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## Age and Fear of Missing Out as Moderators of the Association between Peak Drinks and Alcohol-Induced Blackouts among Adolescents and Young Adults

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### Abstract

Alcohol-induced blackouts are periods of impaired memory in which an individual is unable to recount events that occurred while they were intoxicated and are associated with heavier drinking episodes. The present study examined age and Fear of Missing Out (FoMO) as moderators of the association between peak number of drinks and experiencing alcohol-induced blackouts. Participants ages 15–25 (N = 411; Mean age = 21.4 (SD = 2.5); 61.6% female) completed baseline and daily surveys as part of a larger ecological momentary assessment study. Past month blackout experiences and peak number of drinks were reported at baseline and FoMO was reported in daily surveys one to three weeks following the baseline survey. A zero-inflated negative binomial model was fit to examine the interaction between peak number of drinks with age and FoMO on alcohol-induced blacking out, controlling for relevant covariates. Findings indicated the association between peak number of drinks on the likelihood of alcohol-induced blacking out was significantly moderated by age. The association was stronger for younger compared to older individuals. Findings further indicated the associations between peak number of drinks on both the likelihood and average number of alcohol-induced blacking out was significantly moderated by FoMO. For individuals with higher levels of FoMO, the association between peak drinks and alcohol-induced blacking out was weaker for the likelihood of experiencing any blackouts and stronger for the number of blackouts. Findings provide support to previous literature examining age and FoMO as risk factors for alcohol-induced blackouts among adolescents and young adults.

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#### Contributors

Melissa Lewis is the PI of the grant from which the study data was drawn and lead manuscript preparation, wrote the introduction and methods, and coordination of authors. Zhengyang Zhou was a Co-Investigator on the grant from which the study data was drawn, conducted data analyses, and wrote the results. Dana Litt was a Co-Investigator on the grant from which the study data was drawn and wrote the discussion. Emma Kannard was a staff member on the grant from which the study data was drawn and edited all sections of the manuscript. Ashley Lowery helped the first author with developing the manuscript and edited all sections of the manuscript. All authors conducted multiple rounds of edits and revisions prior to submission.

#### Author Disclosures

Conflict of Interest  
No conflict declared.

## Keywords

Alcohol use; consequences; blackouts; fear of missing out; adolescents; young adults

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## Introduction

Adolescent and young adult alcohol use remains an important public health concern in the U.S. Half (51.9%) of adolescents (grades 8, 10, and 12) report past year alcohol use, 30.8% report being drunk in the past year, and 10.1% report having 5 or more drinks in a row in the past two weeks (Johnston et al., 2021; Miech et al., 2021). Over two thirds (67.2%) of young adults (18–29) report past month alcohol use and 32.4% of young adults report having 5 or more drinks in a row in the past two weeks (Schulenberg et al., 2020). In addition to concern over high frequency and quantity of alcohol use, drinking is associated with a range of negative consequences including missing classes, arguments, injuries, sexual victimization, blackouts, and death (White & Hingson, 2013). Earlier initiation of alcohol use by adolescents and young adults is a public health concern as this may lead to heavier alcohol and substance use and dependence later in life (Bolland et al., 2016; Ohannessian et al., 2015). Thus, identifying risk factors for hazardous alcohol use, including experiencing negative consequences, is critical.

A particularly concerning negative consequence of alcohol use is alcohol-induced memory loss or blackouts, which are defined as a period of impaired memory in which an individual is unable to recount events that occurred while they were intoxicated (Wetherill & Fromme, 2016). Event-level research among college students indicates that drinking events that lead to alcohol-induced blackouts are also associated with other negative consequences when compared to drinking events that do not lead to blackouts (Merrill et al., 2019). In addition to greater acute risk, research shows that alcohol-induced blackouts among Swiss men at age 20 predict the development, maintenance, and severity of alcohol dependence at age 25 (Studer et al., 2019). Similarly, adolescent females in Australia that experienced alcohol-related blackouts were at higher risk for later alcohol use disorder in young adulthood (Yuen et al., 2021). Thus, alcohol-induced blackouts are a particularly concerning negative consequence of adolescent and young adult alcohol use that warrant further research.

