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Original article

Dynamic Associations Between Anxiety Symptoms and Drinking Behavior From Early Adolescence to Young Adulthood

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A B S T R A C T

Purpose: Research is inconclusive with respect to the possible risk-increasing effect of anxiety symptoms on heavy drinking behavior among adolescents and young adults. Adult role transitions and changes in the social context from early adolescence into young adulthood may impact the association between anxiety symptoms and alcohol use.

Methods: The TRacking Adolescents' Individual Lives Survey, including 2,229 individuals at baseline, was used to evaluate the bi-directional and longitudinal associations between anxiety symptoms and alcohol use, using data at 14, 16, 19, 22, and 25 years of age.

Results: Cross-lagged models revealed a relatively stable negative association at 14, 16, and 19 years, showing that relatively higher anxiety symptoms were associated with relatively lower drinking levels three years later. This effect was absent in young adulthood. There was no evidence for significant associations between alcohol use and subsequent anxiety symptoms, with the exception of alcohol use at age 19, which predicted relatively lower levels of anxiety symptoms at age 22.

Discussion: Overall, the results indicated that anxiety symptoms may withhold adolescents from (heavy) drinking, although this protective effect disappeared in young adulthood. Transitions in social contexts as well as autonomy and adult responsibilities could underlie the changing association between alcohol use and anxiety symptoms throughout adolescence and young adulthood.

IMPLICATIONS AND CONTRIBUTION

The influence of anxiety symptoms on alcohol use seems to be of a different nature in adolescence compared to young adulthood. Anxiety in adolescence seems to restrain adolescents from using alcohol, while in later life, this effect extinguishes—possibly due to changes in the social environment and role transitions in young adulthood.

Anxiety and alcohol use disorders are two highly prevalent conditions and are leading contributors to burden of disease worldwide, particularly among young people [1]. Empirical evidence highlights that anxiety symptoms and disorders typically peak during early adolescence and precede the onset of alcohol use problems, which typically develop during late adolescence and young adulthood [2]. In adulthood, anxiety has been identified as a fairly robust predictor of alcohol use and related problems [3]. This association is consistent with self-medication and tension reduction theories, which propose that drinking is motivated by a desire to alleviate emotional distress [4]. In adolescence, however, this link has not been established. Rather, an inconsistent, and often unclear, pattern of both positive and negative associations between anxiety and alcohol use has been found [5]. The inconsistent findings illustrate the urgent need for a longitudinal perspective on the possible bi-directional

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association between anxiety and alcohol use. For this study, we therefore included a large sample of adolescents followed over multiple developmental phases [5].

Studies focusing on early adolescence and mid-adolescence have produced mixed findings as to whether anxiety symptoms are a protective or risk factor for the initiation and escalation of alcohol use [5]. Some studies have shown that early adolescents with anxiety symptoms and anxiety sensitivity delay initiation of alcohol use compared to their peers with no or only few anxiety symptoms [6], and that social anxiety during early adolescence or mid-adolescence protects against—frequent—alcohol use and drunkenness [7,8]. In contrast, there is also some evidence suggesting a positive association between adolescent anxiety symptoms and alcohol use. For instance, the presence of any anxiety disorder in mid-adolescence (13–17 years) has been associated with frequent or heavy drinking among girls [9], and generalized anxiety during early adolescence (9 years) and mid-adolescence (15–16 years) has been shown to place youth at risk for concurrent and subsequent frequent alcohol use [10]. Moreover, although high initial levels of anxiety predicted low alcohol use during early adolescence, slow declines in anxiety symptoms have been associated with an escalation of alcohol use [8]. By late-adolescence to young adulthood (18–24 years), a more consistent relationship emerges, with increased anxiety symptoms being associated with frequent alcohol use, risky use, and alcohol disorders [5,11]. These age-related differences may reflect developmental differences in the association between anxiety and alcohol use problems or reflect variation in the assessment across adolescence and young adulthood. Whereas in adolescent sample, alcohol use is usually assessed by means of general measures such as the frequency and quantity of alcohol consumption, studies in young adult samples more often focus on problematic alcohol use and alcohol use disorder [5]. A positive association between anxiety and problematic alcohol use does not exclude a negative association between anxiety and frequency of alcohol use [12].

