

Online Resource 1

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Temporal Patterns of Alcohol Use in Alcohol Use Disorder: A 12-Month Ecological Momentary Assessment

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eAppendix 1. Full model specifications

Outcomes

We estimated separate multilevel models for:

Overall daily alcohol consumption (overall AC)

$Y_{ij}^{(O)}$ denotes overall daily alcohol consumption (g/day) on day i for participant j . Overall AC was modelled on the log scale; coefficients for this outcome are reported on the log scale.

Drinking frequency

$Y_{ij}^{(F)} \in \{0,1\}$ indicates any drinking (1) versus none (0) on day i for participant j .

Drinking-day amount

$Y_{ij}^{(A)}$ denotes drinking-day amount on day i for participant j . Drinking-day amount (g/day on drinking days) was log-transformed due to right-skewness; coefficients for this outcome are reported on the log scale.

Level-1 predictors (within-person)

Let the following day-level predictors be defined for participant j on day i :

Weekend: indicator for Friday–Saturday versus all other days (coded as described in the main text).

Holiday-related day: indicator for public holidays and the day preceding a public holiday.

Lockdown: indicator for hard-lockdown days (Dec 16, 2020 to Feb 28, 2021) versus all other days.

Dry January: January contrast.

Drinking December: December contrast.

Annual sine: sine-transformed day-of-year function (centered as specified in the main text).

Assessment day: time since study entry modelled as a third-order polynomial.

Level-2 predictors (between-person)

Age, Gender, and Gender $\times$ Age.

Continuous predictors were person-mean centered; categorical variables were coded using sequential-difference coding.

Model 1. Drinking frequency (logistic mixed model)

$$\begin{aligned}
\text{logit}(P(Y_{ij}^{(F)} = 1)) &= \beta_0 + \beta_1 \text{Weekend}_{ij} + \beta_2 \text{HolidayRelated}_{ij} + \beta_3 \text{Lockdown}_{ij} + \beta_4 \text{DryJanuary}_{ij} \\
&+ \beta_5 \text{DrinkingDecember}_{ij} + \beta_6 \text{AnnualSine}_{ij} + \beta_7 \text{AssessmentDay}_{ij} + \beta_8 \text{AssessmentDay}_{ij}^2 \\
&+ \beta_9 \text{AssessmentDay}_{ij}^3 \\
&+ \beta_{10} \text{Gender}_j + \beta_{11} \text{Age}_j + \beta_{12} (\text{Gender} \times \text{Age})_j \\
&+ \beta_{13} (\text{Weekend} \times \text{HolidayRelated})_{ij} + \beta_{14} (\text{Weekend} \times \text{Age})_{ij} + \beta_{15} (\text{Weekend} \times \text{Lockdown})_{ij} \\
&+ \beta_{16} (\text{DryJanuary} \times \text{Lockdown})_{ij} + \beta_{17} (\text{DrinkingDecember} \times \text{Lockdown})_{ij} \\
&+ \beta_{18} (\text{DryJanuary} \times \text{HolidayRelated})_{ij} + \beta_{19} (\text{DrinkingDecember} \times \text{HolidayRelated})_{ij} \\
&+ u_{0j}^{(F)} + u_{1j}^{(F)} \text{Weekend}_{ij} + u_{2j}^{(F)} \text{HolidayRelated}_{ij} + u_{3j}^{(F)} \text{AnnualSine}_{ij} + u_{4j}^{(F)} \text{DryJanuary}_{ij} \\
&+ u_{5j}^{(F)} \text{DrinkingDecember}_{ij}.
\end{aligned}$$

Model 2. Drinking-day amount (linear mixed model; log scale)

