relatively sparse (King & Fazel, 2021). Given the findings of the current study, the development of efficacious approaches to peer-led interventions should therefore be prioritized in order to provide further opportunities to interrupt the processes through which CRE leads to emotional distress.

The above evidence pertaining to intervention efficacy assesses each substantive element *in isolation* (i.e., interventions to address identified risk factors; manage stress and increase coping; promote parenting support; or, foster peer support). This is not meant to imply they should be delivered in isolation; such a piecemeal, fragmented approach (i.e., “a program for every problem”) is unlikely to be successful or sustainable in the longer term (Domitrovich et al., 2010). It is therefore important to consider integrative frameworks that involve work across multiple tiers/levels and components (e.g., universal social and emotional skills curriculum to support well-being; identification of need; provision of targeted support; working with parents/carers; promotion of nurturing school ethos and environment), commonly referred to as the “whole school” approach to mental health promotion (Demkowicz & Humphrey, 2019). However, few interventions are *truly* whole school in nature, which means that the adoption of a whole-school approach is likely to involve drawing together a number of distinct interventions in an overarching framework (Domitrovich et al., 2010). By way of illustration, consider the Australian “Be You” mental health initiative, which comprises five strands: (i) learning resilience; (ii) early support; (iii) family partnerships; (iv) responding together; and (v) mentally healthy communities. Resources and professional development opportunities are provided to support the delivery of each strand. One key resource is a directory of over 80 programs that map onto one or more of the above strands, providing information on area(s) of focus, evidence base, theoretical framework, structure, and other salient features. One can easily envisage how the findings of the current study could be applied as part of the intervention selection

process to provide a tailored yet comprehensive whole school response (for example, screening and intervention to reduce risk factor exposure as part of the early support strand; intervening to improve parenting skills and/or the parent-child relationship as part of the family partnerships strand).

Conclusion

In the current study, preregistered longitudinal moderated mediation analyses of a large adolescent cohort dataset were used to test a series of hypotheses relating to the association between CRE and later emotional distress; the mediating role of perceived stress in the relationship between CRE and later emotional distress; and, the moderating effects of peer and adult-level family support on the relationship between CRE and later perceived stress. Based on these analyses, we conclude that CRE predicts later adolescent emotional distress; that this relationship is partially mediated by perceived stress; and, that both peer and adult-level family support can moderate the impact of CRE on later perceived stress. Collectively, our findings provide support for both cumulative risk theory (Evans et al., 2013) and the protective model of adolescent resilience (Fergus & Zimmerman, 2005; Masten, 2014), while also providing insights into when and how we might intervene to disrupt the processes and mechanisms underpinning the development of emotional distress in adolescence.

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