

# All alcohol exposure counts - testing parental, older sibling, best friend and peer exposure on young adolescent drinking in a seven-wave longitudinal study

Megan Cook  | Koen Smit | Emmanuel Kuntsche 

Centre for Alcohol Policy Research, La Trobe University, NR1 Building, Melbourne, VIC, Australia

## Correspondence

Megan Cook, Centre for Alcohol Policy Research, La Trobe University, Plenty Road and Kingsbury Drive, Bundoora, VIC 3086, Australia.

Email: [m.cook@latrobe.edu.au](mailto:m.cook@latrobe.edu.au)

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## Abstract

**Aims:** Role models around the adolescent, including parents, peers, best friends and older siblings, all act in ways to socialize the adolescent into alcohol use. This study aims to examine the effect of exposure to siblings' drinking alongside the more traditionally examined role models on alcohol use among adolescents.

**Design:** A longitudinal study followed adolescents (45.6% male) who completed a questionnaire every 6 months over 3 years (seven in total).

**Setting:** Netherlands

**Participants:** This resulted in 5112 observations clustered in 765 participants aged between 10 and 16 years.

**Measurements:** We examined three alcohol use measures: alcohol use in the last 6 months, in the last 4 weeks and binge drinking in the last 4 weeks—both cross-sectionally at each time-point and their change from one time-point to the next in a series of multi-level logistic regression models.

**Findings:** Results revealed a non-significant difference in any of the exposure or alcohol use variables between those with or without older siblings. Higher exposure to sibling drinking was significantly associated with all alcohol use outcomes: use in the last 6 months, odds ratio (OR) = 1.54, 95% confidence interval (CI) = 1.25–1.91; last 4 weeks, OR = 2.04, 95% CI = 1.60–2.60; and binge drinking, OR = 2.35, 95% CI = 1.82–3.05. When adding the other role models (i.e. peers, mothers, fathers and best friends), the significant association between siblings' exposure and adolescents' alcohol use remains.

**Conclusions:** It would appear that, after adjustment for the effect of role models, adolescents who are exposed to more sibling drinking are more likely to have drunk alcohol during the past 6 months and past 4 weeks and also to binge drink.

## KEYWORDS

Alcohol exposure, alcohol use, early adolescence, friends drinking, older siblings, parents drinking

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## INTRODUCTION

Young adolescents' alcohol use is associated with various harms, including hangovers, relationship breakdowns and experiences of physical or verbal abuse [1, 2]. In the Netherlands in 2019, 46.6% of adolescents aged between 12 and 16 years reported ever consuming alcohol, and a quarter of patients admitted to hospital for an alcohol-related injury were younger than 25 years [3, 4]. A large body of research has examined patterns of consumption at young ages, as well as predictors of use. From this work, it appears that role models around the adolescent, including parents, peers, best friends and siblings, all tend to act in ways to socialize the young person into alcohol use [5–8]. For example, when one or both parents drink more, children have been found to be more likely to report more drinking and more alcohol-related problems later in life [9]. However, the joint effect of these models of behaviour is rarely investigated, despite socialization rarely occurring in isolation.

Following social learning theory, behaviours are learnt through observation of significant others (i.e. models) demonstrating how to perform a behaviour [10]. More specifically, Bandura contends that experienced models perform a behaviour allowing the observer to develop a cognitive representation, which on later occasions serves as a guide for individual action [10]. Following this, recent research has shown that it is important to consider *exposure* to alcohol use rather than general measures of consumption [11, 12], as the degree to which young people see their role models drink may determine the degree to which young adolescents are inclined to consume alcohol themselves. For example, exposure to parents' drinking [11, 12] and problematic drinking [13] have been found to be positively associated with adolescents' positive alcohol expectancies, as well as being associated with adolescents' use. Similarly, exposure to friends' alcohol use influenced the escalation of use, with stronger risks for those aged under 13 years or over 17 years [7].

