ALCOHOLISM CLINICAL & EXPERIMENTAL RESEARCH

Effects of Sibship Size and Composition on Younger Brothers' and Sisters' Alcohol Use Initiation: Findings from an Australian Twin Sample

Leah S. Richmond-Rakerd, Wendy S. Slutske, Andrew C. Heath, and Nicholas G. Martin

Background: The effects of sibship size and structure on delinquency are well established. Specifically, having a large family and many brothers has been shown to predict offending. However, despite strong links between delinquency and alcohol use, the contribution of sibship factors to drinking behaviors remains largely unexplored. The current study investigated the impact of sibship size and composition on younger brothers' and sisters' ages of drinking and intoxication onset.

Methods: We employed a sample of 4,281 same-sex twins from the Australian Twin Register to examine whether (i) large sibship size facilitates earlier age at first drink (AFD) and age at first intoxication (AFI) in males and females, (ii) having many older brothers predicts earlier ages of AFD and AFI in males, and (iii) having many older brothers results in later AFD and AFI in females. We tested whether effects were moderated by parental divorce and alcohol misuse and mediated by familial religion.

Results: Sibling effects were minimal before accounting for family context. However, when parental divorce and excessive parental drinking were included as moderators, sibling effects were significantly amplified among individuals from homes of divorce, and effects were strongest when siblings were close in age.

Conclusions: Strong close in age older sibling effects indicate that proximal sibling attitudes and behaviors about alcohol likely interact with structural factors to influence younger siblings' drinking. Sibship factors were much more influential in one population (individuals from homes of divorce) than another (respondents with a parental history of excessive drinking), suggesting that sibling effects vary depending on the type of co-occurring familial risk. Prevention efforts performed at the family level, and introduced before first use of alcohol, are likely to delay drinking initiation and help prevent future alcohol problems.

Key Words: Age at First Drink, Siblings, Sibship Composition, Close in Age, Twins.

LARGE FAMILY SIZE is widely found to predict delinquency (Brownfield and Sorenson, 1994; Farrington, 1996), and longitudinal studies in particular provide evidence for increased risk. Family size was one of the strongest predictors of conviction rate in the Cambridge Study of Delinquent Development and the Pittsburgh, Oregon Youth, and Nottingham studies (Farrington, 1993; Farrington and Loeber, 2000; Newson et al., 1993). Hypothesized explanations for this effect include a "contagion" model, in which large families increase exposure to delinquent siblings (Robins et al., 1975), poor parental supervision (Farrington, 1996), and familial disruption (Brownfield and Sorenson, 1994).

Composition (number of males and females in the sibship) may account for family size effects. Studies have found that these effects are explained by the number of brothers (Lauritsen, 1993; Loeber and Stouthamer-Loeber, 1986). Having many brothers predicts delinquency in boys (Lauritsen, 1993; Loeber and Stouthamer-Loeber, 1986), while Lauritsen (1993) found a different effect for girls, in which rates of delinquency decreased as number of brothers increased. However, research on the influence of brothers on female delinquency has produced mixed results. Jones and colleagues (1980) found that brothers only potentiated antisocial behavior in boys. Others have found stronger sibling effects for brothers than sisters (Farrington, 1996). Clarifying the effect of brothers on female risk behaviors is an important research goal.

Similarity in offending may stem from strong sibling bonds (Rowe and Gulley, 1992) and recruitment to co-offend (Reiss and Farrington, 1991). Older sibling behaviors predict younger sibling delinquency, largely through modeling (Slomkowski et al., 2001). Behavioral and attitudinal influences may therefore partially explain structural sibship effects.

From the Department of Psychological Sciences (LSR-R, WSS), University of Missouri, Columbia, Missouri; Midwest Alcoholism Research Center (LSR-R, WSS, ACH), University of Missouri, Columbia, Missouri and Washington University, St. Louis, Missouri; Department of Psychiatry (ACH), Washington University, St. Louis, Missouri; and Genetic Epidemiology Laboratory (NGM), Queensland Institute of Medical Research, Brisbane, Australia.

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Reprint requests: Leah S. Richmond-Rakerd, MA, Department of Psychological Sciences, University of Missouri, 210 McAlester Hall, Columbia, MO 65211; Tel.: 573-882-6860; Fax: 573-882-7710; E-mail: lr526@mail.missouri.edu

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Externalizing disorders and substance use are strongly linked. Conduct disorder (CD) and alcohol abuse are frequently comorbid (Hall et al., 2009), due to shared genetic risk and family environmental factors (Slutske et al., 1998; True et al., 1999). In addition, age of drinking onset is associated with delinquency (Zhang et al., 1997), and family members' deviance can promote adolescents' alcohol use (Stormshak et al., 2004).

Although research on the influence of sibship size and composition on drinking initiation is limited, studies have found that sibling attitudes and behaviors about alcohol are highly influential during adolescence. Younger siblings' drinking norms are associated with those of their older siblings (Brody et al., 1998), and older siblings' frequency and quantity of use predicts younger siblings' use over time (Van Der Vorst et al., 2007). In addition, younger siblings' perceptions of older siblings' drinking, regardless of their accuracy, shape their own alcohol use (D'Amico and Fromme, 1997).

Despite these findings, the influence of sibship size and composition remains largely unexplored. To our knowledge, only 2 studies have examined the relation between family size and adolescent alcohol consumption (Fergusson et al., 1994; Little, 1989), and only 1 study has investigated the association between number of older siblings and drinking and intoxication onset (Hellandsjøbu et al., 2002). Researchers have not investigated the influence of multiple older brothers or looked at outcomes in both younger brothers and sisters.

Understanding the importance of sibship composition to drinking initiation is warranted for several reasons. First, early-life drinking initiation predicts later alcohol use disorders (AUDs; Grant et al., 2001). Second, heavy drinking in adolescence can result in short- and long-term cognitive deficits. Outcomes include impaired memory formation, impaired decision making, and diminished intellectual abilities (Monti et al., 2005; Swartzwelder et al., 1995).

