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Gender differences in the impact of families on alcohol use: A lagged longitudinal study of early adolescents

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Abstract

From the pre-teen to the mid-teen years, rates of alcohol use and misuse increase rapidly. Cross-sectional research shows that positive family emotional climate (low conflict, high closeness) is protective, and there is emerging evidence that these protective mechanisms are different for girls versus boys.

Aims—To explore gender differences in the longitudinal impact of family emotional climate on adolescent alcohol use and exposure to peer drinking networks.

Design—Three-wave two-level (individual, within-individual over time) ordinal logistic regression with alcohol use in the past year as the dependent measure and family variables lagged by one year.

Setting—Adolescents completed surveys during school hours.

Participants—855 Australian students (modal age 10–11 years at baseline) participating in the International Youth Development Study (Victoria, Australia).

Measurements—These included emotional closeness to mother/father, family conflict, parent disapproval of alcohol use, and peer alcohol use.

Findings—For girls, the effect of emotional closeness to mothers on alcohol use was mediated by exposure to high-risk peer networks. Parent disapproval of alcohol use was protective for both genders, but this effect was larger for boys versus girls, and there was no evidence that peer use mediated this effect. Peer drinking networks showed stronger direct risk effects than family variables.

Conclusions—Family factors unidirectionally impact on growth in adolescent alcohol use and effects vary with child gender.

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Introduction

From the early to mid-teens, alcohol use and misuse grows strongly in prevalence. By Grade 8 (13–14 years of age), 36.6% of Americans have consumed alcohol and 17.4% report ever being intoxicated [1]. At 12th Grade (18–19 years), 72.3% of Americans have consumed alcohol and 56.5% report ever being intoxicated [1]. In Australia, rates of alcohol use and misuse may be higher for adolescents than in the United States [2]. Among 12–15 year old Australian students, 83% have ever consumed alcohol and 5% have engaged in recent (past week) heavy episodic drinking (7+ standard drinks for males and 5+ drinks for females per occasion). Among 16–17 year olds, 95% of students have ever consumed alcohol, and 40–44% of current drinkers report heavy episodic drinking in the previous week [3]. Furthermore, there is evidence that boys and girls differ in the age of onset and growth in alcohol use over time. Girls show less alcohol involvement than boys during the pre- and early teens, but their alcohol involvement increases more strongly than boys over subsequent teenage years [4].

A significant body of research has focused on formative social influences on early alcohol use, and parents have an established impact [5]. Consistent with Social Learning Theory [6], disapproval of drinking, effective parental support, and monitoring reduce the likelihood of engagement with peers who drink alcohol, thereby reducing the risk of adolescent alcohol use [4, 7, 8]. Consistent with Social Control Theory [9, 10], family relationship quality is associated with alcohol use cross-sectionally [11–14] and longitudinally [15–17]. There is cross-sectional evidence that family relationship quality is more closely related to girls' alcohol use than boys' alcohol use [14, 18, 19] but there is little research on the extent to which these gender differences hold longitudinally. Available longitudinal research investigating these gender differences in associations has relied on contemporaneous measures of family emotional climate and alcohol use rather than lag associations between these two variables [20]. The problem with this is that significant correlations between family emotional climate and alcohol use can be bi-directionally interpreted and therefore proposed unidirectional effects may be overestimated. By lagging family variables, unidirectional effects can be gauged, enabling stronger statements about the influence of the family on alcohol use.

This paper is a longitudinal study of child gender differences in how family emotional climate influence growth in alcohol use from the pre- to mid-teens. The study included variables known to predict teenage alcohol use, including parent disapproval of drinking [4, 11], peer alcohol use [21], sensation seeking [22], family structure [23, 24], and socioeconomic status [25]. Building on cross-sectional research findings [14, 18], Hypothesis 1 was that there would be gender differences in the direct effects of family closeness, conflict and disapproval of alcohol use on subsequent growth in alcohol use, with girls showing stronger effects than for boys. Hypothesis 2 related to indirect effects. Given that girls may be more susceptible to alcohol-related peer influences than boys [18, 26], it was hypothesized that, compared to boys, girls would show a stronger mediation effect for peer alcohol use on the association of family emotional climate and subsequent growth in alcohol use.

