

Reciprocal developmental pathways between future-related thinking and symptoms of adolescent depression and anxiety: a systematic review and meta-analysis of longitudinal studies.

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Declarations

Conflict of interest

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Authors' contributions

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Abstract

Adolescence is a time when important decisions about the future are made and vulnerability to mental health problems increases. We reviewed longitudinal studies examining the reciprocal pathways between future-related thinking (hopelessness, hope, optimism/positive future expectations) and adolescent depression and anxiety symptoms. Evidence from 22 studies ($N=10,682$) found that negative future-related thinking predicted subsequent depression ($r=0.27, p<.001$), an effect still significant after controlling for baseline depression ($r=0.23, p<.001$). Higher hopelessness ($r=0.34, p<.001$), lower hope ($r=0.16, p<.001$), and reduced optimism/positive future expectations ($r=0.18, p<.001$) were associated with subsequently increased depressive symptoms. Negative future-related thinking also predicted later increased anxiety symptoms ($r=0.15, p=.021$). Concerning the reciprocal pathway, depressive symptoms were associated with later negative future-related thinking ($r=0.32, p<.001$), which remained after baseline levels of future-related thinking were controlled ($r=0.07, p=.02$). There were insufficient studies to infer reciprocal links between anxiety and future-related thinking. Our analyses provided evidence of a reciprocal developmental relationship between depressive symptoms and future-related thinking, implying a negative cycle. Identifying precursors of this cycle could provide the basis for depression prevention in adolescents and promote better decision-making about the future.

Keywords Depression, anxiety, adolescents, future-related thinking, longitudinal study, systematic review

1. Introduction

Adolescence is a formative period of social, physical and psychological development when the risk of developing mental health problems increases sharply, specifically depression and anxiety disorders (Costello et al., 2003; Kessler et al., 2007). Studies have reported that, globally, 34% of adolescents aged between 10 and 19 years are at risk of developing clinical depression, and around 22.5% of young people aged 17 to 25 years in the United Kingdom are estimated to have a probable mental health condition that is most likely to be depression or anxiety (Mojtabai et al., 2016; Newlove-Delgado et al., 2023; Shorey et al., 2022). The occurrence and frequency of depressive episodes during adolescence predict psychosocial, educational, and economic outcomes into adulthood and across the lifespan, including increased odds of later adverse mental health conditions, poor academic and professional attainments, and reduced life opportunities overall (Clayborne et al., 2019; Johnson et al., 2018; Naicker et al., 2013).

Adolescence is also a time when young people develop independence and autonomy and start to take responsibility for making decisions about their future relating to education, employment and relationships (Arnett, 2001; Mehta & LaRiviere, 2023; Scott, 2000; Steinberg, 2005; Steinberg & Morris, 2001). The ability to think clearly and realistically about the future, which is particularly relevant for making such decisions, encompasses both general future-related thinking, such as general feelings, attitudes, and expectations about the future (e.g., hopelessness, optimism/pessimism, feelings of control), as well as episodic future thinking. Episodic future thinking refers to the ability to mentally simulate likely personally relevant future scenarios and mentally experience their phenomenological characteristics, such as vividness (i.e., clear or blurry), valence (i.e., negative, positive, or neutral), and emotional intensity (i.e., how strong the emotions

accompanying the future thinking are; Atance & O'Neill, 2001). For example, adolescents may preview and pre-experience possible positive and negative future events and their impact on their lives, and consequently make decisions and prepare for those events accordingly (Markus & Nurius, 1986; McCue et al., 2019; Schubert et al., 2020).

Existing studies have suggested that depression and anxiety are associated with impairments in episodic future thinking in multiple domains relating to its content (i.e., what the future thinking is about), valence, and specificity (i.e., a particular event or generalised speculation). Depressed individuals were less likely to spontaneously generate thoughts about positive future events, compared with healthy controls (Dillon & Pizzagalli, 2018; Ji et al., 2019; MacLeod et al., 2010; MacLeod & Salaminiou, 2001; Miles et al., 2004). High levels of depression and anxiety symptoms were related to greater anticipation of negative future events as well as reduced vividness and specificity of positive future events and lower anticipatory pleasure from them (Gamble et al., 2019; Hallford, Barry, et al., 2020; MacLeod et al., 1996; MacLeod & Salaminiou, 2001). Highly anxious adolescents anticipated more negative future outcomes and reported more catastrophic thoughts about the future (Liang et al., 2021). In addition to episodic future thinking impairments, depressed young people experienced their future as pessimistic and out of control and were unable to imagine a clear picture of a future self (McCue et al., 2019; Tang, Pavlopoulou, et al., 2023; Williams et al., 2022).

The quality and quantity of future-related thinking are also associated with poor mental health symptoms, and certain cognitive biases in future-related thinking might drive or maintain depression (Lakshmi et al., 2023). One of the cognitive constructs that comprise Beck's Cognitive Triad, negative views of the future, where one holds irrationally negative beliefs about the future, is a well-established depressogenic factor

(Beck, 1979). The related domain of hopelessness, which is a feeling or state of despair towards the future, is a significant predictor of increased risk of both clinical depression and suicidal ideation (Abramson et al., 1989; Beck et al., 1993). A related but distinct domain to hopelessness is hope, which refers to an individual's belief in their capability to produce workable routes towards a desirable outcome (Cheavens, 2000). Hope was inversely correlated with depression and reduced the effects of negative repetitive thinking on increasing depressive symptoms (li et al., 2018; Sun et al., 2014). Moreover, feeling detached from one's future and showing less consideration for the consequences of current actions were related to greater future discounting and symptoms of both depression and anxiety in adolescence (Eaton et al., 2012; McCue et al., 2019; McKay et al., 2016; Percy et al., 2020; Reyna & Farley, 2006). However, most studies of the relationship between future-related thinking and mental health have focused on adulthood, and many have used cross-sectional designs, where the direction of effect cannot be established.

In this systematic review, we report the first comprehensive analysis and synthesis of longitudinal studies focused on adolescence with measures of future-related thinking and mental health. Our goal was to better understand the reciprocal relationship between future-related thinking and depression and generalised anxiety symptoms in adolescents. We searched for both studies measuring general future-related thinking and those examining episodic future thinking. The included studies mainly assessed general future-related thinking, of which we identified and focused on three domains: hopelessness, positive future expectations or optimism, and hope. Hopelessness and hope were kept separate because although correlated, they have been shown to be distinct constructs (Huen et al., 2015). We synthesised evidence both separately for each domain, and collectively pooling together the three domains, where possible. This was to

increase the statistical power to detect an existing effect and was also based on findings from a study examining higher-order future-related thinking constructs that high hopelessness, low hope, and fewer positive future expectations tended to constitute a common construct of maladaptive future thinking, which refers to feeling pessimistic and hopeless about the future (Tang et al., 2024; under review).

Our review aimed to first test whether variations in patterns of future-related thinking predicted depressive or anxiety symptoms in adolescents over time. Furthermore, we also tested the reciprocal pathway from depressive and anxiety symptoms to future-related thinking, that is, whether variations in depressive and anxiety symptoms predicted subsequent changes in patterns of future-related thinking.

2. Methods

2.1. Search strategy

We conducted a systematic review following Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidance (Moher et al., 2015). The review protocol was registered on PROSPERO (CRD42021233469). Four databases, MEDLINE (Ovid), PsycINFO (Ovid), Web of Science Core Collection, and ProQuest, were initially searched in March 2021 using the search template shown in Table 1. Additionally, we hand-searched Google Scholar and EthOS to identify articles not retrieved from the databases. Studies that were published after January 1980 to the point of the research were included. Search results were updated in June 2023, and again in February 2024.

Eligible criteria were studies that: (a) had prospective longitudinal design; (b) included at least one quantitative measurement of any future-related thinking domain (hopelessness, optimism/pessimism, vividness, specificity, valence, frequency etc.), either subjectively or objectively reported; (c) included quantitative measurement of

depression or anxiety symptoms; (d) included adolescents with a mean age older than 16 (inclusive) years and younger than 20 (exclusive) years (i.e., $16 \leq \text{mean age} < 20$), at the time of either baseline or follow-up assessment, and (e) were written in English and peer-reviewed. We excluded studies that were: (a) cross-sectional; (b) included participants with neurological disorders, pervasive developmental disorders or brain injuries; (c) reviews, case studies or conference reports; (d) focused solely on biological aspects, or (e) imaging or neurobiological studies.

The systematic review extracted estimates of prospective associations between future-related thinking and depressive or anxiety symptoms in adolescents aged 16-19 years. We restricted the age range to 16-19 years as we wanted to focus on this critical transitional period from late adolescence to early adulthood. This review was also conducted as part of a series of studies investigating the same age range.

Table 1. Search template, concepts, and terms.

