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Research paper

Peer problems and prosocial behaviours across development: Associations with anxiety and depression in emerging adulthood

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ABSTRACT

Peer problems in childhood and adolescence are associated with anxiety and depression in emerging adulthood. However, it remains unclear whether prosocial behaviours reduce this risk and whether these associations remain after adjusting for familial factors, including genetics. The present study examined how the development of peer problems and prosocial behaviours across childhood and adolescence were associated with anxiety and depression in emerging adulthood, and whether these associations remained when using a monozygotic twin difference design. The study included up to 31,016 participants (50.4 % female) from the Twins Early Development Study (TEDS; N = 19,758) and the Avon Longitudinal Study of Parents and Children (ALSPAC; N = 11,258), with sample sizes varying across analyses based on data availability. Repeated data were collected from ages 4 to 26/28 (TEDS/ALSPAC). Results from latent growth curve and path analyses showed that higher initial levels of peer problems and prosocial behaviours in childhood, as well as more persistent peer problems and prosocial behaviours during childhood, increased risk for anxiety and depression in emerging adulthood. Associations with peer problems remained significant after adjusting for familial factors using monozygotic twin difference scores, suggesting that individual-specific experiences, like children's responses to peer problems, may explain why peer problems increase risk for later anxiety and depression. In contrast, associations with prosocial behaviours did not remain significant after adjusting for familial factors, indicating that whilst prosocial behaviours in childhood were associated with higher levels of anxiety and depression in emerging adulthood, this was largely explained by genetic or environmental factors shared within the family.

1. Introduction

Anxiety and depression are the most prevalent mental health issues among young adults, with rates steadily increasing in recent years (Goodwin et al., 2020; Kessler et al., 2012; Mojtabai et al., 2016). Understanding the factors driving the risk for these mental health conditions is essential to prevent their escalation and recurrence later in life (Moffitt et al., 2007), as anxiety and depression affect young people's physical and mental health, quality of life, and academic performance (Cohen et al., 2015; Kessler et al., 2011; Mojtabai et al., 2015).

Social experiences during childhood and adolescence play a key role in young people's emotional health and well-being. Negative

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interpersonal experiences, such as peer problems, are strongly associated with higher levels of anxiety and depression (Moore et al., 2017; Reijntjes et al., 2010; Ttofi et al., 2011). Children and adolescents who experience peer victimisation, one form of peer problems, are more likely to develop later anxiety and depression (Moore et al., 2017). Conversely, research indicates that engaging in prosocial behaviours, such as being considerate of others' feelings, helping others, sharing, or volunteering, is associated with better mental health, in particular less depression (Memmott-Elison et al., 2020). Displaying prosocial behaviours may reinforce feelings of belongingness and connectedness, which can contribute to better mental health through positive social interactions (Penner et al., 2005).

Studies on peer problems show consistent findings regarding their association with anxiety and depression, but those on prosocial behaviours indicate mixed findings. Whereas most cross-sectional studies suggest that prosocial behaviours contribute positively to mental health, a more complex pattern emerges when examining results from longitudinal studies (Memmott-Elison et al., 2020). Trajectories of consistent and frequent prosocial behaviours over time have been associated with both high and low levels of anxiety and depression symptoms (Flynn et al., 2015; Groeben et al., 2011; Hay and Pawlby, 2003; Perren et al., 2007). These different patterns of associations may be explained by child and family characteristics, such as sex and socioeconomic status (Nantel-Vivier et al., 2014). For example, girls and participants living in low income households may be more likely to experience consistently high levels of prosocial behaviours and depression symptoms (Nantel-Vivier et al., 2014). It remains unclear whether promoting prosocial behaviours during childhood and adolescence may help prevent the long-term risk for anxiety and depression during the transition to emerging adulthood.

Twin studies show that genetic factors contribute to peer problems and prosocial behaviours (Fisher et al., 2015; Knafo-Noam et al., 2018), and that these genetic influences are often shared with anxiety and depression (Brendgen et al., 2022; Morneau-Vaillancourt et al., 2023). Accounting for this genetic overlap is crucial to better understand whether peer problems and prosocial behaviours are associated with anxiety and depression beyond genetic risk. Interventions are likely to be ineffective if these associations are entirely accounted for by familial factors. One way to account for familial factors is to use the monozygotic (MZ) twin difference design. Not only does this method adjust for common genetic influences on anxiety and depression and peer problems/prosocial behaviours, but it also accounts for environmental factors shared by co-twins, such as family socioeconomic status. Because MZ twins share 100 % of their genes and family background, differences between MZ co-twins can only be explained by environmental influences that are unique to each twin (also called non-shared environment).

Studies using the MZ twin difference method have shown that peer problems are associated with anxiety and depression over and above familial confounding (Arseneault et al., 2008; Baldwin et al., 2019; Matthews et al., 2022; Silberg et al., 2016). However, studies focused on prosocial behaviours are lacking. One mechanism by which prosocial behaviours may support mental health is by increasing social acceptance, which in turn may provide social support and appraisal to individuals engaging in prosocial behaviours (Oberle et al., 2023). Efforts to promote prosocial behaviours among young people could therefore have cascading positive influence on their social environment. Before targeting prosocial behaviours as a mechanism to reduce anxiety and depression, it is important to elucidate whether this association remains beyond familial influences.

Four gaps in the literature limit our understanding of the association between peer problems/prosocial behaviours and anxiety and depression. First, longitudinal studies on prosocial behaviours covering multiple developmental windows (childhood, adolescence, emerging adulthood) are rare, as most studies followed participants over childhood (Flynn et al., 2015; Groeben et al., 2011; Hay and Pawlby, 2003; Perren et al., 2007; Nantel-Vivier et al., 2014). It is unclear how the development of prosocial behaviours throughout childhood and adolescence (initial levels and rate of change) contribute to the long-term risk for anxiety and depression, across important developmental transitions and into emerging adulthood. Second, many studies have relied on a single informant, often parents or children, to assess peer problems and prosocial behaviours (Moore et al., 2017; Memmott-Elison et al., 2020). However, parents and children tend to only moderately agree on their ratings of peer problems ($r = 0.36$) and prosocial behaviours ($r = 0.30$) (Bergström and Baviskar, 2021). Parents often underestimate their child's peer problems while overestimating their child's prosocial behaviours compared to the children's own assessments (Booth et al., 2023). Using a multi-informant approach could provide a more comprehensive view of children's social experiences and behaviours (Aebi et al., 2017). Third, it is unclear whether the development of prosocial behaviours is differentially associated with anxiety and depression, as most longitudinal studies aggregated both types of symptoms into a general internalising or emotional problems measure (Flynn et al., 2015; Groeben et al., 2011; Hay and Pawlby, 2003; Perren et al., 2007). Fourth, there is limited understanding of whether prosocial behaviours are linked to more severe expressions of mental health problems, such as anxiety and depressive disorders, with most studies focusing only on symptoms (Memmott-Elison et al., 2020).

The present study addresses these gaps through the following research questions. First, to what extent are initial levels of peer problems and prosocial behaviours in childhood and their rate of change across childhood and adolescence associated with anxiety and depression in emerging adulthood? Second, do these associations remain after adjusting for familial factors, including shared genetic and environmental influences? Third, to what extent do these associations compare when using parent versus child reports of peer problems and prosocial behaviours? Fourth, to what extent do these associations compare when using measures of anxiety versus depression, as well as symptoms versus disorder diagnoses of anxiety and depression?