Method

Sample

The data set analysed was the Victoria, Australian arm of the International Youth Development Study (IYDS), in which 927 children (52% female) were first assessed in 2002 when in grade 5 (wave 1, modal age 10 years) and followed up until grade 11 (Wave 6, modal age 16 years), with the exception of grade 8. The analysis sample consisted of

participants from a randomly selected grade 5 class from 55 schools (approximately 69% public, 9% independent, and 22% Catholic) [27]. The focus of the present study was on waves 2–5 (modal age 11–15 for waves 2–5 respectively) given that one and 12 month prevalence of alcohol use approximately doubles over these years [3, 27], and that family influences on alcohol use may be stronger in the earlier adolescent years than later adolescent years [28]. The analysis sample consists of all individuals with complete data for at least one of waves 2–5. Of 927 initial cases, 72 cases (7.77%) were excluded because of missing data at any wave. Of the total sample 86% completed two or more of these waves. To assess the relationship between predictor/outcomes on attrition, bivariate poisson regressions were conducted on the count of completed waves for each predictor and for alcohol use. Participants who lived with both parents at wave 2 completed significantly more waves than participants with other living arrangements (see Measures) (Boys: $\beta = -.2$, $p < .01$; Girls: $\beta = -.16$, $p < .05$). There were no other significant associations with the number of waves completed. Compared to Wave 1, the retention rates were 98.2, 96.9, 84.6, and 88.0% for Waves 2–5 respectively.

Measures

Participants completed a modified version of the Communities That Care (CTC) youth survey, an epidemiological instrument developed in the United States [29] and validated with minor changes to suit the Australian context [30]. Alcohol use was derived from the item “In the past year, on how many occasions have you had alcoholic beverages (like beer, wine or liquor/spirits) to drink – more than just a few sips?” (0 ‘Never’, 1 ‘1–2 times’, 2 ‘3–5 times’, 3 ‘6–9 times’, 4 ‘10–19 times’, 5 ‘20–29 times’, 6 ‘30–39 times’, 7 ‘40+ times’). Peer alcohol use was assessed with the item “In the past year, how many of your best friends have tried alcohol (like beer, wine or liquor/spirits) when their parents didn’t know about it?” (0–4 friends).

Family conflict was measured using three 4-point Likert scales (1 ‘definitely yes’, 2 ‘yes’, 3 ‘no’, 4 ‘definitely no’), with questions including “We argue about the same things in my family over and over”, “People in my family often insult and yell at each other” and “People in my family have serious arguments” ($\alpha = .81$). Closeness to each parent was measured using three items: “Do you feel close to/share your thoughts and feelings with/enjoy spending time with your mother/father?” (same responses as family conflict, $\alpha = .85$). Parent disapproval of drinking was measured using 2 items: “How wrong do your parents feel it would be for you to drink (beer or wine)/(spirits) regularly?” (1 ‘not wrong at all’ to 4 ‘very wrong’).

Control variables—Sensation seeking was based on three items: “Done crazy things even if they are a little dangerous”, “Done something dangerous because someone dared you to do it” and “Done what feels good no matter what” (1 “Never” to 6 “Once a week or more”, $\alpha = .75$). Family structure was constructed from a multiple response item that asked respondents to select all parents/guardians resident in their home. The reference category was both parents residing in the home ($n = 615$, 74.9%). Due to small numbers, all other custody combinations were coded as ‘other’ ($n = 199$). Socioeconomic status (SES) was based on an algorithm of mother/father education and income [31].

Procedure

Ethics clearance was obtained from the Royal Children’s Hospital, University of Melbourne, Department of Education and Training (for public schools) and the Catholic Education Office. Active parental consent was obtained prior to participation, and the consent of parents was reaffirmed in 2006 (using passive consent). Data collection involved a two-stage sampling strategy. In the first stage, within each state and grade level, public and private

schools were randomly selected using a probability proportionate to grade-level size sampling procedure [32]. A target classroom within each school was randomly selected in the second stage. Further details about recruitment and participation rates are described in McMorris et al. [27].

Study staff administered surveys in classrooms. Students who were no longer attending school were interviewed over the telephone. Items were included to assess whether or not students answered the survey questions honestly. Students were categorized as dishonest if they reported that they were *not honest at all* when filling out the survey, had used a fake drug, or had used illicit drugs on more than 120 occasions in the past 30 days. Few students in the initial sample (17 at wave 1, 35 at wave 2, 6 in both waves) met the criteria for dishonesty. The analysis included only “honest” students.