Research examining who is at greater risk for alcohol-induced blackouts could help to develop targeted prevention efforts. Using an event-level design, Merrill and colleagues (2019) found that blackout likelihood increased as a function of total number of drinks consumed by college students. In addition to alcohol quantity, it is also important to consider age as a potential moderator of the association between alcohol use and alcohol-induced blackouts. Those with lower tolerance or less experience drinking are at greater risk for negative consequences compared to heavier drinkers or those with more frequent drinking behavior (Lee et al., 2009; Lewis et al., 2009). If adolescents and young adults are experiencing alcohol-induced blackouts, emphasis should be put towards prevention efforts aiming to reduce these specific consequences given experiencing blackouts at a younger age is associated with alcohol dependence later in life (Studer et al., 2019; Yuen et al., 2021).

In addition to drinking behavior and age, research should consider individual differences as potential moderators of associations between alcohol consumption and experiencing alcohol-induced blacking out. In particular, research indicates that Fear of Missing Out (FoMO; i.e., fear of peers having worthwhile experiences in one's absence) is associated with alcohol use, heavier drinking episodes, and alcohol-related consequences (Przybylski et al., 2013; Riordan et al., 2015; Riordan et al., 2019). It may be that adolescents and young adults higher in FoMO are more likely to attend social gatherings with alcohol use or more likely to stay longer and ultimately drink more once at social gatherings. In particular to alcohol-induced blackouts, individuals higher in FoMO may drink more per drinking occasion, putting them at greater risk for experiencing blackouts. Examining FoMO as a moderator between alcohol consumption and blacking out will provide insight into whether FoMO cognitions should be targeted in future adolescent and young adult alcohol interventions.

### **The current study**

This study aims to examine whether age and FoMO moderate the association between peak alcohol consumption and experiencing alcohol-induced blackouts among adolescents and young adults ages 15–25. We expect that age and an individual's level of FoMO will moderate the relationship between peak number of drinks and hours of drinking with alcohol-induced blacking out such that this association will be stronger for younger individuals and individuals with higher levels of FoMO.

## **Methods**

### **Participants**

Participants included 15–25 year olds ( $N=411$ ) who were part of a longitudinal ecological momentary assessment (EMA) study reporting drinking cognitions and alcohol use across 12 months. Participants completed an online screening assessment, phone verification call, online baseline assessment, EMA training session via Zoom, and an online 12-month follow-up assessment. Starting the first Thursday following the EMA training session, participants were assessed using a 3-week EMA burst design that was repeated quarterly over the 12-month study. Participant data for the current study included data collected at baseline and during the first burst of EMA data collection. Participants who reported alcohol use in the past month were included in the current study.

Participants (61.6% female) were on average 21.4 years old ( $SD = 2.5$ ) with ages ranging from 15 to 25. Ethnic and racial representation of the sample was 27.5% Hispanic/Latino, 67.9% White, 14.6% Asian, 4.4% more than one race, 7.8% Black, and 5.3% Other/Mixed.

### **Procedure**

The University's Institutional Review Board approved all procedures and no adverse events occurred. Recruitment for this study was conducted in Texas via online recruitment, print advertisements, participant referrals, and flyers. Interested individuals completed the online screening survey to determine study eligibility. Eligibility criteria were 1) age 15 to 25; 2) drink alcohol at least once a month (over the last 6 months) if age 18 or older, or no drinking

criteria for those age 15–17; 3) reside in Texas; 4) provide valid contact and demographic information (i.e., first and last name, phone number, email address, birthdate consistent with their age, birth sex); 5) agree to receive text reminders on their smartphone; 6) if female, must not be pregnant or trying to get pregnant; 7) correctly answering validity check items to rule out computerized responses; 8) have internet access throughout the day; and 9) be willing to complete the training session; and 9) have a schedule that will allow for daily surveys over 12 months.