2. Methods

2.1. Participants and procedures

Participants were from two longitudinal UK cohorts, the Twins Early Development Study (TEDS) and the Avon Longitudinal Study of Parents and Children (ALSPAC). In TEDS, 13,759 families with newborn twins participated in the first assessment wave at 18 months. Families were recruited from a national register of twins born in England and Wales between 1994 and 1996 (see cohort profiles for more details) (Rimfeld et al., 2019; Lockhart et al., 2023). The present study also used data from individual children participating in ALSPAC (G1) (Boyd et al., 2013; Fraser et al., 2013; Northstone et al., 2019). In ALSPAC, pregnant women resident in Avon, UK with expected delivery between 1st April 1991 and 31st December 1992 were invited to take part in the study. A total of 14,901 children alive at 1 year of age participated in ALSPAC. Additional cohort information is provided in the supplementary materials. Both TEDS and ALSPAC assessed participants' behavioural, cognitive, and emotional development from infancy to adulthood. Data were collected from ages 4 to 26 in TEDS and ages 4 to 28 in ALSPAC. Ethical approval for TEDS was granted by the King's College London Research Ethics Committee (References: PNM/09/10–104 and HR/DP-20/2122060). Consent was obtained before data collection at every wave. Ethical approval for ALSPAC was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees. Informed consent for the use of data collected via questionnaires and clinics was obtained from participants following the recommendations of the ALSPAC Ethics and Law Committee at the time.

The present study used the highest number of participants available at each step of analysis. In the first step, a maximum of 19,758 participants from TEDS and 11,258 participants from ALSPAC were included to

estimate latent growth curves of peer problems or prosocial behaviours, as they had at least one available data point between early childhood and emerging adulthood. In the second step, a maximum of 7569 participants from TEDS (1085 complete MZ twin pairs) and 3948 participants from ALSPAC were included to estimate path analyses with anxiety and depression outcomes measured at ages 24, 26, or 28. These were participants for whom data on covariates in early childhood and outcome measures in emerging adulthood were available. The exact number of participants included in each model tested are provided in Table S1 and S2.

2.2. Measures

2.2.1. Peer problems and prosocial behaviours in childhood, adolescence, and emerging adulthood

In TEDS and ALSPAC, peer problems and prosocial behaviours were evaluated using the Strengths and Difficulties Questionnaire (SDQ) (Goodman et al., 1998).. In TEDS, parents reported on their child's peer problems and prosocial behaviours at ages 4, 7, 9, 12, and 21. At age 16, parents reported on prosocial behaviours but not peer problems. TEDS twins provided self-reports of their peer problems and prosocial behaviours at ages 9, 12, 16, 21, and 26. In ALSPAC, parents reported on their children at ages 4, 7, 8, 10, 11, 13, and 17. Although teacher reports were available in TEDS at ages 7, 9, and 12 and in ALSPAC at ages 8 and 11, we did not include them as these measures did not cover the entire period from childhood through adolescence. Similarly, self-reported SDQ was available in ALSPAC at age 25, but we did not include this measure for the same reason. In both TEDS and ALSPAC, peer problems and prosocial behaviours were evaluated using 5 items assessing how things had been over the last 3, 6, or 12 months on a 3-point scale. For each subscale, the average response on all items was multiplied by the total number of items (i.e., 5) to account for participants who had missing items. Participants who answered 3 out of 5 available items were included. Scores ranged from 0 to 10, with higher scores representing more peer problems or more prosocial behaviours. Items are available on the TEDS Data Dictionary: https://www.teds.ac.uk/datadictionary/home.htm.

2.2.2. Anxiety and depression symptoms in emerging adulthood

At age 26, participants in TEDS reported current symptoms of anxiety and depression using four scales: Generalised Anxiety Disorder Assessment, 2-item version (GAD-2) (Spitzer et al., 2006), Generalised Anxiety Disorder - Dimensional (GAD—D) (Lebeau et al., 2012), Patient Health Questionnaire, 2-item version (PHQ-2) (Kroenke et al., 2001), and short Mood and Feelings Questionnaire (sMFQ) (Angold et al., 1995). The GAD-2 and PHQ-2 assessed how often participants had been bothered by emotional problems in the past two weeks on a 4-point scale. The GAD-D included ten items assessing the frequency of thoughts, feelings and behaviours often tied to concerns about family, health, finances and work during the past seven days on a 5-point scale. The sMFQ assessed how participants had been feeling or acting in the past two weeks on a 3-point scale. In TEDS, scores on the GAD-2 and GAD-D were strongly correlated ($r = 0.75$). The same was found for scores on the PHQ-2 and sMFQ ($r = 0.76$). Therefore, we computed an average score for anxiety symptoms using z-standardised scores on GAD-2 and GAD-D and for depression using the PHQ-2 and sMFQ.

In ALSPAC, participants reported on current anxiety and depression symptoms at age 28 using the Generalised Anxiety Disorder Assessment, 7-item version similar to the GAD-2 mentioned above (GAD-7) (Spitzer et al., 2006) and the sMFQ (Angold et al., 1995).

2.2.3. Anxiety and depressive disorders in emerging adulthood

At age 26, participants in TEDS reported on lifetime diagnoses of anxiety or depressive disorder using two types of assessments: a brief and a detailed measure. In the brief measure, participants answered 0 = 'no' or 1 = 'yes' to the item: *'Have you ever been diagnosed with one or more of the following mental health problems by a professional, even if you don't have it currently?'*. Disorder categories included: generalised anxiety disorder; anxiety, nerves, or stress; social anxiety or social phobia; specific phobia; agoraphobia; panic disorder; panic attacks; depression. In the detailed measure, participants answered questions adapted from the Composite International Diagnostic Interview, Short Form (CIDI-SF) (Gigantesco and Morosini, 2008; Kessler et al., 1998). Lifetime diagnoses were evaluated using an algorithm reflecting DSM-5 criteria for generalised anxiety disorder, specific phobia, social anxiety, panic disorder, agoraphobia, and major depressive disorder (for more detail see (Davies et al., 2021)). Measures of disorders were binary, with 1 = 'ever had a disorder' and 0 = 'never had a disorder'. We combined all anxiety disorder measures into a single category, with 1 = 'any anxiety disorder' and 0 = 'no anxiety disorder'. This combination was deemed acceptable due to the high comorbidity and co-occurrence across anxiety disorders (Davies et al., 2023) and the moderate to strong correlations between the different anxiety disorders, and between brief and detailed measures, in this sample (tetrachoric $r = 0.31$ to 0.77). We also combined both brief and detailed lifetime diagnoses of depression into a single measure as they were strongly correlated (tetrachoric $r = 0.69$).

In ALSPAC, participants reported on current generalised anxiety disorder and depressive disorder at age 24 using the Clinical Interview Schedule-Revised (CIS-R) (Lewis, 1994). The CIS-R asked participants about depression symptoms occurring in the last week or month and provided a diagnosis assessment based on the International Classification of Diseases, Tenth Revision (ICD-10).

2.3. Statistical analyses

We conducted descriptive statistics and correlations using R version 4.2.3[45] and structural equation modelling in Mplus version 8.1 (Muthen and Muthen, 2017). We pre-registered the analysis plan: https://osf.io/sy8rw/?view_only=9df8959a64a241348c053aeeec16077d.

2.3.1. Latent growth curves of peer problems and prosocial behaviours

We specified six latent growth curve models to estimate the average trajectories of peer problems and prosocial behaviours: parent-reported peer problems in TEDS, parent-reported prosocial behaviours in TEDS, child-reported peer problems in TEDS, child-reported prosocial behaviours in TEDS, parent-reported peer problems in ALSPAC, and parent-reported prosocial behaviours in ALSPAC.

In latent growth curve models, latent factors can be specified to estimate the initial level (at age 4 or 9 years, also called intercept), rate of change (linear slope), acceleration or deceleration in the rate of change (quadratic slope), and more complex trajectory shapes (e.g., cubic or quartic slope). When models only include an intercept and a linear slope, the linear slope represents a constant rate of change over time. When models include higher order slope terms (e.g., quadratic, cubic or quartic), the linear slope represents the *early rate* of change, as the overall shape of the curve depends on the other slope terms. Higher order slope terms are used to model non-linear, more complex trajectories. The variance of latent factors can be fixed or freely estimated (i.e., random). When latent factors are fixed, the model estimates one average parameter for all participants. When latent factors are freely estimated or random, individual variation around the average intercept and slope parameters can be estimated, thereby providing an estimated trajectory for each participant.

