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Alcohol consumption during the COVID-19 pandemic in Europe: a large-scale cross-sectional study in 21 countries

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ABSTRACT

Aims To investigate changes in alcohol consumption during the first months of the COVID-19 pandemic in Europe as well as its associations with income and experiences of distress related to the pandemic. **Design** Cross-sectional on-line survey conducted between 24 April and 22 July 2020. **Setting** Twenty-one European countries. **Participants** A total of 31 964 adults reporting past-year drinking. **Measurements** Changes in alcohol consumption were measured by asking respondents about changes over the previous month in their drinking frequency, the quantity they consumed and incidence of heavy episodic drinking events. Individual indicators were combined into an aggregated consumption-change score and scaled to a possible range of −1 to +1. Using this score as the outcome, multi-level linear regressions tested changes in overall drinking, taking into account sampling weights and baseline alcohol consumption [Alcohol Use Disorder Identification Test (AUDIT-C)] and country of residence serving as random intercept. Similar models were conducted for each single consumption-change indicator. **Findings** The aggregated consumption-change score indicated an average decrease in alcohol consumption of −0.14 [95% confidence interval (CI) = −0.18, −0.10]. Statistically significant decreases in consumption were found in all countries, except Ireland (−0.08, 95% CI = −0.17, 0.01) and the United Kingdom (+0.10, 95% CI = 0.03, 0.17). Decreases in drinking were mainly driven by a reduced frequency of heavy episodic drinking events (−0.17, 95% CI = −0.20, −0.14). Declines in consumption were less marked among those with low- or average incomes and those experiencing distress. **Conclusions** On average, alcohol consumption appears to have declined during the first months of the COVID-19 pandemic in Europe. Both reduced availability of alcohol and increased distress may have affected consumption, although the former seems to have had a greater impact in terms of immediate effects.

Keywords Alcohol consumption, coronavirus, COVID-19 pandemic, drinking, Europe, public health crisis, SARS-CoV-2.

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INTRODUCTION

Since early 2020, global populations have experienced the rapid spread of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, henceforth: COVID-19 pandemic), leading to more than 200 000 deaths in Europe within the first 6 months of 2020 alone [1]. Numerous measures have been adopted to respond to the spread of the disease, with the European population subjected to varying levels of local or national lockdown, including border closures across countries inside and outside the Schengen Area [2]. These measures have had unprecedented impacts upon private and public life, and continue to affect population health and well-being world-wide [3,4]. Alcohol use has been identified as an important risk factor for poor physical and mental health [5] and is prone to change in stressful times, such as the current COVID-19 pandemic. At the same time, changes in alcohol consumption are likely to affect the course and prognosis of the COVID-19 disease [6–8].

In particular, the policy measures implemented in response to the COVID-19 pandemic are likely to impact drinking behaviours and levels [9–11]. Existing studies examining the initial impact of the COVID-19 pandemic on alcohol consumption in general populations present

conflicting findings, reflecting contrasting theories of which factors are most likely to have shaped drinking during this period. A first set of studies suggests that more individuals increased their drinking than have decreased it, particularly frequent and heavy drinkers [12–16]. As a potential mechanism, elevated exposure to stress during the COVID-19 pandemic which leads to an increase in alcohol consumption is proposed, and supported by emerging evidence [17–19]. Thus, increased consumption is considered a maladaptive coping strategy to manage the psychological distress and arises from an interplay of social isolation, insecurity and financial difficulties [10,11,17,20].

A second set of studies indicates that alcohol consumption may have decreased at the population level during the first months of the COVID-19 pandemic [16,18,21,22]. According to these findings, a reduced number of options to drink alcohol in general and in particular outside the home (e.g. bars, pubs) might, in fact, have led to reduced levels of drinking in general populations [9,19]. Additionally, availability of alcohol would have been reduced due to the closure of outlets and consumption sites, as well as limitations on typical drinking environments related to travelling (e.g. planes, hotels, cruise ships). Conversely, reduced affordability due to growing unemployment and financial insecurity may have affected drinking [9,20]. Evidence supporting this availability–affordability mechanism can be derived from research examining the impact of alcohol control policies [23] and economic crises [20] on alcohol use, the latter being also a consequence of the COVID-19 pandemic. [24].

