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# Neuroticism and extraversion as predictors of first-lifetime onsets of depression, anxiety, and suicidality in high-risk adolescents

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## Abstract

There is substantial evidence that personality traits, in particular neuroticism and extraversions predict depressive and anxiety episodes as well as suicidal ideation. However, little research has examined whether these traits predict the *first* onset of depressive and anxiety disorders and suicidal ideation. Moreover, the few studies to date have not adjusted for pre-existing subthreshold symptoms, assessed dimensionally. In this study, 144 adolescents were assessed at baseline, 9-, and 18-month follow-ups. Neuroticism and extraversion were assessed via self-report, and depressive and anxiety disorders and suicidal ideation were assessed with diagnostic interviews. Adjusting for age, sex, and baseline symptoms, logistic regression analyses showed that neuroticism predicted the first onset of depressive disorders. However, neither neuroticism nor extraversion predicted first onsets of anxiety disorders, extraversion did not predict depressive disorders, and neither trait predicted suicidal ideation onset or severity after adjusting for baseline symptoms. Neuroticism and extraversion may respectively predispose youth to depressive or anxiety disorders but not to suicidal ideation over and above pre-existing symptoms. Results have implications for the early identification of at-risk youth and prevention of depressive and anxiety disorders and suicidal ideation.

**Keywords:** Anxiety; depression; extraversion; neuroticism; suicide

## Introduction

Among adolescents, depressive and anxiety disorders are the leading cause of global burden of disability and among the leading causes of suicide. Approximately 75% of depressive disorders onset in adolescence (Kessler et al., 2007). Affected youth are at risk for psychosocial consequences such as alcohol dependence, suicide attempts, and educational underachievement (Fergusson & Woodward, 2002). Depressive and anxiety disorders have a 10-fold increase in societal cost if they begin before adulthood (Lee et al., 2014). For the majority of those who have had one episode of depression or anxiety, the disorder will become chronic (Burcusa & Iacono, 2007). With each recurrence, treatment prognosis worsens (Strawn et al., 2020; Torpey & Klein, 2008). Depression and anxiety are also key risk factors for the development of suicidal ideation and behaviors (Metts et al., 2023; Nock et al., 2018). To understand the etiology of first-lifetime episodes of depression and anxiety would be a critical advancement that will facilitate targeted psychosocial interventions to mitigate, and potentially prevent, this major public health problem. The current study examines the psychosocial basis of risk for

depression, anxiety, and suicidal ideation in regard to the personality traits of neuroticism and extraversion.

Neuroticism, closely linked to negative emotionality, is characterized by a general tendency to experience fear, anger, and sadness, and a susceptibility to the effects of stress on mood (Shackman et al., 2016). Extraversion, closely linked to positive emotionality, is characterized by a general tendency to experience positive emotions (e.g., joy, exuberance), and being gregarious and engaged with the environment (Watson & Humrichouse, 2006). Both neuroticism and extraversion are higher-order factors in all Big Three (Eysenck et al., 1991; Watson et al., 1999) and Big Five models of personality (McCrae & Costa, 1996).

Much literature has suggested that individual differences in personality traits, in particular neuroticism and extraversion, may respectively confer vulnerability to, or resilience against, depression and anxiety (e.g. Bagby et al., 1997; De Fruyt et al., 2006; Kendall et al., 2015; Klein et al., 2011; Kotov et al., 2010; Metts et al., 2023; Ormel et al., 2013; Wilson & Sponheim, 2014; Zinbarg et al., 2016). There is additionally evidence linking neuroticism in particular to suicidal ideation and behaviors (DeShong et al., 2015; Flint et al., 2021; Hartley et al., 2019; Vrshek-Schallhorn et al., 2011) and to the development of future onsets of depressive and anxiety disorders (Goldstein et al., 2018; Kopala-Sibley et al., 2017; Metts et al., 2021). Indeed, a recent meta-analysis (Fu et al., 2021) confirms that elevated neuroticism is related to a 2.5-fold increase in risk for future depressive episodes. However, little research has examined whether personality traits predict first-lifetime onsets of depressive and anxiety disorders as well as suicidal ideation in

adolescents. Thus, the first aim of this study was to test whether neuroticism and extraversion predict the first-lifetime onsets of depressive and anxiety disorders as well as suicidal ideation in a sample of high-risk adolescents. This is important if we are to identify pre-morbid risk factors for depression, anxiety, and suicidal ideation in youth who are particularly disposed to their development.

### Personality and depressive and anxiety disorders and suicidality onset in youth

Several studies have examined personality dimensions as predictors of first onset of depression and anxiety. Several studies from the Youth Emotion Project have longitudinally examined personality predictors of first onsets of depression and anxiety longitudinally in high schoolers (Kendall et al., 2015; Metts et al., 2021; Zinbarg et al., 2016). These studies have found low positive emotionality and high neuroticism to be a risk factor for emotional disorders and high extraversion to be a protective factor (Kendall et al., 2015; Metts et al., 2021; Zinbarg et al., 2016). Though these studies did not control for baseline clinical symptoms, similar studies controlling for baseline subthreshold disorder status, assessed categorically, have replicated these results. For example, Kopala-Sibley et al. (2017) found that neuroticism predicted first onsets of depressive and anxiety disorders in a community sample of adolescent females. In the same participant sample, Goldstein et al. (2018) found that elevated neuroticism and decreased extraversion and conscientiousness predicted first-lifetime onsets of depressive disorders. First onsets of depression were uniquely predicted by the depressivity facet of neuroticism, and first onsets of anxiety were predicted by the anxiousness facet of neuroticism (Goldstein et al., 2018). While these studies adjusted for baseline subthreshold status of the disorder, assessed categorically per the DSM-IV-TR, this approach may not fully capture importance variance in subclinical premorbid symptoms. Depressive and anxiety symptoms vary substantially even between those who do not meet criteria for subthreshold depression and among those who do (Patten et al., 2012). Indeed, in their meta-analysis, Fu et al. (2021) note that evidence to date cannot rule out the possibility that effects of personality traits on depressive disorder onsets are due to unmeasured effects of pre-morbid subclinical symptoms. The same is likely true for anxiety disorder and suicidality onsets. This is a highly important confound in this literature given that elevated but subclinical symptoms are one of the most robust predictors of future mood and anxiety disorder and suicidality onsets, and that neuroticism and extraversion tend to cross-sectionally correlate moderately to strongly with depressive and anxiety symptoms (Cuijpers & Smit, 2004; Jeronimus et al., 2016).