Individuals 15–17 years old who completed the screening survey were required to provide valid contact information for at least one parent (i.e., first and last name, phone number, email, mailing address). Those who met initial eligibility criteria had at least one parent/guardian contacted to obtain informed consent. Electronic consent for the teen's (15–17) participation in the study was obtained online from one parent/guardian and confirmed by phone. Individuals who were 17 and turned 18 over the course of the study were consented as adults.

Participants received three weeks of surveys in each of the four EMA bursts: up to 8 online surveys per week for 3 consecutive weeks, for a possible total of 24 online surveys. Participants always received 2 surveys (AM and PM) on both Friday and Saturday, and 1 survey on Thursday (PM) and Sunday (AM). For two of the three weeks, participants received 1 PM survey on a random weekday between Monday and Thursday, which was always followed by 1 AM survey the next day. Online surveys were programmed to be completed either on a smartphone or computer. On days where participants did not report alcohol use, filler surveys were presented to participants to make survey time across participants equitable. Participants earned up to \$408 for study participation. The present study used participant data from the baseline survey and filler surveys from the first EMA burst. The survey completion rate for the first EMA burst was 87.1%.

## Measures

**Demographic information**—Participants reported demographics, including age and biological sex (coded *0 = female* and *1 = male*). Demographic information was included from the baseline assessment.

**Peak number of drinks**—To assess peak number of drinks, participants were asked: “Think of the occasion you drank the most this past month. How MUCH did you drink?” (Dimeff et al., 1999). Responses ranged from 0 to 25 drinks.

**Alcohol-induced blackouts**—Participants were asked the Alcohol-Induced Blackout Measure (Miller et al., 2019), which consists of five items, at baseline to indicate how often they “Had fuzzy memories of events that occurred while you were drinking?” within the past month. Response options were coded as *0 = Never*, *1 = 1 time*, *2 = 2–3 times*, and *4 = twice a week or more*. Final responses were summed to represent total blackout frequency (Cronbach's  $\alpha = .85$ ).

**Fear of missing out**—On days during EMA bursts when participants did not report using alcohol, various filler surveys were asked once across days but not at the daily level.

The Fear of Missing Out (FoMO; Przybylski et al., 2013; Cronbach's  $\alpha = .87$ ) scale from burst 1 (starting after the baseline assessment) was included in this study and assessed as a trait. This 10-item scale was used to measure the fear or angst of others having enjoyable experiences in one's absence. Participants were asked to answer according to their general experiences. A sample item is "When I miss out on a planned get-together it bothers me". Responses included ( $0 = \text{Not at all true of me to } 4 = \text{Extremely true of me}$ ). Final scores were an average of the ten items.

**Analytic plan**—Descriptive statistics and correlations were examined for all variables of interest. The outcome variable (i.e., summed score of alcohol-induced blackout experiences in the past 30 days) was a count variable with a skewed distribution having an excessive number of zeros. To account for non-normal distribution, zero-inflation, and over-dispersion of the outcome, a zero-inflated negative binomial model was estimated using the "pscl" R package (Zeileis et al., 2008). The zero-inflated model fits two portions simultaneously: one portion is a logistic regression evaluating the probability of a participant not experiencing any alcohol-induced blackout (i.e., an "excessive" zero), which can be used to measure the likelihood of any alcohol-induced blackout experiences. Of note, when reporting results, we flipped the parameter coefficients in this logistic regression portion estimated from the "pscl" R package so that the probability of experiencing any blackouts could be directly evaluated, which was more intuitive to interpret. The second portion is a negative binomial regression evaluating the mean parameter of alcohol-induced blackout experiences conditioning on the count model, thus measuring the average number of the outcome among those who may potentially engage in alcohol-induced blackout experiences. The zero-inflated negative binomial model included the following predictors: age, biological sex ( $0 = \text{female}, 1 = \text{male}$ ), peak number of drinks, FoMO scale. The moderating effects of FoMO and age on the association between the peak number of drinks and alcohol-induced blackout experiences were examined by including interaction terms between peak number of drinks and FoMO scale, and between peak number of drinks and age, in the model. All analyses were limited to those with complete observations. The sample of the current study was selected from an ongoing larger study, which was sufficiently powered to test the primary outcomes such as alcohol use at the daily level. Post-hoc power analyses for the current study indicate there is sufficient power to detect the two-way interaction effects if the correlation between interaction term and the outcome is more than 0.14 (Baranger, 2021).

