

# European longitudinal study on the relationship between adolescents' alcohol marketing exposure and alcohol use

Avalon de Bruijn<sup>1,2,3</sup>, Jacqueline Tanghe<sup>1</sup>, Rebecca de Leeuw<sup>3</sup>, Rutger Engels<sup>3,4</sup>, Peter Anderson<sup>5,6</sup>, Franca Beccaria<sup>7</sup>, Michał Bujalski<sup>8</sup>, Corrado Celata<sup>9</sup>, Jordy Gossett<sup>10</sup>, Dirk Schreckenber<sup>11</sup>, Luiza Słodownik<sup>12</sup>, Jördis Wothge<sup>11</sup> & Wim van Dalen<sup>12</sup>

STAP (Dutch Institute for Alcohol Policy), Utrecht, the Netherlands,<sup>1</sup> European Centre on Monitoring Alcohol Marketing (EUCAM), Radboud University, Nijmegen, the Netherlands,<sup>2</sup> Behavioural Science Institute, Radboud University, Nijmegen, the Netherlands,<sup>3</sup> Trimbos Institute, Utrecht, the Netherlands,<sup>4</sup> Institute of Health and Society, Newcastle University, Newcastle upon Tyne, UK,<sup>5</sup> Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, the Netherlands,<sup>6</sup> Ecdetica, Rome, Italy,<sup>7</sup> Institute of Psychiatry and Neurology (IPIN), Warsaw, Poland,<sup>8</sup> Dipartimento Dipendenze, Azienda Sanitaria Locale di Milano, Milan, Italy,<sup>9</sup> University of Twente, Enschede, the Netherlands,<sup>10</sup> ZEUS (Centre for Applied Psychology, Social and Environment), Hagen, Germany<sup>11</sup> and State Agency for Prevention of Alcohol Related Problems (PARPA), Warsaw, Poland<sup>12</sup>

## ABSTRACT

**Background and aims** This is the first study to examine the effect of alcohol marketing exposure on adolescents' drinking in a cross-national context. The aim was to examine reciprocal processes between exposure to a wide range of alcohol marketing types and adolescent drinking, controlled for non-alcohol branded media exposure. **Design** Prospective observational study (11–12- and 14–17-month intervals), using a three-wave autoregressive cross-lagged model. **Setting** School-based sample in 181 state-funded schools in Germany, Italy, Netherlands, Poland. **Participants** A total of 9075 eligible respondents participated in the survey (mean age 14 years, 49.5% male). **Measurements** Adolescents reported their frequency of past-month drinking and binge drinking. Alcohol marketing exposure was measured by a latent variable with 13 items measuring exposure to online alcohol marketing, televised alcohol advertising, alcohol sport sponsorship, music event/festival sponsorship, ownership alcohol-branded promotional items, reception of free samples and exposure to price offers. Confounders were age, gender, education, country, internet use, exposure to non-alcohol sponsored football championships and television programmes without alcohol commercials. **Findings** The analyses showed one-directional long-term effects of alcohol marketing exposure on drinking (exposure T1 on drinking T2:  $\beta = 0.420$  (0.058),  $P < 0.001$ , 95% confidence interval (CI) = 0.324–0.515; exposure T2 on drinking T3:  $\beta = 0.200$  (0.044),  $P < 0.001$ , 95% CI = 0.127–0.272; drinking T1 and drinking T2 on exposure:  $P > 0.05$ ). Similar results were found in the binge drinking model (exposure T1 on binge T2:  $\beta = 0.409$  (0.054),  $P < 0.001$ , 95% CI = 0.320–0.499; exposure T2 on binge T3:  $\beta = 0.168$  (0.050),  $P = 0.001$ , 95% CI = 0.086–0.250; binge T1 and binge T2 on exposure:  $P > 0.05$ ). **Conclusions** There appears to be a one-way effect of alcohol marketing exposure on adolescents' alcohol use over time, which cannot be explained by either previous drinking or exposure to non-alcohol-branded marketing.