A developmental perspective on the association between anxiety and alcohol use

Inconsistent findings about the association between anxiety and alcohol use during adolescence may in part be due to changes in the (social) context that usually accompany the transition into young adulthood [13,14]. In early adolescence, anxiety-related characteristics such as fearfulness, social withdrawal, and fear of authority and illegal activities may delay the onset of alcohol use. Among others, these characteristics may reduce the exposure to social situations where drinking may occur, and prevent youth from engaging with peer groups that support drinking [9,15]. From early adolescence to mid-adolescence, peer groups become increasingly important and the need for social acceptance increases [16]. Alcohol use may be one way to affiliate with peers and increase social status [17]. However, as drinking at this age is still illegal, alcohol may be more characteristic of adolescents who have a tendency for sensation-seeking and are looking for adventure [18] and less appealing for the more anxious adolescent. During late adolescence, many young people enter postsecondary education or the workforce. This transition is accompanied by a range of cognitive and social changes, as well as exposure to new norms around drinking behavior [13,19]. Abstaining from drinking is less normative and motives to drink also change during late adolescence [14,20,21]. Motives for drinking in earlier years typically relate to environmental influences such as peers and social rewards, whereas in late adolescence, drinking to regulate internal affect is more pronounced [22]. The transition into young adulthood is characterized by autonomy development, increased work responsibilities [23], and a stronger reliance on one's own social support network [24]. This important developmental transition is likely more challenging for anxious youth than for their less anxious peers [25], possibly increasing anxious adolescents' need to cope with negative affect. Compared to the early adolescents phase, the easier access to alcohol and greater social acceptance of drinking could promote the use of alcohol to cope with negative emotions more strongly in late adolescence and young adulthood [8]. Indeed, prior research indicates that drinking to cope with anxiety and other emotional problems is strongly associated with continued binge drinking [20] and alcohol-related problems [22] in young adulthood specifically (22–30 years). Since anxious adolescents are more likely to engage in coping-motivated drinking, their risk for problematic alcohol use compared to their less anxious peers may be increased [26].

The present study

To date, research studying the longitudinal associations between anxiety symptoms and alcohol use has focused on specific developmental periods (e.g., either early adolescence, mid-adolescence, late-adolescence). However, to test whether associations between anxiety symptoms and alcohol use are dependent upon the specific developmental period, longitudinal research covering the entire period from early adolescence to young adulthood is essential [5]. To address this gap in the literature, this study investigates the longitudinal associations between anxiety symptoms and alcohol use from 14 to 26 years. Using a cross-lagged design allows us to investigate the prospective relationships between anxiety and alcohol use at different ages and identify possible relative changes within this relationship as a consequence of developmental differences between early adolescence and young adulthood.

Methods

Participants

The sample included adolescents participating in the ongoing TRacking Adolescents' Individual Lives Survey (TRAILS) study. This longitudinal population study started in 2001/02 and included Dutch adolescents enrolled at age 11 (baseline). All inhabitants of five municipalities born between October 1, 1990 and September 30, 1991 were invited. One hundred thirty five primary schools were contacted as participation of schools was a prerequisite for inclusion. Either parents or schools could refuse participation. Of the 3,483 children eligible for participation, 2,230 (76%) were included after recruitment. The TRAILS sample is a relatively good representation of the Dutch adolescent population [27]. For a detailed description of study procedure and sample selection, please see Winter et al. [28]. The TRAILS study was conducted in accordance with the general ethical standards and approved by the Central Committee on Research Involving Human subjects. Participation required written, informed consent from adolescents and their parents at participating schools. At baseline, 2,229 (50.7% female; mean

age = 10.61) adolescents participated. For this study, wave 2 (when participants were aged around 14 years) until wave 6 (when participants were aged around 25 years) was used (hereafter referred to as wave 1 to wave 5) due to the relatively young age at baseline and the related absent comprehensive measurement of alcohol use (only yes/no information on alcohol use). There was a three-year time gap between waves allowing us to capture the adolescent period as well as the transition into adulthood. Information on sample size and mean age across waves is presented in Figure 1.