For each model, we first specified a fixed-intercept model and progressively added one parameter at a time to increase the complexity of the growth curve. At each step, we assessed whether adding an additional parameter led to a better fit by evaluating different indices as suggested elsewhere (Curran et al., 2010): Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Standardised Root Mean Square Residual (SRMR). Models were estimated using full information maximum likelihood

(FIML) in ALSPAC to account for missing data. In TEDS, we used the maximum likelihood robust estimator (MLR) and cluster option to account for missing data and family relatedness (i.e., twin data). Participants with at least one available measure of peer problems or prosocial behaviours were included in models.

2.3.2. Path analyses to examine associations with anxiety and depression in emerging adulthood

After estimating the best-fitting latent growth curve models, we examined how each participant's initial levels (intercept) as well as their rate of change over time (slope) in peer problems and prosocial behaviours were associated with anxiety and depression in emerging adulthood.

We followed three steps. First, we specified path analysis models using intercept and slope estimates of parent reported peer problems and prosocial behaviours, in TEDS and ALSPAC separately. Second, we specified models using child reports in TEDS. Third, we specified models using both parent and child reports together in TEDS. To adjust for emotional symptoms and socioeconomic status at age 4, we included these variables as covariates in all models. Path analyses of continuous anxiety and depression symptoms were estimated using FIML in ALSPAC and MLR in TEDS to correct standard errors of the estimates to avoid biased statistical inferences (i.e., false positives) due to correlations between twins of the same family. Family structure in ALSPAC (137 siblings or 1.22 % of the total sample) was not accounted for as it was not expected to impact the findings considering the small number of related participants. For the binary outcomes of anxiety and depressive disorders, models were estimated using weighted least square mean and variance adjusted estimators (WLSMV). We included participants for whom data were available for the outcome variables and covariates (N for TEDS = 6741-7977; N for ALSPAC = 3672-3948; Table S2). Participants who had missing data on any of the explanatory variables, that is, intercept and slope for peer problems or prosocial behaviours, were excluded as models failed when trying to include these variables as endogenous.

2.3.3. Monozygotic twin difference analyses

We then conducted the same path analyses using MZ twin difference scores in TEDS ($N = 1085$ twin pairs) to examine whether associations could be observed beyond familial confounding. We computed difference scores for both explanatory and outcome variables by subtracting twin 1 from twin 2's score and randomly selecting twin order, as typically done in the twin difference method (Brendgen et al., 2017). To verify that we had sufficient statistical power to run these analyses using the subsample of MZ twins, we ran a power analysis using the package "pwr" in R version 4.2.3 (R Core Team, 2023). For 80 % power to detect an effect of 0.02 in a regression model including 10 predicting variables (as in our main models), a sample size of $N = 810$ was sufficient.

3. Results

3.1. Descriptive results

In both cohorts, higher parent-reported peer problems were associated with fewer parent-reported prosocial behaviours within and across time points ($r = -0.08$ to -0.30; Table S3 for TEDS and Table S4 for ALSPAC). Similar correlations were found for child reports in TEDS ($r =$ 0.00 to -0.27). In TEDS, we observed weak to moderate agreement between parent and child ratings of peer problems ($r = 0.13$ to 0.47) and prosocial behaviours ($r = 0.15$ to 0.35) (Table S3).

By age 26, 49 % of TEDS participants had been diagnosed by a professional (single-item self-reported measure) or met diagnostic criteria (detailed symptoms-based self-reported measure) for lifetime experience of any anxiety disorder (Table 2). For lifetime major depressive disorder, the prevalence was 39 %. In ALSPAC, 10 % and 11 % of participants met current diagnostic criteria for generalised anxiety disorder and major depressive disorder, respectively, at age 24. The difference in the number of participants meeting diagnostic criteria across cohorts is due to TEDS evaluating lifetime diagnoses, while ALSPAC assessed current diagnoses. As TEDS included several measures of anxiety and depression, we provide additional descriptive statistics in Table S5.

3.2. Latent growth curves of peer problems and prosocial behaviours

In TEDS and ALSPAC, latent growth curve models for peer problems and prosocial behaviours from childhood to emerging adulthood showed a good fit: RMSEA $\leq$0.07, CFI $\leq$ 0.90, TLI $\leq$ 0.90 (Fig. 1 and Table 1, S1). All models included a random intercept, random linear slope, fixed quadratic slope, and fixed cubic slope. Significant variance around the intercept and linear slope indicated that participants varied in their initial levels and early rate of change in peer problems and prosocial behaviours. Including a random quadratic slope led to estimation problems. Therefore, we were unable to examine whether participants varied in their level of acceleration or deceleration in peer problems or prosocial behaviours.

3.3. Associations with anxiety and depression in emerging adulthood

Using path analysis, we examined whether initial levels and early rate of change in peer problems and prosocial behaviours were associated with anxiety and depression in emerging adulthood (Fig. 2A, B and Table S2). We specified different models including parent reports of peer problems and prosocial behaviours, child reports of peer problems and prosocial behaviours, and parent and child reports together.

3.4. Parent reports of peer problems and prosocial behaviours in TEDS and ALSPAC

Results of models using parent reports of peer problems and prosocial behaviours were consistent in TEDS and ALSPAC and when comparing symptoms and disorders of anxiety and depression (Fig. 2A, B and Table S2). Children for whom a parent reported that they experienced more peer problems at age 4 (initial levels) had higher levels of anxiety and depression symptoms at ages 26 (TEDS) or 28 (ALSPAC). They also had a higher likelihood of having an anxiety or depressive disorder at age 24 (ALSPAC) or by age 26 (TEDS). Early rate of change in peer problems was also positively associated with later anxiety and depression. Because most participants showed decreasing peer problems after age 4 (i.e., their linear slope was negative; see Table 1), participants whose parents reported more *stable* peer problems after age 4 showed higher levels of anxiety and depression at ages 24, 26, or 28. Initial levels and early rate of change in parent-reported prosocial behaviours were not associated with anxiety and depression.

3.5. Child reports of peer problems and prosocial behaviours in TEDS

In TEDS, models including child reports showed that both peer problems and prosocial behaviours were associated with later anxiety and depression, measured both as symptoms and disorders (Fig. 2B and Table S2). This contrasts with models including parent reports, which found that only peer problems, and not prosocial behaviours, were associated with later anxiety and depression. Children who reported more peer problems initially at age 9 were at higher risk for later anxiety and depression. The early rate of change in peer problems, starting at age 9, was positively associated with later anxiety and depression. Because most participants reported decreasing peer problems after age 9 (i.e., their linear slope was negative; see Table 1), participants who reported more *stable* peer problems after age 9 had higher levels of anxiety and depression at age 26. The early rate of change (linear slope) in peer problems over time was more strongly associated with anxiety and depression than initial levels at age 9 (intercept), suggesting that early