Given the diverging evidence on changes in alcohol consumption during the course of the COVID-19 pandemic, it is likely that both mechanisms have influenced drinking in Europe, albeit possibly affecting distinct subpopulations in diverse ways. Based on indicators for income and distress, we propose the following three a priori hypotheses [25]. First, we expect alcohol consumption to decline on average during the first months of the COVID-19 pandemic in Europe, due to reduced availability and affordability. Secondly, due to reduced affordability for lower income groups, we hypothesize that people with lower incomes will report a more substantial decline in their drinking than those with higher incomes. Thirdly, patterns of change will depend upon the level of distress experienced during the pandemic; specifically, and independently of income levels, people who experience distress will be more likely to increase their alcohol consumption than those who do not.

METHODS

This study fully complies with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) statement [26] (see Supporting information, Table S1).

Data

Individual-level data were obtained from the cross-sectional online European Alcohol and COVID-19 survey that collected information on changes in alcohol consumption among European adults (http://www.COVID19-and-alcohol.eu). The survey was originally developed in English, and then translated into 20 languages and disseminated in 21 European countries, using convenience sampling. Data collection took place between 24 April and 22 July 2020. Prerequisites for participation were a minimum age of 18 years and prior consent. The survey was distributed by the individual countries through social media and postings on institutional websites, via press releases, or student and professional networks; in some cases, mainstream media articles were also used to recruit respondents (for details see [27]). To ensure sufficient representation across gender, age and educational attainment, a targeted sampling was adopted in some countries (e.g. via paid ads on social media websites). The study protocol is publicly available [25].

Measures

Respondents were asked whether their (i) frequency of drinking occasions, (ii) quantity of alcohol consumed per occasion or (iii) frequency of heavy episodic drinking (HED) had changed during the past month [i.e. 'drinking much less (often)' (−2), 'drinking slightly less (often)' (−1), 'no change (0)', 'drinking slightly more (often)' (+1) and 'drinking much more (often)' (+2)]. The three variables were summed and divided by six in order to obtain an aggregate consumption-change score scaled to a potential range of −1 to +1, with negative values indicating a decrease and positive values indicating an increase in consumption during the past month [relative to the past 12 months (baseline alcohol consumption)]. The consumption-change score was treated as a continuous variable (for sensitivity analyses on this assumption, see Supporting information, Figure S1 - S4).

Additionally, respondents were asked for their monthly net household income before the spread of COVID-19, and whether they have experienced financial distress due to changes in their financial or occupational situation or distress due to changes in their everyday life within the past month (full questions and answer options are provided in the Supporting information, Material S3).

Statistical analyses

To adjust the sample to the respective population distributions of each country, data were weighted by gender (women, men, other), age group (18–34, 35–54, ≥ 55 years) and educational attainment

(primary, secondary, higher education; see Supporting information, Material S4).

To test the first hypothesis, a weighted multi-level linear regression model was conducted with the consumption-change score as outcome variable for the entire sample, taking into account population weights and country as random intercept (equations are provided in the Supporting information, Material S3). In a sensitivity analysis, we repeated this multi-level linear regression stratified by gender (women, men) and age groups (18–34, 35–54, 55+ years) and tested for gender and age effects by including both measures as independent variables.

In order to evaluate whether the country-specific consumption-change scores significantly differ from 0 and thus indicate average increases or decreases, survey weighted linear regressions for each national subsample were run. All models were adjusted for baseline alcohol consumption as measured by the Alcohol Use Disorder Identification Test (AUDIT-C) [28], as previous studies have shown changes in drinking levels to vary largely across different groups of drinkers [18,29]. AUDIT-C sum scores were centred for each country, allowing interpretation of the intercept as the consumption-change score at the median drinking level in each country.

Multi-level linear regressions were performed to test hypotheses 2 and 3, with the consumption-change score serving as the outcome variable and income group (model 1), financial distress (model 2) and distress due to changes in everyday life (model 3) as independent variables. We considered income as an approximation of affordability of alcoholic drinks [30]. An additional model further included the interaction of income group and financial distress (model 4). Models were adjusted for gender, age group, educational attainment and baseline alcohol consumption. In order to account for temporal changes in the burden from COVID-19 as well as for fluctuations in policy responses, the week in which the respondent took the survey was also entered into the models. In models 2 and 3, income group was included as an additional control variable. In order to account for cross-national differences in policies implemented to contain the spread of COVID-19, the country was included as a random intercept in the regression models.

Three sets of sensitivity analyses were conducted: a first set repeating regression models, but excluding Norwegian respondents as they constitute almost 50% of the sample; a second set in which each indicator of the combined consumption-change measure was considered as an individual outcome, i.e. the original ordinal variables drinking frequency, quantity of alcohol consumed per occasion, and the incidence of HED events scaled to a range between −1 and +1; and a third set excluding respondents who indicated more than 10 household members (n = 49).