Analysis

Statistical analyses were performed with STATA 10 GLLAMM [33, 34]. The statistical design was a random coefficient ordinal logistic regression model of alcohol use with the intercept and slope for time allowed to be random for individuals. The dependent variable (alcohol use) was measured at waves 3, 4, and 5 (ages 12, 14, and 15). The predictors were parent disapproval of alcohol use, mother/father closeness, family conflict, and peer alcohol use and these were treated as time-varying. Family variables were lagged by one year (measured at waves 2, 3 and 4; ages 11, 12 and 14). Control variables included fixed effects for sensation seeking, SES, and family structure. Model testing was conducted separately on boys and girls to improve interpretability and because a pooled model (with gender interacted with family variables) assumes that the variance of the random effect for individuals/age is equal between sexes, which was not the case. The unconditional growth models demonstrated higher inter-individual variability in both intercept and slope for girls than boys, and a stronger correlation between the random intercept and slope for girls (compare variance components for Model 1 in Table 2 versus Table 3).

To test our hypotheses, we fitted four stepped models. Model 1 (unconditional growth model) included a random intercept for individuals plus a random term for age. This permitted an assessment of variation between individuals in the level and rate of change in alcohol use. In Model 2, family environment variables were added (mother/father emotional closeness, family conflict, and parent disapproval of alcohol use). This enabled an evaluation of how much of the growth in alcohol use over adolescence was attributable to changes in family environment. In Model 3 peer alcohol use was added. An evaluation of changes in family environment variables with peer alcohol use in the model was used to test for mediation effects (Hypothesis 2). In Model 4, controls for sensation seeking, family structure and family SES were added.

Results

Pooled bivariate correlations (across time) split by gender are presented in Table 1. There were medium-sized correlations of age and parent disapproval of alcohol use with alcohol use. The correlations between emotional closeness/family conflict and alcohol use were small versus small-to-medium in magnitude for boys and girls respectively. Gender differences in the start points and rates of growth for key variables are depicted in Figure 1a–d. At wave 3 (first alcohol measurement), one-way ANOVAs indicated significant gender differences for alcohol use [girls $M = 2.3$ ($SD = 6.7$) occasions per year, boys $M = 3.4$ ($SD = 8.4$) occasions per year; $F(1) = 3.9$, $p < .05$]. At wave 2 (lagged measures), one-way ANOVAs indicated gender differences between emotional closeness to fathers [$F(1) = 5.3$, $p < .05$] and parent disapproval of alcohol use [$F(1) = 13.8$, $p < .001$]. In terms of rates of growth, girls showed greater growth in alcohol use than boys (Figure 1a). Model 1 (age as

the sole predictor) showed the odds of drinking increased more than fourfold each year for girls [Odds Ratio (OR) = 4.40], and increased approximately 2.5 times/year year for boys (OR = 2.62). Average emotional closeness to mothers and fathers showed a roughly linear decrease over time for both genders (Figure 1c). Parental disapproval of alcohol use showed a minimal decline from wave 2 to 3, and there was a large negative decline from wave 3 to 4 (Figure 1d). Family conflict increased slightly from wave 2 to 3 for both genders, with a marginally greater increase for girls compared to boys (Figure 1b). From wave 3 to 4, both genders reported significant increases in family conflict, with girls reporting greater increases than boys. In sum, these results indicated that growth in alcohol use developed strongly from waves 3–5 and there were large changes in family variables occurred between waves 3 and 4.

Predictors of alcohol use by girls

The results of the lagged logistic regression for girls are presented in Table 2. Model 1 showed strong growth in alcohol use by girls from waves 3–5 (reported above). In Model 2, lagged family variables were added. This resulted in a reduction in the age effect of about 20%. The effect for emotional closeness to mother was significant (OR = .69, $p < .05$). The effects for parent disapproval of alcohol use, emotional closeness to fathers, and family conflict were nonsignificant in Model 2. With peer alcohol use in the model (Model 3), parent disapproval and family conflict became significant ($p < .05$). These effects were weak (dependent on other variables), suggesting a potential suppressor effect for peer alcohol use or a highly correlated other variable. These effects were unlikely to be due to multicollinearity (mean Variance Inflation Factor = 1.28; [35]). Peer alcohol use strongly predicted the frequency of alcohol use, with ORs increasing nonlinearly with the number of peers who consumed alcohol (Table 2/3). To verify the appropriate conditions for mediation were present for the association of parental emotional closeness and alcohol use, a separate multilevel model was conducted with peer use predicted by all the other variables in Model 2. There was a significant negative relationship between emotional closeness to mothers and peer alcohol use ($B = -0.43$, $p < .01$), and with peer alcohol use in the model, emotional closeness to mother became nonsignificant (see Table 2). In terms of emotional closeness to mothers, these results were consistent with Hypothesis 2. The inclusion of control variables (Model 4) resulted in family conflict becoming nonsignificant but the effect for parent disapproval remained significant ($p < .05$). Sensation seeking positively predicted alcohol use and family SES negatively predicted alcohol use.