**Keywords** Adolescents, alcohol advertising, alcohol marketing, binge drinking, drinking, Europe.

Correspondence to: Avalon de Bruijn, European Centre on Monitoring Alcohol Marketing (EUCAM), Radboud University, Nijmegen, the Netherlands. E-mail: adebruijn@eucam.info

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## INTRODUCTION

Europe is the world's heaviest drinking region [1], and rates of youth drinking are particularly problematic [2]. Various alcohol policy measures are being considered to address this heavy drinking culture [3–5]. Specifically, the need for changes to the European Union (EU)'s Audio Visual Media Services Directive (AVMSD [6]), which regulates

(alcohol) advertising on audiovisual platforms, is being considered by the European Commission [7]. Evidence on the influence of alcohol advertising on youth drinking is needed to inform such discussions. The current study examines the potential impact of alcohol marketing exposure on youth drinking in four EU countries. Greater insight into the relationship between alcohol marketing exposure and drinking could help to inform the decisions of policymakers. Three

points set this study apart from previous works. First, the study uses a cross-national sample. Evidence of a universal effect of alcohol marketing exposure on adolescent alcohol use is examined. Secondly, it analyses the longitudinal effect of alcohol marketing exposure on drinking, while also taking into account the effects of various forms of alcohol marketing (most notably TV and web-based). Thirdly, the study design includes the possibility of a reciprocal process of adolescent alcohol use and alcohol marketing exposure. We will elaborate upon the latter two points.

This study builds upon previous conducted studies suggesting that exposure to media and alcohol marketing is associated with the likelihood that adolescents will start drinking alcohol, and with increased drinking among adolescents who have already started to drink [8–10].

Alcohol marketing in mass media, communicated to large audiences via outdoor billboards, print, internet [11] and on television is considered high in volume, both in terms of alcohol advertising expenditures and in hours of exposure.

Cohort studies [12–14] have found dose–response associations between adolescent’s exposure to alcohol advertising on TV and their drinking behaviour. However, a study by Ellickson *et al.* [15] found that the effect of televised alcohol advertising on drinking behaviour could be explained by exposure to other types of alcohol marketing. This underlines the importance of considering other types of alcohol promotion. By modelling a latent alcohol marketing exposure construct, the present study investigates the impact of the cumulative effect of exposure to a large number of marketing channels (TV advertisements, sponsorship, web-based communications, branded merchandise and product promotions).

Cross-sectional and longitudinal studies are likely to underestimate the effects of exposure to alcohol advertising, because they focus principally on (mass media) advertising, which is only one part of the promotional efforts of alcohol producers [8–10]. Youngsters’ media use has changed since the first longitudinal studies on alcohol marketing were conducted [8,9]. Young people in higher-income countries are now less exposed to television advertisements, while their exposure to online advertisements has risen significantly [16]. This demonstrates a need to examine the combined influence of less-studied alcohol marketing channels (sport and event sponsorship, web-based communications, branded merchandise and product promotions) when estimating alcohol marketing’s effect on adolescent drinking in the long term.

Initial analyses on the effect of online alcohol marketing underline the importance of examining the effect of advertising through this medium [17,18]. There is also growing evidence suggesting that ownership of alcohol-branded promotional items effectively reaches adolescents and is associated with increasing use of alcohol [19]. Additionally,

alcohol-branded sports sponsorship is of great importance for the sports industry [20], as sports celebrity endorsement has been found to encourage sales of products [21]. However, limited research exists on the effects of sports sponsoring on substance use [22,23].

Many researchers have relied upon self-report of exposure, especially when measuring alcohol marketing in online advertising, sports and event sponsorship and ownership of promotional items. An important limitation of memory-based measures is the profound underestimation of exposure to alcohol marketing. For example, some respondents might have been exposed to a given alcohol advertisement that they were unable to label or recognize. Additionally, memory-based measures are affected strongly by the respondents’ interpretations. Such measures are highly correlated with potential confounders (e.g. past drinking experience) [13]. For this reason, self-reported exposure measures were complemented in this study with more objective measures of exposure to alcohol marketing [24,25].

The dimension of time in longitudinal studies makes them particularly powerful in untangling relationships of cause and effect [8]. In most of these studies, alcohol marketing exposure and media use are conceptualized as exogenous variables [8]. However, individuals seek out certain media content based on various individual and social factors. According to the ‘reinforcing spirals’ model of media exposure and risk behaviour [26], media effects and media selectivity can form a mutually influential process that serves to escalate engagement in risk behaviour over time [26]. By controlling for non-alcohol branded advertising and sponsorship, researchers can gain more insight into the influence of alcohol branded marketing as being differentiated from overall media use.