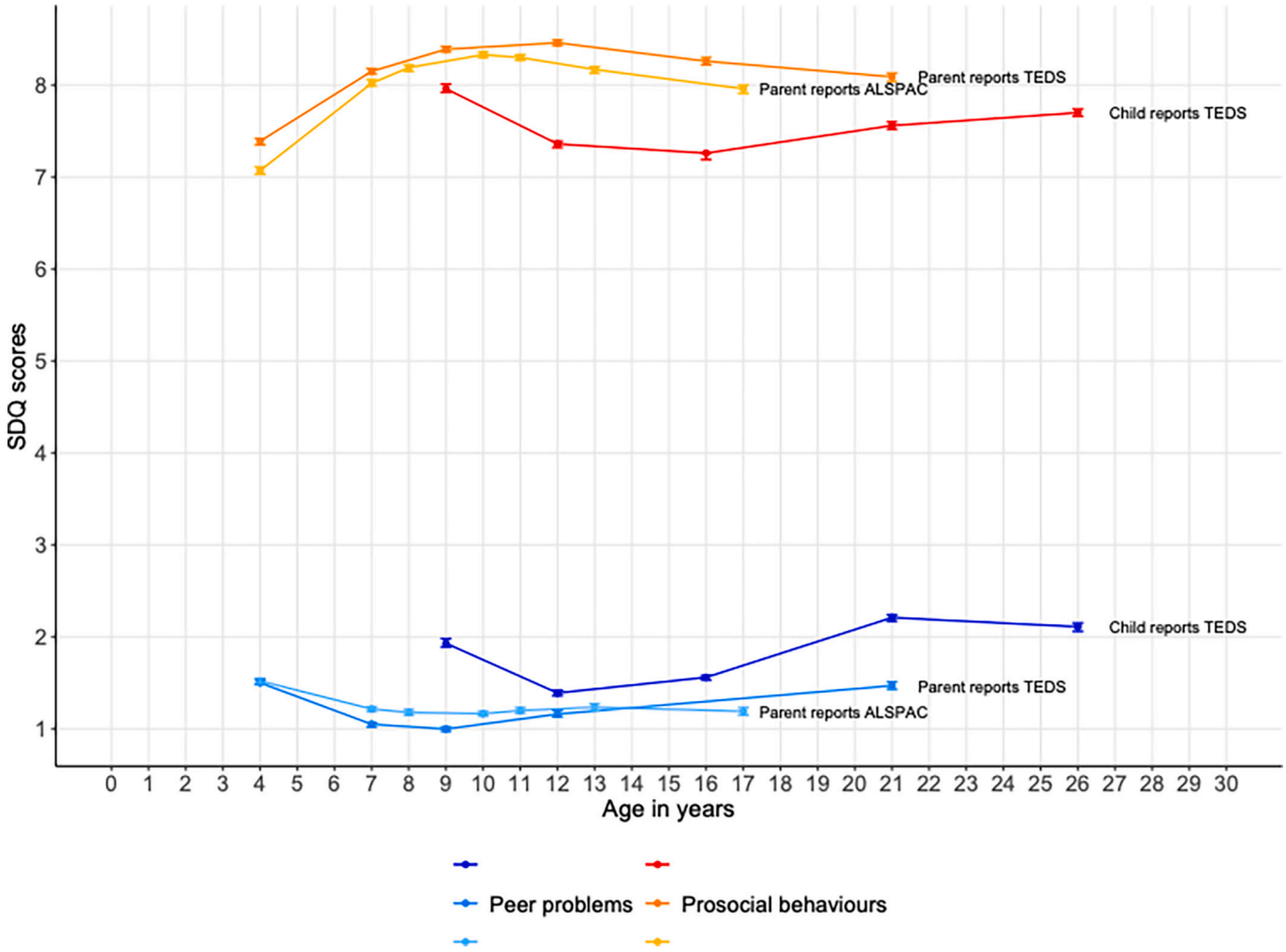


Fig. 1. Latent growth curve models of prosocial behaviours and peer problems in TEDS and ALSPAC. Note. Abbreviations: TEDS = Twins Early Development Study; ALSPAC = Avon Longitudinal Study of Parents and Children; SDQ = Strengths and Difficulties Questionnaire. SDQ scores ranged from 0 to 10. Latent growth curves were estimated in separate models.

change in self-reported peer problems may be more predictive of later anxiety and depression than initial levels in early childhood. In addition to peer problems, participants who reported engaging in more prosocial behaviours at age 9 (initial levels) experienced higher levels of anxiety and depression at age 26 (Fig. 2B). Because most participants reported engaging in progressively fewer prosocial behaviours after age 9 (i.e., their linear slope was negative; see Table 1), those who reported more stable prosocial behaviour after age 9 had higher levels of anxiety and depression at age 26.

3.6. Parent and child reports of peer problems and prosocial behaviours in TEDS

We used TEDS to include both parent and child reports simultaneously in the same model and compare their respective contributions to later anxiety and depression (Fig. 2B and Table S2). Again, initial levels and early rate of change in child-reported peer problems and prosocial behaviours were positively associated with anxiety and depression measured both as symptoms and as disorders. Associations with child reports remained similar to previous models. Most associations with parent reports vanished after including child reports, but three remained significant. Children who experienced more stable parent-reported peer problems after age 4 were more likely to have received an anxiety or depressive disorder by the age of 26. Children who engaged in progressively more prosocial behaviours after age 4 according to parent reports were *less* likely to have received a depressive disorder by the age of 26. This suggests that child reports may be more useful when evaluating risk for later anxiety and depression, but that parents may nonetheless provide additional information regarding the prediction of lifetime diagnosis of anxiety or depressive disorders in their child.

3.7. Monozygotic twin difference analyses

To examine whether the observed associations were robust to familial confounding, we carried out path analyses using MZ twin difference scores of intercepts and slopes of peer problems and prosocial behaviours in TEDS (Fig. 2B and Table S2). Associations with both initial levels and early rate of change in child-reported peer problems remained significant. In contrast, associations with prosocial behaviours were non-significant for the most part. Whereas peer problems increased risk for anxiety and depression even after adjusting for familial factors, the relationships between prosocial behaviours and anxiety and depression were driven by familial factors.

3.8. Sensitivity analyses

We ran sensitivity analyses to examine whether associations differed across sex, diagnosis measure (brief versus detailed), and type of anxiety disorder (generalised anxiety disorder, social anxiety, specific phobia, agoraphobia, panic disorder). We also ran post-hoc analyses in TEDS to

Table 1
Results of latent growth curve models of peer problems and prosocial behaviours in TEDS and ALSPAC.

	TEDS				ALSPAC	
	Child reports		Parent reports		Parent reports	
	Peer problems *N* = 15,973	Prosocial behaviours N = 15,985	Peer problems N = 19,531	Prosocial behaviours N = 19,758	Peer problems *N* = 11,254	Prosocial behaviours N = 11,258
Unstandardised estimate (standard error)						
Mean						
Intercept	1.93 (0.02)	7.96 (0.02)	1.50 (0.01)	7.39 (0.02)	1.52 (0.02)	7.06 (0.02)
Linear slope	−0.31 (0.01)	−0.30 (0.01)	−0.25 (0.01)	0.35 (0.01)	−0.16 (0.01)	0.47 (0.01)
Quadratic slope	0.05 (0.00)	0.04 (0.00)	0.04 (0.00)	−0.04 (0.00)	0.02 (0.00)	−0.06 (0.00)
Cubic slope	−0.001 (0.00)	−0.001 (0.00)	−0.001 (0.00)	0.001 (0.00)	−0.001 (0.00)	0.002 (0.00)
Variance						
Intercept	0.98 (0.05)	1.40 (0.05)	0.90 (0.03)	1.53 (0.04)	1.11 (0.03)	1.98 (0.05)
Linear slope	0.01 (0.00)	0.01 (0.00)	0.003 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
Quadratic slope	–	–	–	–	–	–
Cubic slope	–	–	–	–	–	–
Covariance						
Intercept with linear slope	−0.04 (0.00)	−0.05 (0.00)	−0.01 (0.00)	−0.04 (0.00)	−0.02 (0.00)	−0.07 (0.01)
Residual variance						
Outcome age 4	–	–	1.54 (0.03)	2.10 (0.04)	1.41 (0.03)	2.27 (0.05)
Outcome age 7	–	–	1.14 (0.03)	1.67 (0.03)	1.03 (0.03)	1.39 (0.03)
Outcome age 8	–	–	–	–	1.15 (0.03)	1.62 (0.04)
Outcome age 9	2.20 (0.07)	2.10 (0.06)	1.32 (0.06)	1.45 (0.05)	–	–
Outcome age 10	–	–	–	–	1.02 (0.03)	1.16 (0.03)
Outcome age 11	–	–	–	–	1.06 (0.03)	1.22 (0.03)
Outcome age 12	1.67 (0.05)	2.42 (0.05)	1.30 (0.04)	1.44 (0.04)	–	–
Outcome age 13	–	–	–	–	1.17 (0.04)	1.33 (0.04)
Outcome age 16	1.47 (0.04)	2.55 (0.05)	–	2.07 (0.06)	–	–
Outcome age 17	–	–	–	–	1.20 (0.06)	1.78 (0.06)
Outcome age 21	1.86 (0.04)	2.13 (0.05)	1.64 (0.08)	1.82 (0.07)	–	–
Outcome age 26	0.85 (0.05)	1.52 (0.06)	–	–	–	–