Predictors of alcohol use by boys

The results for boys are presented in Table 3. When family environment variables were added (Model 2), there was a reduction in the OR for age (approximately 20%), indicating that the growth in alcohol use over adolescence was partially mediated by lagged changes in the family environment. The results were different from the pattern for girls, with the mediating effect of age primarily attributable to decreases in parental disapproval of alcohol use (OR: 0.59, $p < .001$) rather than mother closeness. Family conflict and emotional closeness (to either parent) were nonsignificant for boys in these models. These findings are unaltered by the addition of peer alcohol use (Model 3). As for girls, the odds of alcohol use increased nonlinearly with the number of alcohol-using peers. There was no meaningful change in the effect for parent disapproval of alcohol use when peer alcohol use was added, indicating that these variables were independent of each other. When controls were entered (Model 4) there was no meaningful changes in the ORs for family/peer variables, though sensation seeking was significant. SES was unrelated to alcohol use for boys.

Discussion

Building on cross-sectional research findings of gender differences in the impact of the family on alcohol use, this research is one of the first to demonstrate significant longitudinal lag effects that vary for early adolescent females versus males. Family environment influenced subsequent growth in alcohol use independent of autocorrelational and reverse effects. The key gender-specific finding was that emotionally close relationship with mothers was associated with less frequent alcohol use by girls (consistent with Hypothesis 1), and this effect appeared to operate through reducing girls' exposure to high-risk peer networks (consistent with Hypothesis 2). A second finding was that parental disapproval negatively predicted alcohol use in boys, but the effect for parental disapproval on girls' alcohol use was weak. These findings held after accounting for proximal (contemporaneous) variables, including peer alcohol use and family structure, and the intercorrelations of emotional closeness, family conflict, and parental disapproval (Table 1).

This study adds to an emerging literature on the relative importance of family emotional climate for girls [12, 14, 18, 36]. More theoretical work is needed on why some family factors may be differently related to alcohol use by girls versus boys. On the basis of Social Control theory (SCT) [10], adolescents have a default risk of deviance (including alcohol misuse) unless bonds with parents are strong [20]. SCT provides a partial theoretical basis for the result but does not enable a prediction about why bonds may vary in importance between boys and girls. On the basis of Status Characteristics Theory [37] girls may be more or less influenced by gender-salient behaviors depending on the gender-based dynamics of peer groups. Because of their cultural status and the gender-salient nature of alcohol use and misuse, boys are more influential on girls in terms of alcohol consumption than girls are influential on boys. As girls begin to develop mixed-gender peer groups, they may be more vulnerable to alcohol-related socialization by boys than from other girls. Findings from national longitudinal research supports this assertion [37]. Girls may be protected by emotional closeness to mothers, and it may be through mixed-sex friendships characterized by alcohol use that results in weakened social controls for girls. This is an area for further research, as the gender make-up of alcohol-involved peer networks was not measured in the present study.

Consistent with recent research [38], time-varying estimates of parental disapproval of alcohol use in the full model were significantly protective for males, but the main effect was weak for girls (dependent on the inclusion of other variables). This finding was independent of the generally higher levels of parent disapproval of alcohol use among girls (Figure 1c). It is possible that parent disapproval of alcohol use was a weaker predictor of girls' alcohol use because parent disapproval is more conditional on family emotional climate for girls than it is for boys. Further research is needed on the extent to which there are interactions between parent disapproval and the quality of the family relationship for girls compared to boys. While there may be more complex contextual factors that underlie the effect of parent disapproval on girls' alcohol use, the results reinforce the important role that parents have in communicating expectations about alcohol use throughout the early to mid-teenage years [38].