Given that delinquency and alcohol use are strongly linked, we predicted that sibship factors would influence delinquency and drinking initiation similarly. We extended findings from the delinquency literature to test 3 hypotheses regarding the influence of sibship size and composition on younger siblings' drinking initiation: Large sibship size will facilitate earlier ages of drinking and intoxication onset in males and females; having many older brothers will predict earlier ages of drinking and intoxication onset in males; and having many older brothers will result in later ages of drinking and intoxication onset in females. Because there have been mixed findings regarding the effect of brothers on female delinquency, we aimed to clarify their influence on alcohol use. The third hypothesis stems from the protective effect of brothers that was found in an exemplary study of delinquency based on a large representative national data set (Lauritsen, 1993).

MATERIALS AND METHODS

Sample

The sample consisted of adult twins drawn from the Australian National Twin Register, a database of twin pairs and their relatives maintained by the Australian Twin Registry. The cohort consists of 4,268 twin pairs born between 1964 and 1971 (Knopik et al., 2004; Lynskey et al., 2003). Because members of opposite-sex pairs do not report having the same number of brothers and sisters, opposite-sex twins were excluded. Only same-sex monozygotic and dizygotic twins were selected (n = 4,841; 2,139 males and 2,702 females; Table 1).

Procedure

Respondents completed a structured psychiatric telephone interview conducted between 1996 and 2000 (n = 6,265 twins), during which participants were administered the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA-OZ; Bucholz et al., 1994). See Knopik and colleagues (2004) and Lynskey and colleagues (2003) for further information on interview procedures and participant demographics.

Measures

Conduct Disorder. CD was evaluated using a 15-item symptom count variable based on DSM-IV diagnostic criteria.[1] The variable was positively skewed and kurtotic and was rank-transformed. The number of symptoms ranged from 0 to 10 (M = 1.20, SD = 1.64) for males and 0 to 9 for females (M = 0.39, SD = 0.89). The mean number of symptoms for the sample was 0.74 (SD = 1.34); 9.2% of the sample met criteria for CD (endorsed 3 or more symptoms; Table 1). The internal consistency reliability (Cronbach's alpha) of the symptom count was 0.63.

Alcohol Use Disorder. AUD (DSM-IV alcohol abuse and alcohol dependence) was evaluated using an 11-item symptom count variable (Table 1). The variable was positively skewed and kurtotic and was rank-transformed. The number of symptoms ranged from 0 to 7 for both men (M = 1.91, SD = 2.18) and women (M = 0.99, SD = 1.60). The mean number of symptoms for the sample was 1.33 (SD = 1.91). The internal consistency reliability (Cronbach's alpha) of the symptom count was 0.66.

Sibship Composition. Sibship composition was assessed using individuals' reports on their number of biological siblings, alive and dead (not including their co-twin).[2] Differences in age between the twin and their siblings were determined from sibling birthdates included in a demographic database maintained at the Queensland Institute of Medical Research (QIMR) Genetic Epidemiology Unit that was available for 68% of the present sample. Close in age older (CIAO; <3 years older) brother and sister variables were created to assess the importance of age difference between siblings. Sisters were included to determine whether relationships between sibship size variables and drinking outcomes were driven by the number of males or females in the sibship (Table 1).

[1]To ease interpretation, reported means and standard deviations for both CD and AUD are based on the variables prior to transformation. However, reported results are from analyses conducted using the rank-transformed data.
[2]Ninety-six of the siblings with information in the QIMR demographic database were listed as deceased. However, because the date of death was not available we were not able to determine whether they died before or after the respondent's adolescence (when sibling influences on drinking would likely be strongest). See the Results section for an explanation of analyses performed to assess the impact of the inclusion of deceased siblings on sibship effects.

Table 1. Sample Characteristics

	Males		Females		Total	
	N	%	*N*	%	*N*	%
Sample size	2,139	44.2	2,702	55.8	4,841	100
1+ Conduct disorder symptoms	1,096	51.2	631	23.4	1,727	35.7
3+ Conduct disorder symptoms	345	16.1	99	3.7	444	9.2
1+ Alcohol use disorder symptoms	977	46.7	944	34.9	1,921	39.7
Sibship composition						
Full brothers	1,356	63.4	1,745	64.6	3,101	64.0
Full sisters	1,310	61.3	1,593	59.0	2,903	60.0
Full older brothers	1,066	49.9	1,251	46.3	2,317	47.9
Full older sisters	941	44.0	1,167	43.2	2,108	43.6
CIAO brothers	229	10.7	326	12.1	555	11.5
CIAO sisters	203	9.5	322	11.9	525	10.8
Sibship size						
Full siblings	1,842	86.1	2,325	86.0	4,167	86.1
Full older siblings	1,435	67.1	1,755	65.0	3,190	65.9
CIAO siblings	410	19.2	621	23.0	1,031	21.3
Religion						
Roman Catholic	440	20.6	684	25.3	1,124	23.2
Church of England/Anglican	448	21.0	577	21.4	1,025	21.2
No religion	211	9.9	270	10.0	481	9.9
Other	391	18.3	557	20.6	948	19.6
Family of divorce	246	11.5	337	12.5	583	12.0
Excessive parental drinking	335	15.7	497	18.4	761	17.2

CIAO, close in age older.

Sample frequencies for sibship size and composition represent the number of individuals with at least 1 of the specified sibling type. Individuals who endorsed 3 or more conduct disorder symptoms met criteria for the disorder.

Sibship Size. Sibship size was assessed using composite variables, which were created by summing responses for numbers of full, full older, and CIAO brothers and sisters (Table 1). Sibship measures were analyzed as categorical variables to account for a positive skew in the data, in which more individuals had a moderate number (i.e., 1 to 3) than a large number (i.e., 5 or more) of siblings; and to facilitate analyses assessing potentially small mean differences in age of onset between individuals with different numbers of siblings.