Missing data

To evaluate significant differences between individuals who participated in all study waves and those who dropped out of the study, simple *t*-tests were performed on all study variables. Results revealed that participants who dropped out of the study were more likely to be male ($t(1{,}116) = -5.87$, $p < .01$), to have a parent with a non-Western ethnic background ($t(843) = -7.60$, $p < .01$), to have a parent with a history of addiction ($t(768) = -4.34$, $p < .01$), and reporting fewer anxiety symptoms ($t(2{,}093) = 2.56$, $p < .01$). Missing data were handled using Full Information Maximum Likelihood (FIML). FIML allows the use of all information available, without imputing missing values. Individuals who had data present at any wave were included in the final analyses.

Instruments

Anxiety. Due to the differences in developmentally appropriate measurements tools used across the course of the study, anxiety scores were derived using three different questionnaires across waves to assess anxiety. Common items for each age were identified and combined. For waves 1–2, the Revised Child and Anxiety and Depression Scale (RCADS) [29] was used. This scale originally consists of 47 Likert-type items with four answer categories ranging from "never" to "always". Example items can be found in Table 1. In addition to these items, at waves 1–2, three items from the Diagnostic and Statistical Manual-IV anxiety subscale from the Youth Self-Report (YSR) scale were selected [30]. This subscale originally consists of six items. The three answer categories ranged from "not at all" to "often".

For waves 3–5, the Adult Self-Report (ASR) scale was used [30]. This measure is similar to the YSR, but is adjusted with developmental appropriate items. Again, the Diagnostic and Statistical Manual-IV anxiety subscale was selected, originally including seven items, of which five were selected for the purpose of this study to match the selected items for waves 1–2. A confirmatory factor analysis supported the combination and existence of an underlying construct while using the selected five items for each wave. We further explored the validity and measurement invariance (MI) of this construct over five waves in our measurement model.

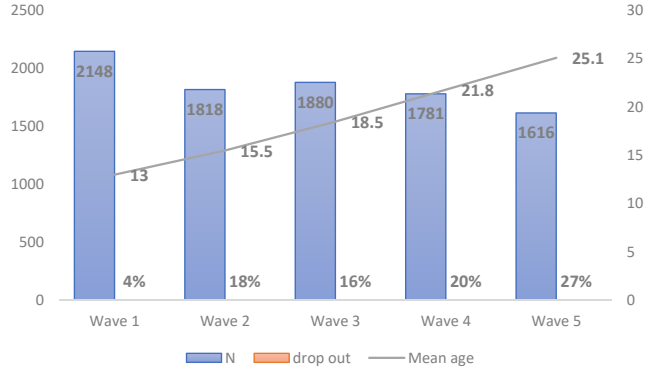

Figure 1. Sample size, drop out (reference baseline), and age for each wave separately.

Alcohol use T1–T5. Alcohol use was assessed with a quantity by frequency measure identifying weekly alcohol use. Participants reported their alcohol consumptions on weekdays, alcohol consumptions during weekend days, and the amount of drinking days during the week and weekend. Total alcohol use was assessed by multiplying drinking days and average number of drinks during the week and weekend separately, and summing up both elements (weekend + week). At wave 5, a quantity by frequency measure was missing and was replaced by first three questions of the Alcohol Use Disorders Identification Test (AUDIT-C) assessing the average quantity and frequency of alcohol use (cf. 31). To ensure comparability, all measures were z-transformed for the measurement model. For descriptive purposes only, and to compare both alcohol measures within one single wave, the AUDIT-C was also provided for wave 4.

Covariates

Education. Previous studies revealed possible differences in alcohol use depending on educational level [31]. Dutch secondary education system places adolescents (at a relatively early age) on a certain educational track depending on their academic performance (i.e., early tracking). Adolescents are either classified in the vocational tracks, higher vocational tracks, or in the preuniversity tracks. Particularly in early adolescence, alcohol use is higher among the vocational tracks [31]. Educational level was assessed at wave 1 as soon as adolescents moved from primary to secondary school. Categories were practical vocational, theoretical vocational, intermediate vocational, and preuniversity.

Parental addiction and anxiety. Parental psychopathology has been linked to internalizing and externalizing in children and adolescents [32]. Therefore, parental addiction (including alcohol and other drugs) and anxiety symptoms were included as covariates. Parental psychopathology was assessed with the Brief TRAILS Family History at baseline only. A trained interviewer provided a description of possible addiction and anxiety symptoms/description of the psychopathology, after which parents indicated to what extent they experienced current or past addiction or anxiety symptoms, received treatment, and/or used medication for that particular psychopathology. A family vulnerability index for anxiety and addiction problems was developed by summing the scores for lifetime occurrence for both parents (yes/no) for anxiety and for addiction separately.