Concept 1 Future-related thinking	AND	Concept 2 Depression or anxiety disorder	AND	Concept 3 Adolescents aged 16.0 to 19.9 years	AND	Concept 4 Study design
prospection, "prospective thinking", foresight, "mental time travel", "future think*", "episodic future", "future-directed thinking", "affective forecast*", "mental simulation", "think* about the future", "imagin* the future", "envision* the future", "anticipat* the future", "forecast* the future", "expect* the future", "generat* future event*", Optimis*, Pessimis*, Hope*, "time perspective", "future orient*", "future consciousness"		depressi*, anxiety, anxious, generalis\$ed anxiety disorder, GAD, worr*, "affective disorder*", "mood disorder*", anhedonia, "psychological distress", "emotional problem*"		adolescen*, "young people", "young person", teenage*, teen*, youth*, "young adult*"		"longitudinal", "prospective", "follow up", "cohort"

2.2. Selection process

The first search conducted in March 2021 returned 1,471 studies, of which 620 were identified from MEDLINE, 208 from PsycINFO, 567 from Web of Science, and 76 from ProQuest. Duplicate records (407) were removed before the remaining 1,064 studies were title and abstract screened applying the inclusion and exclusion criteria by the first author (PT). A second independent reviewer (AMB) reviewed a random selection of 25% of studies. Researchers were blinded to each other's decisions. Disagreements were resolved by joint discussions between the two researchers, and any unresolved disagreements were discussed with KKA, JPO, and ESB. The online platform CADIMA was used to facilitate screening and selection (<https://www.cadima.info/index.php>).

One-hundred and six studies were included for full-text screening by the first author (958 excluded following title and abstract screening). The second search conducted in June 2023 retrieved an additional 372 studies, of which 278 were title and abstract screened and 16 were full text screened. The updated search conducted in February 2024 retrieved another 129 studies, of which 101 were title and abstract screened and 10 were full-text screened. In total, 22 studies ($N=10,682$) were retained for synthesis and analysis (14, 7 and 1 studies from the three searches, respectively). The PRISMA flowchart of the study selection process is presented in Figure 1 (Page et al., 2021).

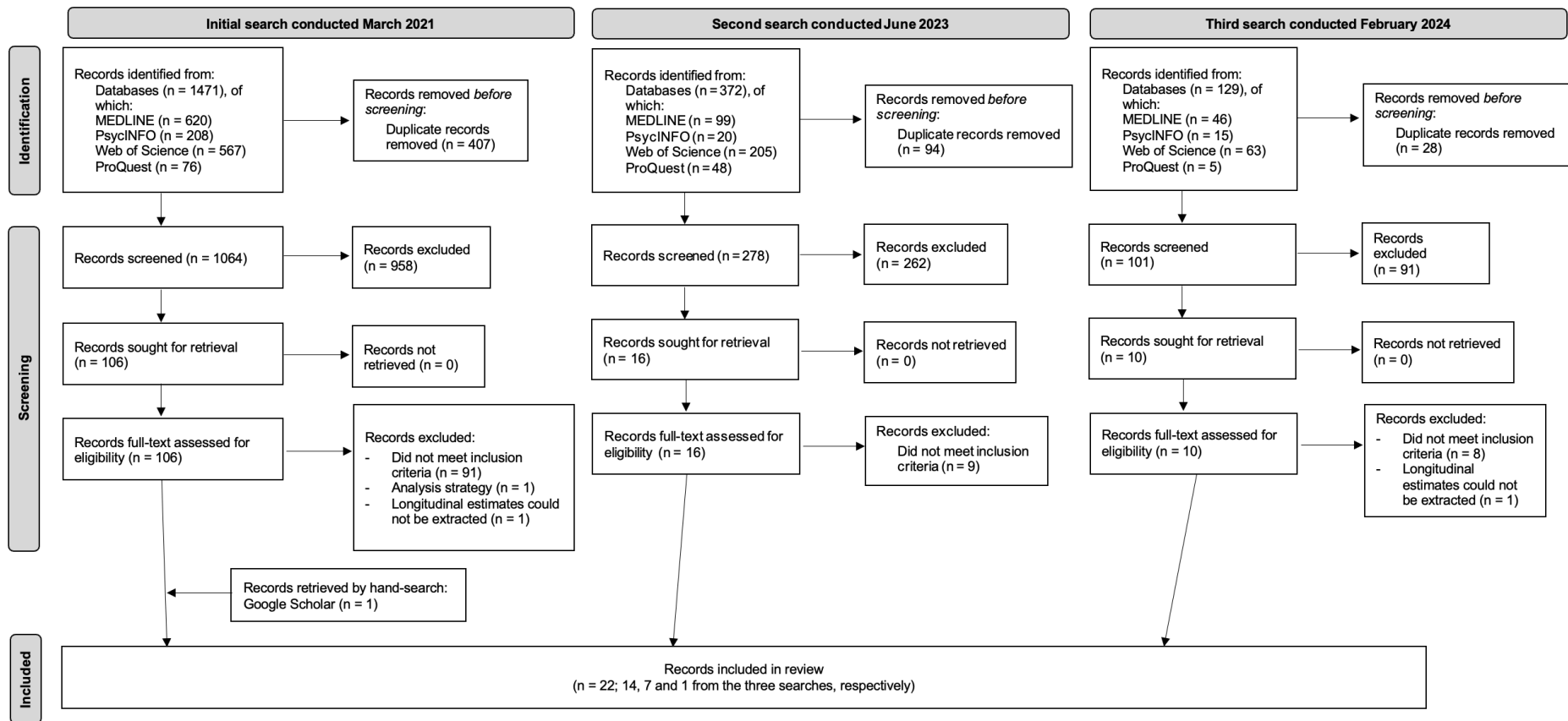


Figure 1. The PRISMA flowchart of the study selection process.

2.3. Data extraction and quality assessment

The following information was extracted: sample age, sex (% female), study design, attrition rate, follow-up duration, study location and setting, domains of future-related thinking measured and the measure(s) used, domains of psychopathology measured and the measure(s) used, the type of statistical analysis, any confounders adjusted, and the estimated effect (Pearson's correlation or the regression coefficient unstandardised b or standardised β). Where studies assessed future-related thinking and/or depression/anxiety symptoms multiple times during the follow-up, the estimated effect was only extracted from assessments that fell within the age range of 16-19 years. For intervention studies, data were only extracted for the treatment-as-usual group, where changes in future-related thinking and psychopathology could not be attributed to an active intervention.

Following full-text screening, the included studies were subjected to a quality appraisal assessment using the Mixed Methods Appraisal Tool (MMAT; Hong et al., 2018). Each study was first screened on whether it had clear research questions, and whether the collected data allowed the research question to be addressed. Studies were rated on five design elements focusing on the sampling strategy, sample characteristics, measures, missing data, and statistical analysis. Each assessed design element accounted for one score, with the total quality score ranging from 0 to 5, where 5 means the highest quality. Twenty-one out of the 22 studies included in this review scored 4 or 5 in the quality assessment, and the remaining one study scored 3.

2.4. Data synthesis

Where there were sufficient studies (at least two) available, we performed meta-analyses to synthesise the data. Analyses were performed using STATA (StataCorp, 2023; version

18.0). Due to the expected heterogeneity between studies, random-effect models with the restricted maximum likelihood (REML) method were employed. This assumes that the true effect sizes will vary between studies (DerSimonian & Laird, 1986; Hedges et al., 1999). For all studies, we extracted Pearson's correlation coefficient or the unstandardised b or standardised β of the regression analyses. We prioritised effect sizes that were estimated from models that accounted for the covariates, for example, where b or β was available from regression analyses, it was extracted rather than Pearson's correlation coefficient when both were reported.

Pearson's correlation coefficients were used to represent pooled effect size in the meta-analysis, and coefficients from regression analyses were converted into Pearson's r following the formula from Peterson & Brown (2005), where $r = .98\beta + .05\lambda$, λ equals 1 when β is non-negative and 0 when β is negative. The heterogeneity between studies was assessed using I^2 and Cochran's Q , where an I^2 value of 25%, 50%, and 75% suggest low, moderate, and high heterogeneity respectively. An I^2 value of 50% or more and a significant p -value ($<.05$) of Cochran's Q test typically suggests significant heterogeneity (Higgins, 2003; Sedgwick, 2013). Publication bias was assessed visually using funnel plots, where a symmetrical distribution of the points indicates an absence of publication bias (Duval & Tweedie, 2000).

We conducted separate meta-analyses for depressive and anxiety symptoms. To pool the effects together, we reversed the effect size of studies on positive future expectations/optimism and hope, so that the overall effect indicated negative future-related thinking (higher hopelessness, lower positive future expectations and optimism, lower hope).

We started with testing the future-related thinking to psychopathology pathway. First, we conducted a meta-analysis of the overall effect of depressive symptoms, pooling studies measuring all future-thinking domains. This was followed by a sub-group analysis for each domain (hopelessness, positive future expectations/optimism, and hope). Next, we conducted a sensitivity analysis that pooled effect sizes only from the studies that had controlled for baseline depressive symptoms.

Second, we conducted a meta-analysis of studies examining anxiety symptoms. We could not conduct a sub-group analysis for each domain or a sensitivity analysis of studies that had controlled for baseline anxiety symptoms due to an insufficient number of studies.

Third, we conducted a meta-analysis of studies that measured combined symptoms of depression and anxiety, followed by a sensitivity analysis of studies that controlled for baseline symptoms. No sub-group analysis was conducted due to an insufficient number of studies.

Finally, we tested the psychopathology to future-related thinking pathway, that is, the reciprocal pathway from depression or anxiety symptoms to subsequent future-related thinking. We conducted a meta-analysis pooling the studies of depression, followed by a sensitivity analysis of studies that controlled for baseline future-related thinking. We could not conduct a meta-analysis of the pathway from anxiety symptoms to subsequent future-related thinking due to an insufficient number of studies.