$$\begin{aligned}
Y_{ij}^{(A)} &= \beta_0 + \beta_1 \text{Weekend}_{ij} + \beta_2 \text{HolidayRelated}_{ij} + \beta_3 \text{Lockdown}_{ij} + \beta_4 \text{DryJanuary}_{ij} \\
&+ \beta_5 \text{DrinkingDecember}_{ij} + \beta_6 \text{AnnualSine}_{ij} + \beta_7 \text{AssessmentDay}_{ij} + \beta_8 \text{AssessmentDay}_{ij}^2 \\
&+ \beta_9 \text{AssessmentDay}_{ij}^3 \\
&+ \beta_{10} \text{Gender}_j + \beta_{11} \text{Age}_j + \beta_{12} (\text{Gender} \times \text{Age})_j \\
&+ \beta_{13} (\text{Weekend} \times \text{HolidayRelated})_{ij} + \beta_{14} (\text{Weekend} \times \text{Age})_{ij} + \beta_{15} (\text{Weekend} \times \text{Lockdown})_{ij} \\
&+ \beta_{16} (\text{DryJanuary} \times \text{Lockdown})_{ij} + \beta_{17} (\text{DrinkingDecember} \times \text{Lockdown})_{ij} \\
&+ \beta_{18} (\text{DryJanuary} \times \text{HolidayRelated})_{ij} + \beta_{19} (\text{DrinkingDecember} \times \text{HolidayRelated})_{ij} \\
&+ u_{0j}^{(A)} + u_{1j}^{(A)} \text{Weekend}_{ij} + u_{2j}^{(A)} \text{HolidayRelated}_{ij} + u_{3j}^{(A)} \text{AnnualSine}_{ij} + u_{4j}^{(A)} \text{DryJanuary}_{ij} \\
&+ u_{5j}^{(A)} \text{DrinkingDecember}_{ij} + \varepsilon_{ij}.
\end{aligned}$$

Model 3. Overall daily alcohol consumption (linear mixed model; log scale)

$$\begin{aligned}
Y_{ij}^{(O)} &= \beta_0 + \beta_1 \text{Weekend}_{ij} + \beta_2 \text{HolidayRelated}_{ij} + \beta_3 \text{Lockdown}_{ij} + \beta_4 \text{DryJanuary}_{ij} \\
&+ \beta_5 \text{DrinkingDecember}_{ij} + \beta_6 \text{AnnualSine}_{ij} + \beta_7 \text{AssessmentDay}_{ij} \\
&+ \beta_8 \text{AssessmentDay}_{ij}^2 + \beta_9 \text{AssessmentDay}_{ij}^3 + \beta_{10} \text{Gender}_j + \beta_{11} \text{Age}_j \\
&+ \beta_{12} (\text{Gender}_j \times \text{Age}_j) + \beta_{13} (\text{Weekend}_{ij} \times \text{HolidayRelated}_{ij}) \\
&+ \beta_{14} (\text{Weekend}_{ij} \times \text{Age}_j) + \beta_{15} (\text{Weekend}_{ij} \times \text{Lockdown}_{ij}) \\
&+ \beta_{16} (\text{DryJanuary}_{ij} \times \text{Lockdown}_{ij}) + \beta_{17} (\text{DrinkingDecember}_{ij} \times \text{Lockdown}_{ij}) \\
&+ \beta_{18} (\text{DryJanuary}_{ij} \times \text{HolidayRelated}_{ij}) \\
&+ \beta_{19} (\text{DrinkingDecember}_{ij} \times \text{HolidayRelated}_{ij}) + u_{0j}^{(O)} + u_{1j}^{(O)} \text{Weekend}_{ij} \\
&+ u_{2j}^{(O)} \text{HolidayRelated}_{ij} + u_{3j}^{(O)} \text{AnnualSine}_{ij} + u_{4j}^{(O)} \text{DryJanuary}_{ij} \\
&+ u_{5j}^{(O)} \text{DrinkingDecember}_{ij} + \varepsilon_{ij}.
\end{aligned}$$

Overall daily alcohol consumption (overall AC) was modelled using a linear mixed model on the log scale; coefficients are reported on the log scale. Weekend indicates Friday–Saturday; holiday-related days include public holidays and the preceding day.

Random effects

Participant-specific random intercepts and random slopes for Weekend, Holiday-related day, Annual sine, Dry January, and Drinking December were included, with correlations among random effects. Final random-effects variance components and correlations are reported in eTable 2.