Tucker *et al.* [27] was the first study attempting to demonstrate the reciprocal process of adolescent alcohol use. To control for this reciprocal effect of drinking status on alcohol advertising receptivity, Tucker *et al.* [23] employed a two-wave autoregressive cross-lagged model. This form of structural equation modelling (SEM) revealed a significant, albeit small, effect of alcohol-related media on middle school student drinking 1 year later. Further research is needed to determine the robustness of this finding. The present study examines whether such a reciprocal relationship could be replicated using a three-wave design and includes a large number of alcohol marketing exposure measures.

By modelling a latent alcohol marketing exposure construct, the present study aimed to (1) test whether there is a cumulative effect of exposure to a large number of alcohol marketing types (TV advertisements, sponsorship, web-based communications, branded merchandise and product promotions) on adolescents’ drinking (frequency of drinking and binge drinking). Autoregressive cross-lagged models were employed to study whether a potential

effect of alcohol marketing exposure on adolescents' drinking can be explained by (2) previous drinking experience and/or (3) exposure to non-alcohol branded media exposure.

## METHOD

### Study sample and procedure

This study was conducted at seven research centres, in Germany (regions Münsterland and Arnsberg), Italy (Milan and Cuneo Province), Poland (Warsaw and Zamość district) and the Netherlands (province Overijssel) [28,29]. Countries were selected to represent a variety of drinking cultures [30,31] and alcohol (marketing) policies. Germany has legal restrictions on the content of alcohol advertising and a watershed on advertising in cinema [32]. Italy has a non-enforced ban on spirits advertising and a watershed for beer and wine advertisements on TV [33], and the Netherlands has a similar watershed on TV and radio [31,34]. In practice, these countries rely mainly upon self-regulation [33]. Compared to these countries, Poland has a wider employed statutory time ban [31]. Besides volume and content restrictions aimed at youth protection, there are legal restrictions on the size of advertising posts and billboards.

All study samples were recruited from state-funded schools. Students were considered eligible for participation in this study if they had received a unique ID number that could connect survey data to student background variables. Of the 9075 eligible respondents who participated in the survey, 6.6% participated only in the first wave (T1), 24.7% also participated in the second (T2) or third wave (T3) and 68.7% participated in all three waves. The overall sample originated from 68 municipalities and 181 schools; 20% from Germany ( $n = 1816$ ), 31% from Italy ( $n = 2784$ ), 22% from the Netherlands ( $n = 2033$ ) and 27% from Poland ( $n = 2442$ ). With respect to sex, 49.5% were male. The mean age was 14.02 years [standard deviation (SD) = 0.797] at T1 (range = 10–18). The number of participating students per school ranged from two to 224.

### Survey

Between T1 (November 2010–February 2011) and T2 (April–May 2011) 4–6 months passed. T3 was measured 11–12 months later (March–April 2012). A 14–17-month period spanned between T1 and T3. In each country, data were collected through self-reported questionnaires and administered by trained research staff. Students were assured that their individual data would not be seen by parents or school staff. Students who volunteered to participate gave written consent. Written parental consent was required in Germany, while in all other countries a letter was distributed to students' parents that explained the

nature of the study and provided a method to retract permission. The European Commission and the Ethical Board of the Radboud University, Nijmegen, the Netherlands (number ECG 24092009) granted ethical approval to conduct the study.

### Measures

#### *Alcohol use*

Frequency of recent alcohol use was established by asking respondents at T1, T2 and T3: 'On how many occasions (if any) have you had any alcoholic beverage to drink during the last 30 days?' (no times; one to two times; three to five times; six to nine times; 10–19 times; 20 times or more). Frequency of binge drinking in the past month was measured by answering the question: 'Think back again over the LAST 30 DAYS. How many times (if any) have you had five or more drinks on one occasion?' (no times; one time; two times; three to five times; six to nine times; 10 times or more). Both questions mirrored questions used in the European School Survey Project on Alcohol and Other Drugs (ESPAD) survey [30] and were treated as categorical variables ranging from 0 to 5.