## Results

### Descriptive information

Table 1 provides the descriptive statistics and correlations for the variables of interest. The average number of alcohol-induced blackout experiences was 1.43 ( $SD = 2.36$ ), with a proportion of zeros equal to 58.9%. The average peak number of drinks was 5.09 ( $SD = 3.84$ ). After adjusting for multiple comparisons using Holm's method, the correlations between peak number of drinks and sex ( $r = 0.17$ ), and peak number of drinks and alcohol-induced blackout ( $r = 0.44$ ) were statistically significant.

## Associations between peak number of drinks and alcohol-induced blackouts

Table 2 shows the results of the zero-inflated negative binomial model. The top panel describes the associations of the *probability* of experiencing any alcohol-induced blackouts with each of the predictors in the logistic portion, whereas the bottom panel describes the associations of the average *number* of alcohol-induced blackout experiences with each of the predictors in the negative binomial portion.

### Logistic results

Results of the logistic portion of the zero-inflated negative binomial model indicated that biological sex was not significantly associated with experiencing any alcohol-induced blackout. Peak number of drinks and FoMO were significantly associated with experiencing any alcohol-induced blackout, along with the interactions between peak number of drinks and FoMO, and between peak number of drinks and age, indicating that the associations were moderated by FoMO and age as hypothesized. The left panel of Figure 1 presents the interaction between peak number of drinks and FoMO, where the predicted probability for a typical participant experiencing any alcohol-induced blackouts was depicted against peak number of drinks (ranged 1 to 12, the 95<sup>th</sup> percentile), under a low, medium, and high level of FoMO scale. The 20<sup>th</sup> percentile, median, and 80<sup>th</sup> percentile were chosen to represent the lower, median, and high levels of FoMO scale, which were 0.7, 1.3, and 2.0, respectively. In the interaction plot, as peak number of drinks increased, the predicted probability of experiencing any alcohol-induced blackouts increased accordingly. Moreover, the increases in probability became less dramatic as the level of FoMO increased, indicating weaker associations between peak number of drinks and experiencing any alcohol-induced blackouts among participants who had higher levels of FoMO. Similarly, the right panel of Figure 1 presents the interaction between peak number of drinks and age, where the predicted probability was depicted under the age of 19, 22, and 24, representing 20<sup>th</sup> percentile, median, and 80<sup>th</sup> percentile of age among the participants. For younger participants, the predicted probability of experiencing any alcohol-induced blackouts increased more dramatically, indicating stronger associations between peak number of drinks and experiencing any alcohol-induced blackouts in the corresponding age group.

### Negative binomial results

Results indicated that age and biological sex were not significantly associated with the average number of alcohol-induced blackout experiences conditioning on the negative binomial portion of the model. The interaction between peak number of drinks and FoMO was significantly associated with the outcome, indicating that the association was moderated by FoMO. Figure 2 presents the interaction, where the predicted number of alcohol-induced blackout experiences for a typical participant who might potentially engage in the experience was depicted under different levels of the FoMO scale of 0.7, 1.3 and 2.0. In the interaction plot, as peak number of drinks increased, the predicted number of alcohol-induced blackout experiences increased accordingly. Additionally, the number increased more dramatically as the level of FoMO increased, indicating stronger associations

between peak number of drinks and number of experiencing alcohol-induced blackouts among participants who had higher levels of FoMO.