Note. Abbreviations: TEDS = Twins Early Development Study; ALSPAC = Avon Longitudinal Study of Parents and Children.
All estimates were statistically significant, $p < .001$. Each model was conducted separately. In all models, the variance of the latent factors for the quadratic and cubic slope was fixed to 0.

investigate why prosocial behaviours were associated with increased risk for anxiety and depression in our data, as this finding is inconsistent with some existing studies (Memmott-Elison et al., 2020).

3.8.1. Sex differences

Two-sample *t*-test and chi-square tests showed that males experienced more peer problems in childhood and adolescence (but not in emerging adulthood). Females engaged in more prosocial behaviours at all time points (Table 2). In emerging adulthood, females showed higher levels of anxiety and depression symptoms and disorders. When running latent growth curves separately for females and males, we found that the average trajectories for peer problems and prosocial behaviours differed across sexes (Fig. S1 and Table S6). On average, females consistently showed higher prosocial behaviours, and males consistently showed higher peer problems. Despite these sex differences, associations between peer problems and prosocial behaviours and later anxiety and depression did not differ between females and males (Fig. S2 and Table S7).

3.8.2. Measures of anxiety disorders

We examined associations with individual anxiety measures in TEDS, including brief single-item and detailed symptom-based measures of generalised anxiety disorder, social anxiety, panic disorder or attacks, agoraphobia, and specific phobia. Associations were similar across the different measures, which justified combining these measures in the main analyses (Fig. S3 and Table S8, S9, S10).

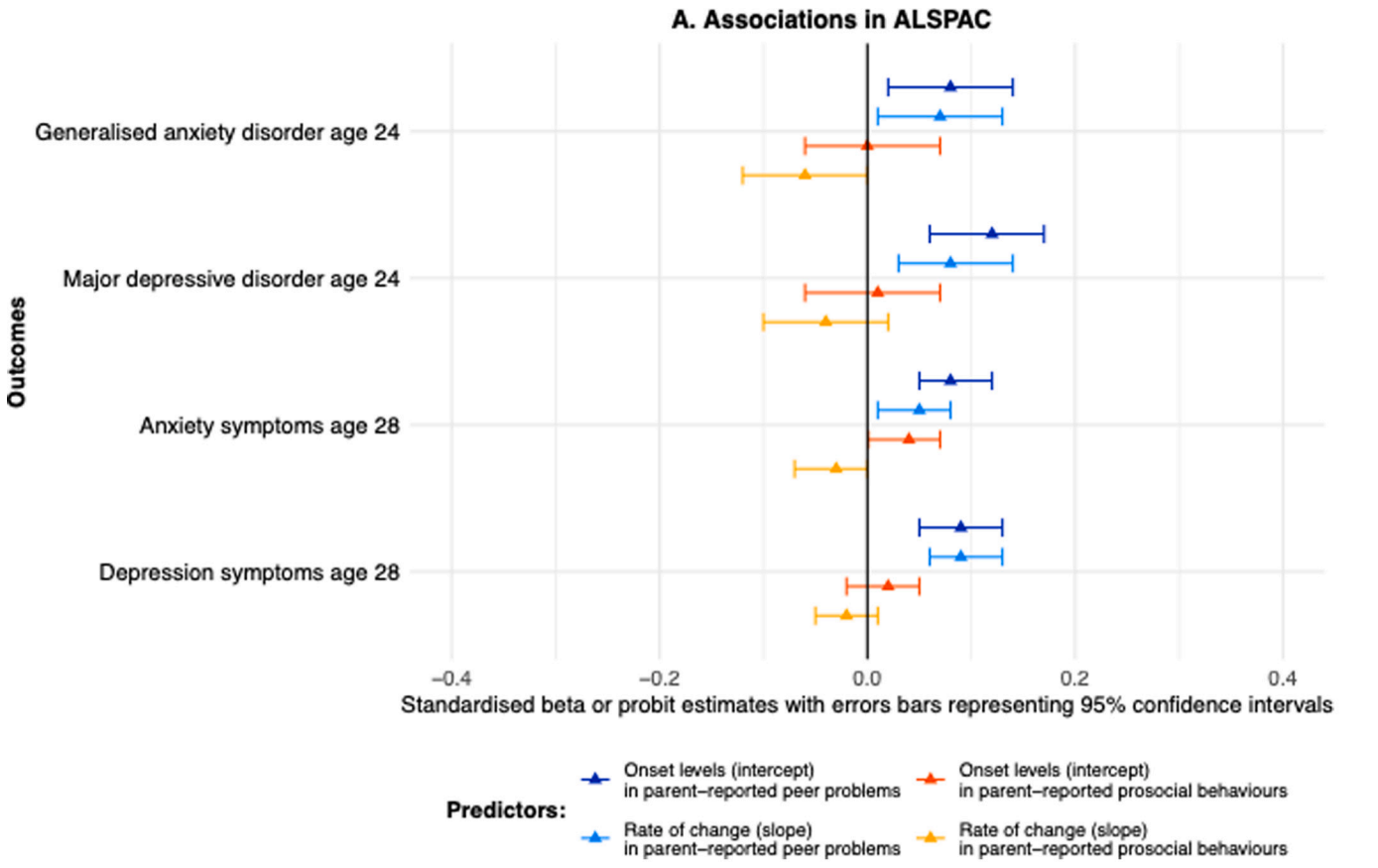
3.8.3. Exploring associations with child-reported prosocial behaviours in TEDS

To better understand why child-reported prosocial behaviours were related to higher anxiety and depression, we conducted sensitivity analyses in TEDS. These analyses are described in the Supplementary materials (Table S11, S13, S14, S15). Results show that, when omitting to adjust for peer problems, self-reported prosocial behaviours were associated with *lower* levels of depression symptoms and non-significantly associated with anxiety symptoms, anxiety disorders, and depressive disorder. However, when adding peer problems as an explanatory variable and thus accounting for the common variance between peer problems and prosocial behaviours, prosocial behaviours became associated with *higher* levels of anxiety and depression, both symptoms and disorders.

4. Discussion

The present study showed that early and persistent peer problems and prosocial behaviours uniquely contributed to higher levels of later anxiety and depression. Using two independent longitudinal samples of children followed up to emerging adulthood, including a twin study, we showed that peer problems increased the risk for later anxiety and depression after adjusting for familial factors. Engaging in more prosocial behaviours was associated with higher levels of anxiety and depression, but this association was mostly accounted for by genetic and environmental factors shared by twins growing up in the same family. Our findings extend previous work by 1) following participants over two decades across childhood, adolescence and emerging adulthood, 2) replicating findings in two different population-based cohorts with consistent results, 3) accounting for familial confounding including shared genetic and environmental influences, 4) gaining a more complete perspective of children's social experiences by harnessing parent and child reports, and 5) observing different manifestations of anxiety and depression with symptoms and disorders assessments.