Stata version 15.1 [31] and R version 4.0.2 [32] statistical software were used. The study materials (e.g. questionnaires, dissemination strategies by country), survey data and codebooks are publicly available at Figshare [27,33] and may be used for further research.

Data sharing statement

The data set supporting the conclusions of this article is available in the Figshare repository, https://doi.org/10.6084/m9.figshare.13580693.v1. Syntax used in the statistical analyses will be made available upon request sent to the corresponding author.

RESULTS

The selection process to obtain the analytical sample of respondents is illustrated in Fig. 1. Our final analytical sample included 31 964 individuals (for a comparison with the actual European population, see Supporting information, Table S2 and Figure S5 - S7). Excluded respondents (see Fig. 1) did not differ considerably with respect to age, educational attainment or AUDIT-C scores

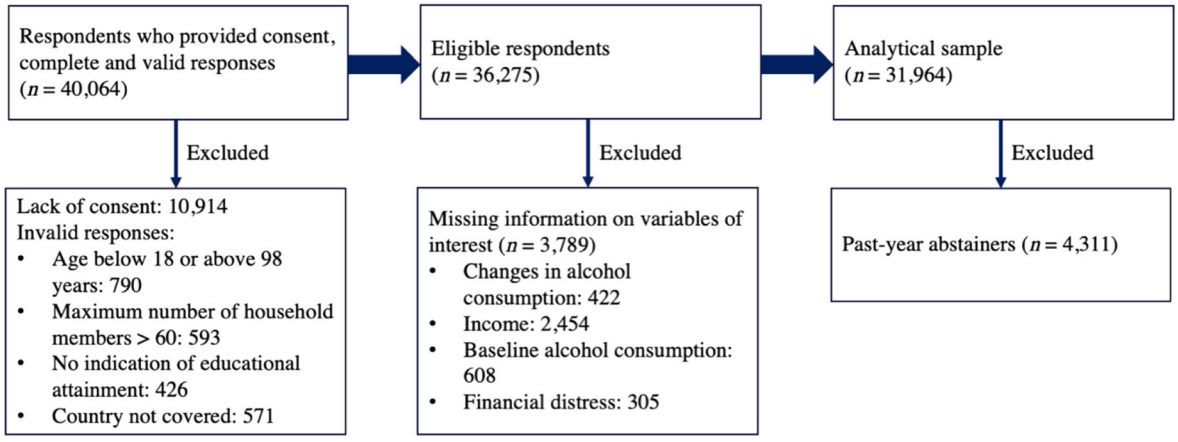

Figure 1 Selection process of respondents to obtain the analytical sample

compared to the final sample (see Supporting information, Table S3 and S4).

The number of participants ranged between 349 from Albania and 15 686 from Norway. Information on baseline alcohol consumption, median income, perceived financial distress and distress due to changes in everyday life by country are presented in Table 1 (for information on sample characteristics, see Supporting information, Table S5). On average, one in five individuals reported experiencing substantial or high financial distress related to the COVID-19 pandemic [21.1%, 95% confidence interval (CI) = 19.5, 22.8], while more than half the sample reported distress due to substantial changes in their everyday life (53.7%, 95% CI = 51.7, 55.6).

Hypothesis 1: Overall change in alcohol consumption

Throughout all countries, the consumption-change score indicated an average decrease of −0.14 (95% CI = −0.18, −0.10; $P < 0.001$). There was no significant difference between women (−0.13, 95% CI = −0.18, −0.07) and men (−0.16, 95% CI = −0.20, −0.12; $P = 0.059$), while the consumption-change score was substantially greater among younger (−0.20, 95% CI = −0.26, −0.15; $P = < 0.001$) and older age groups (−0.13, 95% CI = −0.20, −0.07; $P = 0.004$) compared to those aged 35–54 years (−0.07, 95% CI = −0.11, −0.04; see Supporting information, Table S6 and S7).

Country-specific mean changes in the consumption-change score and the distribution of the aggregate change indicators are presented in Fig. 2. The average consumption-change score ranged between −0.37 (95% CI = −0.52, −0.22; $P < 0.001$) in Albania and +0.10 (95% CI = 0.03, 0.17; $P = 0.004$) in the United Kingdom. Of all the countries examined in our project, only the United Kingdom reported a significant mean increase in alcohol consumption. In Ireland, no statistically significant change was reported (−0.08, 95% CI = −0.17, 0.01; $P = 0.084$). The breakdown of the aggregated change indicator provides further insights into the impact of individual response options on the overall consumption-change score, while a greater deviation from 0 indicates a larger change. In other words, participants whose score indicates an increase or decrease at level 6 have reported a substantial increase or decrease in all three indicator variables, respectively. Levels in between (increase or decrease levels 1 to 5) reflect a combination of slight or substantial changes in these three indicator variables. With regard to overall consumption change, almost half the respondents with a negative consumption-change score (decrease levels 1 to 6) reported to have substantially reduced their consumption (47% or 5967 of 12 709 respondents with decrease level ≥ 3). This is in contrast to drinkers with a positive consumption-change score (increase levels, 1 to 6), who seldomly reported substantial increases (22% or 1568 of 7240 respondents with increase level ≥ 3).