Estimation

Models were estimated in R (lme4 package) using maximum likelihood estimation with $\alpha = .05$. Missing EMA entries were handled in the mixed models, assuming data were missing at random conditional on observed covariates and random effects. No single or multiple imputation was applied. Detailed model specifications, including formula syntax, random-effects structures, and correlation assumptions, are fully documented in the rendered analysis scripts in the OSF repository [1].

eTables

eTable 1. Fixed effects for overall daily alcohol consumption (overall AC)

Overall AC				
Predictor	β	SE	z	p value
Intercept	2.5169	0.0450	55.98	< .001
Age (cohort)	0.0270	0.0030	9.06	< .001
Gender (men)	0.1675	0.0382	4.38	< .001
Weekend (Friday–Saturday vs other days)	0.2700	0.0196	13.76	< .001
Holiday-related day (vs other days)	0.2054	0.0216	9.51	< .001
Hard lockdown (vs other days)	0.0210	0.0169	1.24	.21
Annual pattern (sine)	0.1826	0.0185	9.89	< .001
January (Dry January)	-0.3230	0.0659	-4.90	< .001
December	0.7548	0.0435	17.34	< .001
Observation period, linear	-0.0003	0.0001	-2.63	.009
Observation period, quadratic	0.0000	0.0000	9.09	< .001
Observation period, cubic	-0.0000	0.0000	-7.21	< .001
Age $\times$ gender	0.0001	0.0029	0.04	.97
Weekend $\times$ hard lockdown	-0.0307	0.0107	-2.88	.004
Holiday-related day $\times$ weekend	-0.1174	0.0136	-8.63	< .001
Weekend $\times$ age	-0.0081	0.0009	-8.94	< .001
January $\times$ hard lockdown	0.0182	0.0377	0.48	.63
December $\times$ hard lockdown	0.1656	0.0301	5.51	< .001
January $\times$ holiday-related day	-0.1700	0.0539	-3.15	.002
December $\times$ holiday-related day	0.3080	0.0317	9.71	< .001

Note. SE = standard error; β = fixed-effect estimate. Overall daily alcohol consumption (overall AC) was modelled using a linear mixed model on the log scale; coefficients are reported on the log scale. Weekend indicates Friday–Saturday (vs all other days). Holiday-related days include public holidays and the preceding day. Hard lockdown contrasts hard-lockdown days (December 16, 2020, to February 28, 2021) with all other assessment days.

eTable 2. Random effects variance components and correlations of (a) Overall daily alcohol consumption (overall AC), (b) Drinking frequency (any vs none per day) and (c) Drinking-day amount (g/day on drinking days)

(a) Overall daily alcohol consumption (overall AC)

Random effect	Variance	SD	r (Weekend– Holiday)	r (Annual– January)	r (Annual– December)	r (January– December)
Intercept	0.819	0.905				
Weekend (Friday–Saturday vs other days)	0.0656	0.256				
Holiday-related day (vs other days)	0.0348	0.187	0.58			
Annual pattern (sine)	0.145	0.380				
January (Dry January)	0.519	0.721		0.29		
December	0.237	0.486			0.50	0.11
Residual	2.64	1.62				

(b) Drinking frequency (any vs none per day)