Age of Onset of Alcohol Use. Age of onset was assessed using reports on age at first drink (AFD) and age at first intoxication (AFI). These measures were included in the SSAGA-OZ, which has demonstrated good reliability and validity across assessments of AUDs (Bucholz et al., 1994; Kramer et al., 2009). Lifetime abstainers (1.1% of the sample) did not report on their AFD or AFI. Non-abstainers were asked, "How old were you the first time you had more than just a sip of beer, wine or spirits?" and those who had ever been drunk were asked, "How old were you the first time you got drunk (that is, your speech was slurred or you were unsteady on your feet?"); 5.2% of the sample had never been intoxicated. Responses ranged from 1 to 35 years for AFD and 2 to 35 years for AFI.

Mean AFD and AFI for the sample were 15.86 years (SD = 2.67) and 17.20 years (SD = 2.69), respectively. Mean AFD was 16.20 years (SD = 2.60) and 15.43 years (SD = 2.68) for women and men, respectively. Mean AFI was 17.61 years (SD = 2.76) and 16.73 years (SD = 2.54) for women and men, respectively. Figure 1 displays cumulative age of onset distributions for both phenotypes.

To reduce the effects of outliers, values for AFD and AFI above and below 3 standard deviations from the mean were equated to 3 standard deviations from the mean. For AFD, values ≤ 8 years were equated to 8 years, and those ≥ 24 years were equated to 24 years. For AFI, values ≤ 9 years were equated to 9 years, and those ≥ 25 years were equated to 25 years.

Retest data on AFD and AFI were collected 3.68 years (SD = 0.39, range = 1.1 to 4.3) after the first wave of interviews for a small subsample of the twins. These data provide strong evidence for reliability in respondent recall: AFD ($n = 215$): Pearson's $r = 0.79$, $p < 0.0001$; AFI ($n = 200$): Pearson's $r = 0.70$, $p < 0.0001$. Matched-pairs t-tests show that the mean ages of onset reported at Time 1 and Time 2 for the retest sample did not significantly differ: AFD: $t(214) = -1.91$, $p = 0.06$; AFI: $t(199) = -0.33$, $p = 0.74$. Mean AFD was 15.15 years (SD = 2.92) at Time 1 and 15.42 years (SD = 2.96) at Time 2. Mean AFI was 16.38 years (SD = 2.35) at Time 1 and 16.4 years (SD = 2.97) at Time 2.

To check for potential bias due to retrospective reporting, correlations between individuals' ages at interview and their reported ages of onset were obtained. Correlations were 0.04 and 0.06 for AFD and AFI, respectively. This indicates that the differences between older and younger individuals' reports were minimal.

Religious Faith. Familial religious faith predicts abstention from and patterns of alcohol use (Degenhardt et al., 2007). In addition, ideologies regarding family planning lead certain faiths (i.e., Catholics) to produce more children than others (Lehrer, 2009). Religious faith during respondents' upbringing was therefore assessed, focusing on: Roman Catholic; Church of England/Anglican; No Religion; or Other (Table 1). We investigated whether faith mediated relationships between sibship factors and alcohol use.

Divorce. Parental divorce influences adolescents' alcohol use (Bumside et al., 1986) and was therefore assessed to test whether it moderated associations between sibship factors and alcohol use (Table 1).

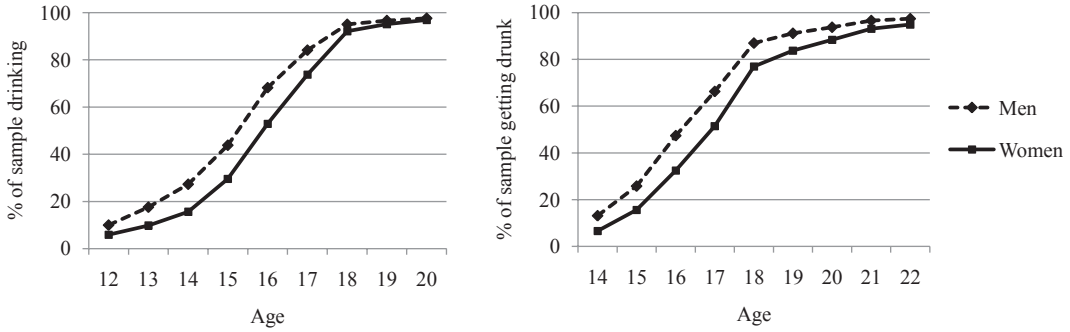

Fig. 1. Cross-sectional cumulative onset distributions for mean age at first drink (left panel) and age at first intoxication (right panel) for the sample. Analyses only include individuals who ever drank.

Excessive Parental Drinking. Children whose parents abuse alcohol are at risk for early drinking initiation (Hussong et al., 2008). Excessive parental drinking was therefore assessed as a potential moderator of associations between sibship variables and alcohol use. Participants were asked if their mother and/or father drank any wine, beer, or spirits when they were between 6 and 13 years of age. If so, they were asked, "Do you think your mother/father drank too much?" Individuals were coded positive for parental alcohol misuse if 1 or both of their parents drank excessively during their youth. They were coded negative if neither parent drank excessively (Table 1).

Statistical Analyses

Analyses were performed using PROC MIXED procedures in SAS version 9.2 (SAS Institute Inc., Cary, NC). Linear mixed models incorporating a compound symmetry covariance structure were constructed. Data were treated as clustered in all analyses, with the twin pair serving as the cluster. A random intercept term was included to account for the clustered data.

First, we aimed to replicate previous findings showing that (i) having a large family and many brothers is a risk factor for CD (Lauritsen, 1993), (ii) an earlier AFD is linked with alcohol problems (Grant et al., 2001), and (iii) delinquency and substance abuse are frequently comorbid (Slutske et al., 1998). To evaluate sibship influences on CD in the current sample, we created separate models assessing the influence of each sibling type on number of CD symptoms. To assess the link between alcohol use initiation and problems, we calculated Pearson correlations between AFD, AFI, and AUD symptoms. To assess the comorbidity between delinquency and alcohol problems, we calculated Pearson correlations between AFD, AFI, CD symptoms, and AUD symptoms.

Next, we performed analyses to investigate whether (i) large sibship size predicts earlier alcohol use onset and (ii) having many older brothers leads to earlier drinking in males and later drinking in females. Separate models were constructed for each sibship size and composition variable to test whether AFD and AFI varied significantly as a function of number of siblings. Main effects of sibship variables and sex and interactions between sibship variables and sex were assessed.