Only one recent Dutch study that we are aware of has begun to consider to the effect of exposure to several role models on young adolescents' consumption, finding that parental alcohol exposure matters for their offspring's alcohol use independently of whether peers or best friends also expose adolescents to alcohol consumption [14]. However, this study did not include a measure of exposure to older siblings' drinking, despite siblings being shown to be a key resource for learning about alcohol [15]. Previous studies have also shown that siblings' alcohol use resemble each other [16], but have not considered whether this may be the result of older siblings modelling (or exposing) younger siblings to their consumption patterns. As such, research including older siblings presents a unique opportunity to examine several sources of exposure, providing a clearer measure of the frequency with which adolescents observe and learn about drinking, useful for suggesting avenues for intervention to reduce harms which more accurately reflect the range of personal sources of young adolescents' alcohol exposure. Therefore, the current study aims to examine the effect of older siblings' exposure alongside several more traditionally examined role models on young adolescent's consumption patterns.

Using longitudinal data, this paper examines the role of exposure to parents (mothers and fathers separately), peers, best friends and older siblings' drinking on young adolescents' (10–13 years at baseline) own alcohol use. We examine three alcohol use measures, both cross-sectionally at each time-point and their change over time, from one time-point to the next in a series of logistic regression models. Following Smit and colleagues [14], we hypothesize that exposure from the different role models will have an additive effect on adolescents' alcohol use. First, we examine the role of mothers', fathers', peers' and best friends' alcohol use exposure on adolescents' consumption, while controlling for the presence of older siblings, to examine these role models influence across the sample. Following the previous research described above, we expect all models' exposure to be positively associated with adolescents' alcohol use. Secondly, among those having older siblings, we examine the impact of sibling alcohol use exposure, and finally, we examine whether sibling exposure was associated with alcohol use when including mothers', fathers', peers' and best friends' exposure. We hypothesize older siblings' exposure to be significantly associated with adolescents use.

## METHODS

We report the details of this study following the 'Strengthening the Reporting of Observational Studies in Epidemiology' guidelines [17].

### Procedure

A sample of young adolescents (aged 10–13 years at baseline) were recruited from 123 primary schools (913 contacted; 13.5%) from five randomly selected provinces in the Netherlands (Gelderland, Groningen, Flevoland, Zeeland and Zuid-Holland) as part of a multi-informant seven-wave longitudinal family study (the current study includes data from adolescents only [11, 14]). Data were collected between 2015 and 2018. Information regarding participation was provided through presentation(s) at primary schools to students and their parents. Families from 104 schools registered via the study website, resulting in 765 participating families (on average seven families per school). At baseline, paper and pencil questionnaires were administered to adolescents in classrooms. During the following 3 years, online questionnaires were sent to adolescents every 6 months. Yearly gifts (€10) were distributed to participating families. A total of 755 sixth-grade adolescents [45.6% male, median<sub>age</sub> = 11.78, range = 10–13, standard deviation (SD) = 0.49 at baseline] from 765 families (98.7%) completed the questionnaire; 97.6% were born in the Netherlands. Of the 755 adolescents, 564 (74.7%) had older siblings. We tested whether the participants who missed any questionnaire (11.9%) differed from the 674 participants (88.1%) who completed every questionnaire; t-tests indicated that those with any missing values did not differ in terms of age from those with full retention during the study ( $t = 1.064, P = 0.296$ ). Moreover,  $\chi^2$  tests indicated that participants with missing values did not differ in terms

of gender proportions ( $\chi^2_{(d.f. = 1)} = 3.76$ ,  $P = 0.053$ ; no missing values = 54.5% girls, missing values = 50.5% girls). The ethics committee of the Faculty of Social Sciences approved the study procedures (ECSW2014-2411-272). More information on recruitment and demographics can be found elsewhere [11, 14]. Analysis was not pre-registered, and the results should be considered exploratory.