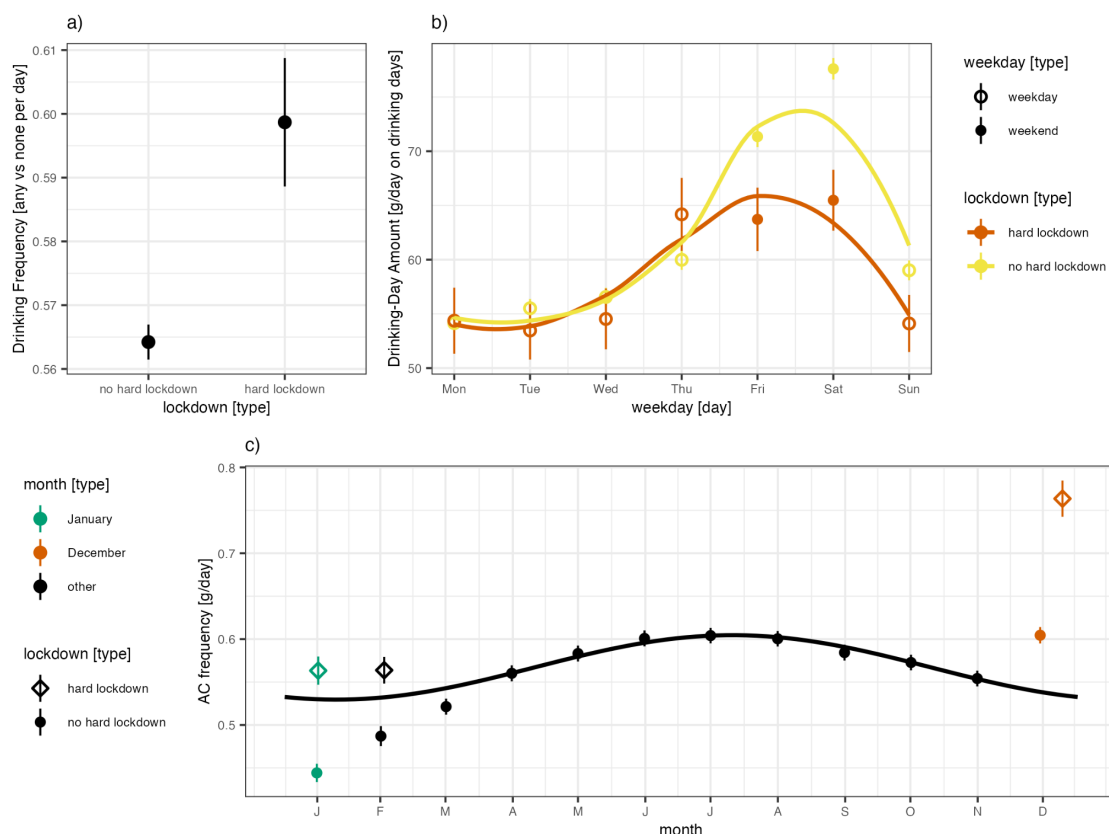
Random effect	Variance	SD	r (Weekend– Holiday)	r (Annual– January)	r (Annual– December)	r (January– December)
Intercept	2.35	1.53				
Weekend (Friday–Saturday vs other days)	0.0801	0.283				
Holiday-related day (vs other days)	0.0553	0.235	0.64			
Annual pattern (sine)	0.343	0.586				
January (Dry January)	1.21	1.10		0.32		
December	0.469	0.685			0.50	0.09

(c) Drinking-day amount (g/day on drinking days)

Random effect	Variance	SD	r (Weekend– Holiday)	r (Annual– January)	r (Annual– December)	r (January– December)
Intercept	0.166	0.407				
Weekend (Friday– Saturday vs other days)	0.0077	0.0876				
Holiday-related day (vs other days)	0.0071	0.0844	0.53			
Annual pattern (sine)	0.0214	0.146				
January (Dry January)	0.0214	0.146		0.18		
December	0.0285	0.169			0.29	0.28
Residual	0.402	0.634				

Note. Correlations are shown only for prespecified pairs (as referenced in the main text); blank cells indicate correlations not reported. Variance components and SDs are reported on the model scale. For the drinking-frequency (logit) model, residual variance is not estimated. Values are rounded for presentation (correlations to 2 decimal places; variance components and SDs to 2–4 decimal places depending on magnitude). Correlations are reported in the row of the second term in each pair (e.g., the Weekend-Holiday correlation is shown in the Holiday-related day row).