Similarly, much research has found positive associations between neuroticism and suicidal ideation (see Rappaport et al., 2017 for a review). In a longitudinal birth cohort, Fergusson et al. (2000) found that high levels of neuroticism during adolescence predicted subsequent suicidal ideation and behaviors in youth 15–21 years of age. Another longitudinal study of high schoolers found that low baseline extraversion predicted suicidal ideation in males at follow-ups (Vrshek-Schallhorn et al., 2011). However, only a few studies have examined whether neuroticism and extraversion predict first-lifetime onsets of suicidal ideation and/or behaviors longitudinally. In a group of youth who were assessed annually from age 12, increased neuroticism was associated with increased probability of suicidal ideation and behaviors (Lawson et al., 2022). Metts et al. (2023) found that the general distress score shared by depression and anxiety as well as the specific symptom measure of anhedonia-apprehension were significant predictors for the onset of suicidal ideation over an eight-year period (Metts et al., 2023). It is therefore likely important to control for symptoms of depression and anxiety when examining personality traits as predictors of first onsets of suicidal ideation.

The current study examined whether individual differences in neuroticism and extraversion predicted the first-lifetime onset of a depressive disorder, anxiety disorder, and/or suicidal ideation in youth at elevated risk for developing these conditions. These adolescents were at high-risk for these disorders by virtue of having at least one parent with a history of them (Weissman et al., 2016). Analyses adjusted for baseline subclinical symptoms in order to test whether personality traits predict first-lifetime onsets of these disorders over and above pre-existing subclinical symptoms. We predicted that while elevated baseline subclinical symptoms would predict future disorder onsets, elevated neuroticism and decreased extraversion would predict first-time onset of depressive and anxiety disorders and the presence and severity of suicidal ideation.

## Methods

### Participants

Families who participated in this study were part of the Calgary Biopsychosocial Risk for Adolescent Internalizing Disorders (C-BRAID) study – a larger longitudinal research program examining premorbid risk factors for first-lifetime onsets of mood and anxiety disorders in adolescence (Pawlak et al., 2022; Soltani et al., 2023; Stein, Bray, et al., 2022; Stein, Tomfohr-Madsen, et al., 2022). This study is a secondary analysis of this longitudinal dataset, albeit the first personality-related longitudinal study analyzed and reported from this larger dataset.

The sample of youth in this study consisted of 144 adolescents aged 11–17. This age range was chosen because adolescence is a significant and unique developmental period with respect to mental health. Specifically, adolescence is a time during which rates of depression, anxiety, and suicidality increase (Hankin et al., 1998; Kessler et al., 2007). Participants were recruited based on parental history of either a depressive or anxiety disorder. It has been shown that parent mental health is a powerful driver of youth mental health (Weissman et al., 1997). The focus of the current investigation was to better understand the mental health trajectory of youth who are at increased risk for the onset of mental health disorders (as a function of family history), *before* the onset of these disorders. This sample was chosen, in part, to enhance the likelihood that a sufficient number of youth would experience onset of mental health disorders and concerns (i.e., develop a depressive or anxiety disorder or experience suicidality) (Weissman et al., 2016) over the course of this prospective longitudinal study to allow for sufficient statistical power for analysis and testing of our hypotheses.

Baseline data was available from 144 participants. At 9-month follow-ups, 114 completed diagnostic interviews to assess for DSM-5 criteria for a depressive or anxiety disorder or suicidality. At the 18-month follow-up, 97 completed diagnostic interviews. Across 9- and 18-month follow-ups, 67 completed both (See Figure 1 for a flowchart of the study design). In total, 144 youth participants completed diagnostic interviews and at least one follow-up time point as well as baseline measures and were included in analyses. The effective sample sizes vary for each model depending on the number of youth with a particular disorder at baseline. 9 youth had a lifetime diagnosis of depression at baseline, 10 had an anxiety diagnosis at baseline and 35 had a history of suicidal ideation or behaviors and were excluded from those
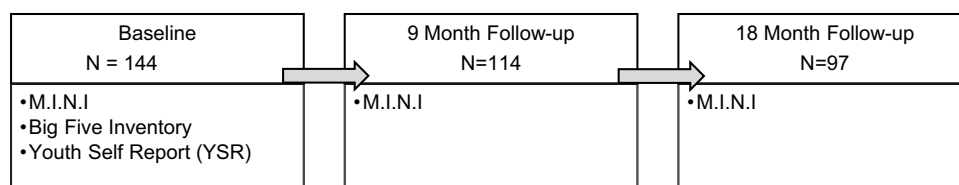
| Baseline<br>N = 144 | 9 Month Follow-up<br>N=114 | 18 Month Follow-up<br>N=97 |
|---|---|---|
| • M.I.N.I<br>• Big Five Inventory<br>• Youth Self Report (YSR) | • M.I.N.I | • M.I.N.I |

**Figure 1.** Study procedure flowchart. Overall, 144 participants completed either a 9- or 18-month follow-up, whereas 67 completed both.

respective models. The depression onset model had an effective sample size of 135, the anxiety onset model had an effective sample size of 134, suicidal onset had an effective sample size of 110, and suicidal severity had an effective sample size of 110. SAS uses listwise deletion to handle missing data.

## Procedure

The data for this longitudinal study were collected between January 2019 and March 2021. All study protocols were approved by the institutional Research Ethics Board. Informed consent was obtained from participants or their legal guardian; minors provided assent. Participants were recruited via advertisements in community clinics, local community centers, online advertisements, and word of mouth. Parent and youth history of depressive and/or anxiety disorders was assessed via structured diagnostic interview. Only youth with a parent with a history of major depressive disorder (MDD), persistent depressive disorder (PDD), bipolar disorder (BD), general anxiety disorder (GAD) or social anxiety disorder (SAD) were included (see Table 1 for parent diagnoses). Youth completed self-reports of depressive and anxiety symptoms as well as neuroticism and extraversion at baseline. Youth completed diagnostic interviews at 9- and/or 18-month follow-ups to assess for onsets of depressive and anxiety disorders and suicidality.