## Measures

### Alcohol use in the last 6 months

For adolescents who indicated consuming alcohol at any point in their life-time, a follow-up question was asked: 'How long ago did you consume alcohol?'. Response options were 'never', 'less than 1 month ago', 'about 6 months ago' and 'more than 6 months ago'. Those who indicated that they consumed alcohol no more than 6 months ago were coded as a recent drinker (1) and those reporting no life-time alcohol use or no alcohol use in the past 6 months were coded as a non-drinker at that time-point (0).

### Alcohol use in the last 4 weeks

Adolescents were asked: 'In the past four weeks, how often did you drink alcohol?'. Response options were: 'I never drank alcohol', '1 to 3 days per month', '1 to 2 days per week', '3 to 4 days per week', '5 to 6 days per week' and 'every day'. Because of skewed distribution and the low prevalence of frequent drinking in this young sample, this variable was dichotomized to 0 ('I did not drink last month') and 1 ('I drank at least once last month').

### Binge drinking in the last 4 weeks

Adolescents were asked: 'In the past 4 weeks, how often did you drink five glasses or more on one occasion?'. The response options were the same as the alcohol use in the past 4 weeks variable, and this variable was also dichotomized to 0 ('no binge drinking in the last 4 weeks') and 1 ('binge drinking in the last 4 weeks').

### Exposure to parental alcohol use

For mothers and fathers separately, adolescents were asked: 'How often have you seen your mother/father drink alcohol in the following situations?'. Adolescents reported the frequency of parental drinking in nine family-specific situations deemed most common for alcohol use, such as a family barbecue or a birthday party [11, 18]. Responses were recorded on a 5-point Likert scale ranging from 0 ('never') to 4 ('always'). Exposure from fathers and mothers were averaged to calculate a mean exposure score and were correlated  $r = 0.541$ ,  $P < 0.001$ .

### Exposure to best friends', peers' and older siblings' alcohol use

Adolescents were asked: 'How often have you seen the following people drink alcohol in the past 4 weeks?'—oldest brother/sister, best friend and peers. Adolescents then reported on the frequency of their exposure to alcohol use by these three groups (if any) using a 5-point Likert scale, ranging from 0 ('never') to 6 ('every day'). These were recoded into frequency per week: 0 (never), 0.5 (1–3 days a month), 1.5 (1–2 days a week), 3.5 (3–4 days a week), 5.5 (5–6 days a week) to 7 (every day).

### Older sibling

Participants were asked how many older brothers and sisters (including any step- or half-siblings) they had, which was coded into 0 = 'no siblings', 1 = 'have siblings'.

### Time-point

The data collection time-point ranged from 0 (T1, baseline) to 6 (T7).

### Demographics (baseline = T0)

Adolescents reported their sex and age.

### Analytical strategy

First,  $\chi^2$  and  $t$ -tests were conducted in SPSS version 27 to test potential differences between those with and without siblings on a bivariate level (the first model, discussed below, then tests this same association in a mutually adjusted way). We considered the 0.1%  $\alpha$ -error level as the significance threshold because the cluster sampling design of having time-points nested within individuals may have affected standard errors [19]. Following descriptive analyses, a series of multi-level logistic regression analyses were performed in Mplus [20] to account for the nesting of time-points (first level of analysis) within individuals (second level of analyses). Of 5355 potential data points ( $n = 765 \times 7$  waves), 5112 data points (95.4%) were available due to incomplete questionnaires. Current analysis is based on all observed values whereby missing data points (4.6%) were handled through the full-information maximum likelihood option in Mplus, which provides unbiased estimates with values missing at random [21]. To account for the increase of alcohol use over time, we included the time-point as a predictor in all models.