#### *Alcohol marketing exposure*

We considered alcohol marketing exposure as a latent variable [35], indicated by 13 alcohol marketing items measuring exposure to online alcohol marketing, televised alcohol advertising, alcohol sport sponsorship, music event/festival sponsorship, ownership of alcohol-branded promotional items and reception of free samples and exposure to price offers (see Table 1). Measures were adapted from those used in previous studies [17,18,36–38]. The alcohol marketing exposure scales for all three waves were internally consistent with Cronbach's  $\alpha$  values of 0.89 in T1, 0.91 in T2 and 0.88 in T3 and were tested to be time-invariant (see Supporting information, Table S2).

#### *Confounders*

Demographic data were recorded for age, gender [30], education and country of residence. Internet use was measured by asking respondents: 'On a usual school day (Monday to Friday) how much hours do you spend using the internet?'. Answer categories were (1) none; (2) less than 1 hour; (3) 1–2 hours; (4) 3–4 hours; and (5) 5 hours or more. Frequency of exposure to non-alcohol sponsored football championships was included, and was similar to the measure of exposure to alcohol-sponsored football championships. Exposure to television programmes without alcohol commercials was measured using an index comparable to that used to measure alcohol-branded television programs (see Table 1).

Table 1 Prevalence alcohol marketing exposure at T1, T2 and T3 by alcohol marketing exposure measure [in % or means with standard deviation (SD)]; n = 9075.

Item	T1	T2	T3
A Received promotional mail, e-mails or joke, chain, or wind-up e-mails mentioning alcohol brands <sup>a</sup>	Self-report 33.0%	37.8%	37.6%
B Looked at a web site for alcohol brands or about drinking (don't include health-related sites) <sup>a</sup>	Self-report 23.3%	25.5%	27.8%
C Downloaded a mobile phone or computer screensaver containing an alcohol brand name or logo <sup>a</sup>	Self-report 18.2%	21.3%	22.2%
D Used a profile page on sites such as hyves, facebook, msn or myspace containing alcohol brand or logo <sup>a</sup>	Self-report 32.0%	32.5%	35.2%
E Noticed an internet page that contained an alcohol advertisement <sup>a</sup>	Self-report 66.1%	63.9%	68.8%
F Televised alcohol marketing exposure index <sup>b</sup>	Objective measure 0.28 (0.22)	0.30 (0.22)	0.28 (0.22)
G In the past week, how many TV adverts have you seen for alcoholic drinks, like beer, wine, alcopops (e.g. Barcardi Breezers) or spirits? <sup>c</sup>	Self-report 3.52 (2.01)	3.63 (1.97)	3.45 (1.99)
H Having seen alcohol sponsored football championships <sup>d</sup>	Objective measure 2.86 (1.38)	2.60 (1.45)	2.44 (1.99)
I Have you noticed any sponsorship of music events by (brands of) alcohol companies? <sup>e</sup>	Self-report 20.5%	22.9%	26.2%
J Received free gifts, showing alcohol brand logos, given out at events such as concerts, festivals or sports events <sup>e</sup>	Self-report 40.9%	43.8%	48.1%
K Ownership promotional items <sup>e</sup>	Self-report 26.3%	30.3%	30.5%
L Received free samples of alcohol products <sup>a</sup>	Self-report 22%	24.8%	29.4%
M Received special price offers for alcohol <sup>a</sup>	Self-report 30.5%	32.5%	39%

<sup>a</sup>Adapted from Gordon *et al.* [17,18,36]; answers: -2 never, -1 rarely, 0 sometimes, 1 often, 2 very often. <sup>b</sup>Respondents were asked about the frequency with which they had seen a selection of eight television programmes in approximately 1–2 months before the survey (1 never, 2 rarely, 3 sometimes, 4 often, 5 very often). A total score of televised alcohol advertising exposure was composed by multiplying the number of advertisements broadcast in each programme by the frequency of watching the programme and by standardizing into an index score between 0 and 1. <sup>c</sup>Adapted from Hanewinkel *et al.* [37]; answers: 0, 1, 2, 3, 4, 5, 6 or more advertisements. <sup>d</sup>Respondents were asked 'How often have you watched the following four football championships?' (names of the championships are country-specific, see Supporting information, Table S1; answers: 0 never, 1 rarely, 2 sometimes, 3 often, 4 very often. A total score was composed by adding total frequency of watching of all alcohol-sponsored football championships. <sup>e</sup>Answers: 0 indicating no exposure noticed and 1 indicating exposure noticed.