In-depth analyses of the individual indicators of change revealed that drinking frequency did not change significantly in seven countries (Denmark, France, Germany, Ireland, Poland, Slovenia, Ukraine), while quantities of alcohol consumed remained the same in only two countries (Germany, Ireland). The frequency of HED events was reported as decreasing in almost all countries except for the United Kingdom where, on average, frequency of HED occasions neither increased nor decreased (for details see Supporting information, Table S8).

Hypothesis 2: Changes in alcohol consumption by income group

Results of the multi-level regressions presented in Table 2 show that the consumption-change score was substantially higher among respondents with low or average incomes compared to those with high incomes (see Supporting information, Table S9 for complete regression results). This means that respondents with low or average incomes were less likely to report a decline in alcohol consumption while those with high incomes were more likely to do so, or, in other words, respondents with high incomes reported the largest reductions in alcohol consumption. Excluding respondents who indicated more than 10 household members did not alter the results (see Supporting information, Table S10). However, in the sensitivity analysis excluding Norwegian respondents, the consumption-change score did not significantly differ between respondents with low incomes compared to those with high incomes ($P = 0.466$).

Hypothesis 3: Changes in alcohol consumption by experienced distress

Reports of both financial distress and distress due to changes in everyday life were associated with a significantly less pronounced decrease in the consumption-change score compared to those reporting no such distress experiences (see Table 2). Those experiencing financial distress reported a slight decrease in consumption of −0.06 (95% CI = −0.08, −0.03), compared to a more marked decrease (−0.12, 95% CI = −0.14, −0.10) among those not experiencing such distress. In contrast to financial distress, predicted mean consumption only slightly varied with distress experiences due to changes in everyday life (−0.12, 95% CI = −0.14, −0.09; compared to no distress: –0.10, 95% CI = −0.12, −0.08). Excluding Norwegian respondents or those indicating more than 10 household members did not substantially alter the results (see Supporting information, Table S11 and S12).

Table 1 Descriptive statistics by country.