eFigures



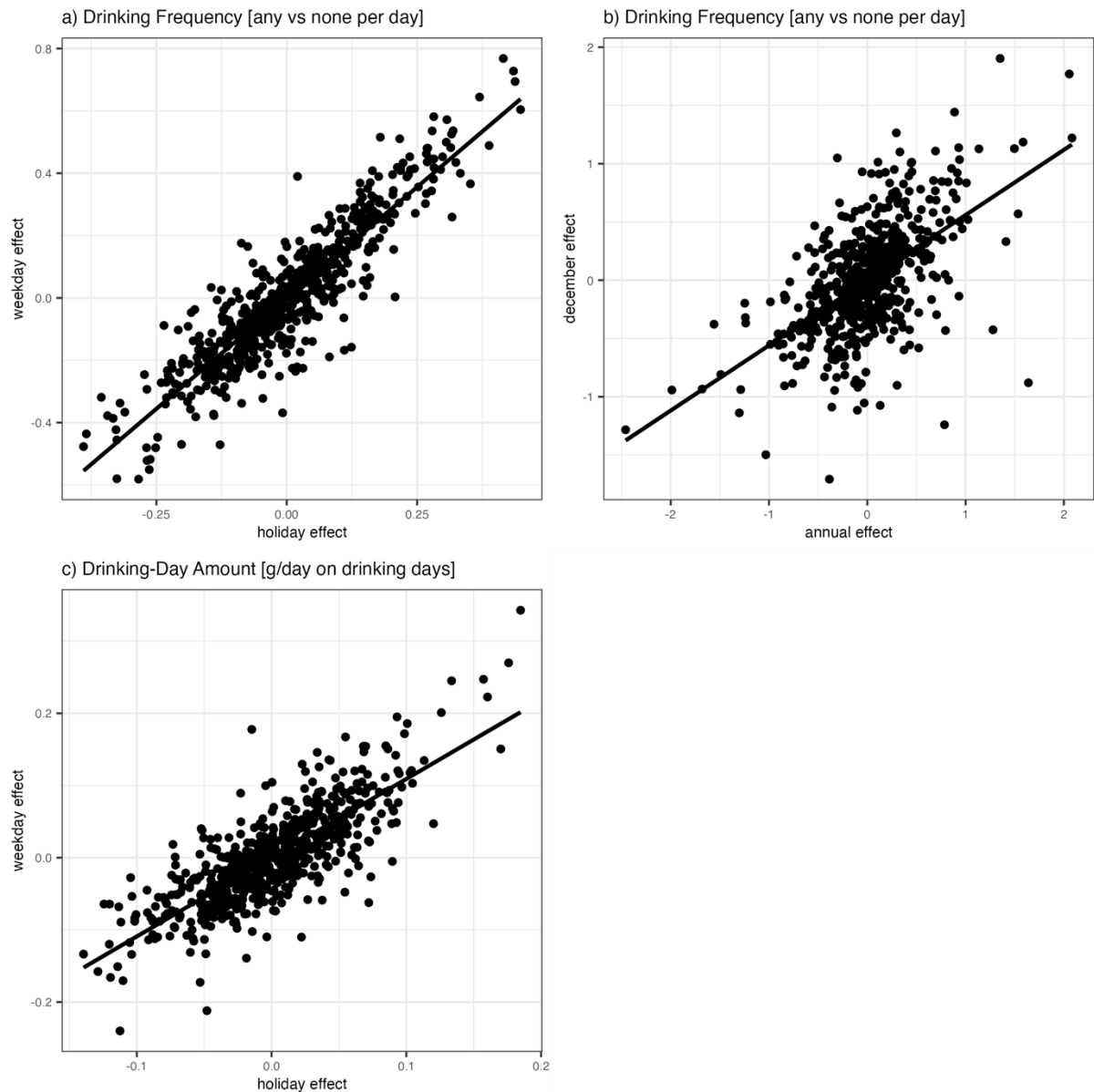
eFigure 1. Model-implied means of drinking outcomes by lockdown status and calendar time

a) Drinking frequency (any vs none per day) by lockdown type (hard lockdown vs no hard lockdown).

b) Day-of-week variation in drinking-day amount (g/day on drinking days) by lockdown type (hard lockdown vs no hard lockdown) and day type (weekday vs weekend).

c) Annual variation in overall daily alcohol consumption (overall AC; g/day) by month, highlighting January (Dry January) and December festive periods, stratified by lockdown type.

Note. Weekend indicates Friday–Saturday (vs all other days). Month categories indicate January, December, and other months. Points indicate model-implied means. AC indicates alcohol consumption.



eFigure 2. Correlations between participant-specific random effects across temporal predictors

a) Association between individual-specific weekday-type (weekend vs weekday) and holiday-related day effects for drinking frequency (any vs none per day).

b) Association between individual-specific annual seasonal (sine) effects and december effects for drinking frequency (any vs none per day).

c) Association between individual-specific weekday-type (weekend vs weekday) and holiday-related day effects for drinking-day amount (g/day on drinking days).

Note. Each point represents a participant. Weekend indicates Friday–Saturday (vs all other days). Holiday-related days indicate public holidays and the day preceding a public holiday.

eReferences

1. Arntz F, Spitta G, Bahr NS, Rapp MA. OSF repository. Temporal patterns of alcohol use in individuals with AUD: A 12-month ecological momentary assessment study. 2026; <https://osf.io/n3zph>