Analytic strategy

Descriptive statistics and Pearson/Spearman correlations for all study variables were presented. For descriptive purposes, a mean score of the five anxiety items was calculated. For subsequent analyses, separate items were added as latent indicators. Simple *t*-tests were used to identify significant differences

Table 1
Items used for anxiety; matching items provided for items that were not consistently available over time

Item	Wave	Item content	14 years	16 years	19 years	22 years	26 years
			M (SD/min/max)	M (SD/min/max)	M (SD/min/max)	M (SD/min/max)	M (SD/min/max)
1.	Wave 1–2	I worry about things (RCADS)	0.88 (0.57)/0–3	1.07 (0.61)/0–3			
	Wave 3–5	I often worry (ASR)			0.54 (0.66)/0–2	0.71 (0.71)/0–2	0.57 (0.66)/0–2
2.	Wave 1–5	I am nervous or tense (YSR)	0.55 (0.57)/0–2	0.51 (0.59)/0–2	0.50 (0.59)/0–2	0.62 (0.66)/0–2	0.43 (0.59)/0–2
3.	Wave 1–5	I am afraid of certain animals, situations, or places other than school (YSR)	0.42 (0.64)/0–2	0.32 (0.59)/0–2	0.49 (0.60)/0–2	0.39 (0.58)/0–2	0.41 (0.58)/0–2
4.	Wave 1–5	I am too anxious or afraid (YSR/ASR).	0.22 (0.45)/0–2	0.19 (0.43)/0–2	0.20 (0.45)/0–2	0.31 (0.56)/0–2	0.20 (0.46)/0–2
5.	Wave 1–2	I worry that something bad is going to happen to someone in my family (RCADS)	0.56 (0.71)/0–3	0.58 (0.73)/0–3			
	Wave 3–5	I worry about my family or relatives (ASR)			0.41 (0.60)/0–2	0.45 (0.62)/0–2	0.43 (0.61)/0–2

RCADS = Revised Child and Anxiety and Depression Scale; YSR = The Youth Self-Report scale; ASR = Adult Self-Report Scale; SD = standard deviation.

between waves. Cross-lagged panel models allow for the investigation of reciprocal prospective relationships between two variables on multiple waves. For this particular research question, we are interested in between-person effects and possible changes within this relationship over time. For instance, are adolescents with high anxiety at higher risk for future alcohol use (and vice versa) and do we observe similar prospective relationships in adolescence versus young adulthood? According to Orth et al., between-person differences over time are best evaluated with cross-lagged models [33]. Cross-lagged models identify changes on a group level and therefore changes over time should be interpreted as relative changes rather than absolute changes. To evaluate the prospective relationship between anxiety and alcohol use, a measurement model for each construct was first confirmed, followed by a cross-lagged panel analysis of the associations between alcohol and anxiety over time. Each of these models was estimated with Mplus version 8, using the Maximum Likelihood Robust Standard errors estimator method to control for non-normality of the data and Weighted Least Square Mean and Variance for categorical data.

Measurement model. A first step in our approach was to evaluate the consistency and validity of the anxiety scale. Anxiety symptoms over the course of the study (14–26 years) were assessed with validated items of two different scales (YSR/ASR and RCADS). A confirmatory factor analysis—using Weighted Least Square Mean and Variance as estimation method—was performed to evaluate the factor loadings of each of the items for each wave separately (Table 2). In a second step, MI across time was evaluated by constraining (1) factor loadings, (2) intercepts, (3) intercepts and factor loadings, while evaluating and comparing model fit measures (Comparative fit index [CFI] Tucker–Lewis index [TLI], root mean square error of approximation [RMSEA]) in relation to a more stricter model (Table 2). In the process of model selection, the following thresholds are used, with acceptable model fit as minimum requirement: A CFI and TLI above 0.90 is acceptable, above 0.95 is good. Similarly, an RMSEA below 0.08 is acceptable, and below 0.06 is good [34,35].