## Discussion

Results partially supported the hypothesis that age would moderate the association between peak number of drinks and alcohol-induced blackouts. Findings indicated the association between peak number of drinks on the likelihood of alcohol-induced blacking out was significantly moderated by age such that the association was stronger for younger individuals compared to older individuals. Age did not moderate the associations between peak drinking and the number of blackout experiences.

The findings of age moderating associations between peak number of drinks and alcohol-induced blackouts may be indicative that younger age groups are less likely to use harm reduction strategies to reduce the risk of experiencing negative consequences, have lower tolerance to alcohol, and less drinking experience. Given that many strategies to reduce risk (e.g., setting a pre-determined number of drinks, determining a time to leave in advance, telling your friends about your plans to limit drinking) require some planning, younger individuals whose drinking is more likely a response to their social environment rather than a result of planned drinking may be more likely to experience severe consequences, such as blacking out, as a result of their unplanned drinking (Gerrard et al., 2008; Fairlie et al., 2019).

Overall, hypotheses for the interaction between peak number of drinks and FoMO were supported such that the associations between peak drinks and both the likelihood and count of alcohol-induced blacking out episodes were moderated by FoMO. Specifically, the effect of peak alcohol consumption on the likelihood of experiencing an alcohol-induced blackout tended to be weaker for those higher in FoMO whereas the effect of peak alcohol consumption on the average number of alcohol-induced blacking out tended to be stronger with higher level of FoMO. These results partially support previous literature that has linked FoMO to alcohol-related consequences (Riordan et al., 2015; Riordan et al., 2019). Interestingly, the work by Riordan and colleagues (2015) found that FoMO was associated with experiencing more negative alcohol-related consequences but not overall higher alcohol use. This is also supported by our results that there was not a significant bivariate correlation between alcohol consumption and FoMO. However, given the significant interactions found both on the likelihood and number of alcohol-related consequences, the results of the present study may indicate that FoMO may be better conceptualized as an individual difference that moderates associations between alcohol consumption and consequences, such as blacking out, rather than as a direct predictor of alcohol-induced blackouts. The results of this work further contributes to the literature by indicating that FoMO moderates associations between peak number of drinks and a specific negative consequence (i.e., blacking out) which is a particular public health concern among adolescents and young adults.

Although our study did not directly test why FoMO may be a risk factor for alcohol-induced blackouts, it has been posited that those who report higher levels of FoMO may also report lower satisfaction related to two fundamental psychological needs, relatedness and

connectedness to others (Przybylski et al., 2013). Thus, these high FoMO individuals may be more likely to seek out social environments or gatherings (e.g., bars, clubs, parties) where heavier drinking is likely to occur as a means to have these needs met and in turn, being in these higher-risk environments may lead to more frequent alcohol-induced blackouts. Alternatively, FoMO may be more likely among those individuals with a higher drive for rewarding social experiences, and may lead them to consume more drinks and/or stay longer in social environments reinforcing alcohol use in order to maximize opportunities to socialize with others (i.e., not leave a social situation and miss out) which could then help explain the increased risk of experiencing alcohol-induced blackouts among these individuals. Prior research suggests that motivations for blacking out include coping with depression or a stressful event (i.e., bad day) as well as for enhancement and social reasons, such as celebrations (Miller et al., 2020; Riordan et al., 2019). Future research should examine these potential mechanisms that could explain our findings by focusing specifically on psychological need attainment, the important role of context, and motivations for blacking out.