Following investigation of main effects of sibship variables, all models were re-run testing for (i) moderation by parental divorce, (ii) moderation by excessive parental alcohol use, and (iii) mediation by familial religion.

RESULTS

Relationships Between Drinking Initiation, AUD, and CD

Number of AUD symptoms was negatively correlated with AFD (n = 3,396; Pearson's $r = -0.23$, $p < 0.0001$) and AFI ($n = -0.27$; Pearson's $r = -0.27$, $p < 0.0001$).

Number of CD symptoms was negatively correlated with AFD and AFI (AFD (n = 4,620): Pearson's $r = -0.27$, $p < 0.0001$; AFI (n = 4,222): Pearson's $r = -0.28$, $p < 0.0001$). Individuals with greater levels of CD exhibited more AUD symptoms (Pearson's r (n = 3,444) = 0.27, $p < 0.0001$).

Effects of Sibship Size and Composition on CD

There was a main effect of sex in predicting CD symptoms in the sample and across all models ($p < 0.0001$). Men exhibited more symptoms (M = 1.20, SD = 1.64) than women (M = 0.39, SD = 0.89). There were main effects of number of full siblings, $F(3, 2{,}733) = 3.50$, $p = 0.02$, Cohen's $d = 0.08$,[3] and number of full older siblings, $F(3, 2{,}710) = 3.27$, $p = 0.02$, Cohen's $d = 0.08$, in predicting number of CD symptoms.

There was a main effect of sex for all sibship composition models ($p < 0.0001$). Surprisingly, number of full brothers and full older brothers did not influence CD. Number of full sisters was related to CD, $F(3, 2{,}714) = 4.62$, $p < 0.01$, Cohen's $d = 0.08$, as was number of full older sisters, $F(3, 2{,}709) = 6.76$, $p < 0.001$, Cohen's $d = 0.09$.

Effects of Sibship Size and Composition on Alcohol Use Initiation

F-statistics, p-values, and effect sizes from models testing for the influences of sibship variables, sex, and their interaction on AFD and AFI are presented in Table 2.[4] There were no main effects of sibship size variables or interactions with sex for AFD or AFI. Main effects of sex were detected across all models at the $p < 0.0001$ level.

Influence of Parental Divorce

Coming from a family of divorce predicted early AFD, $F(1, 3{,}168) = 10.27$, $p = 0.001$, Cohen's $d = -0.14$, and early AFI, $F(1, 2{,}894) = 29.06$, $p < 0.0001$, Cohen's $d = -0.25$. There was a main effect of sex for both models ($p < 0.0001$). Figure 2 displays cumulative age of onset distributions for AFD and AFI for individuals from intact families and homes of divorce.

Main effects of and interactions with divorce were tested in all models. Effect sizes from significant interactions are presented in Table 3. In supplementary materials accompanying this manuscript, Tables S1a–S1d display model statistics and effect sizes for tests of moderation that produced significant effects. Significant interaction effects were detected for 4 different models: (i) number of CIAO siblings,[5] (ii) number of CIAO sisters, (iii) number of full brothers, and (iv) number of full older brothers.

[3]To enable the calculation of Cohen's d effect sizes, effect sizes were calculated based on mean differences in number of CD symptoms and age of alcohol use onset between individuals without any of the specified sibling type and those with 1 or more.

[4]To account for multiple testing, a Bonferroni-corrected significance level of $p < 0.001$ was applied to all statistical tests (see Tables 2, 3, and S1a–S1d). Most of the tests of main and interaction effects did not remain significant under this correction. However, mean differences for nonsignificant interaction effects remained of small-moderate effect (e.g., Cohen's $d = -0.35$ and -0.36).

[5]To test whether the inclusion of deceased siblings influenced the results, we re-ran all analyses assessing the influence of CIAO siblings after excluding individuals who were deceased. Eleven CIAO siblings (5 CIAO brothers and 6 CIAO sisters) were deceased. Removing these individuals from analyses did not change the results.

Table 2. Model Results: Effects of Sibship Size and Composition on Alcohol Use Initiation

	AFD			AFI		
Measure	*F*	*p*-Value	ES	*F*	*p*-Value	ES
Sibship size						
Full siblings	2.29	0.08	0.07	0.56	0.64	−0.03
Sex	59.03	<0.0001*		69.14	<0.0001*	
Full siblings × Sex	0.68	0.47		0.59	0.62	
Full older siblings	0.61	0.61	0.01	0.33	0.81	−0.04
Sex	78.98	<0.0001*		91.19	<0.0001*	
Full older siblings × Sex	1.25	0.29		0.72	0.54	
CIAO siblings	2.16	0.14	−0.04	1.68	0.19	−0.04
Sex	47.03	<0.0001*		55.06	<0.0001*	
CIAO siblings × Sex	1.85	0.17		0.08	0.77	
Sibship composition						
Full brothers	1.44	0.23	0.07	0.99	0.39	0.00
Sex	69.39	<0.0001*		85.42	<0.0001*	
Full brothers × Sex	1.66	0.17		1.46	0.22	
Full sisters	0.25	0.86	0.02	0.18	0.91	−0.02
Sex	59.21	<0.0001*		69.24	<0.0001*	
Full sisters × Sex	0.97	0.41		0.91	0.44	
Full older brothers	0.45	0.72	0.02	0.78	0.51	−0.02
Sex	61.91	<0.0001*		78.31	<0.0001*	
Full older brothers × Sex	2.13	0.09		1.65	0.18	
Full older sisters	1.24	0.29	0.02	0.77	0.51	−0.04
Sex	47.81	<0.0001*		55.66	<0.0001*	
Full older sisters × Sex	0.54	0.65		0.06	0.98	
CIAO brothers	1.97	0.16	−0.06	0.33	0.57	−0.02
Sex	34.38	<0.0001*		40.18	<0.0001*	
CIAO brothers × Sex	1.12	0.29		0.09	0.77	
CIAO sisters	0.11	0.74	0.00	1.21	0.27	−0.05
Sex	31.75	<0.0001*		28.35	<0.0001*	
CIAO sisters × Sex	0.74	0.39		1.04	0.31	

AFD, age at first drink; AFI, age at first intoxication; ES, effect size (Cohen's *d*); CIAO, close in age older.