Country	Sample size	Mean AUDIT–C score (95% CI)		Median income[a]		% Financial distress (95% CI)		% Distress due to changes in everyday life (95% CI)	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Albania	349	2.8 (2.4–3.3)	3.4 (2.6–4.3)	124.85 EUR[b]	125.00 EUR[b]	52.0 (46.6–57.3)	49.8 (40.5–59.2)	71.1 (66.0–75.7)	65.3 (55.8–73.7)
Czechia	1355	4.2 (4.1–4.3)	4.5 (4.3–4.8)	16431.25 CZK	16 650.33 CZK	16.6 (14.7–18.7)	16.5 (13.3–20.5)	53.7 (51.0–56.3)	51.9 (46.9–56.9)
Denmark	2337	4.8 (4.7–4.9)	5.0 (4.8–5.2)	9988.20 DKK	9988.20 DKK	15.2 (13.7–16.7)	12.5 (10.1–15.3)	42.5 (40.5–44.5)	36.6 (33.0–40.4)
Finland	3550	4.3 (4.2–4.4)	4.9 (4.7–5.0)	1500.00 EUR	1500.00 EUR	14.3 (13.2–15.5)	15.3 (13.5–17.3)	41.2 (39.6–42.9)	37.2 (34.8–39.7)
France	360	4.3 (4.0–4.6)	4.8 (4.3–5.3)	1250.00 EUR	1000.00 EUR	17.3 (13.7–21.6)	19.7 (14.1–26.9)	59.5 (54.3–64.5)	48.0 (40.7–55.3)
Germany	1513	4.6 (4.4–4.7)	4.6 (4.4–4.8)	1250.00 EUR	1250.00 EUR	14.6 (12.9–16.5)	15.2 (13.0–17.8)	62.2 (59.7–64.7)	60.6 (57.2–63.8)
Greece	470	3.6 (3.4–3.8)	4.2 (3.7–4.7)	666.67 EUR	500.00 EUR	25.3 (21.5–29.5)	26.7 (19.5–35.3)	54.7 (50.1–59.2)	54.9 (46.4–63.2)
Hungary	506	3.4 (3.2–3.6)	3.4 (3.1–3.8)	150 224.55 HUF	133 494.33 HUF	41.6 (37.3–46.0)	47.5 (41.6–53.5)	72.0 (67.9–75.8)	72.1 (66.4–77.2)
Iceland	544	3.3 (3.1–3.5)	3.8 (3.4–4.2)	211 986.14 ISK	198 737.50 ISK	12.4 (9.9–15.5)	13.1 (8.8–19.0)	40.5 (36.4–44.7)	36.7 (29.5–44.4)
Ireland	493	4.9 (4.7–5.2)	5.6 (4.9–6.2)	1250.00 EUR	1250.00 EUR	19.4 (16.1–23.2)	22.9 (15.5–32.5)	77.9 (74.0–81.4)	75.7 (66.4–83.1)
Italy	841	3.2 (3.0–3.4)	3.4 (3.1–3.8)	1166.67 EUR	1000.00 EUR	17.1 (14.7–19.9)	21.7 (17.1–27.2)	64.9 (61.6–68.1)	57.5 (51.8–63.0)
Norway	15 686	4.1 (4.1–4.2)	4.5 (4.5–4.6)	16 455.52 NOK	18 299.67 NOK	13.0 (12.5–13.5)	12.9 (12.1–13.7)	49.0 (48.2–49.7)	42.3 (41.1–43.5)
Poland	1033	5.1 (4.9–5.3)	4.8 (4.5–5.1)	3340.06 PLN	2674.10 PLN	21.9 (19.5–24.5)	26.7 (21.0–33.2)	70.5 (67.6–73.2)	73.4 (67.1–78.8)
Portugal	661	3.1 (3.0–3.3)	3.4 (3.1–3.7)	750.00 EUR	625.00 EUR	12.0 (9.7–14.7)	9.8 (6.5–14.6)	64.6 (60.9–68.2)	60.1 (52.1–67.7)
Russia	693	3.9 (3.7–4.2)	4.3 (3.8–4.9)	42510.00 RUB	31 882.50 RUB	18.7 (15.9–21.8)	20.6 (14.8–27.9)	42.1 (38.4–45.8)	40.7 (33.3–48.5)
Slovakia	415	3.9 (3.6–4.1)	4.1 (3.5–4.6)	666.67 EUR	500.00 EUR	13.5 (10.5–17.2)	6.8 (4.3–10.5)	45.4 (40.6–50.3)	33.8 (26.2–42.3)
Slovenia	508	3.2 (3.0–3.4)	3.9 (3.5–4.4)	833.33 EUR	700.00 EUR	15.6 (12.7–19.1)	14.8 (9.8–21.6)	49.5 (45.1–53.9)	38.7 (31.2–46.9)
Spain	2840	3.9 (3.8–4.0)	4.1 (3.9–4.3)	1000.00 EUR	875.00 EUR	27.8 (26.1–29.5)	32.2 (29.2–35.5)	74.8 (73.1–76.4)	72.9 (69.7–75.9)
Sweden	777	3.3 (3.1–3.4)	3.7 (3.3–4.1)	25 029.00 SEK	22 526.10 SEK	15.1 (12.7–17.8)	18.2 (12.8–25.2)	48.8 (45.3–52.4)	39.6 (32.9–46.6)
Ukraine	438	3.5 (3.2–3.7)	3.4 (2.9–3.8)	7296.75 UAH	7296.75 UAH	29.6 (25.5–34.2)	26.4 (18.8–35.6)	46.9 (42.2–51.7)	41.7 (32.6–51.4)
United Kingdom	836	6.2 (6.0–6.4)	7.2 (6.8–7.6)	1241.33 GBP	1240.65 GBP	17.3 (14.8–20.0)	22.8 (17.7–28.8)	69.6 (66.4–72.7)	64.3 (58.3–70.0)
Total	31 964	4.2 (4.2–4.2)	4.5 (4.4–4.7)	1287.50 EUR[c]	1287.50 EUR[c]	16.3 (15.9–16.7)	21.1 (19.5–22.8)	53.2 (52.7–53.8)	53.7 (51.7–55.6)

CI = confidence interval; SD = standard deviation. Alcohol Use Disorder Identification Test (AUDIT-C) score ranged between 1 and 12 (past-year abstainers AUDIT-C score = 0 were excluded from the sample). [a]Income was weighted for the number of household members; [b]Income categories were provided in EUR; [c]Currencies other than the EUR were converted into EUR (based on exchange rate of 30 July 2020).