We ran four models to test the effect of older siblings' alcohol exposure, alongside several more traditionally examined role models (mothers, fathers, peers and best friends), on young adolescents' drinking. In the first model, we tested the impact of exposure to

mothers, fathers, peers and best friends on adolescents' alcohol use in the last 6 months, alcohol use in the last 4 weeks and binge drinking in the last 4 weeks, while controlling for sex, age at baseline, changes of drinking status over time (time-point) and having an older sibling. In a second model (2a), in the subsample of those with older siblings, we examined the impact of exposure to older siblings' drinking on the three alcohol use outcome variables while controlling for sex, age at baseline and changes of drinking over time (time-point). In the third model (2b), we simultaneously examined the impact of sibling, mother, father, peer and best friend exposure on the three alcohol use outcomes while controlling for age, sex and time-point. To test the impact of exposure on changes of drinking status over time, the final model (2c) examined the relations in model 2b adjusted for alcohol use at the previous time-point. In all previous models, we tested whether the models of behaviour, at any given time-point in the 7.5-year-long study, had an impact upon young adolescents use while controlling for sex and age at baseline. However, the final model, adjusted for the previous time-point, means that we have the change from one time-point to the next, for example, given an adolescent who has not consumed alcohol at the previous time-point, what is the likelihood that they will drink at this time-point (versus not).

## RESULTS

More than two-thirds (69.7%) had an older sibling. On average across all seven time-points, adolescents reported very occasional alcohol use exposure from mothers and fathers, and peer exposure and best friend alcohol use exposure was fewer than once per week (Table 1). The results were the same for those with and without siblings. Just over 20% of adolescents reported consuming alcohol in the last 6 months, ~6% of adolescents reported consuming alcohol at least

once during the last 4 weeks and ~2.5% reported binge drinking in the last 4 weeks.

The first multi-level regression model (Table 2) showed that higher exposure to parents' and peers' drinking was associated with all three alcohol use outcomes. Those with higher exposure to mothers' drinking were significantly more likely to consume alcohol in the last 6 months, in the last 4 weeks and to have binged in the last 4 weeks. However, the effects for exposure to fathers' drinking were non-significant. Adolescents exposed to best friends' drinking were more than two times more likely to consume alcohol in the last 4 weeks and nearly two times as likely to have binged in the last 4 weeks. Those exposed to peer drinking were more than three times as likely to have consumed alcohol in the past 6 months. The older the adolescent at baseline, the higher was their likelihood to have consumed alcohol in the last 6 months and to have had binge drinking experiences in the last 4 weeks. In our sample of 755 adolescents, we did not find any significant differences in alcohol use between girls and boys and between those with and without older siblings.

The second model (2a, Table 3) shows that higher exposure to sibling drinking was significantly associated with all alcohol use outcomes, while controlling for age, sex and changes in drinking status over time (time-point). Adolescents exposed to siblings' drinking were two times more likely to engage in binge drinking and to have consumed in the last 4 weeks. Results from model 2b show that when adding the other role models (i.e. peers, parents and best friends), the significant association between siblings' exposure and adolescents' alcohol use remains, although there is some attenuation in ORs towards null (e.g. binge drinking decreases from OR = 2.35,  $P < 0.001$  to OR = 1.94,  $P < 0.001$ ). Similarly, mothers', best friends' and peers' exposure remain significantly associated with adolescents' alcohol use; however, best friends' exposure only affects binge drinking. The final model (2c) includes alcohol use at the previous time-point. Here,

**TABLE 1** Descriptive statistics of demographics, alcohol use exposure and alcohol use [mean (SD), results presented are averaged over all time-points].