## Data analysis

As has been described above, prevalence of alcohol use, frequency of past-month drinking and prevalence of binge drinking were measured by categorical variables. Consequently, non-parametric tests were used in all analyses.

SPSS version 20.0 was used for the initial analyses. The  $\chi^2$ - and *t*-tests were performed to check whether subjects included in the analysis differed systematically from those not reached during latter assessment(s). Zero-order correlations between all study variables (including latent variables) were analysed using Spearman's rank correlation coefficients and multiple mean comparisons with Tukey's test were conducted to test for differences in prevalence of alcohol use between countries.

Multi-level analyses were performed to check for heterogeneity at the country level. Results did not indicate significance of the random effect at the country level. Therefore, analyses presented in this paper focus on the overall model.

SEM was employed to determine the temporal association between frequency of past-month drinking and the latent construct of alcohol marketing exposure [27] using Mplus version 6.11 software [39]. Autoregressive paths in the cross-lagged correlation analysis were included for alcohol marketing exposure and frequency of past-month alcohol use [40]. Covariances were included within each wave between both variables of interest (assuming a reciprocal effect between alcohol marketing exposure and alcohol use within a wave). A similar model was conducted to test the cross-lagged correlation between alcohol marketing exposure and frequency of past-month binge drinking.

The modelling techniques used here are used widely to assess causal models in data derived from non-experimental, longitudinal research designs [41]. We used the weighted least squares with mean and variance adjustment (WLSMV) estimator in Mplus. Data were nested because of the school-based sample design and cross-country setting [28]. We were unable to estimate a three-level model because of the limited number of countries [42]. Alternatively, in all models, school was identified as a cluster variable which resulted in sandwich-adjusted variance [44] and country differences were considered by including country as a confounder. To account for attrition, we conducted analyses using full information estimation, which avoids sample biases that may occur when those participants who missed the follow-up survey(s) are excluded [44]. We tested for linearity of the direct and indirect alcohol marketing relationships and found them to be linear; thus, we fitted linear models [45]. The final models included all covariates as exogenous variables. All estimates presented were standardized to be interpreted in terms of standard deviations.

## RESULTS

### Attrition analysis

A logistic regression analysis on the likelihood of attrition by several characteristics indicated that students who participated only in the first wave (T1) differed from those who also participated in later waves (see Supporting information, Table S4). Those who participated only in T1 were more likely to be older, to be male, to live in an urbanized area and to have smoked. Considering these differences, students who dropped out after the first wave were less likely to have used alcohol in the last 30 days, and these students did not differ in prevalence of binge drinking in the last 30 days to those who also participated in later waves.

### Characteristics of the study sample

#### *Descriptive statistics*

Descriptive statistics for frequency of past-month drinking, frequency of past-month binge drinking and all covariates are presented in Supporting information, Table S1. Overall, at the time of the first wave 33% had consumed alcohol at least once in the last 30 days and 25% had reported to drink more than five alcoholic drinks on at least one occasion during this period; however, this finding varied substantially between countries (see Fig. 1). For example, 50% of respondents in Italy drank in the past month, compared to 21% of respondents in the Polish sample ( $\chi^2_{(3)} = 573.06$ ;  $P < 0.001$ ). Differences in binge drinking rates were somewhat smaller at T1 and T2, but intensified at T3. Differences in binge drinking rates between Italian, German and Dutch youngsters remained after controlling for age ( $P < 0.001$ ). No significant difference was found in monthly drinking rate between Dutch and Polish youngsters and monthly binge drinking rates between Italian and Polish youngsters ( $P = 0.516$ ) after controlling for age ( $P = 0.094$ ).

#### *Associations between study variables*

Zero-order correlations between the study variables demonstrated significant crude associations between drinking measures at T1, T2 and T3 ( $0.440 \leq r_S \leq 0.574$ ,  $P < 0.01$ ), binge drinking measures at T1, T2 and T3 ( $0.402 \leq r_S \leq 0.524$ ,  $P < 0.01$ ) and alcohol marketing exposure constructs at T1, T2 and T3 ( $0.720 \leq r_S \leq 0.816$ ,  $P < 0.01$ ). Positive correlations were found between drinking measures and binge drinking measures ( $0.387 \leq r_S \leq 0.722$ ,  $P < 0.01$ ), drinking measures and alcohol marketing exposure measures ( $0.360 \leq r_S \leq 0.516$ ,  $P < 0.01$ ) and binge drinking measures and alcohol marketing exposure measures ( $0.326 \leq r_S \leq 0.483$ ,  $P < 0.01$ ) measured at all three waves (see Supporting information, Table S2).