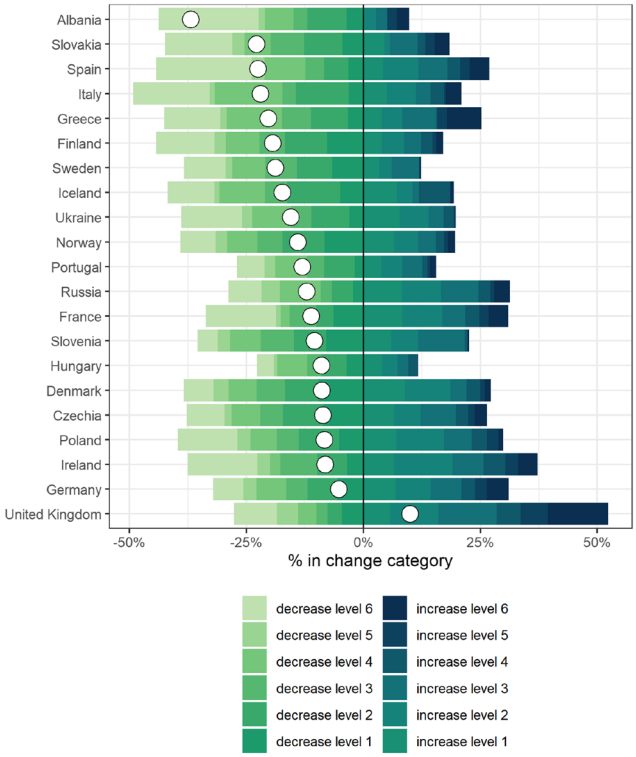

Figure 2 Distribution of the aggregate consumption-change score and the weighted mean of the consumption-change score based on the calculated continuous variable (white circle) by country. Negative values (or decrease levels) indicate a decrease in overall consumption-change score, whereas positive values (or increase levels) indicate an increase. A darker color reflects a higher level of increase in the consumption-change score. All values are significant at $P < 0.050$, except for Ireland ($P = 0.084$). Levels 1–6 are the result of combining the two levels of each single change indicator (decrease: −2 and −1; increase: +1 and +2) and indicate the degree of change. While level 6 includes all people reporting 'much' changes in all three indicators (drinking frequency, quantities of alcohol per occasion, frequency of heavy episodic drinking events), all other levels are a combination of (positive and/or negative) changes

Table 2 Results of multi-level linear regressions of changes in overall alcohol consumption (outcome).

	Coef.	*95% Confidence interval*	*p-value*
Model 1: Income group (reference: high income)			
Low income	0.02	0.00–0.04	.039
Average income	0.05	0.03–0.06	< .001
Model 2: Financial distress (reference: no financial distress)			
Substantial financial distress	0.06	0.05–0.08	< .001
Model 3: Distress due to changes in daily life (reference: no distress)			
Substantial distress	0.02	0.01–0.03	.002

Consumption-change score (outcome) ranged between −1 and +1, with values higher than 0 indicating an increase in consumption and values lower than 0 indicating a reduction. Model 1 was adjusted for sex, age group, education, baseline alcohol consumption and week of survey response; models 2 and 3 were adjusted for sex, age group, educational attainment, baseline alcohol consumption, income group and week of survey response. Random intercept: country. Sample sizes: models 1 and 2: 31964; model 3: 31943 (< 0.01% missing values).

Analysing the interaction between experiencing financial distress and income group revealed that the association between financial distress and the consumption-change score was driven by people with high incomes. As shown in Fig. 3, reductions in alcohol consumption during the pandemic were most pronounced among individuals with high incomes experiencing no financial distress (−0.17, 95% CI = −0.19, −0.14) compared to low- and average-income groups without such distress experiences. In contrast, among those experiencing financial distress, individuals with high incomes reported a substantially smaller decline in their consumption (−0.02, 95% CI = −0.06, 0.02) compared to their counterparts with low- and average-income and financial distress (respectively, −0.10, 95% CI = −0.14, −0.07 and −0.06, 95% CI = −0.08, −0.03; see Supporting information, Table S13).