Effect sizes calculated based on mean differences in age of onset between individuals without any of the specified sibling type and those with 1 or more. To account for multiple testing, a correction to alpha ($p < 0.001$) was applied. Asterisks indicate *p*-values that remained significant under this correction.

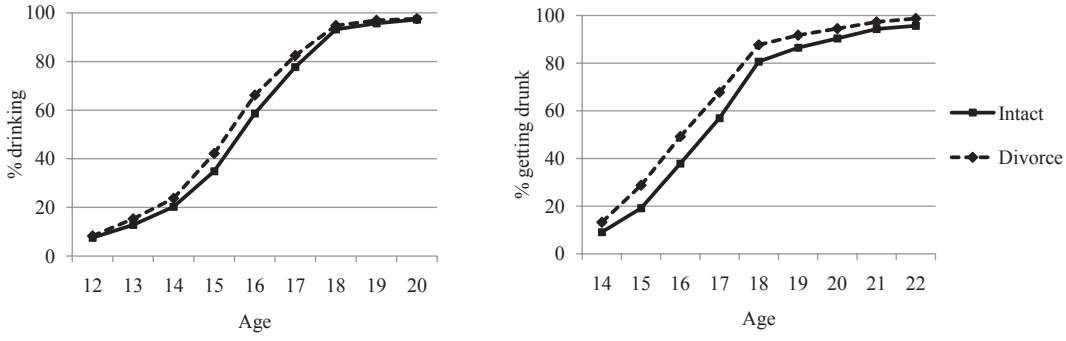

Fig. 2. Cross-sectional cumulative onset distributions for mean age at first drink (left panel) and age at first intoxication (right panel) for individuals from intact families and homes of divorce. Analyses only include individuals who ever drank.

Having many CIAO siblings promoted earlier drinking (Cohen's $d = -0.35$) and intoxication (Cohen's $d = -0.36$) in individuals from homes of divorce, but not in people from intact families (Fig. 3). A significant 3-way interaction between divorce, sex, and number of CIAO sisters revealed that having many CIAO sisters facilitated earlier AFD (Cohen's $d = -1.19$) and AFI (Cohen's $d = -0.95$) in men from homes of divorce, but not those from intact families. A significant 3-way interaction between divorce, sex, and number of full brothers revealed that having many full brothers promoted later drinking initiation among men from homes of divorce (Cohen's $d = 0.37$), but had no effect on AFD in men from intact families. Another significant 3-way interaction revealed that number of full older brothers protected against early drinking initiation in men from homes of divorce (Cohen's $d = 0.22$), but not for men from intact homes.

Table 3. Effect Sizes for Sibship Influences on Alcohol Use and Moderation by Parental Divorce and Excessive Parental Drinking

Measure	AFD	AFI
Sibship size		
Full siblings	0.07 (−0.03, 0.16)	−0.03 (−0.13, 0.07)
Full older siblings	0.01 (−0.05, 0.08)	−0.04 (−0.11, 0.02)
CIAO siblings	−0.04 (−0.12, 0.04)	−0.04 (−0.12, 0.04)
Sibship composition		
Full brothers	0.07 (0.01, 0.13)	0.00 (−0.07, 0.06)
Full sisters	0.02 (−0.04, 0.08)	−0.02 (−0.08, 0.04)
Full older brothers	0.02 (−0.03, 0.08)	−0.02 (−0.08, 0.04)
Full older sisters	0.02 (−0.04, 0.07)	−0.04 (−0.10, 0.02)
CIAO brothers	−0.06 (−0.15, 0.04)	−0.02 (−0.12, 0.08)
CIAO sisters	0.00 (−0.09, 0.09)	−0.05 (−0.15, 0.05)
CIAO siblings × Parental divorce		
Homes of divorce	−0.35 (−0.58, −0.13)	−0.36 (−0.59, −0.12)
Intact families	−0.03 (−0.11, 0.05)	−0.02 (−0.10, 0.07)
Full brothers × Sex × Divorce		
Men (homes of divorce)	0.37 (0.12, 0.63)	
Men (intact families)	−0.07 (−0.17, 0.04)	
Full older brothers × Sex × Divorce		
Men (homes of divorce)	0.22 (−0.04, 0.48)	
Men (intact families)	−0.08 (−0.17, 0.01)	
CIAO sisters × Sex × Divorce		
Men (homes of divorce)	−1.19 (−1.74, −0.63)	−0.95 (−1.51, −0.40)
Men (intact families)	0.02 (−0.14, 0.18)	0.07 (−0.09, 0.24)
CIAO brothers × Excessive parental drinking		
Excessive drinking	0.18 (−0.05, 0.40)	
Normative drinking	−0.13 (−0.24, −0.02)	

Effect size, Cohen's *d*; CIAO, close in age older; AFD, age at first drink; AFI, age at first intoxication.

Ninety-five percent confidence intervals are presented in parentheses.

Influence of Excessive Parental Alcohol Use

There were main effects of excessive parental alcohol use on AFD, $F(1, 3{,}860) = 10.00$, $p = 0.002$, Cohen's $d = -0.12$, and AFI, $F(1, 3{,}622 = 13.93$, $p < 0.001$, Cohen's $d = -0.15$, and main effects of sex for both models ($p < 0.0001$). The only model for which excessive parental drinking was found to have a significant moderating effect was that for which number of CIAO brothers was included as a predictor. There was no effect of number of CIAO brothers for individuals whose parents drank excessively, but there was an effect for individuals whose parents drank normatively (Cohen's $d = -0.13$). However, the effect size was small (the difference in age of onset for individuals with and without any CIAO brothers was 0.3 years).

Influence of Familial Religious Faith

Sibship variables did not relate to AFD or AFI before accounting for moderation by parental divorce and excessive parental drinking. Therefore, we did not test for mediation by familial religious faith.