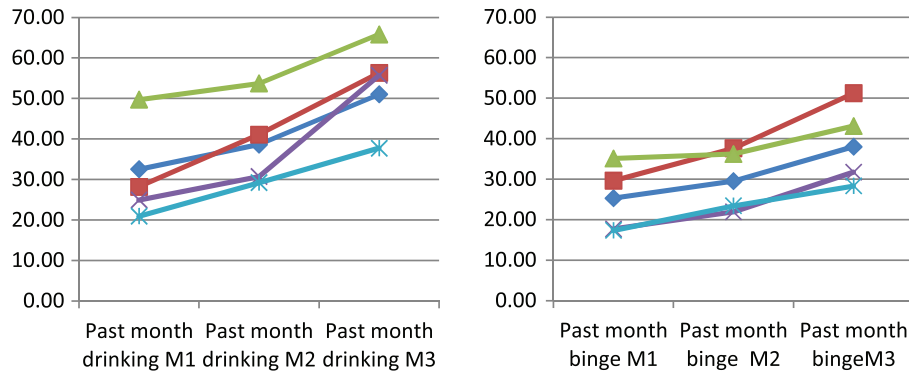


Figure 1 Dark blue indicates all four countries, red: Germany, green: Italy, purple: Netherlands, light blue: Poland

SEM

Cross-lagged model

Having developed a measurement model for alcohol marketing exposure observed to be time-invariant (see Supporting information, Table S3), we then included frequency of past-month alcohol use at T1, T2 and T3 with the covariates (described above), in a cross-lagged model. The model provided a satisfying fit to the data [ $\chi^2_{(985)} = 28834, P < 0.001$ ; root mean square error of approximation (RMSEA) = 0.014; confirmatory factor analysis (CFI) = 0.915].

The results are indicated in Fig. 2 with standardized coefficients. Covariances between alcohol marketing exposure items were included in the model and were significant ( $P < 0.001$ ). These were omitted from the figure for graphical simplicity (see Supporting information, Table S5).

Demographics were included as exogenous variables in the model (see Supporting information, Table S5); their

effects are omitted from the figure for graphical simplicity. Including non-alcohol-branded sponsorship of football championships, exposure to non-alcohol-branded television programmes and internet use did not increase the fit of the model and were excluded from the final model.

Longitudinal stability coefficients were observed for adolescents' alcohol marketing exposure. Higher exposure at T1 predicted increased exposure at T2 and T3. Higher exposure at T2 predicted increased exposure at T3. Similar stability coefficients were observed for frequency of past-month drinking and frequency of past-month binge drinking.

Examination of the parameter estimates showed that the effect of alcohol marketing exposure at T1 to frequency of past-month drinking at T2 was statistically significant [estimate = 0.420; standard error (SE) = 0.058; 95% confidence interval (CI) = 0.324–0.515;  $P < 0.001$ , standardized estimate = 0.140]. Similarly, the effect of alcohol marketing exposure at T2 to frequency of past-month drinking at T3