The results have implications for prevention and early intervention programs for alcohol use, with potential modifications to address gender differences in the influence of mother's emotional closeness to girls. Peer alcohol use was the strongest predictor of alcohol use and this effect was independent of family variables, reinforcing the importance of prevention strategies that target peer groups. The results also support the expansion of mainstream prevention strategies (typically school-based programs) to include parent-oriented prevention programs [e.g., 39], and indicate that cautious positions of parents on alcohol use

throughout the teen years are particularly protective. Researchers have called for prevention programs that are sensitive to the specific needs of girls [12, 40, 41]. The results indicate that enhancement of mother-daughter bonds prior to or during the years from grades 7 to 9 may be protective, and this aligns with recent research showing that on-line strategies that build mother-daughter relationships are effective [41]. Family conflict had a weak association with girls' subsequent alcohol use. Significance levels depended on the presence of collateral variables in the model (Table 2), and average family conflict increased with age for the whole sample (Figure 1b). This suggests that parent-oriented programs that target teen alcohol use and have finite resources may be best redirecting energies spent on family conflict management to other alcohol-related risks (at least for samples with mild conflict). In qualification, prior research has found that severe family conflict is related to teen alcohol use [13]. When severe family conflict is present, a focus on conflict management may be important. Also, family conflict management may have other benefits for adolescents.

The present study has several strengths, including a design that permits stronger conclusions than has previously been possible about the longitudinal role of families in the early growth of alcohol use in children. The lagged effects are probably conservative estimates given the comparatively long delay. Attrition and the amount of missing data were low and the design included controls for known strong predictors of alcohol use. In this study, parental alcohol use was not measured. However, the direct impact of parent alcohol misuse on adolescent alcohol misuse is small and mediated through parental support and monitoring [16]. While family emotional climate was unrelated to boys' alcohol use, family emotional climate may be important for boys at other developmental periods or for other health risk behaviors. Finally, the study relied on self-report data without collateral reports. Although "non-honest" participants were excluded, responses for some participants may have limited reliability.

Conclusion

Parent disapproval of alcohol use and peer use predicted subsequent growth in alcohol use independent of other potential directions of influence. For girls, mother-daughter relationship quality protects girls from the influence of peers who consume alcohol.

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Figure 1.

1a. Drinking frequency over time

1b. Family conflict over time

1c. Parental closeness over time

1d. Parental disapproval of alcohol use over time

Table 1

Pooled correlations (across time) for key family variables and alcohol use for boys and girls.

	(a)	(b)	(c)	(d)	(e)	(f)
(a) Alcohol use	1	0.42***	-0.25***	-0.21***	0.21***	-0.35***
(b) Age	0.36***	1	-0.22***	-0.20***	0.16***	-0.33***
(c) Mother closeness	-0.15***	-0.28***	1	0.39***	-0.36***	0.20***
(d) Father closeness	-0.12***	-0.19***	0.52***	1	-0.34***	0.15***
(e) Family conflict	0.09**	0.11***	-0.29***	-0.29***	1	-0.21***
(f) Parent disapproval of alcohol use	-0.41***	-0.29***	0.16***	0.08**	-0.13***	1

Notes.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Correlations reported below the main diagonal are for boys, above the main diagonal for girls. N (observations for girls) = 1206, N (observations for boys) = 1064.

Table 2

Alcohol consumption in the past year – Girls (n = 448 Students, 1206 Observations)

	Model 1		Model 2		Model 3		Model 4	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	4.40***	(3.50–5.54)	3.50***	(2.76–4.43)	1.73***	(1.44–2.09)	1.80***	(1.49–2.18)
Mother closeness (lagged)			0.69*	(0.50–0.96)	0.85	(0.64–1.13)	0.85	(0.64–1.13)
Father closeness (lagged)			0.96	(0.72–1.28)	0.95	(0.74–1.22)	0.98	(0.76–1.26)
Family conflict (lagged)			1.18	(0.91–1.53)	1.26*	(1.00–1.59)	1.23	(0.98–1.56)
Parent disapproval (lagged)			0.80	(0.64–1.01)	0.74**	(0.60–0.92)	0.77*	(0.62–0.95)
Peers' drinking (ref: none of your four closest friends drink)								
1 friend drinks					3.14***	(1.85–5.33)	3.04***	(1.78–5.19)
2 friends drink					4.62***	(2.55–8.37)	4.41***	(2.43–8.02)
3 friends drink					11.81***	(6.09–22.92)	11.16***	(5.73–21.75)
4 friends drink					35.78***	(20.40–62.77)	35.57***	(20.22–62.57)
Sensation seeking							1.43***	(1.13–1.80)
Single parent family							1.20	(0.77–1.87)
Family SES							0.63*	(0.41–0.96)