In both samples, we found that parent reports of children's peer problems, but not prosocial behaviours, were related to participants' anxiety and depression in emerging adulthood. However, when considering both parent and child reports together, we found that mostly child - and not parent - reports of peer problems and prosocial



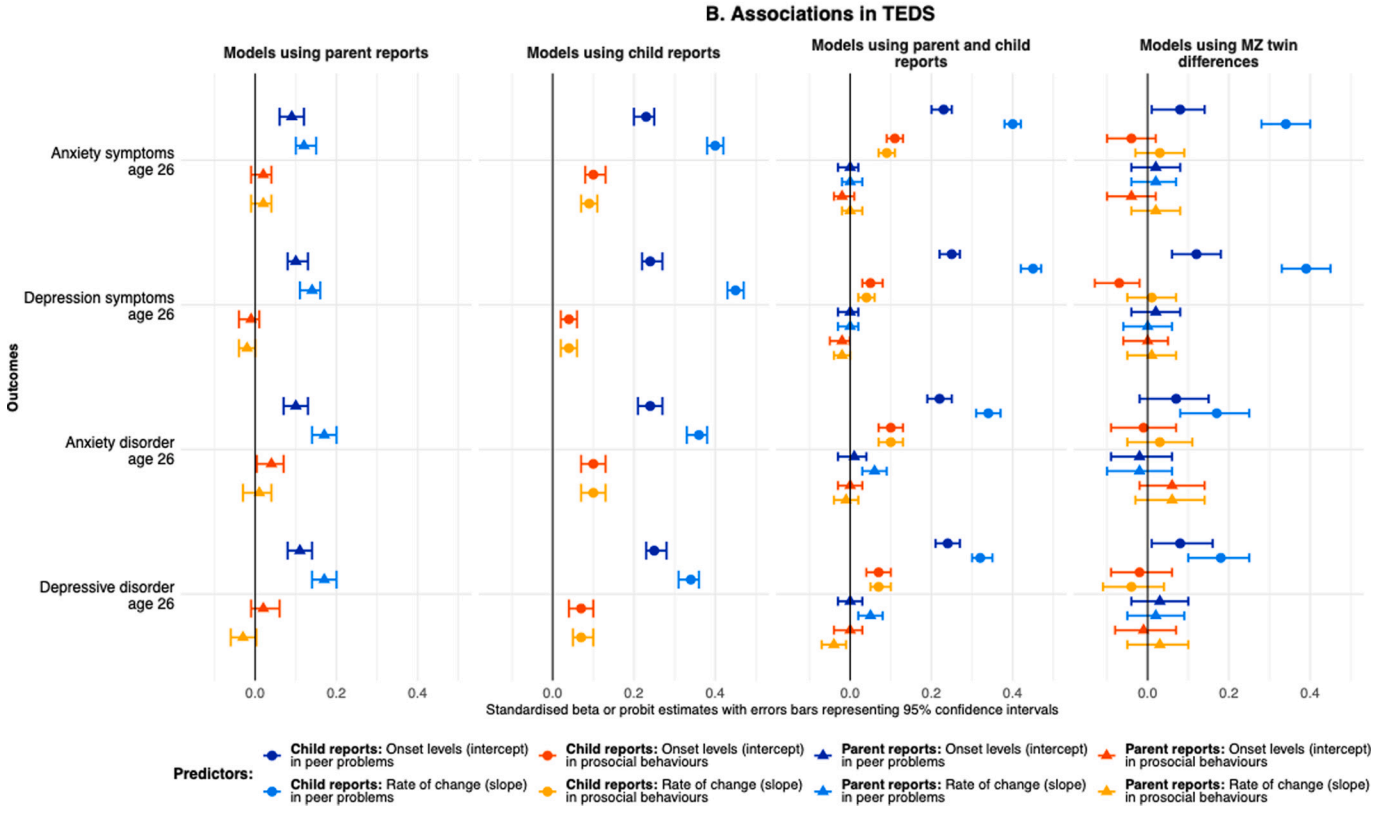


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Fig. 2. Associations between initial levels and rate of change in peer problems and prosocial behaviours and anxiety and depression in ALSPAC and TEDS. Note. Abbreviations: TEDS = Twins Early Development Study; ALSPAC = Avon Longitudinal Study of Child Development; MZ = monozygotic. Estimates and confidence intervals are presented in Table S2. Beta coefficients were estimated in models for anxiety and depression symptoms; probit coefficients were estimated in models for anxiety and depressive disorders. Error bars represent 95 % confidence intervals. Anxiety and depression symptoms in ALSPAC were assessed using the Generalised Anxiety Disorder 7-item (GAD7) and the short Mood and Feelings Questionnaire (sMFQ) respectively. Anxiety and depression disorders in ALSPAC were assessed using the Clinical Interview Schedule-Revised (CISR-R). Anxiety symptoms in TEDS represent a composite score computed from the average of standardised scores on the Generalised Anxiety Disorder-Dimensional (GAD-D) and Generalised Anxiety Disorder 2-item (GAD2). Depression symptoms in TEDS represent a composite score computed from the average of standardised scores on the Patient Health Questionnaire 2-item (PHQ-2) and sMFQ. Anxiety disorder in TEDS includes both brief and detailed diagnosis assessments of all lifetime anxiety disorders including GAD, social anxiety, specific phobia, agoraphobia, panic disorder. Depressive disorder in TEDS includes both brief and detailed diagnosis assessments of major depressive disorder. Baseline models adjusted for family socioeconomic status and child emotional symptoms at age 4 years. MZ twin difference models adjusted for child emotional symptoms at age 4 years.

Table 2
Descriptive statistics of main variables in TEDS and ALSPAC.