## Measures

### Demographics

Demographics were assessed via a self-report questionnaire completed by youth and parents. Specifically, youth and parents reported on their age, sex, gender, and ethnicity, while parents reported their marital status, household income, and education levels (Table 1).

### Depressive and anxiety disorder and suicidality onsets and severity

The Mini-International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) was used to assess parents' lifetime history of MDD, PDD, BD, GAD and/or SAD. The MINI-Kid (Sheehan et al., 2010), validated for ages 6–18, was used to assess depressive and anxiety disorders as well as suicidality in youth. These brief structured diagnostic interviews show good interrater reliability and respectively converge well with the Structured Clinical Interview for the DSM and the Kiddie Schedule for Affective Disorders (Duncan et al., 2018). The MINI and MINI-Kid were administered by a single interviewer, with at least a bachelor's degree, who underwent training by a licensed clinical psychologist. This training included didactic lessons on diagnostic interviewing for mental health, role play exercises, and observation with feedback of the interviewer by the psychologist of interviews with participants. This was done both in person and via practice with recorded diagnostic interviews. Interviews were recorded for additional reference and reliability checks if needed. The MINI and MINI-Kid show strong test-retest reliability (Duncan et al., 2018). At follow-ups, participants are asked about the period since their

last visit to the lab. Youth were categorized as having a depressive disorder over the follow-up period if they met criteria for MDD, PDD, or BD, and as having an anxiety disorder if they met criteria for SAD, panic disorder, GAD, or separation anxiety. The MINI does not have a section for anxiety or depressive disorders not otherwise specified so diagnostic onset was limited to these specific disorders. Specific phobia was excluded from onsets as the typical age of first onset for this disorder is before adolescence (Solmi et al., 2022) and was not therefore a focus of the study. Suicidality was assessed at follow-up via the MINI-Kid suicidality module (Sheehan & Giddens, 2015), this subscale contains 19 items rated "yes/no." Youth are coded as experiencing any suicidality if they said yes to any item. Each item is additionally assigned a weight, the sum of which is used to calculate a total suicidality severity score. For example, a "yes" to "Did you think that you would be better off dead or wish you were dead or need to be dead?" received a score of 1. A "yes" to "Did you think about hurting yourself, with the possibility that you might die? Or did you think about killing yourself?" receives a score of 6. Having a way or method in mind to kill themselves, thinking about what they would use to kill themselves, or when or where they would kill themselves receive scores of 8. A "yes" to "Did you do things to get ready to kill yourself, but you stopped yourself just before you hurt yourself?" receives a weight of 10. Another question asks, "How likely are you to try to kill yourself within the next 3 months on a scale of 0–100%?" Any response of greater than 0% is scored as a yes and receives a score of 13. Suicidality severity is calculated based on the participant's total score (0 = "none", 1−8 = "mild", 9−16 = "moderate", >17 = "high"). Suicidality severity was treated as a continuous variable ranging from 0 to 3. The MINI Suicidality module is well validated as evidenced by its convergence with self-report measures of suicidality (Yoon et al., 2020) and its utility in predicting future suicidal behaviors in recently discharged psychiatric patients (Roaldset et al., 2012). See Table 2 for breakdown of child diagnoses and presence of suicidality.

For any child who reported a greater than zero percent likelihood of trying to kill themselves, a full suicide risk screening was conducted, including assessing intent to kill themselves, access to means to do so, plans to do so, and perceived ability to resist the urge to kill themselves. If the child reported a 10% or greater chance or we otherwise felt there was any likelihood of the child attempting suicide or harming themselves with intent to die, this endorsement of suicidal ideation and our concerns for their safety were discussed with both the youth and their parent. If we felt the child may be at imminent risk of suicidal behaviour, the parent was urged to take their child to the local hospital's emergency room. One child to date has been taken to the emergency room. All participants in this study, including both parents and youth, receive a comprehensive list of mental health resources in the community that are accessible by both parents and teens in the event of urgent distress or emergency situations. This approach follows standard ethical guidelines according to which researchers may not break confidentiality with the adolescent unless they are deemed to be a danger to themselves or someone else. All

**Table 1.** Sociodemographic characteristics and key variables

| Characteristic | Parent | Child |
|---|---|---|
| Mean Age (SD) | 43.49 (5.75) | 13.58 (1.54) |
| **Sex** | | |
| Female | 133 (92.4%) | 94 (65.3%) |
| Male | 11 (7.6%) | 50 (34.7%) |
| **Diagnosis** | | |
| Depression Only | 52 (36.1%) | 7 (4.9%) |
| Anxiety Only | 7 (4.9%) | 3 (2.1%) |
| Both | 78 (54.2%) | 1 (0.7%) |
| **Ethnicity** | | |
| White | 111 (77.1%) | 98 (68.1%) |
| Asian/Pacific Islander | 14 (9.7%) | 7 (4.9%) |
| Indigenous | 6 (4.2%) | 4 (2.8%) |
| Hispanic/Latino | 7 (4.9%) | 3 (2.1%) |
| Arabic | 2 (2.3%) | 2 (1.4) |
| Multiracial | 3 (1.4%) | 26 (18.1%)3 |
| Other | 1 (0.7%) | 3 (2.1%) |
| Did not disclose | – | 1 (0.5%) |
| **Marital Status** | | |
| Single/Never Married | 8 (5.6%) | – |
| Married/Common Law | 107 (74.3%) | – |
| Divorced/Separated | 28 (19.4%) | – |
| Widowed | 1 (0.7%) | – |
| **Annual Household Income** | | |
| <$25,000 | 6 (4.2%) | – |
| $25–49,999 | 20 (13.9%) | – |
| $50–74,999 | 19 (13.2%) | – |
| $75–99,999 | 25 (17.4%) | – |
| $100–124,999 | 20 (13.9%) | – |
| $125–149,999 | 12 (8.3%) | – |
| $150–174,999 | 11 (7.6%) | – |
| <$175,000 | 24 (16.7%) | – |
| Did not disclose | 7 (4.9%) | – |
| **Education** | | |
| Some High School | 4 (2.8%) | – |
| High School Diploma | 9 (6.3%) | – |
| Some College/University | 33 (22.9%) | – |
| Trade School | 22 (15.3%) | – |
| College Degree or more | 74 (51.4%) | – |
| Other | 2 (1.4%) | – |