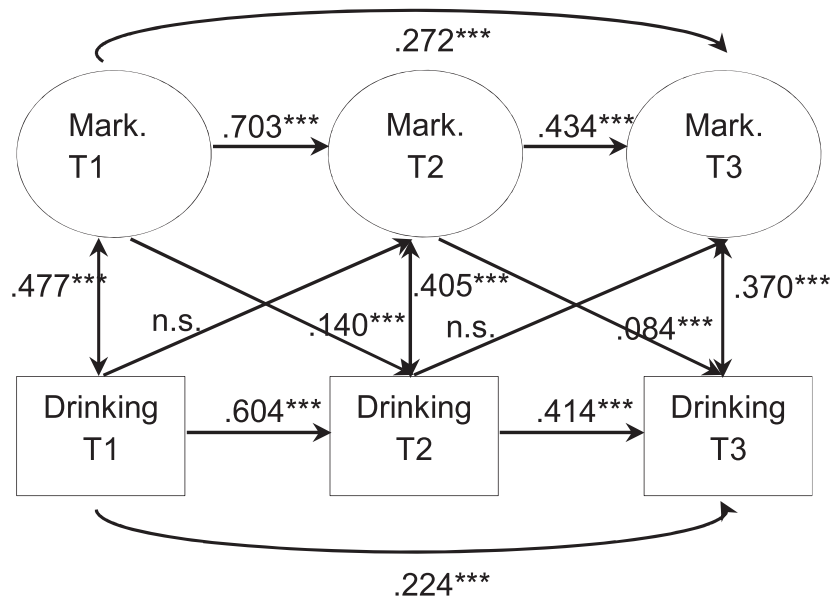


Figure 2 Presented are standardized coefficients; \*\*\* $P < 0.001$ ; not significant (n.s.) =  $P > 0.05$ ; confounders, covariances within each wave, factor loadings of the latent variables and measurement errors are not shown (see for factor loadings S2);  $n = 9031$ ; confirmatory factor analysis (CFI) = 0.925; root mean square error of approximation (RMSEA) = 0.014

was statistically significant (estimate = .200; SE = 0.044; 95% CI = 0.127–0.272;  $P < 0.001$ , standardized estimate = 0.084). The effect from frequency of past-month drinking at T1 and T2 to alcohol marketing exposure at T2 and T3, respectively, was not statistically significant ( $P > 0.05$ ).

A similar model, shown in Fig. 3 (full model in Supporting information, Table S6), predicted frequency of past-month binge drinking provided a satisfying fit to the data ( $\chi^2_{(985)} = 2819$ ,  $P < 0.001$ ; RMSEA = 0.014; CFI = 0.924). Examination of the parameter estimates showed that the effect of alcohol marketing exposure at T1 to frequency of past-month binge drinking at T2 was statistically significant (estimate = 0.409; SE = 0.054; 95% CI = 0.320–0.499;  $P < 0.001$ , standardized estimate = 0.142). Similarly, the effect of alcohol marketing exposure at T2 to frequency of past-month binge drinking at T3 (estimate = 0.168; SE = 0.050; 95% CI = 0.086–0.250;  $P = 0.001$ , standardized estimate = 0.073) was statistically significant. The effect of frequency of past-month binge drinking at T1 to alcohol marketing exposure at T2 was statistically significant (estimate = 0.032; SE = 0.009;  $P < 0.001$ , standardized estimate = 0.070); however, the effect of alcohol marketing exposure at T2 on frequency of past-month binge drinking at T3 was not significant ( $P > 0.05$ ).

## DISCUSSION

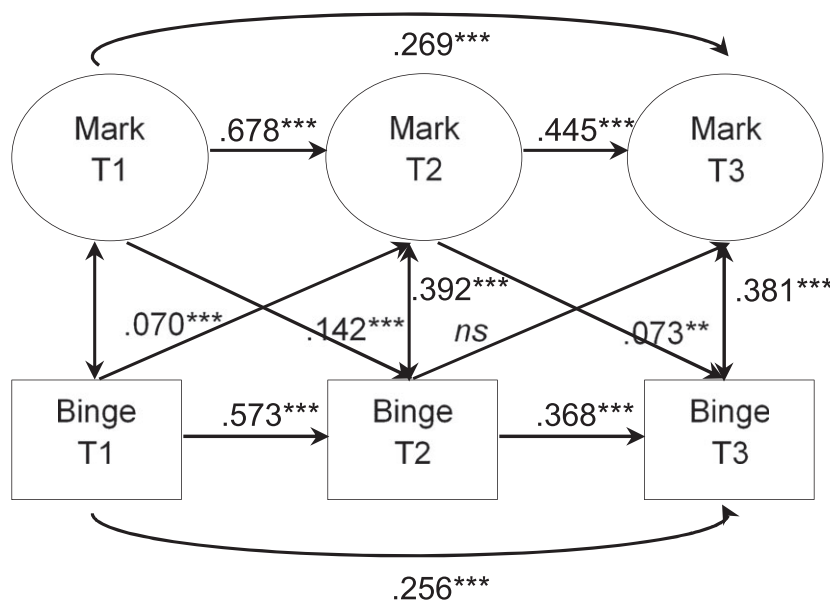
The present study analysed the combined effect of exposure to various types of alcohol marketing. In this way we