|                                   | Total sample    | Sibling <sup>a</sup> |                 | Test value | P        |
|-----------------------------------|-----------------|----------------------|-----------------|------------|----------|
|                                   |                 | No sibling           | Sibling         |            |          |
| Alcohol use exposure <sup>b</sup> | <i>n</i> = 5112 | <i>n</i> = 1407      | <i>n</i> = 3948 | <i>t</i>   | <i>P</i> |
| Mothers                           | 1.25 (0.92)     | 1.21 (0.90)          | 1.26 (0.93)     | 1.77       | 0.077    |
| Fathers                           | 1.52 (0.97)     | 1.48 (0.93)          | 1.53 (0.99)     | 1.66       | 0.098    |
| Sibling                           | –               | –                    | 0.16 (0.53)     | –          | –        |
| Friends                           | 0.05 (0.28)     | 0.04 (0.22)          | 0.05 (0.30)     | 1.36       | 0.174    |
| Peers                             | 0.10 (0.36)     | 0.09 (0.33)          | 0.10 (0.37)     | 0.89       | 0.375    |
| Alcohol use <sup>b</sup> in the:  | <i>n</i> = 5112 | <i>n</i> = 1407      | <i>n</i> = 3948 | $\chi^2$   | <i>P</i> |
| Last 6 months                     | 21.0%           | 19.2%                | 21.7%           | 3.66       | 0.056    |
| Last 4 weeks                      | 6.3%            | 5.2%                 | 6.7%            | 3.72       | 0.054    |
| Binge drinking (last 4 weeks)     | 2.6%            | 2.3%                 | 2.7%            | 0.73       | 0.392    |

For parents: frequency of drinking in nine situations [range = 0 (never) to 4 (always)] and for siblings/peers/best friends: frequency of drinking days per week.

<sup>a</sup>Groups are based on having a sibling (at baseline).

<sup>b</sup>Due to the nesting of observations within individuals, only  $P < 0.01$  was considered as significance level. SD = standard deviation.

**TABLE 2** Associations between parents, best friends and peer exposure with adolescents' alcohol use (ORs with 95% CIs).

| Model 1                    | n = 755                          |                                 |                                    |
|----------------------------|----------------------------------|---------------------------------|------------------------------------|
|                            | Alcohol use in the last 6 months | Alcohol use in the last 4 weeks | Binge drinking in the last 4 weeks |
| Within individuals         |                                  |                                 |                                    |
| Mother's exposure          | 1.59 <sup>***</sup> (1.30–1.95)  | 1.56 <sup>**</sup> (1.19–2.04)  | 1.57 <sup>*</sup> (1.09–2.25)      |
| Father's exposure          | 1.07 (0.90–1.27)                 | 1.03 (0.82–1.30)                | 1.03 (0.72–1.47)                   |
| Best friend exposure       | 2.19 (0.69–6.99)                 | 2.64 <sup>*</sup> (1.07–6.49)   | 1.91 <sup>*</sup> (1.16–3.13)      |
| Peer exposure              | 3.19 <sup>***</sup> (1.95–5.20)  | 2.21 <sup>**</sup> (1.24–3.96)  | 2.01 <sup>**</sup> (1.22–3.30)     |
| Time-point                 | 1.43 <sup>***</sup> (1.34–1.53)  | 1.72 <sup>***</sup> (1.54–1.92) | 1.67 <sup>***</sup> (1.41–1.97)    |
| Between individuals        |                                  |                                 |                                    |
| Age at baseline (years)    | 2.35 <sup>***</sup> (1.62–3.42)  | 1.59 <sup>***</sup> (0.98–2.59) | 2.73 <sup>***</sup> (1.42–5.24)    |
| Sex                        | 0.70 (0.48–1.01)                 | 0.83 (0.53–1.31)                | 0.73 (0.40–1.33)                   |
| Older sibling <sup>a</sup> | 1.32 (0.86–2.03)                 | 1.32 (0.78–2.21)                | 1.31 (0.63–2.75)                   |

<sup>a</sup>0 = 'no siblings', 1 = 'have siblings'. OR = odds ratio; CI = confidence interval.

<sup>\*</sup>P < 0.05;

<sup>\*\*</sup>P < 0.01;

<sup>\*\*\*</sup>P < 0.001.

sibling exposure was consistently associated with the alcohol outcomes, as was mothers' exposure. Peer exposure was found to be associated with use in the last 6 months and use in the last 4 weeks but not binge drinking, whereas best friends' exposure is related to use in the last 4 weeks and binge drinking but not use in the last 6 months. Finally, there were no significant sex effects in any of the models.