Relationships Between Mediators and Moderators

We investigated the association between parental divorce and excessive parental alcohol use, and excessive paternal and maternal alcohol use. Individuals from homes of divorce were more likely than individuals from intact families to have parents who drank excessively (OR = 2.00, 95% CI = 1.65 to 2.44). Among individuals from intact families, 656 (18.87%) had a parental history of excessive drinking. Among individuals with divorced parents, 174 (35.15%) had a parental history of excessive drinking. Respondents whose father drank excessively were more likely to have a mother who drank excessively than respondents whose father drank moderately (OR = 6.07, 95% CI = 4.03–9.12). Among respondents without a paternal history of excessive drinking, 58 (2.56%) had a maternal history. Among respondents with a paternal history of excessive drinking, 64 (13.76%) had a maternal history. Given the relationship between divorce and excessive parental drinking, we tested the joint effect of the moderators on AFD and AFI. We constructed linear models predicting AFD and AFI from divorce, excessive parental drinking, and an interaction between the 2 variables. For AFD, there were no effects of either variable and no interaction. For AFI, there was a main effect of divorce, $F(1, 2{,}809) = 12.29$, $p < 0.001$. The lack of main effects for both moderators in the first model and excess parental drinking may seem surprising given that they were independently strongly related to AFD and AFI. However, this is likely due to collinearity between the moderators.

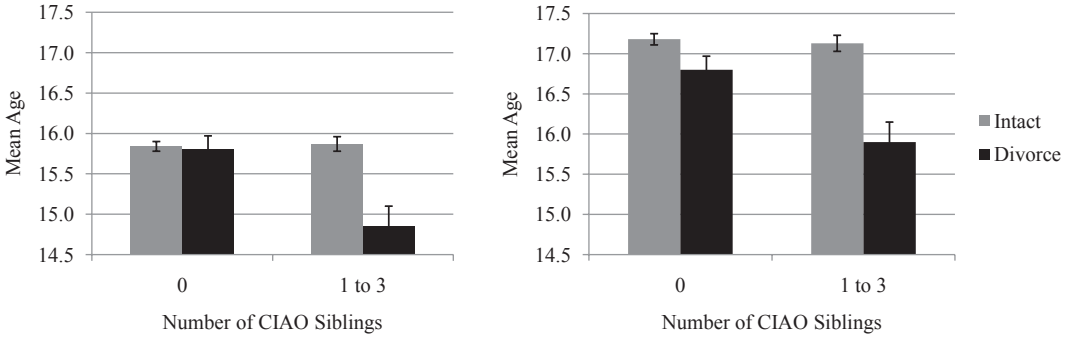

Fig. 3. Mean age at first drink (left panel) and age at first intoxication (right panel) for individuals with CIAO siblings (<3 years older) from intact homes and families of divorce. CIAO, close in age older.

There were concerns that coming from a Catholic family might explain the moderating effect of divorce, in which AFD and AFI was related to having CIAO siblings among individuals from families of divorce, but not individuals from intact families. Respondents from Catholic families were not more likely than those from other faiths to come from a family of divorce ($\chi^2 = 2.23$, df = 1, $p = 0.14$), nor were they more likely to have CIAO siblings ($\chi^2 = 3.32$, df = 1, $p = 0.07$). Finally, familial Catholicism was not significantly related to AFD, $F(1, 1{,}593) = 0.85$, $p = 0.34$, or AFI, $F(1, 1{,}614) = 0.27$, $p = 0.60$. Therefore, the moderating effect of divorce was not attributable to familial Catholicism.

DISCUSSION

This study investigated the impact of sibship size and composition on alcohol use initiation. Drawing on findings from the delinquency literature, we tested whether family size and number of brothers differentially affected alcohol use in males and females. Sibling effects were minimal before accounting for aspects of the family environment known to influence alcohol use (divorce and excessive parental drinking). However, when family context was accounted for, sibling effects were significantly amplified among individuals from homes of divorce, and effects were strongest when siblings were close in age.

CIAO siblings exerted facilitative effects on respondents' drinking when they were from homes of divorce, but not when they were from intact families. The influence of CIAO siblings on younger siblings' drinking is in accord with findings that sibling similarity in alcohol use decreases with increasing age difference (Trim et al., 2006). This indicates that proximal sibling effects probably interact with structural variables. Adolescents whose siblings are close in age interact with mutual peer groups (Trim et al., 2006) and might engage in collaborative drinking. Older siblings may encourage younger siblings to drink, similar to "recruitment to cooffend" (Reiss and Farrington, 1991). Modeling of drinking norms is also likely to occur (Brody et al., 1998). Effects are probably magnified when the number of siblings increases (similar to the "contagion hypothesis"; Robins et al., 1975).

Among individuals from intact families, people with several CIAO siblings were equally likely to start drinking or get intoxicated earlier as people without any CIAO siblings. Among individuals from homes of divorce, however, people with 1 to 3 CIAO siblings had their first drink more than a full year and first got intoxicated nearly a full year earlier than people without any CIAO siblings. CIAO siblings may therefore exert the strongest effects in family environments that contain other risk factors for substance involvement.

Older siblings may facilitate maladaptive coping during familial disruption. Abbey and Dallos (2004) found that siblings relied more on each other for emotional support throughout parental divorce. Sibling relationships may become more "affect intense," resulting in high levels of both hostility and warmth (Sheehan et al., 2004). Increased sibling interaction might facilitate engagement in shared activities, such as drinking. In addition, the affect intensity of sibling relationships in families of divorce may induce greater stress. Increased sibling conflict and the stresses of divorce may motivate individuals to initiate alcohol use. It should be noted that while CIAO siblings exerted facilitative effects on drinking, having many full brothers and full older brothers promoted later ages of drinking onset for men from homes of divorce. Siblings that are close in age may be more likely to engage in collaborative drinking than those who are many years apart. Rather than promote alcohol involvement, older siblings may adopt a parental, protective attitude that helps delay younger siblings' drinking initiation.