3. Results

3.1. Study and sample characteristics

A summary of the key study characteristics of the 22 included studies is presented in Table 2. All studies, except for Dorn et al. (1993), were published in peer-reviewed

journals between 2000 and 2023. Twenty-one studies were of a longitudinal observational design. One was a non-randomised intervention study, from which data were extracted for the treatment-as-usual group (Granö et al., 2016). A total of 10,682 participants (58% female) were included. Most studies were conducted in North America (14 in the United States and one in Canada), three in Europe (Finland, Netherlands and Spain), three in China/Hong Kong, and one covering multiple countries. Eighteen studies recruited community-based samples of adolescents and young people from middle and high schools, colleges and universities, and four studies recruited adolescents from a clinical setting or the legal system (Dorn et al., 1993; Granö et al., 2016; Horwitz et al., 2017; Stutts & Cohen, 2022). The follow-up duration ranged from 4 weeks to 7 years, and the attrition rate ranged from 2% to 55%, where reported in the article.

Table 2. Characteristics of the included studies.

Author	Participants (sample size, % female, age at baseline)	Study type	Setting	Follow-up duration and attrition	Future-related thinking domain and measure	Mental health and measure	Earlier future-related thinking and subsequent mental health	Earlier mental health and subsequent future-related thinking
1. Arnau et al., 2007	476; 61% female; M=18.7; SD=0.9	Longitudinal observational study	the United States, undergraduate college students.	2 months; 9%	State hope; The Snyder Hope Scale (SHS)	Depression and anxiety; The Beck Depression Inventory-II (BDI-II), the Centre for Epidemiologic Studies Depression Scale (CES-D), and the Depression, Anxiety, and Stress Scale (DASS) – anxiety and stress subscales	There was evidence that hope in <i>agency</i> thinking was associated with later depression and anxiety (beta=-.14, p<.05 for both), but not <i>pathway</i> thinking.	Neither depression nor anxiety demonstrated any longitudinal effects on either the <i>agency</i> (beta=-.06) or <i>pathway</i> (beta=-.01) components of hope.
2. Catanzaro et al., 2000	513; 70% female; M=18.5, SD=1.4	Longitudinal observational study	the United States, college students.	4-6 weeks; not reported	Dispositional optimism and pessimism; Life Orientation Test (LOT)	Depression; The Beck Depression Inventory-II (BDI-II)	Dispositional optimism was correlated with concurrent depression (r=-.13), and so was dispositional pessimism (r=.33); but neither was associated with follow-up depression after baseline depression symptom was controlled for.	Not reported
3. Dorn et al., 1993	40; 100% female; M=17.3, SD=1.3, 14-19	Longitudinal observational study	the United States, prenatal clinic patients.	23 weeks; 22%	Optimism; Life Orientation Test (LOT)	Depression and anxiety; Subscales from the Diagnostic Interview Schedule for Children (DISC), and the Spielberger State Trait Anxiety Inventory (STAI)	Optimism during pregnancy was correlated with postpartum anxiety (r=-.57), total DISC symptoms (r=-.51) and trait anxiety (r=-.47), but not depression alone (r=-.34).	Not reported

4.	Faura-Garcia et al., 2023	785, 57.1% female; M=15.64, SD=1.08†	Longitudinal observational study	Spain, high school students.	1 year; not reported	Hopelessness; The Beck Hopelessness Scale (BHS) Spanish version	Depression; The Depression, Anxiety, and Stress Scale (DASS) – depression subscale, Spanish version	Earlier hopelessness was correlated with later depression ($r=0.45$, $p<.01$); hopelessness was also associated with later depression in cross-lagged model ($b=0.45$, $p<.05$).	Earlier depression was correlated with later hopelessness ($r=0.25$, $p<.01$).
5.	Gerard & Booth, 2015	675; 51% female; mean age not reported but range 14-17	Longitudinal observational study	the United States, middle and high school students.	6 months; 15%	Hope; The Hopefulness subscale of the Child/Adolescent Measurement System	Depression; The Centre for Epidemiology Studies Depression Scale for Children (CES-DC)	Youth hope associated with later depression even after controlling for demographics and other risk factors, $r=-.50$, $p<.01$; $\beta=-.11$, $p<.01$.	Not reported
6.	Granö et al., 2016	84; 68% female; treatment group M=15.5, SD=1.6†; TAU group M=16.3, SD=0.8	Non-randomised intervention study	Finland, clinical sample, secondary-care adolescent outpatient unit.	386 days; 25%	Hopelessness; The Beck Hopelessness Scale (BHS)	Depression; The Beck Depression Inventory-II (BDI-II)	Baseline hopelessness not associated with later depression for the treatment group ($r=0.215$, $p=.272$). Hopelessness is associated with later depression only for treatment as usual group (TAU, $r=0.418$, $p=.034$); no effect found for both groups combined ($r=0.249$, $p=.07$).	Not reported
7.	Hankin et al., 2001	270; 63% female; M=16.2, SD=0.9	Longitudinal observational study	the United States, public high school students.	5 weeks; 8.5%	Hopelessness; The Beck Hopelessness Scale (BHS)	Depression; The Beck Depression Inventory-II (BDI-II), and the Hopelessness Depression Symptoms Questionnaire-Revised (HDSQ-R)	Hopelessness was associated with later depression, $r=.39$, $p<.001$; the association was stronger for hopelessness depressive symptoms, $r=.43$, $p<.001$; Hopelessness was also associated with both hopeless-related BDI items (HD-BDI), $r=.38$, $p<.001$, and non-hopeless-related BDI items (NHD-BDI), $r=.26$, $p<.001$.	Depression was associated with later hopelessness, $r=.46$, $p<.001$.

8.	Horwitz et al., 2016	59; 68% female; M=17.6, SD=1.6, 14-19	Longitudinal observational study	the United States, service-seeking adolescents from a medical emergency department.	2 to 4 years, mean follow-up duration 3.03 years; not reported	Hopelessness; The Beck Hopelessness Scale (BHS)	Depression; Baseline: the Reynolds Adolescent Depression Scale-2: Short Form (RADS-2:SF); follow-Up: the Patient Health Questionnaire-9 (PHQ-9)	Baseline Positive-expectation subscale ($r=.424, p<.01$) and Negative-expectation subscale ($r=.296, p<.05$) both correlated with later depression. In multivariate regressions controlling for depression, suicidal ideation, and negative-expectation hopelessness at baseline, positive-expectation hopelessness was the only significant predictor of depressive symptoms at follow-up, $\beta=.421, p<.05$.	Not reported
9.	Hui et al., 2023	104; 53% female; M=18.2, SD=2.69	Longitudinal observational study	Hong Kong, young people receiving services provided by the Integrated Children and Youth Service Centres (ICY-SCs) in Hong Kong.	3 months; not reported	Hopelessness; The Beck Hopelessness Scale (BHS)	Depression and anxiety; the Patient Health Questionnaire-9 (PHQ-9), the Generalized Anxiety Disorder-7 (GAD-7)	In Univariate regressions, baseline hopelessness was associated with later depression, $\beta=0.40, p<0.001$, and anxiety, $\beta=0.29, p=0.003$. In multiple regressions, baseline hopelessness was associated with later depression, $\beta=0.25, p=0.037$, but not anxiety, $\beta=0.05, p=0.651$.	Not reported
10.	Kennard et al., 2006	450; 61% female; M=15.7, SD=1.2, 14-18†	Longitudinal observational study	the United States, community-based high school youth of mixed ethnic background.	6 months; 2%	Hopelessness; The Hopelessness Scale for Children (HSC)	Depression; The Beck Depression Inventory-II (BDI-II)	Hopelessness at baseline is not associated with follow-up depression after controlling for demographics, baseline depression and other cognitive factors (self-efficacy, cognitive error), $b=4.24, b(SE)=2.89, \beta=0.08$.	Not reported

11. Li et al., 2018	381; 54% female; M=19.7, SD=1.1, 17-23	Longitudinal observational study	China, college students.	1 year; 7%	State hope; The Snyder's state hope scale (ASHS)	Depression; The Centre for Epidemiologic Studies Depression Scale (CES-D)	There was evidence that hope in both <i>pathway</i> ($r=-.28, p<.01$) and <i>agency</i> thinking ($r=-.21, p<.01$) were associated with later depression. After controlling for baseline depression, only <i>pathway</i> thinking was associated with later depression, $\beta=-0.19, p<.01$.	Depression was associated with subsequent hope in both <i>pathway</i> ($r=-.16, p<.01$) and <i>agency</i> thinking ($r=-.25, p<.01$).
12. Marchetti et al., 2021	469; 64% female; $m=15.3, SD=0.7†$	Longitudinal observational study	the United States, public high school students.	1 year; 17%	Hopelessness; The Adolescent Cognitive Style Questionnaire (ACSQ)	Depression; The Centre for Epidemiologic Studies Depression Scale (CES-D)	Hopelessness was associated with later depression, $r=0.26$.	Depression was associated with later hopelessness $r=0.2$.
13. Oettingen et al., 2016	67; 74% female; M=19.1, SD=1.0	Longitudinal observational study	the United States, university students.	4 weeks; 24%	Positive future fantasies; The semiprojective measure of the positivity of fantasies	Depression; The Centre for Epidemiology Studies Depression Scale for Children (CES-DC)	There was no significant correlations found between future fantasy and later depression: $r=.14, -.16, .16$ for positive fantasy, negative fantasy, positivity of fantasies (P-N), respectively.	There was no significant correlations found between depression and later future fantasy: $r=-.18, .12, -.16$ for positive fantasy, negative fantasy, positivity of fantasies (P-N), respectively.
14. Prince et al., 2019	338; all male; M=15†	Longitudinal observational study	the United States, community-based African American and Latino adolescent males.	2 years; 27%	Future expectation (positive expectations); The Future Expectations Questionnaire	Depression; The 27-item Children's Depression Inventory at wave 1 to 4, the Beck Depression Inventory at Wave 5	There was no evidence that positive future expectations at age 15 was associated with depression at age 17, $r=-.10, p>.05$.	There was evidence that depression at age 15 was associated with positive expectations at age 17, $r=-0.21$.