**Table 2.** Child disorder prevalence at baseline and follow-up and number of onsets

| Condition | *n* at baseline (%) | *n* at 9 month (%) | *n* at 18 month (%) | *n* of first onsets (%) |
|---|---|---|---|---|
| Depression[1] | 9 (6.3%) | 17 (14.9%) | 20 (20.6%) | 24 (17.8%) |
| Anxiety[2] | 10 (6.9%) | 11 (9.6%) | 16 (16.5%) | 19 (14.2%) |
| Suicidality[3] | 35 (24.1%) | 26 (22.8%) | 32 (33.0%) | 23 (20.9%) |

[1]Includes MDD, PDD, and Bipolar Disorder
[2]Includes GAD, Social Anxiety Disorder, Separation Anxiety Disorder, or Panic Disorder
[3]Includes any indication of wanting to die or thinking they would be better off dead

1991, 2008). The BFI asks participants to rate the extent to which a series of statements describes them on a scale of 1 (*Disagree strongly*) to 5 (*Agree strongly*). Example items for Neuroticism are "is emotionally stable, not easily upset," (reversed) and "can be moody." Example items for extraversion are "is talkative" and "is full of energy." Neuroticism and Extraversion scores on the BFI have been associated with depressive and anxiety symptoms in the general population as well as internalizing diagnoses in psychiatric populations (Gosling et al., 2003; Kotov et al., 2010; Rammstedt & John, 2007). In the current study, the Neuroticism and Extraversion subscales respectively had alphas of .82 and .83, showing good reliability.

### Baseline depressive and anxiety symptoms

The Youth Self-Report is a 112-item self-report questionnaire for youth aged 11−18 to assess internalizing and externalizing symptoms. It is a widely used, well validated, self-report measure of depression and anxiety in youth (Achenbach & Rescorla, 2001). Behaviors are rated on a 3-point scale ranging from 0 = "not true" to 2 = "very true or often true", based on the preceding 6 months. The current study focuses on DSM-Affective and DSM-Anxiety symptoms subscales which respectively assess depressive and anxiety symptoms. The Cronbach alpha was 0.77 for baseline depressive symptoms for our sample. The DSM-anxiety symptoms subscale showed marginal internal consistency ($\alpha = .64$) which is consistent with prior research using this scale (Colins, 2016; Lacalle et al., 2012). These scales show good convergent reliability based on their ability to identify youth with the disorder compared those without.

The DSM-Affective scale includes one item inquiring about suicidal ideation, and this was not excluded from the baseline depressive symptoms assessment. The aim of this study was to examine the effect of personality on the first onset of suicidality while adjusting for preexisting symptoms. Depressive symptoms are a strong predictor of suicidality, and thoughts of suicide or death are widely recognized as a core part of depressive symptoms and are typically included in depression scales such as the Hamilton Depression Rating Scale or Beck Depressive Inventory (Beck et al., 1996; Hamilton, 1960). As such, this item was retained in the Affective symptoms subscale given our interest in examining if personality traits predict suicidality onset over and above current depressive symptoms, including thoughts of death or suicide.

adolescent and parent participants are informed of this prior to participation as part of the informed consent process.

### Neuroticism

The Big Five traits of Neuroticism and Extraversion were assessed at baseline with the self-report Big Five Inventory (BFI; John et al.,

### Analyses

We first present descriptive statistics and bivariate zero-order correlations between all study variables (Table 3). Analyses subsequently consisted of bivariate logistic regression models as

**Table 3.** Descriptive statistics and bivariate correlations

| | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex (1) | 1.35 | .48 | – | .17* | .01 | −.31*** | −.24** | −.25** | −.19* | −.23** | −.16+ | −.14 |
| Age (2) | 13.58 | 1.54 | .17* | – | −.08 | .00 | .03 | −.01 | .04 | .09 | .11 | .02 |
| Child Extraversion (3) | 27.25 | 6.44 | .01 | −.08 | – | −.37*** | −.50*** | −.27** | −.14+ | −.22** | −.28*** | −.21* |
| Child Neuroticism (4) | 22.32 | 6.25 | −.31*** | .00 | −.37*** | – | .60*** | .63*** | .41*** | .32*** | .28*** | .18 |
| Baseline depressive symptoms (5) | 3.41 | 3.01 | −.24** | .03 | −.50*** | .60*** | – | .58*** | .34*** | .42*** | .50*** | .29*** |
| Baseline anxiety symptoms (6) | 2.73 | 2.36 | −.25** | −.01 | −.27** | .63*** | .58*** | – | .40*** | .35*** | .32*** | .19* |
| Depressive Dx at follow-up (7) | .21 | .41 | −.19* | .04 | −.14+ | .41*** | −.34*** | .40*** | – | .54*** | .42*** | .16+ |
| Anxiety Dx at follow-up (8) | .15 | .36 | −.23** | .09 | −.22** | .32*** | .42*** | .35*** | .54*** | – | .45*** | .31*** |
| Suicidality at follow-up (yes/no) (9) | .32 | .47 | −.16+ | .11 | −.28*** | .28*** | .50*** | .32*** | .42*** | .45*** | – | .52*** |
| Suicidality severity (10) | 5.79 | 16.23 | −.14 | .02 | −.21* | .18* | .29*** | .19* | .16** | .31*** | .52*** | – |

$***p < .001, **p < .01, *p < .05, {}^{+}p < .10.$

well as linear regression models in SAS 9.4. Child age and sex were covaried in all models to examine effects of predictors of interest over and above age and sex, given that older age and female sex are robustly associated with increased rates of depressive and anxiety disorders (Hankin et al., 1998). The outcome variable was either whether participants had experienced a DSM-5 depressive disorder, anxiety disorder, or suicidality as assessed by the MINI-Kid at either 9-month or 18-month follow-up. Linear regression models examined suicidality severity at either 9- or 18-month follow-ups as an outcome. Outcomes were regressed onto sociodemographic variables and baseline symptoms and our predictor of interest at baseline.