Analysis model; cross-lagged panel model. In a second step, the cross-lagged effects of anxiety and alcohol use from 14 to 26 years were analyzed. The model included auto-regressive paths between alcohol use over time, as well as anxiety over time, cross-sectional correlations between anxiety and alcohol use, and cross-lagged paths between anxiety and alcohol. For readability purposes, auto-correlation was presented in the figure caption. At baseline, participant sex and educational level and parental anxiety and addiction (only available at baseline) were added as covariates. To reduce model complexity, models were adjusted for associations between the covariates and anxiety and alcohol at wave 1 only. The current results may therefore not capture any changes in the strength of covariate associations over the course of adolescence. However, the correlation matrix (Table 4) showed the associates between the covariates and anxiety and alcohol were (relatively) stable over time.

Results

Descriptive statistics and correlations are presented in Tables 3 and 4. Anxiety symptoms declined in late adolescence (19–22 years; $t(2,095) = 11.55$, $p < .01$), but increased at 26 years ($t(1,689) = -7.32$, $p < .01$). Alcohol use increased strongly between 14 and 16 years and between 16 and 19 years, and stabilized in young adulthood (22–26 years), and significantly decreased at age 26 ($t(1,409) = 6.54$, $p < .01$).

Measurement model; confirmatory factor analyses anxiety symptoms

A confirmatory factor analysis revealed a stable latent factor of anxiety for all waves separately (wave 1–5). Factor loadings of all five anxiety items revealed good to acceptable levels of fit with the latent construct of anxiety (factor loadings ranging between 0.50 and 0.86). MI over time for the latent construct of anxiety was partly established [36]. A model in which only factor loadings were constrained outperformed a model testing full MI with both intercepts and factor loadings constrained (Table 2). However, model fit indices only slightly improved for a model with only factor loadings constrained. Additional analyses identifying which exact intercepts were causing difficulties for scalar MI revealed that particularly a model in which the intercepts of

Table 2
Model fit measure for testing measurement invariance for the latent factor anxiety from 14 years to 26 years

	CFI	TLI	RMSEA
Baseline model	0.92	0.91	0.05
Factor constrained	0.93	0.92	0.05
Full constrained	0.91	0.91	0.05

CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation.

Table 3
Descriptive statistics

	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5
	N = 2,148	N = 1,818	N = 1,880	N = 1,781	N = 1,616
Age	13.57 (0.53)	16.28 (0.71)	19.08 (0.60)	22.29 (0.65)	25.66 (0.60)
Female sex (%)	51%				
Educational level %					
Lower vocational	32%				
Intermediate vocational	25%				
Higher vocational	20%				
Academic	23%				
Parental addiction(%)[a]	8.5%				
Parental anxiety (%)[a]	18.5%				
Anxiety	0.53 (0.38)	0.53 (0.39)	0.43 (0.41)	0.41 (0.41)	0.50 (0.46)
Alcohol use					
Quantity by frequency	1.66 (4.56)	6.95 (9.56)	10.18 (11.64)	10.18 (11.01)	-
AUDIT-C				4.69 (2.92)[b]	4.18 (2.65)

AUDIT-C = Alcohol Use Disorders Identification Test.
[a] Percentage of father and/or mother with a history of anxiety or addictive symptoms.
[b] Not included in analyses but for descriptive reasons presented here.

items were constrained separately within their original scale (RCADS vs. YSR items) resulted in better model fit. This suggests that these particular items may be higher/lower rated during different phases of development, possibly reflecting developmental differences in the assessment of the symptoms [34]. Since differences were very small, we decided to continue with a model with full MI with the intercepts of the items "I worry about things" and "I worry about my family or relatives" being freely estimated over time.

Analysis model; cross-lagged panel models including alcohol use and anxiety symptoms

Cross-lagged relationships between anxiety and alcohol from 14 to 26 years were evaluated in models controlling for sex, educational level, parental addiction, and parental anxiety at 14 years (Figure 2). Overall fit measures indicated good model fit (CFI = 0.94; RMSEA = 0.03; TLI = 0.93). Results revealed high stability for anxiety symptoms (betas ranging between 0.75 and 0.83) over time, and moderate to high stability for alcohol use (betas ranging between 0.24 and 0.65), with more stable drinking patterns in later adolescence and young adulthood than in early adolescence. Cross-lagged effects revealed a fairly consistent negative association between anxiety symptoms and alcohol use three years later. Higher anxiety scores were associated with relatively less drinking behavior three years later. This pattern was consistently found from 14 to 16 years, from 16 to 19 years, and from 19 to 22 years. No evidence for an association was found between anxiety levels at 22 years and subsequent alcohol use at 26 years.