Excessive parental drinking was only found to significantly interact with number of CIAO brothers to influence AFD. In addition, this effect size ($d = 0.18$) was much smaller than the effect sizes related to AFD for individuals from homes of divorce with CIAO siblings ($d = -0.35$) and CIAO sisters ($d = -1.19$). These differences in influence are surprising given that both parental divorce and excessive parental drinking have been shown to promote risk for alcohol involvement (Bumside et al., 1986; Hussong et al., 2008). It seems, therefore, that one type of familial factor may induce greater risk than the other. Parental divorce may present environmental risk for drinking that is facilitated by sibling effects, but the risk for early drinking conferred by CIAO siblings is tempered in the context of parental alcohol misuse. Despite these potential differences, individuals are often exposed to concurrent familial risk factors for drinking. Indeed, results showed that excessive parental drinking and divorce were positively associated. Given that these factors are not entirely distinct, it is likely that they also interact to influence individuals' susceptibility to sibship influences and the likelihood of initiating alcohol use. These findings are consistent with extensive literature demonstrating that genetic and environmental influences both interact and operate independently to influence the onset and trajectory of individuals' drinking (Enoch, 2006; McGue et al., 2001; Pagan et al., 2006).

Lauritsen (1993) noted that number of siblings was not linearly related to risk for delinquency. She found that the average level of offending for adolescents in families of 1 or 2 children was comparable, but that the average level in families with 3, 4, or 5 children was significantly higher. We noted a similar effect in our analyses. For instance, men from homes of divorce without any full brothers had their first drink nearly a full year earlier than men with 1 full brother. However, the difference in age of onset between men from homes of divorce with 1, 2, and 3 or more full brothers, respectively, was minimal. Therefore, it seems that simply having a sibling promotes significant influence on alcohol involvement and that the effects conferred by additional siblings may be much smaller. Future research is needed to

identify which characteristics might cause one sibling to be particularly influential.

Sibship effects were found to influence AFD more often than AFI. Significant interactions with parental divorce were observed for 4 models predicting AFD (number of CIAO siblings, number of CIAO sisters, number of full brothers, and number of full older brothers). However, significant interactions were only found in 2 models predicting AFI (number of CIAO siblings and number of CIAO sisters). Both facilitative and protective effects of different types of siblings were found for AFD (e.g., individuals from homes of divorce with many CIAO siblings were at risk for earlier drinking, while those with many full older brothers started drinking later). However, only facilitative sibship effects were found for AFI. The present findings suggest that AFD is more sensitive to familial risk factors for substance involvement than AFI. In addition, CIAO siblings promote increased risk for alcohol use initiation, particularly in high-risk environments, such as homes of divorce. Sibling attitudes about drinking likely interact with structural variables to confer risk for early use. Family-level interventions should therefore focus on sibship composition, relational variables, and older siblings' expectancies about drinking. Targeting interventions to precede first alcohol use, rather than first intoxication, is likely to have greater impact.

One limitation of the current study is generalizability, as the sample consists largely of heavy drinkers and is mostly Caucasian. Focusing on geographically diverse groups will add to knowledge of how sibship composition and age of onset are influenced by differences in race and ethnicity. Another limitation is the use of a twin sample, as the high degree of genetic relatedness and shared experiences between twins may minimize additional sibling effects. Explorations of sibship influences in nontwin samples will help define whether effects are more robust when individuals do not have a co-twin. In addition, present results suggest that CIAO siblings may be particularly influential in homes of divorce; however, the number of individuals from homes of divorce with CIAO siblings was very small compared to the number of respondents with CIAO siblings from intact homes. A total of 880 individuals from intact homes had at least 1 CIAO sibling, while only 119 people from homes of divorce had at least 1 CIAO sibling. Future studies with a greater number of participants exposed to adverse family environments and possessing CIAO siblings will help determine whether these effects persist. Finally, this study focused on the effects of sibship size and composition, regardless of older brothers' AFD and other alcohol use phenotypes. Present findings suggest that CIAO siblings' attitudes and behaviors about alcohol may be particularly influential. Therefore, future research assessing the impact of sibship size and composition should directly measure the alcohol-related cognitions and behaviors of the entire sibship.

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REFERENCES

Abbey C, Dallos R (2004) The experience of the impact of divorce on sibling relationships: a qualitative study. Clin Child Psychol Psychiatry 9:241–259.

Brody GH, Flor DL, Hollett-Wright N, McCoy JK (1998) Children's development of alcohol use norms: contribution of parent and sibling norms, children's temperaments, and parent-child discussions. J Fam Psychol 12:209–219.

Brownfield D, Sorenson AM (1994) Sibship size and sibling delinquency. Deviant Behav 15:45–61.

Bucholz KK, Cadoret R, Cloninger CR, Dinwiddie SH, Hesselbrock VM, Nurnberger JI, Reich T, Schmidt I, Schuckit MA (1994) A new, semi-structured psychiatric interview for use in genetic linkage studies: a report on the reliability of the SSAGA. J Stud Alcohol Drugs 55:149–158.

Bumside MA, Baer PE, McLaughlin RJ, Pokorny AD (1986) Alcohol use by adolescents in disrupted families. Alcohol Clin Exp Res 10:274–278.

D'Amico EJ, Fromme K (1997) Health risk behaviors of adolescent and young adult siblings. Health Psychol 16:426–432.

Degenhardt L, Chiu WT, Sampson N, Kessler RC, Anthony JC (2007) Epidemiological patterns of extra-medical drug use in the United States: evidence from the National Comorbidity Survey Replication, 2001–2003. Drug Alcohol Depend 90:210–223.

Enoch M-A (2006) Genetic and environmental influences on the development of alcoholism: resilience vs. risk. Ann NY Acad Sci 1094:193–201.

Farrington DP (1993) Childhood origins of teenage antisocial behavior and adult social dysfunction. J R Soc Med 86:13–17.

Farrington DP (1996) The explanation and prevention of youthful offending, in *Delinquency and Crime: Current Theories* (Hawkins JD ed.), pp. 64–148. Cambridge University Press, New York.

Farrington DP, Loeber RL (2000) Epidemiology of juvenile violence. Child Adolesc Psychiatr Clin N Am 9:733–748.