## DISCUSSION

Using a large longitudinal study of 10–16-year-olds, the present study examined the effect of older siblings' alcohol exposure, alongside several more traditionally examined role models (mothers, fathers, peers and best friends), on young Dutch adolescents' drinking patterns. Following our hypothesis and previous research [11, 12, 14], exposure to mothers' and peers' alcohol use was associated with a significant increase in all three alcohol use indicators among adolescents. However, there was a non-significant effect for exposure to fathers' drinking. Previous findings on exposure to mothers' and fathers' alcohol use, while limited, often show the most robust effects for fathers' drinking [11]. As such, our results may reflect maternal closeness (see also [13]) or mothers' discussion of alcohol with adolescents, which may make them primary models of consumption (following social learning theory [10]). Additionally, it may be that fathers' drinking has become normalized and there is very little variance compared with mothers' drinking. Next, building upon previous research [5], we differentiated between best friends' and general peers' alcohol exposure and found that exposure to best friends' alcohol use was also associated with a significant increase in consumption during the last 4 weeks and binge drinking. Building upon previous research [7], these results show the importance of exposure to friends' use for those aged between 10 and 16 years. Moreover,

and overall, our results support the assertion that parents, peers and best friends are all important models of behaviour for young adolescents' alcohol use.

In terms of siblings, we extend previous literature [8, 15, 16] by considering exposure to siblings' drinking behaviour rather than general measures of use, and consider this exposure in the context of other role models. We found that there was no significant difference in any of the exposure or alcohol use variables between those with and without older siblings. Instead, higher exposure to sibling drinking was found to be significantly associated with all alcohol use outcomes. This suggests that having an older sibling does not constitute a risk factor for young adolescent drinking *per se*, but that it is exposure to their drinking (if any) which is important. This adds to the emerging literature regarding the importance of exposure to role models' alcohol consumption [14] and is consistent with the assumptions of social learning theory [10], whereby behaviours are learnt through observation of significant others (i.e. models).

While previous research has shown strong congruence between siblings' alcohol use during adolescence [16], our results show that exposure to sibling alcohol use remains an important predictor when considering exposure to parents', peers' and best friends' drinking, and additional to the usual progression in alcohol initiation throughout early adolescence. These results suggest an additive effect for each individual model of behaviour, including (importantly) siblings, independent of changes over time. That is, exposure to, and observation of, all models' consumption has an effect on young adolescents' alcohol use [10]. These results demonstrate that multiple relationships affect individual adolescents' risk for alcohol use through alcohol exposure, including multiple family relationships (something which, beyond Smit and colleagues recent work [14], has yet to be studied). Results from the final model also demonstrated that older siblings remain an important influence on adolescents' drinking once

**TABLE 3** The associations of exposure with recent alcohol use, monthly alcohol drinking and monthly binge drinking for those with older siblings (ORs with 95% CIs).