assessed the relationship between alcohol marketing exposure and alcohol use among adolescents. Building upon Tucker *et al.* [27], we studied the possibility of a spiral process between alcohol marketing exposure and alcohol use by estimating a cross-lagged model. Our findings suggest that when considering the reciprocal process between alcohol marketing exposure and alcohol use at each time-point, there remains a one-way effect of alcohol marketing exposure on adolescents' alcohol use over time [46]. This effect was found in a cross-country sample among adolescents in varying cultural, regulatory and drinking contexts [1].

When taking into account the impact of alcohol-branded media exposure, we found non-alcohol-branded media exposure not to be associated with adolescents' drinking. Our findings suggest that alcohol advertising exposure affects drinking, not general advertising or media exposure. Previous studies have typically measured alcohol marketing exposure by media use (e.g. when watching sports) [47]. However, our finding confirms the critique claiming that measures such as mass media exposure and computer skills are fragile and lack internal validity [48].

## Limitations

We examined the causal order of alcohol marketing exposure and drinking using an autoregressive cross-lagged model, which is seen as an appropriate method [49]. However, such designs do not rule out other potential third-variable confounders. Although we controlled



**Figure 3** Presented are standardized coefficients; \*\*\* $P < 0.001$ ; \*\* $P < 0.01$ ; not significant (ns) =  $P > 0.05$ ; confounders, covariances within each wave, factor loadings of the latent variables and measurement errors are not shown (see for factor loadings S2);  $n = 9031$ ; confirmatory factor analysis (CFI) = 0.924; root mean square error of approximation (RMSEA) = 0.014

statistically for potential third variables, it is theoretically impossible to ensure that all potential confounds have been measured. Additionally, the autoregressive model does not account for absolute changes in individual scores. To account for such individual differences of change, scholars have suggested the use of latent growth curve models [49]. This could be a suggestion for further research.

Even though the current study aimed to measure exposure from a range of alcohol marketing channels, it is possible that the total effect of exposure to alcohol marketing was still underestimated. Our study focused on marketing channels that are believed to be most relevant to European adolescents. However, our study did not differentiate between the effects of specific alcohol marketing channels. Consequently, we cannot present any conclusions on the significance of specific types of alcohol marketing in predicting drinking. We also did not examine differences in validity of self-reported versus objective measures of alcohol marketing exposure. It would be beneficial for further research to focus on these matters to test the internal validity of self-reported measures.

To our knowledge, this longitudinal study on alcohol advertising and promotion is the first study that has a cross-national design. Countries included represent a variety of European drinking cultures and alcohol (marketing) policies. There is little theory available on whether we are able to make wider inferences. However, available research from, among others, the United States, New Zealand, Australia and the United Kingdom [36,50,51] suggest that alcohol marketing exposure is associated positively with youth drinking in a large variety of countries independent from national contexts.

## Conclusion

We found evidence of a one-directional long-term effect of alcohol marketing exposure on adolescents' drinking in a sample with a cross-national design. This effect could be neither explained by previous experiences of drinking nor by exposure to non-alcohol-branded media exposure.

Our results raise the demand for legal restrictions of the volume of alcohol marketing in the European Union, the AVMSD [6] is the only EU regulation on alcohol advertising. This directive regulates the content of alcohol marketing (in audiovisual media) and does not restrict the volume of alcohol marketing on TV or elsewhere. Our results suggest that the volume of exposure to alcohol marketing matters; it emphasizes the need to restrict the volume of alcohol marketing to which young people are exposed in everyday life.

## Declaration of interests

None

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### Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

**Table S1** Sample descriptives (percentages or means with standard deviations).

**Table S2** Zero-order correlations.

**Table S3** Model results measurement models alcohol marketing exposure at T1, T2 and T3.

**Table S4** Logistic regression on the likelihood of dropping out after the first wave.

**Table S5** Full autoregressive cross-lagged model for alcohol marketing exposure (mark) and frequency past-month drinking (drinking).

**Table S6** Full autoregressive cross-lagged model for alcohol marketing exposure (mark) and frequency past-month binge drinking (binge).