15. Rice et al., 2006	181; 65% female; mean age not reported but range 17-20.	Longitudinal observational study	the United States, university students.	10 weeks; 55%	Hopelessness; The Beck Hopelessness Scale (BHS)	Depression; The Centre for Epidemiology Studies Depression Scale for Children (CES-DC)	Hopelessness as associated with later depression (r=.45, p<.001).	Depression was associated with later hopelessness (r=.39, p<.001).
16. Ricker et al., 2022	166; 64% female; M=15.9, SD=1.2, 14-19†	Longitudinal observational study	the United States, community-based high school students.	4 months; 28%	Hope; The Trait Hope Scale (HS)	Depression and anxiety; The Beck Depression Inventory, 2nd Edition (BDI-II), and the Multidimensional Anxiety Scale for Children-10 (MASC-10)	Baseline hope were correlated with both later depression (r=-0.29, p<.01) and anxiety (r=-0.19, p<.01); but multilevel regression showed hope was only associated with later depression, beta=-0.12, p<.001, and not anxiety beta=-0.04, p=0.33.	Not reported
17. Sasser et al., 2019	800; 52.4% female; M=14.4, SD=0.5†	Longitudinal observational study	the United States, community-based youth from multiple geographical sites.	2 years; 33.4%	Future expectation; The Future Events Questionnaire	Internalising problems (depression and anxiety); the Child Behaviour Checklist (CBCL/4-18); parent-reported at age 16	More optimistic outlook for a personal future at age 14 was related with less internalising problems at age 16 (r=-.17, p<.01).	Not reported
18. Skinner et al., 2022	810; 50.4% female; M=16.7, SD=0.9	Longitudinal observational study	9 countries (China, Colombia, Italy, Jordan, Kenya, the Philippines, Sweden, Thailand, and the United States), community-	3.3 years; 39%	Future expectation/orientation; The Future Orientation Scale	Combined depression and anxiety; self-report 2 items: "I feel more anxious now than I did before the outbreak" and "I feel more depressed now than I did before the outbreak". 4-	Baseline future orientation was not associated with subsequent increase in perceived internalising problems (r=0.03); beta=-0.01, p>.05.	Not reported

19. Stutts & Cohen, 2022	1364; 14% female; M=16.0	Longitudinal observational study	based young adults. the United States, adolescents who were convicted of an offense in the juvenile or adult court system.	7 years; not reported	Hopelessness (perceived chance for future success); The Perceptions of Chances for Success Scale	point Likert, a mean score calculated from the two items. Depression; The Depression subscale of the Brief Symptom Inventory (BSI)	No evidence from bivariate correlations, but baseline hopelessness intercept predicted depression intercept at the end of study (beta=-0.18, SE=0.04, p<.001).	Not reported
20. Troister et al., 2013	945; 80% female; the general group M=18.2; the high-risk group M=18.17	Longitudinal observational study	Canada, university students.	5 months; not reported	Hopelessness; The Beck Hopelessness Scale (BHS)	Depression; The Beck Depression Inventory-II (BDI-II)	Hopelessness was associated with later depression, both in the general group (r=.44, p<.01), and the high-risk group (r=.45, p<.01).	Baseline depression was associated with hopelessness 5 months later in both groups: general group, r=.39, p<.01; high-risk group, r=.56, p<.01.
21. Weinberg et al., 2023	1429; 57% female; M=17.9, SD=1.9	Longitudinal observational study	Netherlands, adolescents attending vocational schools.	1 year; 10%	Optimism; Future Emotions Questions Scale	Emotional symptoms, conduct problems, hyperactivity, and peer problems; Strengths and Difficulties Questionnaire (SDQ)	Baseline optimism predicted later depression, beta=-0.11, p<.01, but the effect was gone when controlling for sense of control and self-esteem.	Not reported
22. Yang et al., 2022	276; 55% female; M=19.0, SD=1.5	Longitudinal observational study	China, college students.	10 weeks; 4%	Future expectation; The Sentence Completion for Events in the Future Test (SCEFT)	Depression; The Depression, Anxiety, and Stress Scale (DASS) - depression subscale.	The percentage of negative future events was correlated with later depression (r=0.23, p<.01), but in regression models, it was not associated with T2 depression, b=3.63, p=0.17).	Baseline depression was correlated with T2 percentage of negative future events, r=0.36, p<.01. In regression models, baseline depression was positively associated with T2 % negative future events b=0.01, p<.001.

Note. † The sample's mean age was within the 16-19 age range at follow-up assessment(s), therefore the study was included.

3.2. Future-related thinking domains measured in the included studies

Studies included a broad range of future-related thinking domains, including hope (Arnau et al., 2007; Gerard & Booth, 2015; Li et al., 2018; Ricker et al., 2022), hopelessness (Faura-Garcia et al., 2023; Granö et al., 2016; Hankin et al., 2001; Horwitz et al., 2017; Hui et al., 2023; Kennard et al., 2006; Marchetti et al., 2021; Rice et al., 2006; Stutts & Cohen, 2022; Troister et al., 2013), optimism and pessimism (Catanzaro et al., 2000; Dorn et al., 1993; Weinberg et al., 2023), future expectations and fantasies (Oettingen et al., 2016; Prince et al., 2019; Sasser et al., 2019; Yang et al., 2022), and future orientation (the extent to which an individual thinks about and plans ahead for the future; Skinner et al., 2022). There was also considerable variation in the way these concepts were measured. For example, studies examining hopelessness about the future used either the Beck Hopelessness Scale (BHS; Beck et al., 1974), the Hopelessness Scale for Children (HSC; Kazdin et al., 1986), or the Adolescent Cognitive Style Questionnaire (ACSQ; Hankin & Abramson, 2002). Hopelessness was also measured using a proxy concept of perceived chance of success, which assessed future aspirations and the perceived likelihood of achieving those aspirations (Menard & Elliott, 1996; Stutts & Cohen, 2022). To simplify the synthesis and analysis of the studies, future-related thinking was categorised into three domains: hopelessness (10 studies), positive future expectations or optimism (8 studies), and hope (4 studies).

3.3. Mental health symptoms measured in the included studies

Fifteen out of the 22 studies measured only depressive symptoms, using a range of measures. The most frequently used were the Beck Depression Inventory (Beck et al., 1988) and the Centre for Epidemiology Studies Depression Scale (Radloff, 1977). Seven studies measured both depression and anxiety symptoms, of which four studies included

separate anxiety measures (i.e., the Generalised Anxiety Disorder Scale; Spitzer et al., 2006), and three studies measured combined depression and anxiety symptoms (i.e., internalising problems, emotional problems, and aggregated depression and anxiety scores).

3.4. Meta-analysis findings

3.4.1. Future-related thinking and subsequent depressive symptoms

3.4.1.1. Overall effect

We pooled 18 studies that examined hopelessness ($k=10$), positive future expectations/optimism (reversed; $k=4$), and hope (reversed; $k=4$) and subsequent depressive symptoms. The meta-analysis revealed a significant small-to-medium association between more negative future-related thinking and subsequently increased depressive symptoms ($r=0.27$, 95% CI 0.20 to 0.34, $p<.001$; Figure 2).

3.4.1.2. Subgroup analysis

Subgroup analysis of the hopelessness, positive future expectations/optimism, and hope domains are shown in Figure 2.

Hopelessness. The meta-analysis of 10 studies revealed a medium association between early hopelessness and subsequent depressive symptoms ($r=0.34$, 95% CI 0.25 to 0.43, $p<.001$). Tests of heterogeneity suggested a large amount of heterogeneity between studies ($I^2=88.17\%$; $Q=98.80$, $p<.001$), which was likely due to the range of hopelessness measures used in the studies. We conducted a sensitivity analysis by removing the Marchetti & Pössel (2022) study and the Stutts & Cohen (2022) study, which measured cognitive styles and perceived chance of success as proxy indices of hopelessness. The magnitude of the overall association slightly increased to $r=0.38$ (95% CI 0.29 to 0.48,

$p < .001$), but the heterogeneity only marginally reduced ($I^2 = 83.42\%$; $Q = 45.32$, $p < .001$). The funnel plot (Supplementary Figure 1) showed some asymmetry highlighting the Kennard et al. (2006) study, which we then removed and ran an additional sensitivity analysis. The remaining seven studies all used the Beck Hopelessness Scale as the measure of hopelessness. The overall magnitude of the association for the remaining six studies increased ($r = 0.45$, 95% CI 0.40 to 0.49, $p < .001$), and heterogeneity was no longer significant ($I^2 = 10.7\%$; $Q = 5.45$, $p = .49$).