To examine first onsets, within each logistic regression model, participants who had a history of that specific diagnosis or who reported any suicidality at baseline were dropped. Thus, logistic regressions compared the first onset group to the unaffected group, and the effective sample size differed for each disorder (see Table 4 for effective sample sizes in each model). Analyses respectively controlled for subclinical depressive or anxiety symptoms, assessed dimensionally, when predicting depressive or anxiety disorder onsets. Analyses predicting suicidality onsets and severity controlled for baseline depressive and anxiety symptoms. This was done in order to adopt a conservative approach to data analysis examining the incremental predictive utility of personality traits for the subsequent emergence of disorders. Analyses therefore examined whether personality traits predict the odds of first-lifetime onset of depressive or anxiety disorder or suicidality, and suicidality severity, adjusting for baseline subclinical symptoms of depression or anxiety as well as sociodemographic characteristics. This is important given that depression, anxiety, suicidality, and personality are substantially correlated cross-sectionally (e.g., Kotov et al., 2010), and so any effects of personality on subsequent depressive or anxiety disorder or suicidality onsets or severity could be due to an unmeasured cross-sectional association with subclinical symptoms. Moreover, subthreshold symptoms are one of the most robust predictors of the onset of future diagnosable illnesses and as well as suicidality (Burcusa & Iacono, 2007). These analyses are therefore highly conservative. Each personality predictor of interest was examined in separate models given their moderate correlation.

All dimensional predictors, with the exception of age, were standardized. We report standardized odds ratios, which are interpreted as the change in probability of a disorder onset associated with a one standard deviation change in the predictor variable. We also report Area Under the Curve from Receiver Operator Curves for the entire model to examine its accuracy in predicting disorder onsets. While predictors of first onsets of each disorder were examined separately, some participants experienced first onsets of multiple disorders. Results were Bonferroni corrected for multiple comparison correction based on the number of predictors in each model. Models for depression and anxiety onset were corrected to $p = .01$ (.05/5) and suicidality onset and suicidal severity to $p = .008$ (.05/6).

Post hoc sensitivity analyses in GPower (Faul et al., 2009) for a logistic regression with an onset rate of 18% (24/135) at a $p = .01$ and four predictors (i.e., age, sex, baseline symptoms, and personality trait) showed analyses have 80% power to detect an odds ratio of 2.26 for our depression model. For a logistic regression with an onset rate on 14% (19/134) at a $p = .01$ and four predictors, analyses have 80% power to detect odds ratios of 2.44 for our anxiety model. For a logistic regression with an onset rate of 21% (23/110; suicidality model) at a $p = .008$ with five predictors (i.e., age, sex, baseline depressive and anxiety symptoms, and personality trait), analyses have 80% power to detect odds ratios of 2.48 for our suicidality model. As such, we were adequately powered to detect clinically significant effect sizes (Chen et al., 2010) but are likely underpowered to detect small effects.

## Results

### Descriptive statistics and bivariate correlations

Demographic characteristics are shown in Table 1. Adolescents were approximately 65% female, with a mean age of 13.58 years ($SD = 1.54$), and 68.1% identified as white. Parents were 92% female, with a mean age of 43.49 ($SD = 5.75$), and 77.1% identified as white. Most parents were married/common law (74.3%), with 74.3% having college/university education or higher. The median annual household income was $75,000−$99,999.

The number of first onsets of each disorder are shown in Table 2. Table 3 includes descriptive statistics and bivariate correlations between variables. Of the 135 participants who completed baseline measures, who had been assessed at follow-up and had no history of depression, 17.8% ($n = 24$) developed a first onset of depressive disorder. Of the 134 participants who completed baseline measures, who had been assessed at

**Table 4.** Logistic regression models predicting first lifetime depressive, anxiety, and suicidality onsets

| | *n* for model | *n* onsets | *b* | SE | Odds Ratio | 95% CI | *p* | AUC |
|---|---|---|---|---|---|---|---|---|
| **Model 1: Depressive disorder onsets** | | | | | | | | |
| **Block 1:** | **135** | **24** | | | | | | .78 |
| Sex | | | −1.16 | .67 | .31 | .08–1.17 | .085[+] | |
| Age | | | −.02 | .16 | 0.98 | .72–1.35 | .913 | |
| Baseline depression symptoms | | | .75 | .23 | 2.13 | 1.32–3.40 | .001** | |
| **Block 2:** | | | | | | | | |
| Neuroticism | 135 | 24 | 1.12 | .36 | 3.07 | 1.51–6.22 | .002** | .83 |
| Extraversion | 135 | 24 | .07 | .29 | 1.07 | .61–1.88 | .812 | .78 |
| **Model 2: Anxiety disorder onsets** | | | | | | | | |
| **Block 1:** | **134** | **19** | | | | | | .81 |
| Age | | | .25 | .18 | 1.29 | .91–1.82 | .157 | |
| Sex | | | −2.19 | 1.07 | .11 | .01–.91 | .041* | |
| Baseline anxiety symptoms | | | .83 | .29 | 2.29 | 1.30–4.04 | .004** | |
| **Block 2:** | | | | | | | | |
| Neuroticism | 134 | 19 | .50 | .36 | 1.64 | .82–3.32 | .165 | .82 |
| Extraversion | 134 | 19 | −.55 | .30 | .58 | .32–1.05 | .071[+] | .84 |
| **Model 3: Suicidality onsets** | | | | | | | | |
| **Block 1:** | **110** | **23** | | | | | | .76 |
| Age | | | .08 | .17 | 1.09 | .78–1.51 | .671 | |
| Sex | | | −.17 | .64 | .94 | .26–3.32 | .923 | |
| Baseline depression symptoms | | | 1.13 | .39 | 3.09 | 1.44–6.60 | .004** | |
| Baseline anxiety symptoms | | | .23 | .30 | 1.26 | .69–2.27 | .453 | |
| **Block 2:** | | | | | | | | |
| Neuroticism | 110 | 23 | −.55 | .41 | .58 | .26–1.29 | .180 | .77 |
| Extraversion | 110 | 23 | −.40 | .33 | .67 | .35–1.26 | .223 | .77 |