|                            | Model 2a, n = 564               |                                 |                                 | Model 2b, n = 564               |                                 |                                 | Model 2c, n = 564               |                                  |                                    |
|----------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|------------------------------------|
|                            | Last 6 months                   | Last 4 weeks                    | Binge drinking                  | Last 6 months                   | Last 4 weeks                    | Binge drinking                  | Last 6 months                   | Last 4 weeks                     | Binge drinking                     |
|                            |                                 |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                                    |
| <b>Within individuals</b>  |                                 |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                                    |
| Mother's exposure          |                                 |                                 |                                 | 1.50 <sup>***</sup> (1.20–1.87) | 1.47 <sup>*</sup> (1.09–1.99)   | 1.47 <sup>*</sup> (1.00–2.16)   | 1.44 <sup>***</sup> (1.20–1.72) | 1.49 <sup>**</sup> (1.18–1.89)   | 1.50 <sup>**</sup> (1.14–1.98)     |
| Father's exposure          |                                 |                                 |                                 | 1.11 (0.92–1.34)                | 1.04 (0.81–1.34)                | 1.20 (0.83–1.73)                | 1.08 (0.93–1.27)                | 1.01 (0.083–1.24)                | 1.05 (0.077–1.43)                  |
| Sibling exposure           | 1.54 <sup>***</sup> (1.25–1.91) | 2.04 <sup>***</sup> (1.60–2.60) | 2.35 <sup>***</sup> (1.82–3.05) | 1.36 <sup>**</sup> (1.09–1.69)  | 1.66 <sup>***</sup> (1.31–2.11) | 1.94 <sup>***</sup> (1.55–2.47) | 1.45 <sup>***</sup> (1.18–1.79) | 1.54 <sup>***</sup> (1.21–1.94)  | 1.85 <sup>***</sup> (1.50–2.27)    |
| Best friend exposure       |                                 |                                 |                                 | 2.22 (0.54–9.19)                | 2.60 (0.89–7.64)                | 1.83 (1.11–3.04)                | 1.95 (0.77–4.98)                | 2.06 (1.00–4.23)                 | 1.55 (1.11–2.16)                   |
| Peer exposure              |                                 |                                 |                                 | 2.83 <sup>***</sup> (1.65–4.84) | 2.08 (1.06–4.10)                | 1.63 (1.02–2.60)                | 2.60 <sup>**</sup> (1.60–4.21)  | 2.09 (1.05–4.13)                 | 1.41 (0.93–2.14)                   |
| Time-point                 | 1.55 <sup>***</sup> (1.44–1.67) | 1.95 <sup>***</sup> (1.70–2.25) | 1.79 <sup>***</sup> (1.47–2.18) | 1.43 <sup>***</sup> (1.32–1.54) | 1.72 <sup>***</sup> (1.52–1.96) | 1.63 <sup>***</sup> (1.35–1.95) | 1.42 <sup>***</sup> (1.30–1.54) | 1.51 <sup>***</sup> (1.33–1.72)  | 1.64 <sup>***</sup> (1.37–1.97)    |
| Previous alcohol use       |                                 |                                 |                                 | --                              | --                              | --                              | 6.04 <sup>***</sup> (3.73–9.79) | 7.19 <sup>***</sup> (2.90–17.86) | 15.91 <sup>***</sup> (2.36–107.49) |
| <b>Between individuals</b> |                                 |                                 |                                 |                                 |                                 |                                 |                                 |                                  |                                    |
| Age (years)                | 2.66 <sup>***</sup> (1.71–4.14) | 2.18 <sup>*</sup> (1.19–3.99)   | 2.99 <sup>**</sup> (1.50–5.97)  | 2.32 <sup>***</sup> (1.53–3.52) | 1.64 (0.93–2.90)                | 2.44 <sup>**</sup> (1.25–4.75)  | 1.68 <sup>**</sup> (1.22–2.29)  | 1.39 <sup>**</sup> (1.02–1.90)   | 1.86 <sup>**</sup> (1.13–3.05)     |
| Sex                        | 0.071 (0.46–1.10)               | 0.90 (0.51–1.61)                | 0.70 (0.37–1.35)                | 0.69 (0.46–1.04)                | 0.91 (0.54–1.55)                | 0.72 (0.38–1.35)                | 0.75 (0.55–1.01)                | 0.91 (0.62–1.36)                 | 0.75 (0.47–1.20)                   |

OR = odds ratio; CI = confidence interval.

<sup>\*</sup>P < 0.05;<sup>\*\*</sup>P < 0.01;<sup>\*\*\*</sup>P < 0.001.

consumption has been initiated, suggesting that older siblings are not simply important for adolescents' initiation to alcohol consumption, but have an impact upon changes in drinking throughout early adolescence.