Positive future expectations/optimism (reversed). There was a significant association of small magnitude between baseline reduced positive future expectations and optimism and subsequently increased depressive symptoms ($k = 4$; $r = 0.18$, 95% CI 0.08 to 0.27, $p < .001$). One study did not report the effect size and was therefore not included in the meta-analysis (Catanzaro et al., 2000). Cochran's Q and I^2 indicated a low level of heterogeneity ($I^2 = 30.89\%$; $Q = 3.95$, $p = .27$).

Hope (reversed). There was a small-sized significant association between baseline reduced hope and more subsequent depressive symptoms ($k = 4$; $r = 0.16$, 95% CI 0.08 to 0.24, $p < .001$). There was moderate heterogeneity between studies ($I^2 = 63.02\%$; $Q = 8.08$, $p = .04$).

3.4.1.3. Studies controlling for baseline depressive symptoms

Eight studies controlled for baseline depressive symptoms in their models and examined the role of hope (Arnau et al., 2007; Gerard & Booth, 2015; Li et al., 2018), optimism (Catanzaro et al., 2000; Yang et al., 2022), and hopelessness (Faura-Garcia et al., 2023; Horwitz et al., 2017; Kennard et al., 2006). Catanzaro et al. (2000) did not report the effect size and was therefore not included in the meta-analysis. We conducted a sensitivity analysis limited to the other seven studies. When baseline depression was adjusted for,

reduced hope, optimism and increased hopelessness were still associated with later depressive symptoms ($r=0.23$, 95% CI 0.11 to 0.35, $p<.001$; Figure 3). Heterogeneity between studies was high ($I^2=91.35\%$; $Q=94.42$, $p<.001$).

3.4.2. Future-related thinking and subsequent anxiety symptoms

Four studies that were included measured hope (reversed; $k=2$; Arnau et al., 2007; Ricker et al., 2022), hopelessness ($k=1$; Hui et al., 2023), and optimism (reversed; $k=1$; Dorn et al., 1993). The pooled evidence revealed a significant overall association between reduced hope, optimism and increased hopelessness and subsequent anxiety symptoms ($r=0.15$, 95% CI 0.02 to 0.28, $p=.021$; Figure 4), with moderate heterogeneity between studies ($I^2=59.69\%$; $Q=7.09$, $p=.07$). The Arnau et al. (2007) study controlled for baseline anxiety symptoms and reported a significant effect of reduced hope ($\beta=0.14$, $p<.05$), while the other three studies did not control for baseline symptoms.

3.4.3. Future-related thinking and subsequent combined depression and anxiety symptoms

We pooled the studies which examined combined depression and anxiety symptoms, internalising and emotional problems (Sasser et al., 2019; Skinner et al., 2022; Weinberg et al., 2023). The three studies measured optimism ($k=1$) and positive future expectations ($k=2$). The overall effect was not significant ($r=0.08$, 95% CI -0.03 to 0.20, $p=.150$; Figure 5), and heterogeneity was high ($I^2=89.99\%$; $Q=17.48$, $p<.001$), suggesting mixed evidence for the association between optimism and mixed depression and anxiety symptoms. The Skinner et al. (2022) and Weinberg et al. (2023) studies controlled for baseline symptoms, and a sensitivity analysis of the two studies did not find a significant overall effect ($r=0.04$, 95% CI -0.10 to 0.18, $p=.549$).

3.4.4. Depressive symptoms and subsequent future-related thinking

Ten studies examined the association between baseline depressive symptoms and subsequent future-related thinking. There was a significant positive association between higher baseline depressive symptoms and subsequent negative future-related thinking ($r=0.32$, 95% CI 0.21 to 0.42, $p<.001$; Figure 6). The level of heterogeneity was, however, very high ($I^2=92.32\%$; $Q=145.18$, $p<.001$). The funnel plot (Supplementary Figure 2) suggested possible three outliers (Arnau et al., 2007; Oettingen et al., 2016; Troister et al., 2013). We therefore removed the three studies and ran a sensitivity analysis, which reduced the heterogeneity ($I^2=84.15\%$; $Q=46.26$, $p<.001$) and slightly increased the magnitude of the effect size ($r=0.34$, 95% CI 0.25 to 0.43, $p<.001$).

3.4.4.1. Studies controlling for baseline future-related thinking

We conducted a sensitivity analysis of the three studies that controlled for baseline future-related thinking (Arnau et al., 2007; Li et al., 2018; Yang et al., 2022). Depressive symptoms were significantly related to more subsequent hopelessness ($r=0.07$, 95% CI 0.01 to 0.13, $p=.02$; Figure 7), and heterogeneity was low ($I^2=11.65\%$; $Q=2.42$, $p=.298$).

3.4.5. Anxiety symptoms and subsequent future-related thinking

Arnau et al. (2007) was the only study that examined the effect of anxiety and found no evidence that anxiety symptoms were associated with subsequent hope, with baseline hope adjusted in the model ($\beta=-0.06$, $p>.05$).

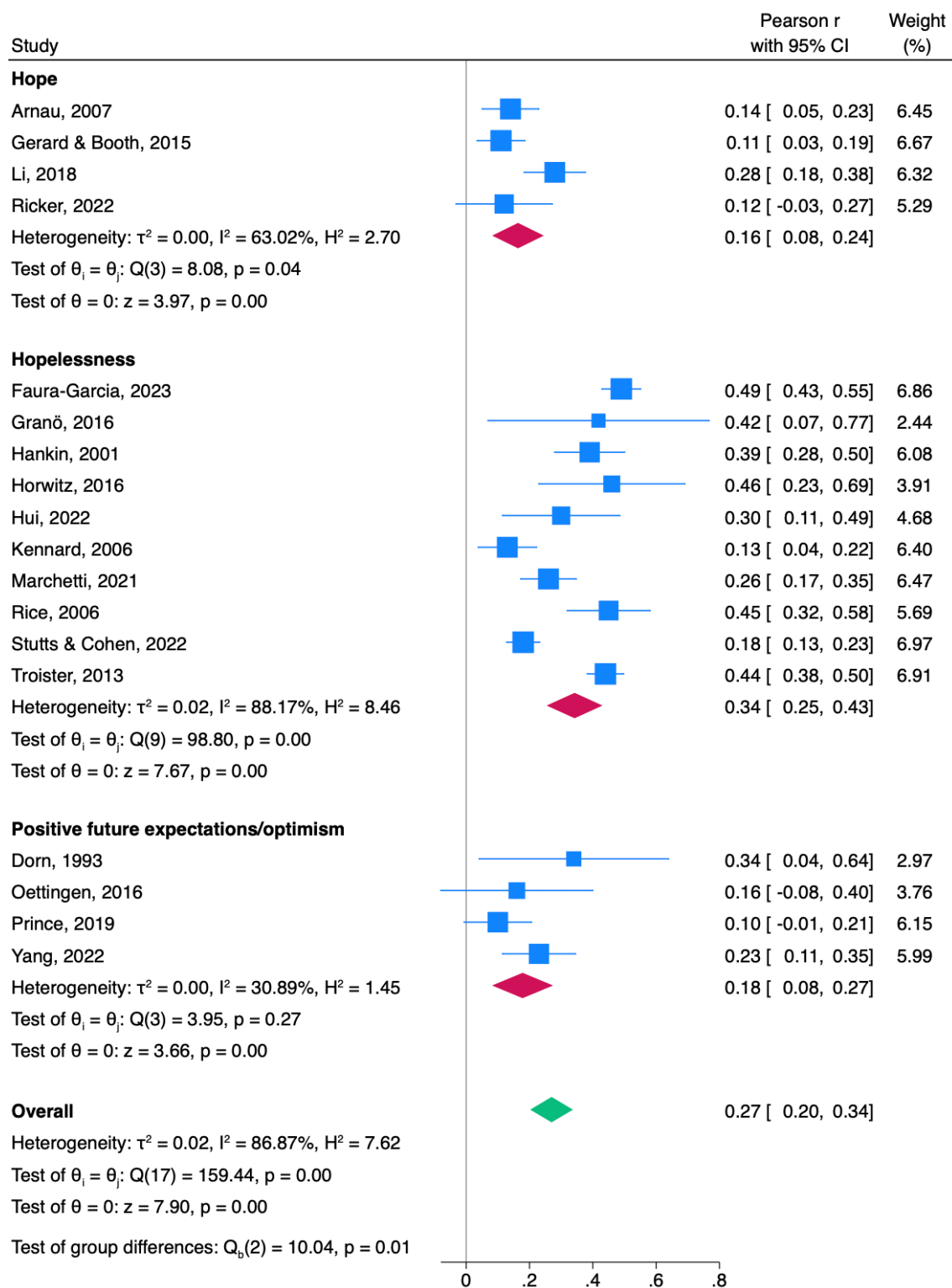


Figure 2. Forest plot for studies (total sample size $N=7,074$) examining the associations between hopelessness ($N=4,655$), positive future expectations and optimism (reversed; $N=721$), and hope (reversed; $N=1,698$) and subsequent depressive symptoms. The three red diamonds are the pooled effect size for each subgroup; the green diamond is the pooled overall effect size.