***$p < .001$, **$p < .01$, *$p < .05$, [+]$p < .10$. Notes: For model 1, each predictor in block 2 was examined in a separate model adjusting for child sex and baseline affective symptoms, for model 2, child sex, age, and baseline anxiety symptoms, for model 3 child sex, age, and baseline affective and anxiety symptoms. AUC for each Block 2 is for total model adjusting for aforementioned predictors. SE = Standard Error; CI = Confidence interval; AUC = Area under the curve from receive operating curve analyses.

follow-up, and had no history of anxiety disorders, 14.2% ($n = 19$) developed a first onset of an anxiety disorder. Of the 110 participants who completed baseline measures, who had been assessed at follow-up, and had no history of suicidality at baseline, 20.9% ($n = 23$) of adolescents developed a first onset of suicidality at follow-up. Female sex was associated with having both a depressive and anxiety disorder at follow-up and showed a trend-level association with any suicidality at follow-up. Age was not significantly related to depressive or anxiety disorders or suicidality at follow-up. Higher baseline depressive symptoms were associated with higher neuroticism and lower extraversion. Higher anxiety symptoms at baseline were associated with higher neuroticism and lower extraversion.

Higher baseline depressive and anxiety symptoms were associated with having a depressive or anxiety disorder and suicidality as well as higher suicidality severity at follow-up. Higher neuroticism at baseline was associated with experiencing a depressive or anxiety disorder as well as suicidality and higher suicidality severity. Lower extraversion at baseline was associated with experiencing an anxiety disorder and suicidality, as well as higher suicidality severity at follow-up and was associated with the occurrence of a depressive disorder at a trend-level.

### *Depressive disorder onset (Table 4, Figure 2A-C)*
Adjusting for baseline depressive symptoms, age and sex did not significantly predict depressive disorder onsets. Higher baseline depressive symptoms predicted a 2.1-fold increase in the odds of a depressive disorder onset. Over and above age, sex, and baseline depressive symptoms, higher neuroticism predicted a 3-fold increased odds of a depressive disorder onset. This model predicted depressive disorder onsets with 83% accuracy (Table 4). Extraversion did not predict depressive disorder onsets adjusting for baseline depressive symptoms.

### *Anxiety disorder onset (Table 4, Figure 2D-F)*
Adjusting for baseline anxiety symptoms, sex predicted anxiety disorder onset such that females were more likely to experience an anxiety disorder compared to males, though this was not significant at the Bonferroni corrected significance level. Age was not significantly related to anxiety disorder onset. Higher baseline subclinical anxiety symptoms predicted a 2.3-fold increase in the odds of anxiety disorder onset. Adjusting for baseline anxiety symptoms, neither neuroticism nor extraversion predicted the onset of an anxiety disorder at follow-up.
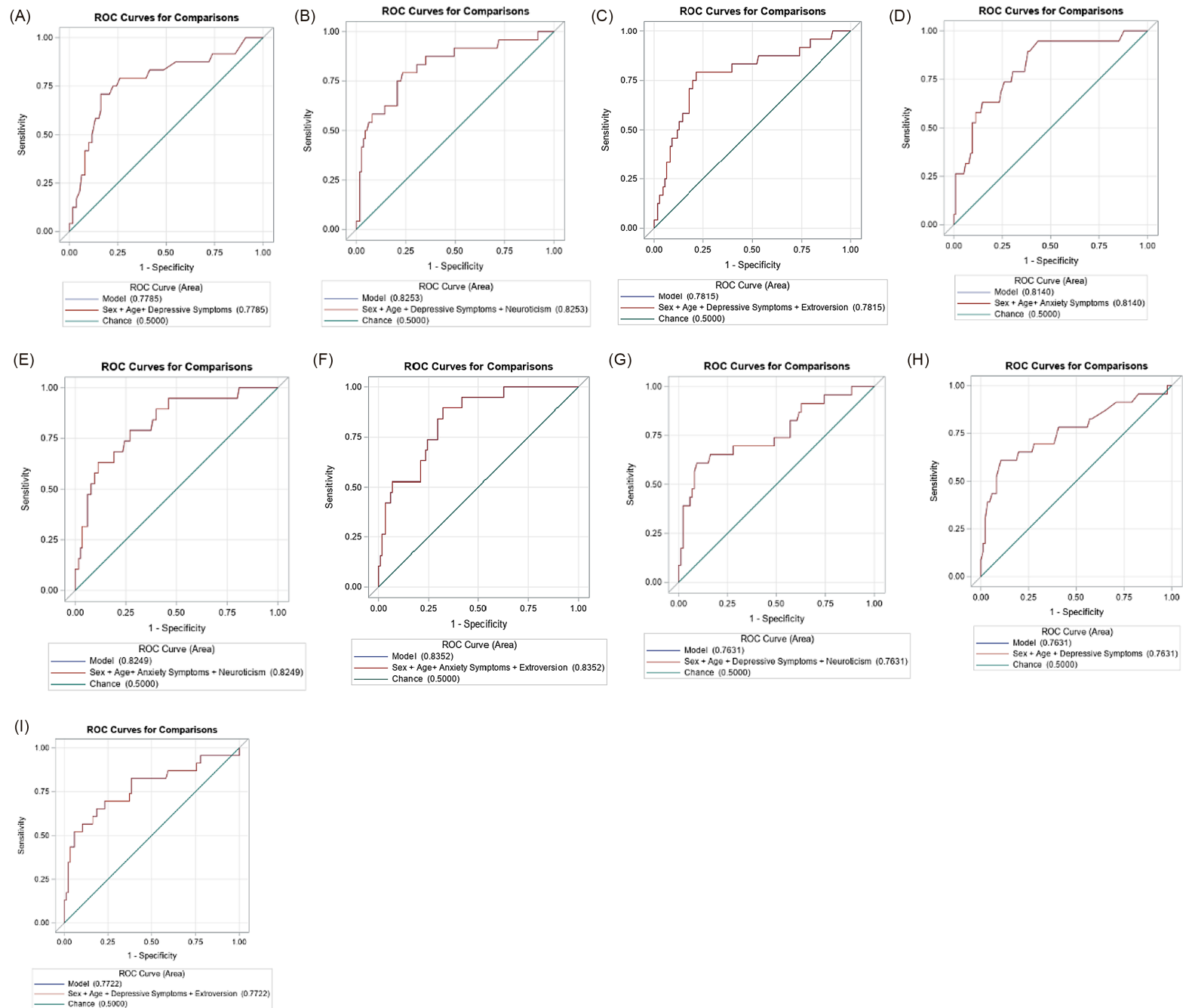
**Figure 2.** Predicting diagnosable onset of DSM-5 Anxiety and Depressive Disorders and Suicidality. (A–C) depict depression disorder onsets. (D–F) depict anxiety disorder onsets. (G–I) depict suicidality onsets.