Alcohol use at age 19 was negatively associated with anxiety symptoms at 22 years, indicating that adolescents who drank more at age 19 reported relatively fewer anxiety symptoms three years later. No other associations were observed between alcohol use and subsequent anxiety. All cross-lagged associations were robust for confounding of sex, educational level, and parental anxiety or addiction.

Discussion

Previous research is inconclusive about the relationship between anxiety symptoms and alcohol use across adolescence [5]. Anxiety symptoms have been identified both as risk factor as well as protective factor for alcohol use, possibly dependent on developmental differences between adolescence and young adulthood. To shed light on the inconsistencies in the literature, this study used a developmental framework to evaluate the directional associations between anxiety and alcohol form early

Table 4
Correlations between alcohol use and anxiety from 14 to 26 years including correlations with confounding variables at baseline

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Anxiety 14 y	1.00												
2. Anxiety 16 y	0.49**	1.00											
3. Anxiety 19 y	0.41**	0.52**	1.00										
4. Anxiety 22 y	0.37**	0.48**	0.53**	1.00									
5. Anxiety 26 y	0.34**	0.47**	0.52**	0.61**	1.00								
6. Alcohol 14 y	−0.01	0.02	0.03	0.01	0.01	1.00							
7. Alcohol 16 y	−0.08**	−0.10**	−0.07**	−0.08**	−0.04	0.25**	1.00						
8. Alcohol 19 y	−0.11**	−0.12**	−0.06*	−0.11**	−0.03	0.07**	0.40**	1.00					
9. Alcohol 22 y	−0.14**	−0.18**	−0.11**	−0.13**	−0.12**	0.07*	0.29**	0.53**	1.00				
10. Alcohol 26 y	−0.08**	−0.16**	−0.09**	−0.08*	−0.09**	0.05	0.26**	0.41**	0.59**	1.00			
11. Sex (female = 0)	−0.31**	−0.35**	−0.26**	−0.26**	−0.24**	−0.01	0.12**	0.32**	0.40**	0.32**	1.00		
12. Parental addiction	0.02	0.05	0.07**	0.07**	0.04	0.02	0.01	−0.02	−0.06*	0.03	1.00	1.00	
13. Parental anxiety	0.07**	0.06*	0.09**	0.04	0.01	0.01	0.02	−0.01	−0.05*	−0.01	−0.04	0.01	1.00
14. Educational level	0.040	−0.025	−0.01	−0.04	0.01	−0.10**	−0.16**	0.01	0.09**	0.20**	−0.07**	−0.14**	−0.01

*$p < .05$, **$p < .01$.