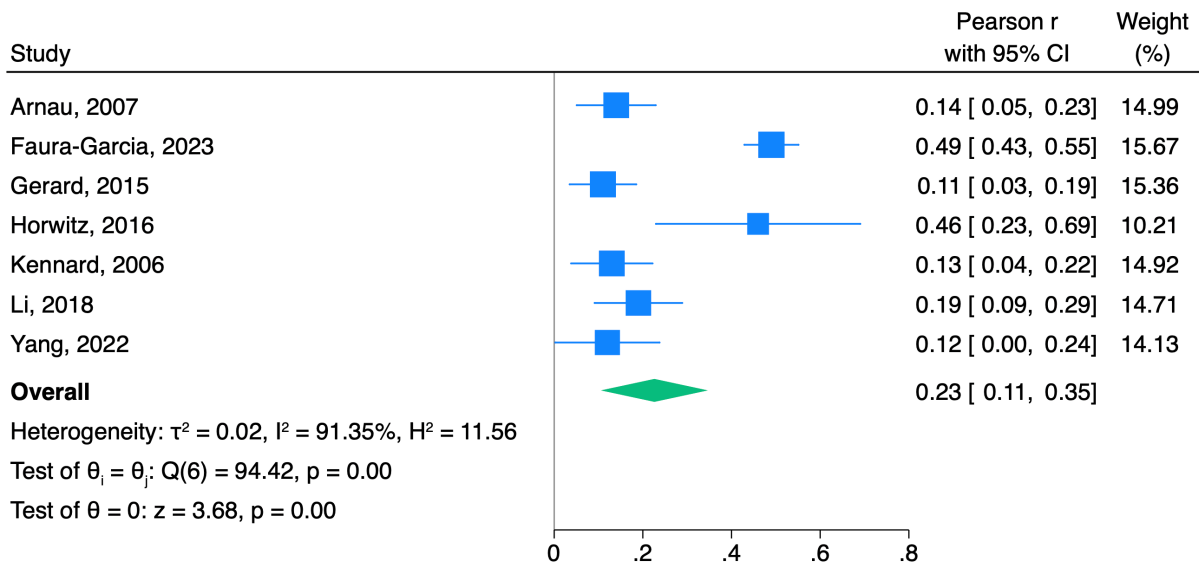


Figure 3. Forest plot for studies (total sample size=3,102) examining the associations between hopelessness, optimism (reversed), hope (reversed) and subsequent depressive symptoms, controlling for baseline depressive symptoms.

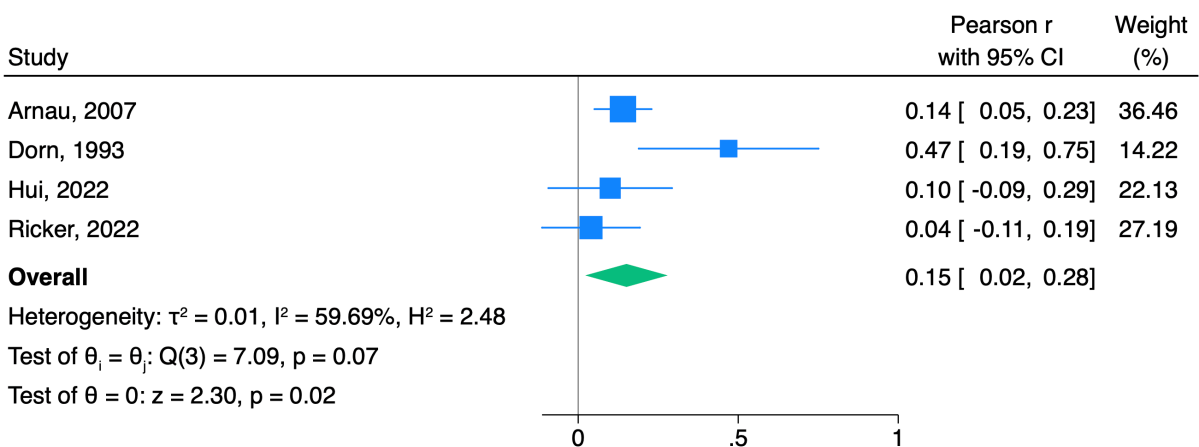


Figure 4. Forest plot for studies (total sample size=786) examining hopelessness, optimism (reversed), hope (reversed) and subsequent anxiety symptoms.

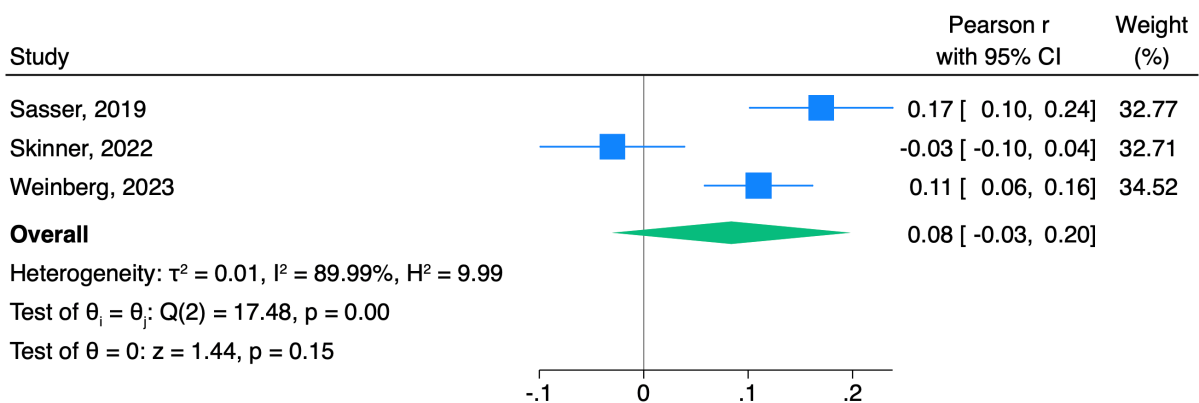


Figure 5. Forest plot for studies (total sample size=3,039) examining optimism (reversed) and subsequent combined depression and anxiety symptoms.

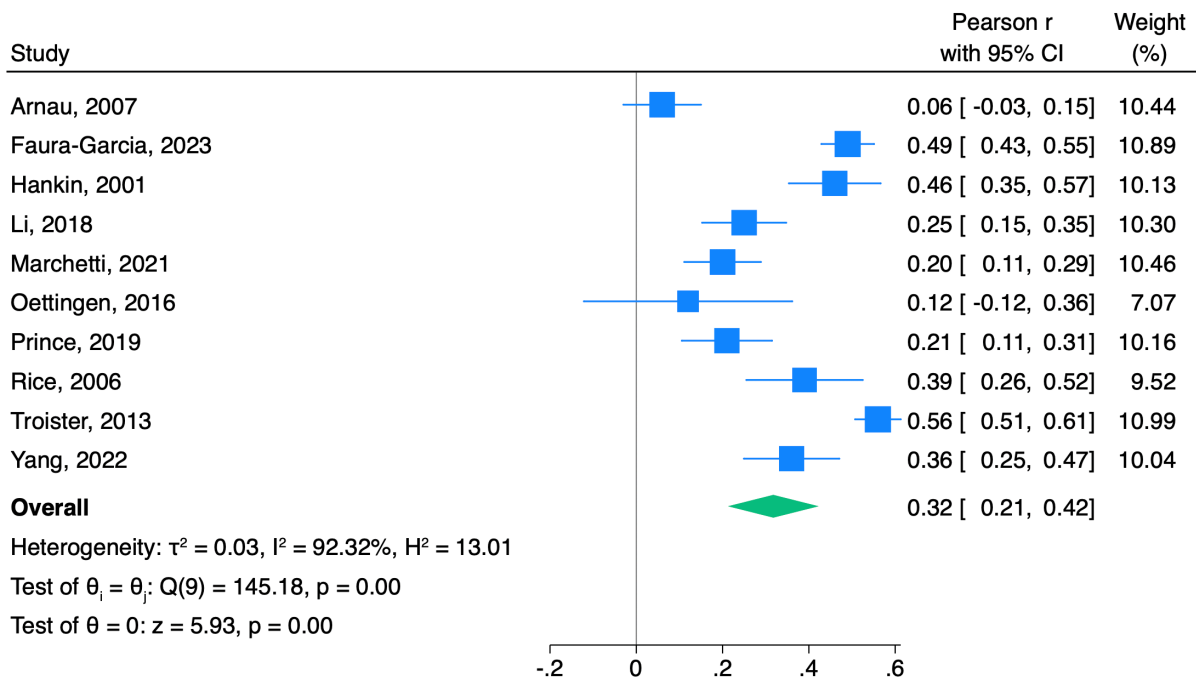


Figure 6. Forest plot for studies (total sample size=4,188) examining depressive symptoms and subsequent future-related thinking.