### **Clinical implications**

The current findings suggest that future interventions aiming to reduce alcohol-induced blackouts among adolescents and young adults may want to target both younger individuals and those who report higher levels of FoMO as their peak drinking is more likely to be associated with alcohol-induced blackouts than those who were older and those who were lower in FoMO. These findings are concerning given that experiencing blackouts at a younger age is associated with alcohol dependence later in life (Studer et al., 2019; Yuen et al., 2021). Given that younger individuals may be less planful in their drinking, have less experience drinking, and have lower tolerance (Gerrard et al., 2008; Lee et al., 2009; Lewis et al., 2009), teaching these individuals how to use protective behavioral strategies for drinking events (e.g., set a predetermined number of drinks, plan when to leave, etc.) may be particularly useful to help reduce alcohol-induced blackouts. Potential ways for interventions to focus on reducing or managing FoMO may include teaching individuals to identify and avoid contexts or environments that may trigger FoMO and related drinking, helping people find ways to relate and connect to others that do not involve alcohol, and teaching individuals higher in FoMO how to manage their FoMO-related anxiety. Although we are unaware of any interventions specific to FoMO and drinking, the above suggestions are in line with a study that developed a FoMO reduction technique for social media (Alutaybi et al., 2020).

### **Limitations and future directions**

While this study makes important contributions to the field, it is not without limitations. First, the FoMO measure was taken from an EMA burst assessment that occurred one to three weeks following the baseline assessment. Thus, FoMO was not measured at the same time (baseline) as reports of peak number of drinks and alcohol-induced blackouts. However, FoMO is generally conceptualized as a trait and not a state (Przybylski et al., 2013) and was measured as such in the present study, so this concern is somewhat ameliorated. However, future research could examine if FoMO varies across days and if it could be conceptualized as a state construct. In addition, there is a need to examine alcohol



consumption, FoMO, and blacking out using longitudinal and daily level designs so that the mechanisms behind their associations can be better understood. Finally, given that this data comes from a larger study with select inclusion criteria, the results of this study may not generalize to other adolescent and young adult populations.

## Conclusions

The present study identified two moderating factors, age and FoMO, that may increase the associations between peak number of drinks and alcohol-induced blackouts. Given the public health concerns related to alcohol-induced blackouts and their association with alcohol dependence among adolescents and young adults, future research is needed to determine both the mechanisms behind these associations as well as to test potential targeted intervention strategies to reduce the risk of alcohol-induced blackouts.