	N (% female)	M(SD)	M female (SD)	M male (SD)	Range (min-max)	% yes	% yes female	% yes male
TEDS								
Peer problems age 4 – parent	15,199 (51 %)	1.49 (1.51)	1.36* (1.42)	1.63* (1.59)	0; 10	–	–	–
Peer problems age 7 – parent	14,856 (52 %)	1.00 (1.43)	0.89* (1.30)	1.12* (1.54)	0; 10	–	–	–
Peer problems age 9 – parent	6624 (53 %)	1.06 (1.55)	0.96* (1.41)	1.18* (1.67)	0; 10	–	–	–
Peer problems age 12 – parent	11,381 (53 %)	1.10 (1.53)	0.98* (1.40)	1.24* (1.65)	0; 10	–	–	–
Peer problems age 21 – parent	10,346 (55 %)	1.41 (1.73)	1.42 (1.72)	1.39 (1.75)	0; 10	–	–	–
Prosocial behaviours age 4 – parent	15,222 (51 %)	7.37 (1.86)	7.65* (1.78)	7.08* (1.90)	0; 10	–	–	–
Prosocial behaviours age 7 – parent	14,858 (52 %)	8.19 (1.76)	8.49* (1.59)	7.87* (1.87)	0; 10	–	–	–
Prosocial behaviours age 9 – parent	6630 (53 %)	8.28 (1.71)	8.62* (1.51)	7.89* (1.84)	0; 10	–	–	–
Prosocial behaviours age 12 – parent	11,411 (53 %)	8.54 (1.65)	8.81* (1.50)	8.24* (1.75)	0; 10	–	–	–
Prosocial behaviours age 16 – parent	9894 (55 %)	8.23 (1.95)	8.49* (1.84)	7.90* (2.03)	0; 10	–	–	–
Prosocial behaviours age 21 – parent	10,357 (55 %)	8.13 (1.99)	8.37* (1.88)	7.84* (2.07)	0; 10	–	–	–
Peer problems age 9 – child	6520 (53 %)	1.93 (1.78)	1.85* (1.76)	2.02* (1.80)	0; 10	–	–	–
Peer problems age 12 – child	11,362 (53 %)	1.35 (1.58)	1.24* (1.53)	1.47* (1.63)	0; 10	–	–	–
Peer problems age 16 – child	9855 (56 %)	1.55 (1.50)	1.50* (1.48)	1.60* (1.52)	0; 10	–	–	–
Peer problems age 21 – child	9187 (62 %)	2.17 (1.80)	2.19 (1.86)	2.15 (1.70)	0; 10	–	–	–
Peer problems age 26 – child	7615 (66 %)	2.12 (1.74)	2.14 (1.78)	2.08 (1.67)	0; 10	–	–	–
Prosocial behaviours age 9 – child	6556 (53 %)	7.91 (1.84)	8.32* (1.64)	7.44* (1.94)	0; 10	–	–	–
Prosocial behaviours age 12 – child	11,365 (53 %)	7.45 (1.91)	7.91* (1.73)	6.93* (1.96)	0; 10	–	–	–
Prosocial behaviours age 16 – child	9852 (56 %)	7.13 (1.94)	7.62* (1.80)	6.51* (1.94)	0; 10	–	–	–
Prosocial behaviours age 21 – child	9189 (62 %)	7.65 (1.88)	8.02* (1.70)	7.04* (2.00)	0; 10	–	–	–
Prosocial behaviours age 26 – child	7615 (66 %)	7.76 (1.88)	8.08* (1.72)	7.16* (2.03)	0; 10	–	–	–
Current anxiety symptoms age 26	7879 (66 %)	0.00 (0.94)	0.12* (0.97)	−0.22* (0.83)	−1.06; 4.15	–	–	–
Current depression symptoms age 26	8040 (65 %)	0.01 (0.95)	0.08* (0.97)	−0.12* (0.88)	−1.09; 3.17	–	–	–
Lifetime anxiety disorder (any) age 26	7144 (74 %)	–	–	–	–	49	54[t]	37[t]
Lifetime major depressive disorder age 26	7805 (72 %)	–	–	–	–	39	42[t]	32[t]
ALSPAC								
Peer problems age 4 – parent	9508 (%)	1.52 (1.48)	1.41* (1.41)	1.63* (1.54)	0; 10	–	–	–
Peer problems age 7 – parent	8406 (%)	1.06 (1.43)	0.95* (1.30)	1.16* (1.53)	0; 10	–	–	–
Peer problems age 8 – parent	7770 (%)	1.31 (1.55)	1.22* (1.46)	1.41* (1.63)	0; 10	–	–	–
Peer problems age 10 – parent	8035 (%)	1.13 (1.52)	1.05* (1.41)	1.21* (1.61)	0; 10	–	–	–
Peer problems age 11 – parent	7341 (%)	1.11 (1.56)	1.02* (1.48)	1.21* (1.64)	0; 10	–	–	–
Peer problems age 13 – parent	7035 (%)	1.20 (1.61)	1.09* (1.49)	1.32* (1.72)	0; 10	–	–	–
Peer problems age 17 – parent	5646 (%)	1.11 (1.50)	1.04* (1.45)	1.20* (1.56)	0; 10	–	–	–
Prosocial behaviours age 4 – parent	9508 (%)	7.04 (1.97)	7.34* (1.86)	6.76* (2.01)	0; 10	–	–	–
Prosocial behaviours age 7 – parent	8410 (%)	8.17 (1.76)	8.49* (1.59)	7.86* (1.85)	0; 10	–	–	–
Prosocial behaviours age 8 – parent	7780 (%)	8.02 (1.89)	8.36* (1.73)	7.69* (1.98)	0; 10	–	–	–
Prosocial behaviours age 10 – parent	8053 (%)	8.31 (1.66)	8.63* (1.49)	8.01* (1.66)	0; 10	–	–	–
Prosocial behaviours age 11 – parent	7345 (%)	8.33 (1.69)	8.62* (1.54)	8.04* (1.78)	0; 10	–	–	–
Prosocial behaviours age 13 – parent	7041 (%)	8.21 (1.74)	8.46* (1.62)	7.96* (1.83)	0; 10	–	–	–
Prosocial behaviours age 17 – parent	5649 (%)	7.98 (1.89)	8.17* (1.80)	7.78* (1.95)	0; 10	–	–	–
Current anxiety symptoms age 28	4242 (66 %)	6.68 (5.46)	7.36* (5.65)	5.36* (4.8)	0; 21	–	–	–
Current depression symptoms age 28	4211 (63 %)	6.64 (6.01)	7.27* (6.36)	5.42* (5.36)	0; 26	–	–	–
Current generalised anxiety disorder age 24	3953 (63 %)	–	–	–	–	10	12[t]	07[t]
Current major depressive disorder age 24	3962 (63 %)	–	–	–	–	11	13[t]	07[t]

Note. Abbreviations: TEDS = Twins Early Development Study; ALSPAC = Avon Longitudinal Study of Parents and Children; N = number of participants; M = mean; SD = standard deviation.

*Significant Welch two-sample t-test, $p < .05$. [t]Significant chi-square test, $p < .05$.

Current anxiety and depression symptoms in TEDS were respectively assessed using the average of standardised scores on the 1) Generalised Anxiety Disorder 2-item (GAD2) and Generalised Anxiety Disorder-Dimensional (GAD-D), and 2) Patient Health Questionnaire 2-item (PHQ2) and short Mood and Feelings Questionnaire (sMFQ). Lifetime anxiety disorder in TEDS includes both brief (self-reported) and detailed diagnostic assessments of any anxiety disorder including GAD, social anxiety, specific phobia, agoraphobia, panic disorder. Brief assessments were based on a question asking whether participants had ever received a diagnosis from a professional. Detailed assessments were based on an adapted version of the Composite International Diagnostic Interview, Short Form [CIDI-SF]). Lifetime MDD in TEDS includes a brief assessment of depression and a detailed diagnostic assessment of major depressive disorder. Current anxiety symptoms in ALSPAC were assessed using the Generalised Anxiety Disorder 7-item scale (GAD7). Current depression symptoms in ALSPAC were assessed using the sMFQ. Generalised anxiety disorder and major depressive disorder in ALSPAC was assessed using the Clinical Interview Schedule-Revised (CIS-R).

behaviours were related to later anxiety and depression. Parents may be unable to witness some of their child's social experiences, for example interacting with peers at school. It could also be that parent ratings rely on the teacher and child informing the parent about the child's behaviours at school. Parents also reported higher prosocial behaviours than the children themselves at all time points, suggesting a positive bias when evaluating their children's prosocial behaviours. Despite this, we found a few significant associations with parent reports after considering child reports. The early rate of change in parent-reported peer problems and prosocial behaviours were associated with having experienced anxiety and depressive disorders by age 26. However, we found no association between parent reports and *current* symptoms of anxiety and depression at age 26. Therefore, parent reports of early change in peer problems and prosocial behaviours during childhood may provide a complementary point of view when assessing the risk that their child will receive an anxiety and depression disorder by age 26, but not when assessing the risk that their child will experience anxiety and depression symptoms at age 26. Parents may be more attuned to noticing behaviours associated with anxiety and depression in their children earlier in development, when they share a household (during childhood and adolescence) than in adulthood when children often live independently.

Children who experienced early and persisting peer problems reported higher levels of anxiety and depression at age 26. The rate of change in self-reported peer problems over time, from ages 4 to 26, was more strongly associated with later anxiety and depression than initial levels at age 4. The extent to which peer problems persisted over time, particularly during childhood, was more important for later anxiety and depression than their starting point at age 4. Our findings align with evidence suggesting that early and increasing peer problems are related to concurrent depression symptoms (Rudolph et al., 2011), but also contribute to knowledge by suggesting that focusing on how peer problems evolve during childhood may help identify those at risk of anxiety and depression in the long-term.