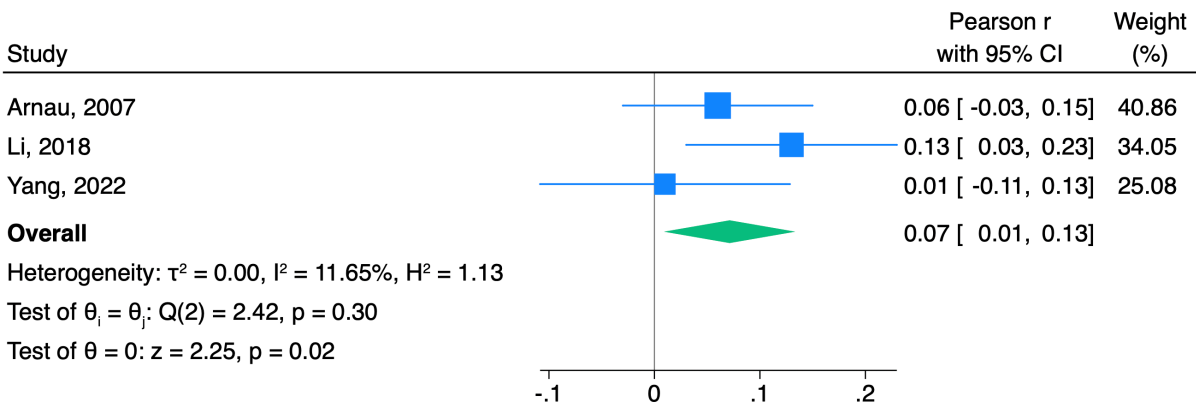


Figure 7. Forest plot for studies (total sample size=1,133) examining depressive symptoms and subsequent future-related thinking, controlling for baseline future-related thinking.

4. Discussion

We systematically searched and reviewed the evidence on the longitudinal and reciprocal pathways between future-related thinking and symptoms of depression and generalised anxiety in adolescents aged 16-19 years. Despite the substantial variability in the way future-related thinking was conceptualised and measured, findings demonstrated consistent evidence supporting a reciprocal relationship between symptoms of depression and anxiety and future-related thinking. Several domains of future-related thinking were linked to subsequent mental health difficulties, which, in turn, predicted subsequent future-related thinking. Our review highlighted the lack of a normative measure of future-related thinking and the paucity of studies examining its associations with anxiety. There were five findings of note.

First, meta-analyses revealed consistent evidence of the association between several future-related thinking domains and subsequent elevated depressive and anxiety symptoms. Specifically, increased hopelessness ($r=0.34$), the related but independent domain of reduced hope ($r=0.16$), alongside the domain describing fewer positive future expectations and reduced optimism ($r=0.18$), were associated with increased subsequent depressive symptoms longitudinally with effect sizes of small to moderate magnitude. These findings were consistent across studies and indicated that pessimism (i.e., a lack of positive expectations and hope about the future and a low expected likelihood of achieving future aspirations) is a significant predictor of later increased levels of depression symptoms. More importantly, when we specifically examined the effects in studies that had controlled for baseline levels of depressive symptoms, the overall effect was reduced but remained significant ($r=0.23$). The single study (Arnau et al., 2007), which controlled for baseline anxiety symptoms, also found that increased hope was

associated with fewer anxiety symptoms, subsequently. This suggested that negative future-related thinking styles, including more hopelessness and low optimism and hope, precede and may have contributed to subsequent increases in depressive and anxiety symptoms. Our finding in adolescence was in line with previous adult literature where reduced positivity in future-related thinking was predictive of sub-clinical depressive symptom severity, whereas positive future-related thinking may buffer against increased risk of developing depressive symptoms (Hamilton et al., 2015; Kosnes et al., 2013; Marsh et al., 2018).

Second, we examined and synthesised the evidence on the reciprocal pathway linking symptoms of depression and anxiety to subsequent future-related thinking. Evidence from nine studies suggested that higher levels of depressive symptoms were associated with more subsequent hopelessness and fewer positive future expectations ($r=0.32$). This finding was consistent with existing adult studies that major depressive disorder and elevated depressive symptoms are associated with decreased specificity, vividness, and anticipatory pleasure when simulating episodic future events (Hallford, Sharma, et al., 2020; MacLeod & Byrne, 1996; MacLeod & Salaminiou, 2001). Among the included studies, only the Arnau et al. (2007) study measured anxiety separately but did not find evidence that anxiety symptoms predicted subsequent levels of hope. This might be because a hopeful mindset may build resilience to anxiety and buffer against worries about negative future outcomes, more than the other way around (Richardson, 2023). Hope has also been found to predict lower subsequent anxiety levels in adults (Gallagher et al., 2020).

Third, very few studies examined the link between future-related thinking and anxiety symptoms. Only four of the included studies had separate measures of anxiety,

and three measured combined depression and anxiety symptoms. Despite the limited number of studies, there was a significant overall association ($r=0.15$) suggesting that reduced hope and optimism were associated with more subsequent anxiety symptoms. However, there was no evidence for a link between future-related thinking and combined depression and anxiety symptoms. This highlighted the need for more longitudinal studies to investigate the role of future-related thinking in adolescent anxiety symptoms specifically.

Fourth, we found that studies conceptualised future-related thinking in different ways and adopted a range of different measures, which signified the lack of a standard measure of the broader construct. For example, studies have assessed related constructs or proxy indices to conceptualise hopelessness, such as dysfunctional attributions or the subjective perceived importance and the chance of achieving specific events in the future (Marchetti & Pössel, 2022; Stutts & Cohen, 2022). Similarly, a range of measures were adopted for optimism and positive future expectations, which captured time perspective, planning, and anticipation of future consequences (Dorn et al., 1993; Weinberg et al., 2023). Studies also adopted semiprojective measures where participants were allowed to generate episodic future events freely and rated the positivity of those personal events (Oettingen et al., 2016; Yang et al., 2022). The wide range of measures used resulted in the high heterogeneity, which was significantly reduced in the sensitivity analysis by removing studies with potential publication bias or studies that had used different measures from the majority of other studies.

Finally, the groups of adjusted confounders varied largely between studies. Consequently, we cannot synthesise the estimated associations between future-related thinking and psychopathology, taking into account a similar group of confounders. This

makes it difficult to infer how much predictive value the future-related thinking factors have on top of other risk factors that were not included in the models. Moreover, although the review sought to retrieve both studies of episodic future thinking and general future-related thinking, the included articles all focused on the general future thinking domains. This highlights a need for longitudinal studies examining the temporal links between the phenomenological features of episodic future thinking and symptoms of depression and anxiety.

Strengths. This is the first comprehensive systematic review and meta-analysis of the longitudinal associations between future-related thinking, depression and generalised anxiety symptoms in adolescents. By restricting our inclusion criteria to prospective longitudinal designs, we retrieved and synthesised studies that examined the temporal relationships between future-related thinking and adolescent mental health symptoms. This is especially relevant given the existing cross-sectional research in adulthood and adolescence showing a close link between the two phenomena and provides important insight into the role future-related thinking may play in driving and maintaining depressive and anxiety symptoms. We examined the reciprocal bi-directional pathways and found evidence that maladaptive future-related thinking was associated with both later depression and anxiety symptoms and that depressive symptoms were associated with subsequent negative future-related thinking, whilst anxiety symptoms were not. This highlighted the need for future longitudinal studies to further disentangle the temporal relationship between maladaptive future-related thinking and mental health difficulties, especially the pathway from symptoms of mental health disorders to subsequent future-related thinking and the effects of anxiety more generally.

Because there was high heterogeneity between studies, we conducted sensitivity analyses to reduce the variability in the measures of future-related thinking domains. This reduced the heterogeneity to not significant in the analyses of early hopelessness, hope and positive future expectations, and later depressive symptoms. Crucially, we conducted a separate analysis of studies that had controlled for baseline symptoms and found a robust effect of future-related thinking on depressive symptoms.

The included studies covered a range of geographical locations across North America, Europe, and East Asia, with one multi-country study. The sample included both community-based young people and those recruited from a clinical setting, which strengthened the reliability and generalisability of our findings. Moreover, all studies included in this review were of moderate to high quality, which further increased the reliability and quality of the results.

Limitations. Our review also has limitations. First, there was high heterogeneity in the future-related thinking measures of the included studies. Apart from the Beck Hopelessness Scale (Beck et al., 1974), the adopted measures were very diverse, bringing difficulties in pooling all studies together. The range of different measures used across studies probably explained the high initial heterogeneity, however, by removing studies that used proxy indices of hopelessness and only keeping studies that used the Beck Hopelessness Scale, heterogeneity was no longer significant.

Second, only seven studies controlled for baseline or earlier depressive symptoms in the analyses, and fewer controlled for baseline future-related thinking when examining the reciprocal pathway. Moreover, a lot of studies included future-related thinking as a covariate in addressing the role of other factors, such as self-efficacy, academic aspiration, parental control, peer victimization, and social cognition, in predicting outcomes

including depressive and anxiety symptoms, suicidal ideation, and academic adjustment. This made it impossible to extract an estimate of the prospective association between future-related thinking and mental health while controlling for a similar group of confounders.

Third, there was a lack of studies examining the associations between anxiety symptoms and future-related thinking. Furthermore, although we examined the longitudinal associations, there was not enough evidence to infer causality, as most studies were observational, and we do not know the temporal order in which maladaptive future-related thinking and mental health problems first emerged. Finally, as the review only included studies on adolescents aged 16-19 years, we cannot generalise the findings to early-to-mid adolescence, which is a time of onset of mental disorders especially in girls.

Implications. This review provided evidence for the role of several future-related thinking domains in subsequent depression and anxiety symptoms during late adolescence. It highlighted the need for further research targeting this developmental stage. There are three research implications for future studies.