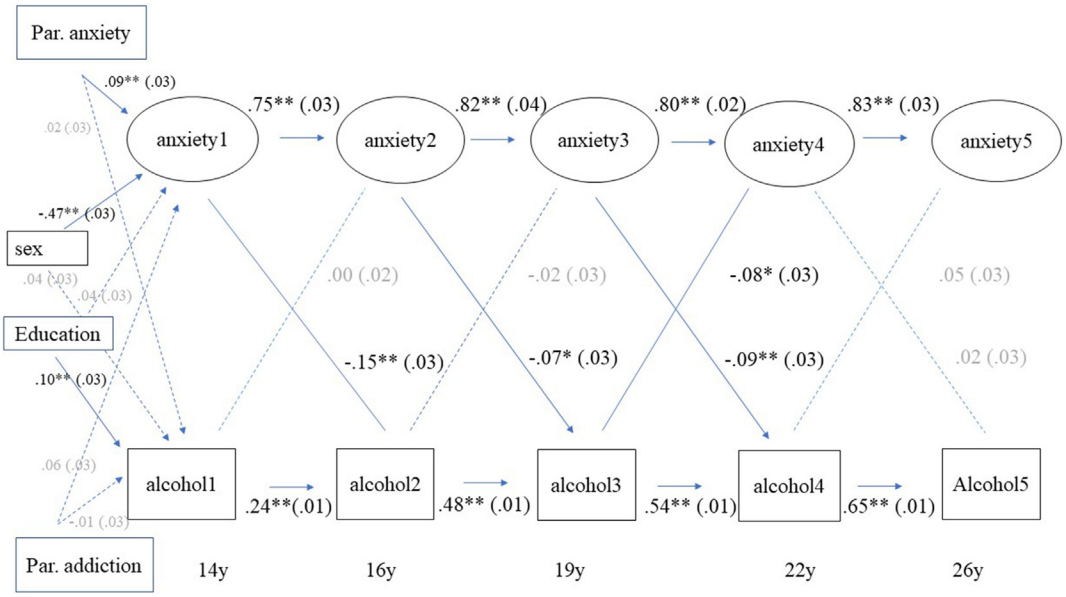

Figure 2. Cross-lagged model for alcohol use and anxiety symptoms from 14 to 26 years. Auto-correlations were left out but included in the model. The following correlations emerged. Between alcohol and anxiety 14 years: −0.01 (0.02); 16 years: 0.04 (0.03); 19 years: 0.10 (0.02)*; 22 years: −0.01 (0.02); 26 years: −0.02 (0.02). * = $p < .05$; ** = $p < .01$.

adolescence (14 years) to young adulthood (26 years). We found no evidence for a positive association between anxiety symptoms and alcohol use during adolescence or early adulthood. Adolescents who reported more anxiety symptoms did not drink more than peers reporting fewer anxiety symptoms. In contrast, between ages 14 and 19, higher anxiety symptoms were consistently associated with relatively lower levels of alcohol consumption at the subsequent assessment point three years later. By age 22, there was no longer evidence of a negative association between anxiety and alcohol use.

The findings of our study provide support for the idea that anxiety symptoms may withhold adolescents from experimenting with alcohol use. This is in line with previous studies indicating that anxiety has no major impact on adolescent alcohol consumption [8] and possibly delays the onset of experimenting with alcohol use [6]. The result of this study indicates that this seemingly protective effect of anxiety symptoms disappears in young adulthood. At the group level, we observed an increase in alcohol use from 14 years until 22 years, which stabilized and then slightly decreased at age 26. It should be noted however that measures for alcohol use at 26 years (AUDIT-C) included in our cross-lagged model were different from measures of alcohol use on previous waves. The decrease was relative in comparison to the AUDIT-C, also assessed at 22 years and included for descriptive purposes. Both the absence of a negative effect at age 22, as well as the decrease in alcohol use in late adolescence, could indicate an altered function of alcohol use in young adulthood in which drinking to cope with negative feelings is more prominent [14]. Positive reinforcement motives for alcohol use (e.g., drinking while hanging out with friends, or being accepted) may predominate drinking behavior in adolescence (and explain the increase until 22 years), while negative reinforcement motives—such as drinking to forget problems or relief stress—become more visible after the transition into adulthood (explain the absence of a protective effect). Previous findings indeed illustrate that coping motives for drinking are more common after late adolescence (22 years) [20]. This negative reinforcement or drinking to cope has been found to underlie more problematic trajectories of alcohol use [22]. The findings of the present study suggest that the relationship between anxiety and alcohol use is dynamic and could reflect an altering function of alcohol use during adolescence and young adulthood. This reasoning is in line with previous research showing changing relationships between anxiety and alcohol use over the course of adolescence. In particular, increase in alcohol use was found to be associated with relatively higher anxiety symptoms, possibly reflecting coping processes [8]. However, in contrast to our study in which such effect only became visible in young adulthood, Pardee et al. (2014) found an alcohol-anxiety association in mid-adolescence. Differences in analytical approach (growth models vs. cross-lagged models) could possibly explain these age variations. Replication of this finding or extending this research by including older adults is therefore crucial. These findings highlight the importance of considering risk factors for alcohol use in a developmental context [21], especially in the adolescent and young adult phases where the (social) role that alcohol consumption fulfills maybe highly dependent on the environment (e.g., educational context, peer relationships) [8,17,20]. Cross-lagged associations from alcohol use predicting anxiety symptoms three years later were overall absent, with the exception of a negative association at age 19. On a group level, alcohol use at age 19 was associated with fewer anxiety symptoms three years later. A possible explanation for this specific negative relationship may be that drinking at this age is more socially accepted and may represent age-appropriate experimentation with risky behaviors like alcohol use [18]—experimental behavior that is less obvious to the sensation avoidant anxious adolescent. This experimental use may take place in social settings (e.g., clubs, bars) in the presence of peers and friends, and reflecting a relatively normal developmental transition into young adulthood in