## Suicidality onset (Table 4, Figure 2G-I)

Adjusting for baseline depressive and anxiety symptoms, age and sex were unrelated to the odds of suicidality onset. Higher depressive symptoms at baseline predicted a 3.1-fold increase in the odds of experiencing suicidality at follow-up, although anxiety symptoms did not significantly predict suicidality onset. Over and above age, sex, and baseline depressive and anxiety symptoms, neither personality trait predicted suicidality onset.

## Suicidality severity (Table 5)

Increased baseline depressive symptoms, but not sex or age, predicted increased suicidality severity but this did not survive Bonferroni correction. Anxiety symptoms did not predict suicidality severity adjusting for age, sex, and depressive symptoms. Adjusting for baseline depressive and anxiety symptoms, age, and sex, there were no significant effects of any personality trait on suicidality severity. The model including child age, sex, and baseline depressive and anxiety symptoms explained 12% of variance in suicidality severity.

## Discussion

This study examined the personality traits of neuroticism and extraversion as potential markers for the first-lifetime onset of depression, anxiety, and suicidal ideation, as well as suicidality severity, over and above effects of pre-existing subthreshold symptoms assessed dimensionally. Identifying pre-morbid risk markers of depression and anxiety before disorder onset in adolescence will inform knowledge of the etiology of these disorders and may be key to early identification and prevention of these disorders that make up a significant portion of economic burden worldwide, particularly in adolescents (Clayborne et al., 2019; Johnson et al., 2018). However, if personality traits do not predict first onsets of disorders after adjusting for subthreshold symptoms, it is possible that targeting those subthreshold symptoms rather than the personality trait directly may lead to more effective early identification and prevention efforts.

### Depressive disorder onset

At the zero-order level, greater neuroticism and lower extraversion were associated with elevated baseline depressive and anxiety symptoms and with experiencing a depressive or anxiety order, as well as a suicidality onset and elevated suicidality severity. When examining first onsets after adjusting for age and sex as well as preexisting subthreshold symptoms, first-lifetime onset of depression at follow-up was predicted by higher baseline neuroticism. Previous research has found that higher neuroticism predicted depression onset, but they did not consider baseline subthreshold symptoms, assessed dimensionally, in their analysis (Fu et al., 2021; Goldstein et al., 2018; Kopala-Sibley et al., 2017; Zinbarg et al., 2016). The current results add to a growing body of literature that neuroticism is a significant risk factor for first-lifetime onsets of depression, and this effect is independent of pre-existing subthreshold depressive symptoms.

### Anxiety disorder onsets

Baseline anxiety symptoms were positively correlated with neuroticism and negatively correlated with extraversion, and these measures were also correlated with anxiety disorder onset. However, we found no statistically significant predictive effect of personality traits on the development of an anxiety disorder after adjusting for baseline anxiety symptoms. Similar longitudinal

studies have found odds ratios of 1.33−1.86 when examining neuroticism predicting anxiety disorders which is consistent with our non significant odds ratio of 1.64 indicating that with our current sample size and onset rate we were likely unable to detect smaller effects (Goldstein et al., 2018; Kopala-Sibley et al., 2017). A prior meta-analysis by Kotov et al. (2010) linked anxiety disorders to reduced extraversion while longitudinal studies of adolescents have found predictive effects of extraversion on agoraphobia and social phobia (Goldstein et al., 2018; Prince et al., 2021). As such, the current results are consistent with cross-sectional research that neuroticism is robustly associated with anxiety symptoms (Alizadeh et al., 2018; He et al., 2018; Karsten et al., 2013; Liao et al., 2019; Williams et al., 2021). However, results are inconsistent with some longitudinal studies that found that neuroticism predicted specific anxiety disorder onsets (i.e., GAD, panic, agoraphobia, and specific phobia) (Christensen et al., 2021; Goldstein et al., 2018; Prince et al., 2021). A disorder-specific meta-analysis showed weaker associations of personality traits predicting anxiety disorders versus depressive disorders (Kotov et al., 2010). Another meta-analysis looked at the confounding effects of baseline symptoms and psychiatric history and found that after adjusting for these confounds effect sizes were halved, highlighting the importance of considering these effects when predicting onsets (Jeronimus et al., 2016). Indeed, prior longitudinal studies either did not control for pre-existing symptoms, or controlled for subthreshold status, assessed categorically (Christensen et al., 2021; Goldstein et al., 2018; Kopala-Sibley et al., 2017; Prince et al., 2021). It is therefore possible that personality traits may have disorder-specific effects in terms of first onsets. However, we were underpowered to perform disorder-specific tests. Alternatively, the current data suggest that while low extraversion and elevated neuroticism are linked to anxiety disorder onsets, at least some of this effect may be due to unmeasured cross-sectional associations with pre-existing subthreshold anxiety symptoms, and larger samples may be necessary to detect effects of neuroticism and extraversion on first onsets of anxiety disorders after adjusting for pre-existing symptoms.