First, future studies should address the lack of a standard measure which captures multiple future-related thinking aspects that are most relevant to the adolescent developmental stage. Our review highlighted the high heterogeneity in the constructs that were examined by existing studies and the methods of how they were operationalised. Although the use of mixed measures in the studies captured a diverse array of future-related thinking domains, a single comprehensive measure that captures multiple aspects of maladaptive future-related thinking is needed and should be adopted in longitudinal study designs. A recently developed Adolescent Future Thinking Rating

Scale (AFTRS; Tang, Sonuga-Barke, et al., 2023) provides an easy-to-administer questionnaire to measure future-related thinking aspects particularly relevant to adolescent mental health. Investigating the factorial structure of multiple future-related thinking constructs would greatly inform how adolescent future thinking could be conceptualised and measured, which is foundational for further disentangling its associations with poor mental health.

Second, despite the existing longitudinal studies, many of them did not account for the possible confounding effects of sex, baseline symptoms severity, as well as established cognitive vulnerabilities of depression and anxiety, such as dysfunctional attributional styles, Beck's Cognitive Triad (Negative View of Self and World), and negative repetitive thinking. As future-related thinking is a specific subtype of cognition that is orientated towards the future, it is crucial to separate its effects independently from the non-future-oriented general cognitive risk factors, so that its unique, and potentially causal effects can be estimated. Future studies should therefore continue to examine the temporal relations to distinguish the predictor and the outcome, taking into account possible cognitive and demographic confounders.

Furthermore, our review highlighted a lack of studies examining generalised anxiety disorder. Although highly comorbid with depressive disorders, generalised anxiety may signify heightened worries, fears, ruminative thinking, and catastrophic anticipations about the future, which differs from how depression affects young people's mood and feelings (Tang, Pavlopoulou, et al., 2023). With anxiety disorders being the most common mental health condition worldwide, young people aged 16-29 years were most likely to have some form of anxiety among all age groups in the UK (World Health Organisation, 2019; Office for National Statistics, 2021). Future studies should gather

more evidence regarding how generalised anxiety interacts with future-related thinking in young people.

There are also clinical implications for a reciprocal pathway between future-related thinking and mental health problems.

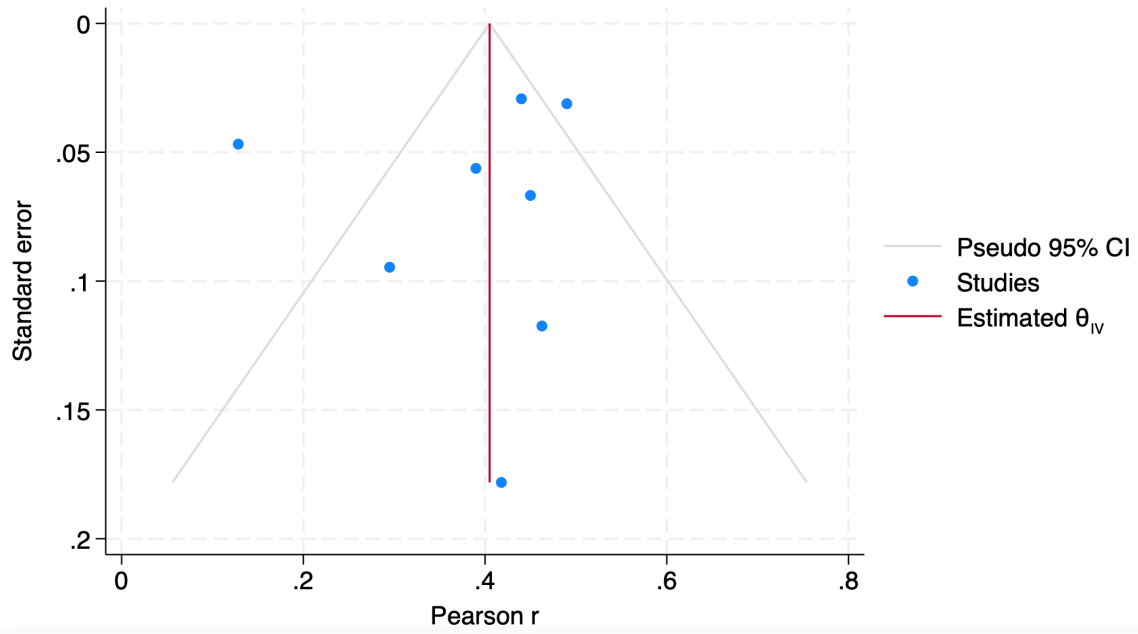
First, negative future-related thinking, including feeling hopeless and pessimistic and having few positive future expectations, is predictive of symptoms of both depression and generalised anxiety among young people. Therefore, long-standing maladaptive future-related thinking patterns in young people might be considered a marker for increased vulnerability and early cognitive manifestations of prodromal depression and generalised anxiety. In addition, earlier detection of depression may result from clinicians being explicitly alert to shifts in patterns of future-related thinking as well as enquiring about established prodromal symptoms of depression, such as sleep disturbance, loss of motivation, gastrointestinal symptoms and fatigue (Iacoviello et al., 2010).

Second, maladaptive future-related thoughts and increased depressive symptoms seem to be mutually reinforcing, forming a negative cycle. Identifying precursors of this cycle could act as the basis for depression prevention in adolescents and as a breakpoint for promoting best interests, better decision-making, and reducing symptom severity.

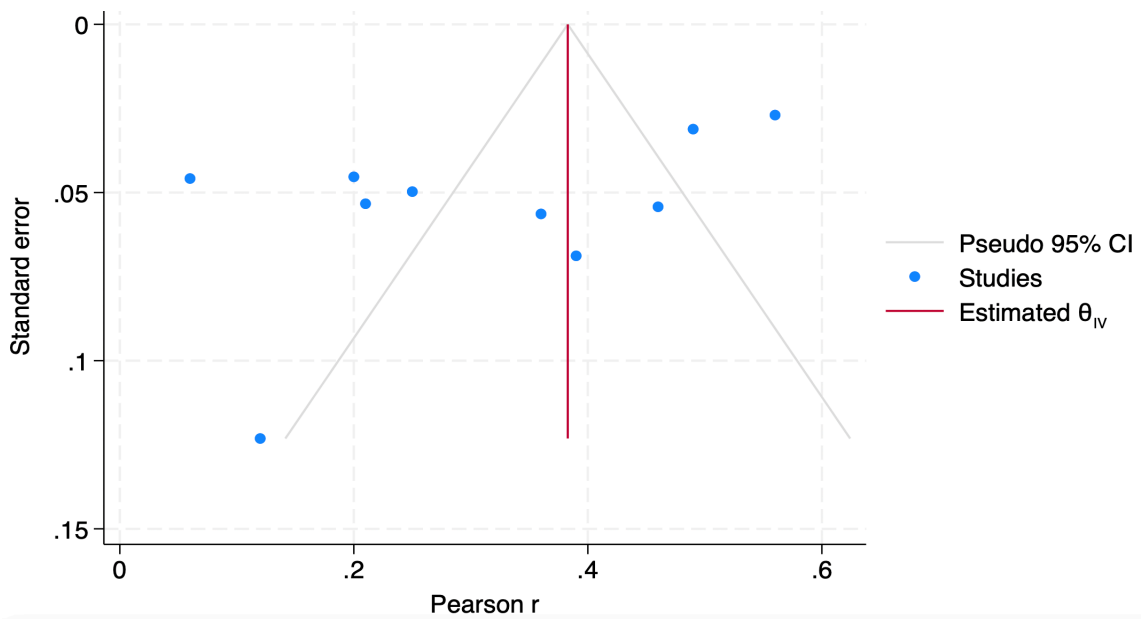
Moreover, providing support in the decision-making process, especially for decisions regarding the personal future, could potentially alleviate the negative long-term consequences of increased future negativity on mental health among vulnerable young people who have a higher risk of developing clinically significant depression and anxiety. Existing research has shown that depression is related to reduced future-related thinking specificity in adults, and interventions that enhance a detailed prospective

mental imagery could increase anticipatory pleasure for the future, which may help with alleviating depressive symptoms in the long run (Bogaert et al., 2023; Hallford et al., 2018; Hallford, Sharma, et al., 2020; Hallford, Yeow, et al., 2020). This provides a potential direction for prevention of and early intervention in adolescent depression, through developing therapies that (a) focus on enhancing detailed mental imagery, (b) could be delivered by trained practitioners at a stage prior to entry into a healthcare pathway e.g. to students in school, college, or university.

In conclusion, despite the high heterogeneity in the measures of future-related thinking domains, we found longitudinal links between future-related thinking and subsequent symptoms of depression and anxiety in late adolescence. Depression is reciprocally linked to future-related thinking, whilst evidence is insufficient to make inferences about anxiety. More research is needed to examine the higher-order construct of adolescent future-related thinking and how it relates longitudinally to depression, and more importantly, generalised anxiety, accounting for the confounding effect of general cognitive vulnerabilities. This review highlighted the predictive value of maladaptive future thinking on poor mental health, which could assist with early identification and intervention for those with an increased risk of developing depression and anxiety, with the caveat that evidence at the current stage is insufficient to conclude the relative impact of maladaptive future-related thinking patterns, or whether they occupy a consistent position in a causal chain toward depression and anxiety.



Supplementary Figure 1. Funnel plot for studies examining hopelessness and subsequent depression.



Supplementary Figure 2. Funnel plot for studies examining depression and subsequent future-related thinking.

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