which alcohol use is more socially accepted [13]. Anxious adolescents may more likely avoid this experimentation and avoid these social situations. The finding that alcohol consumption is associated with reduced anxiety symptoms could indicate that avoidance of normative social experiences constitutes a risk factor or marker for increasing anxiety symptoms over the transition to early adulthood.

The findings of the present study contradict previous findings indicating that anxiety may be a risk factor for (the initiation of) alcohol use [9,10]. Contrasting results may be due to the various facets of anxiety under investigation [8] or the severity of anxiety [10] across studies. For example, there is prior evidence that generalized anxiety is not associated with alcohol use, while anxious apprehension and anxiety sensitivity predicts alcohol use [8]. Although our findings result from rigorous assessments, including a large sample of adolescents, they should be interpreted with a degree of caution. First, the results may only relate to the general population of adolescents and young adults. A different picture could emerge among at-risk populations, such as those with a clinical diagnosis of anxiety or heavy or problematic drinkers [5,37]. Previous research indicated that the association between anxiety symptoms and drinking behavior may be different for alcohol consumption and problematic use; however, our study examined consumption only [12]. Future research could include multiple measures of alcohol use such as binge drinking episodes and symptoms of addictions, to develop a more comprehensive picture of the prospective relationship between anxiety and alcohol use. A second limitation concerns the use of different items over time for anxiety symptoms. We feel that this was justified, however, because this was developmentally appropriate (e.g., YSR vs. ASR) and we established a sound model with a stable factor for anxiety symptoms. Third, the larger time gap between waves (around three years) made it impossible to assess short-term reciprocal relationship between anxiety symptoms and alcohol use. Nonetheless, the results provide important insights into the developmental course and long-term reciprocal associations between anxiety and alcohol use over adolescence and into early adulthood. Fourth, the results should be interpreted considering several underlying assumptions regarding the psychometrics of the indicators and the factor models. Continuous indicators were treated as normally distributed and independent with any deviation from these assumptions handled via the use of robust maximum likelihood to estimate standard errors more accurately. The categorical indicators were treated as ordinal-categorical with factor models assuming local independence, monotonicity, and MI. We empirically examined these assumptions via the use of model fit indices and formal MI testing. Since we combined ordinal and continuous data in one model, handling missing data can pose computational challenges to the model. A recent study by Lin and Cheung (2021) demonstrated that FIML can be applied safely and without bias in estimates in combined models such as in our model [35]. Finally, the generalizability to other samples may be limited due to cultural influences such as drinking norms and availability of alcohol beverages to adolescents. Particularly, the legal drinking age of alcohol use—which was 16 years at the time of the study—may have impacted the relationship between anxiety and alcohol use.

Implication and conclusion

The results of this study provide no evidence for anxiety being a risk factor for alcohol use in adolescence and young adulthood. It is important to replicate this finding with at-risk populations as well as replicate this finding with multiple measures of alcohol use, including more problematic measures of alcohol use. In contrast, anxiety symptoms contribute to reduced alcohol use. This protective influence diminishes in young adulthood (> 22 years). Changing social environments (e.g., high school drinking norms, stabilization of relationships) and increased demands in young adulthood around responsibility, education, and financial security may explain why the relationship between anxiety symptoms and alcohol depends on age. Acknowledging the important role of the social context, and in particular the role of social status, has been identified as a promising approach in boosting motivation for behavior change among adolescents [38]. Supporting young adults during important transitions phases such as a changing educational context or entering the job market could prevent problematic alcohol use [39]. Since alcohol consumption is socially accepted in many cultures, influences in the social environment with peers and parents—directly or indirectly affecting adolescents' exposure to social gatherings in which alcohol is consumed—may be important factors to consider in relation to risky alcohol use [40] and possibly in interaction with anxiety symptoms.

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