Cut-points	Est.	Std. error	Est.	Std. error	Est.	Std. error	Est.	Std. Error
K_{11}	4.20	0.43	1.56	1.02	1.36	0.90	0.74	0.97
K_{12}	5.83	0.50	3.08	1.06	2.87	0.93	2.27	1.00
K_{13}	7.15	0.55	4.33	1.09	4.09	0.95	3.50	1.02
K_{14}	8.33	0.60	5.45	1.12	5.17	0.97	4.60	1.04
K_{15}	9.50	0.64	6.57	1.15	6.23	1.00	5.67	1.06
K_{16}	10.23	0.67	7.28	1.16	6.89	1.01	6.34	1.07
K_{17}	10.94	0.70	7.97	1.18	7.52	1.02	6.98	1.08

Variance Components								
σ_0^2	15.06	4.31	9.70	3.64	6.90	2.74	7.56	2.83

	Model 1		Model 2		Model 3		Model 4	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
σ_1^2	0.66	0.20	0.46	0.18	0.31	0.14	0.34	0.14
σ_{01}	-2.23	0.82	-1.36	0.69	-1.12	0.56	-1.26	0.58
Log likelihood	-1860.38		-1853.33		-1751.69		-1743.68	

* p < 0.05;

** p < 0.01;

p < 0.001; OR – Odds ratio; CI – Confidence interval; σ_0^2 : Level-2 residual variance in the intercept; σ_1^2 : Level-2 residual variance in the slope for age; σ_{01} : Level-2 residual covariance of σ_0^2 and σ_1^2 . Higher values of cut-point K_{1j} means a lower probability of a response above the category j , and a higher chance of a response at or below category j .

Table 3

Alcohol consumption in the past year – Boys (n = 407, 1064 observations)

	Model 1		Model 2		Model 3		Model 4	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	2.62***	(2.19–3.14)	2.13***	(1.78–2.54)	1.28***	(1.10–1.49)	1.32***	(1.13–1.53)
Mother closeness (lagged)			0.83	(0.60–1.15)	0.86	(0.63–1.16)	0.86	(0.64–1.17)
Father closeness (lagged)			0.92	(0.70–1.22)	0.94	(0.72–1.22)	0.93	(0.72–1.21)
Family conflict (lagged)			0.92	(0.72–1.17)	0.92	(0.73–1.15)	0.89	(0.71–1.12)
Parent disapproval (lagged)			0.59***	(0.48–0.73)	0.58***	(0.47–0.70)	0.60***	(0.49–0.73)
Peers' drinking (ref: none of your four closest friends drink)								
1 friend drinks					2.64***	(1.55–4.49)	2.47***	(1.45–4.19)
2 friends drink					6.19***	(3.49–10.99)	5.80***	(3.28–10.25)
3 friends drink					7.46***	(4.04–13.79)	6.87***	(3.72–12.67)
4 friends drink					23.08***	(13.34–39.93)	20.42***	(11.88–35.11)
Sensation seeking							1.47***	(1.23–1.77)
Single parent family							1.34	(0.89–2.02)
Family SES							0.90	(0.61–1.34)

	Est.	Std. error	Est.	Std. error	Est.	Std. error	Est.	Std. error
Cut-points	2.64	0.35	–0.93	0.88	–1.12	0.80	–1.11	0.90
K_{11}	4.00	0.40	0.32	0.90	0.18	0.81	0.19	0.91
K_{12}	4.93	0.43	1.19	0.92	1.08	0.82	1.10	0.92
K_{13}	5.87	0.47	2.08	0.93	1.98	0.83	2.00	0.93
K_{14}	7.00	0.51	3.15	0.96	3.04	0.85	3.08	0.94
K_{15}	7.84	0.55	3.95	0.97	3.82	0.86	3.88	0.95
K_{16}	8.36	0.57	4.46	0.98	4.31	0.87	4.38	0.96
K_{17}								

Variance Components	8.34	3.24	4.51	2.59	3.31	2.03	3.08	1.99
σ_0^2								

	Model 1		Model 2		Model 3		Model 4	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
σ_1^2	0.35	0.15	0.21	0.13	0.17	0.11	0.17	0.11
σ_{01}	-1.09	0.62	-0.53	0.51	-0.48	0.43	-0.47	0.43
Log likelihood	-1694.05		-1681.63		-1596.26		-1584.80	

* $p < 0.05$;

** $p < 0.01$;

$p < 0.001$; OR – Odds ratio; CI – Confidence interval; σ_0^2 : Level-2 residual variance in the intercept; σ_1^2 : Level-2 residual variance in the slope for age; σ_{01} : Level-2 residual covariance of σ_0^2 and σ_1^2 .