### Suicidality onsets

In unadjusted correlations, increased neuroticism, decreased extraversion, and increased baseline depressive and anxiety symptoms were associated with a suicidality onset and increased suicidality severity at follow-up. This is consistent with prior research (Fergusson et al., 2000; Lawson et al., 2022; Rappaport et al., 2017) that has found that suicidal ideation onset or an increase in suicidality severity at follow-up was correlated with higher baseline depression and anxiety symptoms, higher baseline neuroticism, and lower baseline extraversion. Elevated baseline depressive, but not anxiety, symptoms predicted an increased odds of a suicidal ideation onset; however, over and above this effect, no personality trait predicted first onsets of suicidal ideation or suicidality severity at follow-up. While several cross-sectional studies have found that neuroticism is a risk factor while extraversion is a protective factor for suicidal ideation in both community and patient samples, this was not replicated in our longitudinal sample after adjusting for prior symptoms (Blüml et al., 2013; Flint et al., 2021; Su et al., 2018). Results therefore suggest that effects of neuroticism or extraversion on the development of suicidal ideation may be partly due to an

**Table 5.** Regression models predicting suicidality severity

|  | *n* | *b* | SE | *t* | 95% CI | *p* | $R^2$ |
|---|---|---|---|---|---|---|---|
| **Block 1:** | **110** |  |  |  |  |  | **.12** |
| Sex |  | −.75 | 3.22 | −.23 | −7.15 to 5.64 | .816 |  |
| Age |  | .16 | .91 | 0.17 | −1.65 to 1.96 | .864 |  |
| Baseline depression symptoms |  | 4.62 | 2.16 | 2.14 | .33 to 8.91 | .034* |  |
| Baseline anxiety symptoms |  | 1.98 | 1.83 | 1.08 | −1.65 to 5.62 | .282 |  |
| **Block 2:** |  |  |  |  |  |  |  |
| Neuroticism | 110 | −2.72 | 2.03 | −1.34 | −6.75 to 1.31 | .184 | .13 |
| Extraversion | 109 | −1.11 | 1.69 | −.66 | −4.47 to 2.24 | .512 | .12 |

***p < .001, **p < .01, *p < .05, +p < .10. Notes: Each predictor in block 2 was examined in a separate model adjusting for child age, sex, and baseline affective and anxiety symptoms. SE = Standard Error; CI = Confidence Interval.

unmeasured cross-sectional association with pre-existing depressive symptoms. Alternatively, effects may be too small to detect in the current sample.

### Clinical implications and future directions

This work provides further support for targeting personality for the prevention of mood disorders as results suggest that targeting adolescent neuroticism may prevent first onsets of depressive disorders. For example, the unified protocol for the transdiagnostic treatment of emotional disorders is a cognitive behavioral therapy partly based upon the premise that neuroticism is a core transdiagnostic factor that is present in several mood and anxiety disorders, making it a key treatment target (Barlow et al., 2020; Kopala-Sibley, 2022). The goal of this treatment is to identify and modify the negative emotions that lead to maladaptive avoidant coping mechanisms common in emotional disorders, such that patients learn to re-engage nonjudgmentally with their emotions (Barlow et al., 2020; Kopala-Sibley, 2022). A randomized control trial of adults showed that treatment using the unified protocol resulted in improvements in clinical severity, symptoms of depression and anxiety, levels of positive and negative affect, and overall quality of life (Farchione et al., 2012), although we are not aware of any studies using the unified protocol for depressive prevention, rather than treatment. Future prevention work may benefit from examining whether the unified protocol in high-risk adolescents may prevent first onsets of depressive disorders. Alternatively, some evidence suggests that implementing school-based approaches towards emotional wellness including social and emotional learning objectives could help reduce neuroticism while boosting pro-social behaviors and reduce symptoms of depression and anxiety, thereby possibly preventing future disorder onset (Kilbourne et al., 2018; Koschmann et al., 2019).

### Strengths and limitations

Our study had several strengths such as a prospective longitudinal design with a risk-enriched sample as well as controlling for baseline subthreshold symptoms. Our study also had limitations such as a modest sample size where enough youth developed a disorder for predictive purposes in the broad categories of depression and anxiety, but we were underpowered to predict disorder-specific onsets (i.e., MDD, BD, PDD, GAD, SAD, panic disorder, and separation anxiety). We are also underpowered to detect smaller effects for our outcomes of interest. It should be

noted that our suicidality outcome primarily assesses suicidal ideation and as such these results may not be generalizable to suicidal behaviour and suicide attempts (Klonsky et al., 2016; Klonsky & May, 2014; Nock et al., 2018). In addition, we did not have a formal control group or low-risk group for comparison. While this is not strictly necessary for the purpose of this study as youth who did not develop a disorder are considered the control group we cannot generalize our findings to other populations that are not at familial high-risk for mood and anxiety disorders. Listwise deletion of missing data may have also produced biases in results. Future work may benefit from alternative approaches to missing data while sensitivity analyses may be useful to check assumptions around different methods of dealing with missing data and how they affect model results. The anxiety symptoms measure also had moderate reliability and while this is consistent with previous literature (Colins, 2016; Lacalle et al., 2012), it may have impacted results. Our sample, while representative of the catchment area, is relatively homogenous being predominately white, educated, and middle class, which limits generalizability to other populations. Our relatively short follow-up period also prevents us from making predictions regarding timing of first onset of mood or anxiety disorders and an important future direction would be to use survival analyses to determine onset timing.

### Conclusions

This research expands the current literature on longitudinal research in adolescents at high familial risk for developing depressive or anxiety disorders. Despite adolescence being a critical period for the development of anxiety and depression, particularly in youth with a family history of the disorders, there is limited longitudinal research on the effect of personality on first onset of these disorders (Fu et al., 2021). The current study showed that elevated neuroticism and decreased extraversion were both linked to future onsets of depressive and anxiety disorders and suicidality. However, after adjusting for pre-existing symptoms, only neuroticism predicted first onset of depression. Results have implications for efforts aimed at prevention of depressive and anxiety disorders in adolescents.

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