DISCUSSION

Our findings indicate that drinkers who took part in our survey on average reduced their alcohol consumption during the first months of the COVID-19 pandemic in Europe, except for Ireland and the United Kingdom. While

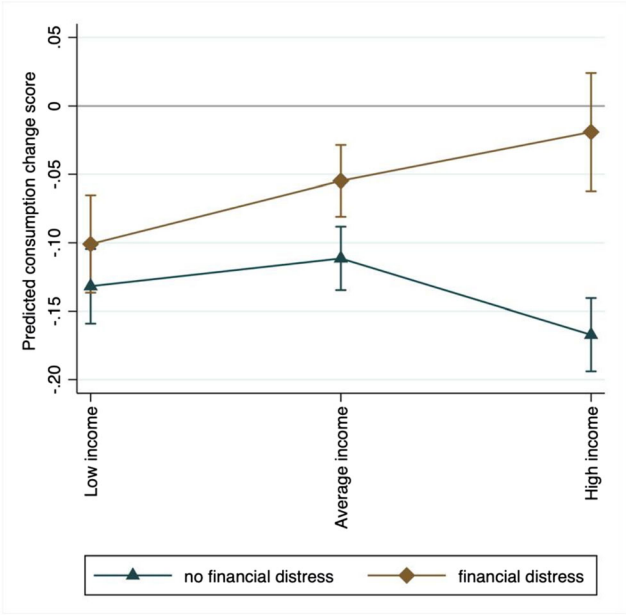

Figure 3 Predicted change in the consumption-change score by income and financial distress. The *y*-axis shows the predicted mean consumption-change score estimated by the regression model, with 0 indicating no change in consumption. In order to allow comparability across countries, income was *Z*-standardized and logarithmized; low income: less than or equal to one standard deviation below the mean; average income: mean ± 1 standard deviation (SD); high income: more than or equal to 1 SD above the mean

the average consumption remained unchanged in Ireland, drinking frequencies and quantities consumed per occasion increased considerably in the United Kingdom, but not the frequency of HED events. Decreases in the overall alcohol consumption were mainly driven by a decline in the frequency of HED events. Changes in consumption were associated with income and experiences of distress: for drinkers with low incomes alcohol use generally declined, regardless of any experienced financial distress. However, for those with average or high incomes, changes in alcohol use were dependent upon such financial distress experiences.

Strengths and limitations

We launched the European Alcohol and COVID-19 survey in response to the extraordinary situation created globally by the COVID-19 pandemic reaching Europe in early 2020. Due to the collaborative efforts of alcohol researchers across Europe and using different dissemination strategies [27], it was possible to reach more than 30 000 drinkers within a short period of time.

The project data constitute a convenience sample of more than 30 000 individuals throughout Europe which is, in many ways, comparable to samples from other general population alcohol surveys (see Supporting information, Material S5). Compared to national population estimates, women, younger adults, those with higher educational attainment and individuals on higher incomes were over-represented in our sample. This is similar to the composition of other European population-based COVID-19 surveys [29,34,35], meaning that subpopulations who are particularly vulnerable in this situation, such as elderly people, may not be sufficiently represented in our sample. Of note, however, is that we successfully included a substantial proportion of heavy drinkers in our sample—a group often poorly covered in other general population surveys [36,37].

Because this survey sample may not be fully representative of the total adult European population,[1] we do not intend to draw inferential conclusions concerning the European general population as a whole based on our findings. However, given that the primary aim of the study was to test relationships between variables in the general population, representativeness is not a key requirement [38,39]. In this study, we sought to compare relationships between groups defined a priori. Whenever conclusions were drawn concerning the general population, weights were applied in order to adjust the study population distribution to the actual population distribution of each country. We validated our approach with further sensitivity analyses.

Under-reporting of alcohol consumption due to self-reported measures is another common limitation of alcohol survey research which, because of our convenience sampling and the lack of available per-capita data for the survey period, could not be validated against sales data [36]. Additionally, our assessment of changes in alcohol consumption relied upon respondents' subjective evaluations of changes in drinking. In order to account for pre-COVID ('baseline') alcohol consumption, we asked respondents about their past-year alcohol intake using the validated AUDIT-C instrument. However, this measurement is not fully independent of the items used to capture

[1]For a more general discussion on the use of the term representativeness in general population surveys, see [38].

changes in consumption during the pandemic. Respondents' reports on changes in alcohol consumption and their subjective perceptions of containment measures may also not only reflect the level of exposure, but may also be influenced by social desirability biases [40], by social and cultural norms and influences of national media on these perceptions [41]. Finally, the measures taken by national governments to contain the spread of the COVID-19 virus as well as their timing varied greatly within and between countries during the study period. To account for these fluctuations, we included the study countries as random intercepts in all statistical models and the week of the respondents' survey participation in models testing for associations, the latter being significantly associated with the consumption-change score (see Supporting information, Table S9).