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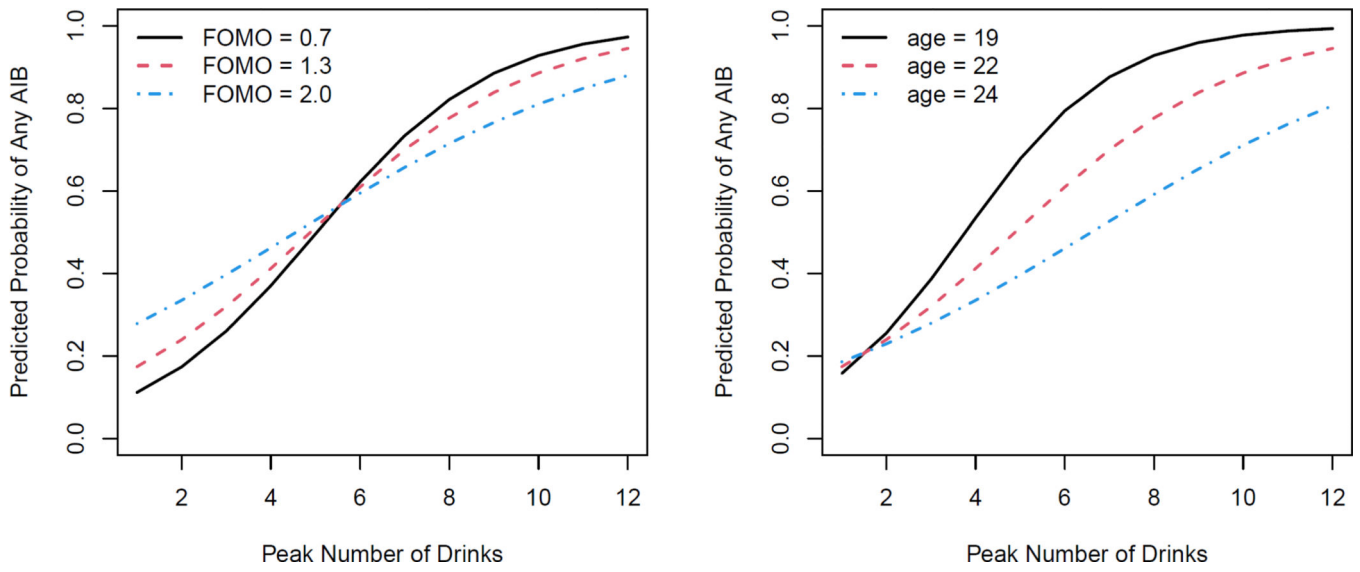
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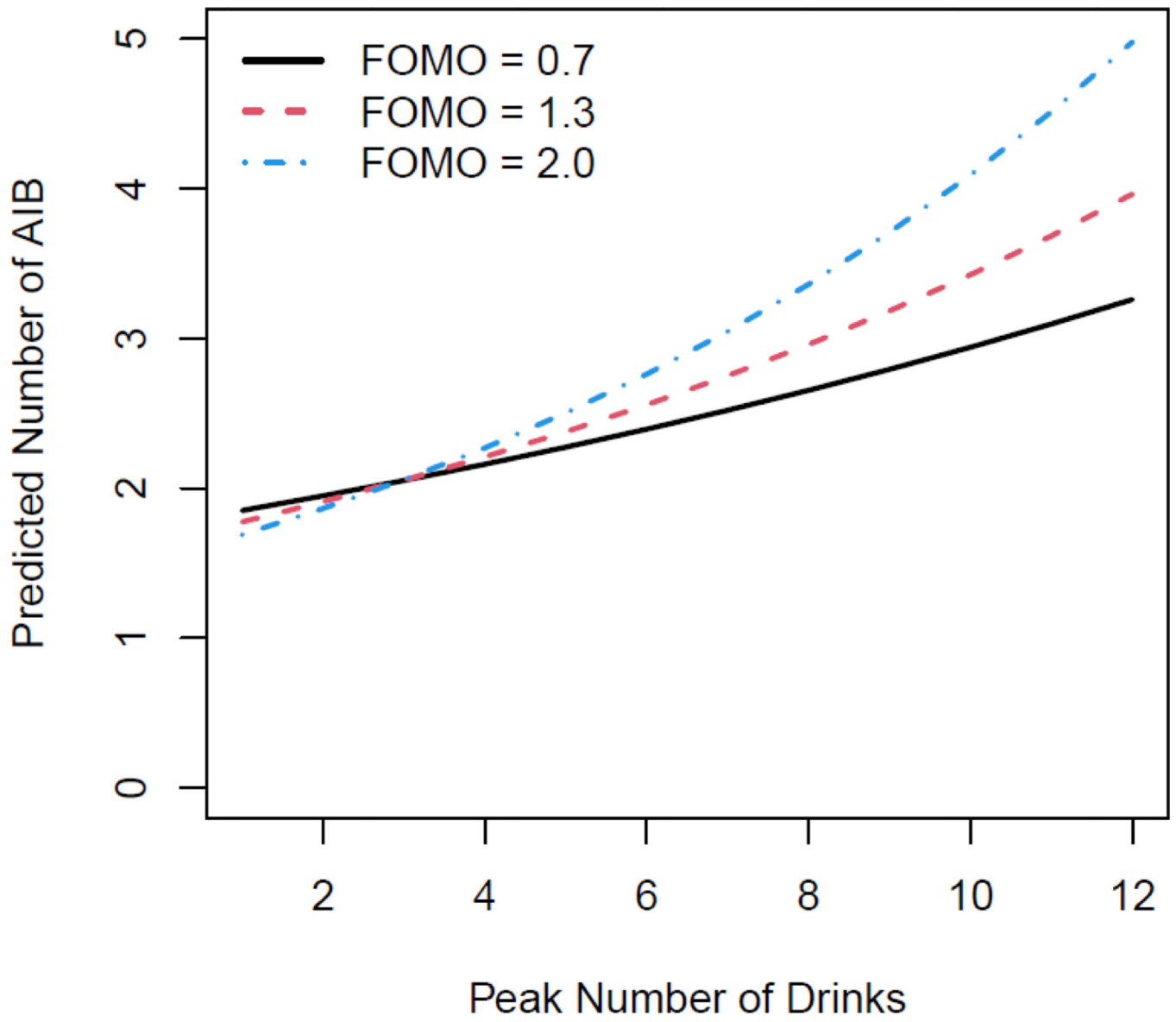
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**Figure 1.** Interactions between Peak Number of Drinks and FoMO (left panel), and between Peak Number of Drinks and Age (right panel), on the predicted probability of experiencing any alcohol-induced blackouts (AIB).