Self-reports of early and persistent prosocial behaviours were also associated with higher levels of anxiety and depression in emerging adulthood. This finding is inconsistent with cross-sectional studies showing that prosocial behaviours is associated with less depression symptoms (Memmott-Elison et al., 2020), but aligns with longitudinal studies indicating that prosocial behaviours may be related to higher risk for anxiety and depression (Groeben et al., 2011; Hay and Pawlby, 2003; Perren et al., 2007; Nantel-Vivier et al., 2014). Consistently engaging in prosocial behaviours over time, such as helping and comforting peers, may be an indicator of underlying dispositions, such as being sensitive to the opinion of others (e.g., people pleasing attitudes) (Tone and Tully, 2014; Zahn-Waxler et al., 2000), or moral cognition such as empathy concerns (Eisenberg et al., 1991; Van Der Graaff et al., 2018). Groeben and colleagues (Groeben et al., 2011) showed that children who engaged in prosocial behaviours but expressed low social participation and assertiveness with peers experienced more emotional difficulties. Children who are overly concerned with others' opinions may neglect their own social needs by avoiding social situations to alleviate their emotional symptoms, which could further exacerbate anxiety and depression. We also found that higher levels of prosocial behaviours in late adolescence and emerging adulthood were correlated with lower levels of anxiety and depression in emerging adulthood. Occasionally engaging in prosocial behaviours may partially alleviate anxiety and depression in the short term, a finding supported by studies conducted over short periods (Konac et al., 2021; Schacter and Margolin, 2019; Wang and Saudino, 2015). These associations may also be explained by young people having more control over who they surround themselves with in late adolescence and emerging adulthood, compared to childhood and early adolescence (Padilla-Walker et al., 2017). Engaging in prosocial behaviours in close relationships, rather than with peers in general, may be more rewarding and therefore associated with better mental health at these ages. Future studies should further explore the implications of prosocial behaviours for mental health by distinguishing sporadic displays of prosocial behaviours from more stable behavioural tendencies, and paying attention to when (at what age) and with whom (e.g., peers, close friends) young people engage in prosocial behaviours.

Considering whether children and adolescents experience peer problems may be important to better understand the relationship between self-reported prosocial behaviours and later manifestations of anxiety and depression. Before adjusting for peer problems, higher initial levels and more stable child-reported prosocial behaviours were associated with lower risk for depression symptoms at age 26. After adjusting for peer problems, initial levels and early stability in prosocial behaviours became associated with increased risk for anxiety and depression, both symptoms and disorders. For children with peer problems, prosocial behaviours may be differently related to anxiety and depression than they are for children without peer problems. Children with peer problems who still engage in prosocial behaviours might be doing so as a coping mechanism, which could correlate with elevated anxiety and depression (Groeben et al., 2011). Children who are socially isolated, excluded, rejected, or victimised by peers often have a lower social status and are less accepted by their peers (Sentse et al., 2015). Engaging in prosocial behaviours toward peers may not necessarily lead to more positive peer interactions for these children, which could affect their self-confidence in social situations, thereby contributing to increasing their long-term risk for anxiety and depression.

Our findings also shed light on the potential mechanisms that could explain why peer problems and prosocial behaviours are associated with higher levels of anxiety and depression. Compared to their co-twin, MZ twins who experienced more peer problems had higher levels of anxiety and depression. MZ twins completely share familial, including genetic, factors. This association can only be explained by experiences that are unique to each twin. This reinforces the possibility that peer problems contribute to anxiety and depression beyond familial risk, as shown in previous twin studies (Arseneault et al., 2008; Silberg et al., 2016; Singham et al., 2017). Experiences unique to each individual, such as how children respond to peer problems or how peer problems may impact children's ability to make friends, may play a role in explaining why children with peer problems are at higher risk for long-term anxiety and depression. Despite that more prosocial behaviours were associated with higher anxiety and depression between individuals across samples, these associations vanished after adjusting for genetic and environmental factors shared by MZ twins of the same family. Twin studies have shown a genetic overlap between prosocial behaviours and anxiety and depression symptoms in children (Wang and Saudino, 2015), and parenting and family income have been associated with trajectories of prosocial behaviours (Nantel-Vivier et al., 2014). Heritable or familial characteristics may explain why children who engaged in more prosocial behaviours had higher anxiety and depression in emerging adulthood. Interventions promoting prosocial behaviours during childhood and adolescence may be ineffective in reducing the long-term risk for anxiety and depression, as other familial factors likely play a role in these associations.

Finally, we found that associations were mostly consistent across different assessments of anxiety and depression in both TEDS and ALSPAC. Effect sizes were similar when comparing 1) anxiety versus depression, 2) symptoms and disorders of anxiety and depression, 3) current versus lifetime disorders of anxiety and depression, 4) brief single-item versus detailed symptom-based measures of anxiety and depression disorders, and 5) different anxiety disorders (generalised anxiety, social anxiety, phobia, agoraphobia, panic disorder). This suggests that peer problems and prosocial behaviours may increase risk for a wide range of different manifestations of anxiety and depression. It is also possible that the different measures of anxiety and depression overlapped to some extent, perhaps by tapping into a core internalising dimension (Caspi et al., 2014; Lahey et al., 2017).

The present study had four limitations. First, most participants were White, limiting the generalisation of findings to other groups in the

population. Second, child reports of peer problems and prosocial behaviours were more strongly associated with anxiety and depression outcomes, compared to parent reports. This could be explained by shared method variance, as anxiety and depression outcomes were also reported by children. Third, we were only able to examine the extent to which the *early* rate of change (linear slope), and not the extent to which it accelerated or decelerated over time, was related to outcomes. Models did not converge when estimating the variance of more complex slope parameters (quadratic, cubic). Fourth, because we used latent growth curve parameters (intercept and linear slope) as explanatory variables, we only adjusted for variables that were assessed at the start or prior to the latent growth curves (i.e., socioeconomic status and child emotional symptoms at age 4). Although we indirectly adjusted for a wide range of unobserved familial confounders by using the MZ twin difference method, other unmeasured variables may have accounted for the observed associations.

5. Conclusion

Our findings suggest that early and persistent peer problems and prosocial behaviours in childhood were uniquely associated with higher levels of anxiety and depression in emerging adulthood. Peer problems increased this risk after adjusting for familial factors, including shared genetic and environmental influences. In contrast, genetic or environmental factors shared by twins growing up within the same family accounted for the associations with prosocial behaviours. Targeting peer problems in schools, for example by raising awareness, could be an avenue to prevent later anxiety and depression. However, promoting prosocial behaviours may not be the most effective way of reducing risk for anxiety and depression, as familial factors likely explain why children and adolescents who engage in prosocial behaviours may experience elevated levels of anxiety and depression. Further research is needed to better understand the mechanisms underlying the association between prosocial behaviours and anxiety and depression in the long-term.

CRediT authorship contribution statement

Geneviève Morneau-Vaillancourt: Visualization, Software, Methodology, Formal analysis, Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Alex S.F. Kwong:** Validation, Software, Formal analysis, Data curation, Conceptualization, Writing – review & editing. **Katherine N. Thompson:** Validation, Conceptualization, Writing – review & editing. **Megan Skelton:** Methodology, Investigation, Conceptualization, Writing – review & editing. **Ellen J. Thompson:** Methodology, Investigation, Conceptualization, Writing – review & editing. **Elham Assary:** Methodology, Investigation, Conceptualization, Writing – review & editing. **Celestine Lockhart:** Methodology, Investigation, Conceptualization, Writing – review & editing. **Olakunle Oginni:** Methodology, Investigation, Conceptualization, Writing – review & editing. **Elisavet Palaiologou:** Methodology, Investigation, Conceptualization, Writing – review & editing. **Thomas McGregor:** Methodology, Investigation, Conceptualization, Writing – review & editing. **Louise Arseneault:** Validation, Supervision, Conceptualization, Writing – review & editing. **Thalia C. Eley:** Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization, Writing – review & editing.

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Declaration of competing interest

All authors have nothing to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2025.04.010.

Data availability

TEDS and ALSPAC data are available upon request. Procedures are described here: https://www.teds.ac.uk/researchers/teds-data-access-policy

https://www.bristol.ac.uk/alspac/researchers/access/

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