Fergusson DM, Lynskey MT, Horwood LJ (1994) Childhood exposure to alcohol and adolescent drinking patterns. Addiction 89:1007–1016.

Grant BF, Stinson FS, Harford TC (2001) Age at onset of alcohol use and DSM-IV alcohol abuse and dependence: a 12-year follow-up. J Subst Abuse 13:493–504.

Hall W, Degenhardt L, Teesson M (2009) Understanding comorbidity between substance use, anxiety and affective disorders: broadening the research base. Addict Behav 34:526–530.

Hellandsjøbu ET, Watten RG, Foxcroft DR, Ingebrigtsen JE, Relling G (2002) Teenage alcohol and intoxication debut: the impact of family socialization factors, living area and participation in organized sports. Alcohol Alcohol 37:74–80.

Hussong A, Bauer D, Chassin L (2008) Telescoped trajectories from alcohol initiation to disorder in children of alcoholic parents. J Abnorm Psychol 177:63–78.

Jones MB, Offord DR, Abrams N (1980) Brothers, sisters and antisocial behavior. Br J Psychiatry 136:139–145.

Knopik VS, Heath AC, Madden PAF, Bucholz KK, Slutske WS, Nelson EC, Statham D, Whitfield JB, Martin NG (2004) Genetic effects on alcohol dependence risk: re-evaluating the importance of psychiatric and other heritable risk factors. Psychol Med 34:1519–1530.

Kramer JR, Chan G, Kuperman S, Bucholz KK, Edenberg HJ, Schuckit MA, Polgreen LA, Kapp ES, Hesselbrock VM, Nurnberger JI, Bierut LJ (2009) A comparison of diagnoses obtained from in-person and telephone interview, using the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA). J Stud Alcohol Drugs 70:623–627.

Lauritsen J (1993) Sibling resemblance in juvenile delinquency: findings from the National Youth Survey. Criminology 31:387–409.

Lehrer EL (2009) Religion, Economics, and Demography. Routledge, New York.

Little RE (1989) An exploration of the effect of select family socialization variables on teenage alcohol use. J Alcohol Drug Educ 34:22–28.

Loeber R, Stouthamer-Loeber M (1986) Family factors as correlates and predictors of juvenile conduct problems and delinquency. Crime Justice 7:29–149.

Lynskey MT, Heath AC, Bucholz KK, Slutske WS, Madden AF, Nelson EC, Statham DJ, Martin NG (2003) Escalation of drug use in early-onset cannabis users vs co-twin controls. JAMA 289:427–433.

McGue M, Iacono WG, Legrand LN, Elkins I (2001) Origins and consequences of age at first drink. II. Familial risk and heritability. Alcohol Clin Exp Res 25:1166–1173.

Monti PM, Miranda R Jr, Nixon K, Sher KJ, Swartzwelder HS, Tapert SF, White A, Crews FT (2005) Adolescence: booze, brains, and behavior. Alcohol Clin Exp Res 29:207–220.

Newson J, Newson E, Adams M (1993) The social origins of delinquency. Crim Behav Ment Health 3:19–29.

Pagan JL, Rose RJ, Viken RJ, Pulkkinen L, Kaprio J (2006) Genetic and environmental influences on stages of alcohol use across adolescence into young adulthood. Behav Genet 36:483–497.

Reiss AJ, Farrington DP (1991) Advancing knowledge about co-offending: results from a prospective longitudinal study of London males. J Crim Law Criminol 82:360–395.

Robins LN, West PA, Herjanic BL (1975) Arrests and delinquency in two generations: a study of black urban families and their children. J Child Psychol Psychiatry 16:125–140.

Rowe DC, Gulley BL (1992) Sibling effects on substance use and delinquency. Criminology 30:217–234.

Sheehan G, Darlington Y, Noller P, Feeney J (2004) Children's perceptions of their sibling relationships during parental separation and divorce. J Divorce Remarriage 41:69–94.

Slomkowski C, Rende R, Conger KJ, Simons RL, Conger RD (2001) Sisters, brothers, and delinquency: evaluating social influence during early and middle adolescence. Child Dev 72:271–283.

Slutske WS, Heath AC, Dinwiddie SH, Madden AF, Bucholz KK, Dunne MP, Statham DJ, Martin NG (1998) Common genetic risk factors for conduct disorder and alcohol dependence. J Abnorm Psychol 107:363–374.

Stormshak EA, Comeau CA, Shepard SA (2004) The relative contribution of sibling deviance and peer deviance in the prediction of substance use across middle childhood. J Abnorm Child Psychol 32:635–649.

Swartzwelder HS, Wilson WA, Tayyeb MI (1995) Age-dependent inhibition of long-term potentiation by ethanol in immature versus mature hippocampus. Alcohol Clin Exp Res 19:1480–1485.

Trim RS, Leuthe E, Chassin L (2006) Sibling influence on alcohol use in a young adult, high-risk sample. J Stud Alcohol Drugs 67:391–398.

True WR, Heath AC, Scherrer JF, Xian H, Lin N, Eisen SA, Lyons MJ, Goldberg J, Tsuang MT (1999) Interrelationship of genetic and environmental influences on conduct disorder and alcohol and marijuana dependence symptoms. Am J Med Genet 88:391–397.

Van Der Vorst H, Engels RCME, Meeus W, Dekovic M, Van Leeuwe J (2007) Similarities and bi-directional influences regarding alcohol consumption in adolescent sibling pairs. Addict Behav 32:1814–1825.

Zhang L, Wieczorek WF, Welte JW (1997) The impact of age of onset of substance use on delinquency. J Res Crime Delinq 34:253–268.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Table S1a. Influence of Divorce and Close in Age Older Siblings on Age at First Drink and Age at First Intoxication.

Table S1b. Influence of Divorce and Full Brothers on Age at First Drink and Age at First Intoxication.

Table S1c. Influence of Divorce and Full Brothers on Age at First Drink and Age at First Intoxication.

Table S1d. Influence of Divorce and Close in Age Older Brothers on Age at First Drink and Age at First Intoxication.