**Figure 2.** Interaction between Peak Number of Drinks and FoMO scale on the predicted number of alcohol-induced blackout (AIB) experiences.

**Table 1**

Descriptive Statistics and Correlations

	<i>M</i> or %	<i>SD</i>	Range	1	2	3	4
1. Age	21.39	2.48	15–25	-			
2. Biological Sex	61.60% female	-	-	.05	-		
3. Peak Number of Drinks	5.09	3.84	1–25	.08	.17**	-	
4. FoMO	1.36	0.79	0–4	-.06	-.12	-.10	-
5. Alcohol-induced Blackouts	1.43	2.36	0–15	-.03	.09	.44***	.06

*Note.* *N* = 411

\* *p* < .05

\*\* *p* < .01

\*\*\* *p* < .001. (adjusted for multiple testing); *M* = Mean; *SD* = Standard deviation.

**Table 2**  
Results of Zero-inflated Negative Binomial model for Alcohol-induced Blackout Experiences

	Log OR/Log IRR (SE)	OR/IRR	OR/IRR CI
<i>Logistic Regression Portion</i>			
Intercept	-5.70 (2.57) *	300.31	(1.94, 46414.43) <sup>a</sup>
Age	0.11 (0.11)	0.90	(0.72, 1.12)
Male Sex	0.04 (0.31)	0.96	(0.53, 1.75)
Peak Number of Drinks	2.15 (0.63) ***	0.12	(0.03, 0.40)
FoMO	1.05 (0.42) *	0.35	(0.15, 0.79)
Peak Number of Drinks × Age	-0.07 (0.03) **	1.07	(1.02, 1.13)
Peak Number of Drinks × FoMO	-0.19 (0.08) *	1.21	(1.03, 1.42)
<i>Negative Binomial Regression Portion</i>			
Intercept	1.62 (1.36)	5.07	(0.35, 72.67) <sup>b</sup>
Age	-0.04 (0.06)	0.96	(0.84, 1.09)
Male Sex	0.10 (0.14)	1.10	(0.84, 1.45)
Peak Number of Drinks	-0.17 (0.17)	0.84	(0.60, 1.18)
FoMO	-0.11 (0.15)	0.90	(0.67, 1.20)
Peak Number of Drinks × Age	0.01 (0.01)	1.01	(0.99, 1.02)
Peak Number of Drinks × FoMO	0.04 (0.02) *	1.04	(1.00, 1.07)

Note.

\*  $p < .05$

\*\*  $p < .01$

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$p < .001$ , *SE* = Standard error; *OR* = odds ratio for logistic regression portion; *IRR* = incidence rate ratio for negative binomial regression portion; *CI* = 95% confidence interval. Biological sex was coded as 0 = Female, 1 = Male.

<sup>a, b</sup> : The large values of the upper bounds for the intercepts were due to the fact that the covariates were not mean standardized in the analysis.