Finally, we did not find any sex differences in any alcohol use indicators. This follows previous consumption data showing no significant differences between boys and girls aged 12–16 years in the prevalence of any alcohol use and heavy episodic drinking in the past month [4, 22]. These findings may suggest that well-established sex differences in consumption may begin to become evident during or after adolescence or when drinking becomes more habitual [22, 23].

### Implications for preventive action

In terms of prevention or intervention efforts which aim to reduce the various harms associated with young adolescents' alcohol use [1, 2], these results suggest three potential avenues. First, following previous research [11, 12, 14], prevention efforts should focus upon reducing exposure (rather than all drinking) and secondly, attention should be given to sibling relationships, whether that be to reduce exposure or to use the sibling relationship as a resource for educating younger siblings [15]. Finally, any harm reduction effort should be multi-dimensional, focusing upon the range of sources of exposure that influence adolescents' drinking, including the family (e.g. parents and older siblings), broader influences (e.g. best friends and peers) and the larger physical and social environments (e.g. adults outside the family, outlet density and other neighbourhood characteristics [24, 25]) in which young adolescents grow up. In other words, we advocate for holistic prevention efforts which include all models of behaviour to address the normativity of alcohol in the adolescents' proximate social environment. Focusing attention upon these avenues for prevention or intervention could occur through existing campaigns and efforts (e.g. Health Schools and Drugs [26]), as our results suggest new targets for attention rather than the need for new content.

### Limitations, strengths and recommendations for future research

Several limitations need to be kept in mind when interpreting the results. First, participation was voluntary and based on active consent, which may result in selection bias, and the reported results may not be generalizable to the Dutch context. Similarly, the sample fails to reflect the multi-cultural diversity of the Dutch population [27, 28], and future research would be needed in a range of different samples to confirm the generalizability of the results presented here. Secondly, the parental exposure measure did not capture a wide range of consumption patterns; that is, drunkenness or heavy use, which may result in some under-reporting. Finally, we treated time as linear, and future research may wish to consider more flexible modelling options, such as cubic splines or fractional polynomials. However, this study is strengthened by the longitudinal study design which includes seven

waves of young adolescents' data collected at 6-monthly intervals and at a time when alcohol use initiation often occurs. The study is also strengthened by the joint examination of several role models, which demonstrates that exposure of different models had an additive effect. Future research should investigate mechanisms behind this additive effect and whether it affects alcohol-related cognitions and the frequency/intensity of adolescents' use. Research following adolescents into later adolescent and adult years may also allow researchers to investigate what long-term effects multiple alcohol use exposure in early adolescence has. Additionally, the results reinforce older siblings' exposure as a worthy and important avenue for future research investigating young people's relationship with alcohol.

### CONCLUSIONS

The current study extends the previous limited literature on older siblings, exposure and young adolescent alcohol use by investigating the effect of exposure to sibling drinking alongside several more established models of drinking behaviour. We found that exposure to sibling alcohol use remains important when considering exposure to mothers, fathers, peers and best friends, and when considering drinking and its changes from ages 10 to 16 years. Moreover, the risk for young adolescent drinking is not having an older sibling *per se*, but the exposure to older siblings' alcohol consumption. In examining the joint effect of several sources of exposure, we have sought to provide a better measure of the frequency with which adolescents observe and learn about drinking from key people in their lives and, as such, these results highlight the importance of future work on exposure which extends beyond parents to consider other sources of information as adolescents come closer to, and initiate, alcohol use.

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### DECLARATION OF INTERESTS

None.

### AUTHOR CONTRIBUTIONS

**Megan Cook:** Writing-original draft; writing-review and editing. **Koen Smit:** Conceptualization; data curation; formal analysis; writing-review and editing. **Emmanuel Kuntsche:** Conceptualization; funding acquisition; methodology; supervision; writing-original draft; writing-review and editing.

### ORCID

Megan Cook  <https://orcid.org/0000-0002-0832-4291>

Emmanuel Kuntsche  <https://orcid.org/0000-0001-8931-0790>

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