Interpretation of findings

Our findings support our a priori hypothesis that alcohol consumption would decline during the first months of the COVID-19 pandemic, suggesting a greater impact of the availability–affordability mechanism than the distress mechanism, at least for Europe [9]. However, the impact of reduced affordability on alcohol consumption as a consequence of the pandemic (hypothesis 2) can only be partly supported by our results, as drinkers with high incomes were the most likely to report declines in their consumption, which contrasts with the assumption that these drinkers would be less affected by reduced affordability during the pandemic. Thus, reduced availability may have been a more important determinant in this regard.

The limited impact of affordability on drinking behaviour could be due to: (i) largely constant or slightly declining alcohol prices in the first half of 2020 [42]; (ii) the fact that, irrespective of income, at the start of pandemic most European populations might have been similarly affected by this public health crisis, including, but not limited to, stay-at-home policies and border closures; and (iii) income serves only as an approximation of affordability, which does not take into account differences between countries in alcohol prices relative to other goods [43]. With regard to the former two considerations, a health crisis such as the ongoing COVID-19 pandemic may differ from purely economic crises, at least for a predominantly high-income region such as Europe. There might be other factors important for the observed decline in alcohol consumption related to availability: first, during the lockdown, which was imposed at least temporarily, completely or partially in all countries, on-premise consumption sites such as restaurants, bars and pubs were largely closed, which has presumably led to a reduced availability of alcohol. While off-premise consumption could be largely unaffected, as grocery and state monopoly stores were mostly open, restrictions in movement and groups strongly advised not to go out limited purchase closures. However, and probably more importantly, was the restriction of social gatherings such as family celebrations, concerts or parties, which are often accompanied by heavy drinking. This rationale is supported by our findings of a considerable decline in the HED frequency as well as in the overall consumption among young adults, which was also found in other studies [12,19].

Given this general picture, the increase in alcohol consumption in the United Kingdom and the largely unchanged consumption in Ireland seem to be notable anomalies. Our findings related to the United Kingdom are consistent with those from other recently published analyses based on longitudinal data [13,15,44], while routinely collected data of household purchases suggest that there were no marked changes in alcohol purchases when on-trade and off-trade purchases were taken into account [22].

One possible explanation for the diverging patterns in Ireland and the United Kingdom could be an interaction between particularly high levels of distress related to COVID-19 in these countries and a wider adoption of alcohol as a coping strategy in the general population. During the study period, England specifically recorded one of the highest levels of excess mortality in Europe [45] and an increase in alcohol-specific deaths rates [46]. It is also noticeable that both Ireland and the United Kingdom are among those in which the average AUDIT-C score greatly exceeded the overall mean, indicating an oversampling of heavier drinkers in comparison to other countries. However, comparisons of the AUDIT-C responses in the Irish sample with the results of an Irish general population survey found this oversampling to be below 5% (see Supporting information, Material S5). Additionally, it is worth mention that the United Kingdom seems to be one of the only European countries where liquor stores were added to the list of 'essential' businesses allowed to remain open during the early stages of lockdown, together with pharmacies and supermarkets, with alcohol deemed to be an 'essential' good during the crisis and ensuring that it remained available [47]. One of the prime arguments for keeping liquor shops open is to prevent severe alcohol withdrawal in people with alcohol use disorder [48,49]. A loosening of alcohol policies, however, by keeping liquor shops open and additionally allowing home delivery and on-line purchases of alcohol might have increased at-home drinking [50,51], with the first evidence emerging from Australia, Canada, the United States and New Zealand [48,52,53]. Finally, the United Kingdom was not the only country where off-site alcohol retail continued as before. In countries where alcohol is not sold in licensed liquor shops but in supermarkets, such as in Czechia, Germany and the Netherlands, off-site alcohol retail was not

restricted in any way during the confinement periods. Thus, perhaps restrictions in off-site alcohol retail cannot satisfactorily explain the findings. In order to disentangle and understand relevant pathways, more in-depth research on alcohol consumption during the COVID-19 pandemic in the United Kingdom as well as across countries is needed.

In line with previous findings, we found further support that financial distress and distress due to changes in everyday life may increase drinking levels [12,13,15,16,22,29]. Surprisingly, we found the impact of financial distress on alcohol consumption to be particularly pronounced among individuals with high incomes compared to those with low or average incomes. One explanation could be that high-income individuals perceive loss of income or concerns around job insecurity as a greater threat to their current socio-economic position.

Declaration of interests

None.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1 Checklist of information (GATHER) that should be included in new reports of global health estimates.
Table S2 Number and proportion of respondents with missing information by country.
Table S3 Comparison of key demographic characteristics of the respondents excluded because of missing information *versus* the final sample.
Table S4 Demographic characteristics of the survey population and the actual European population.
Table S5 Descriptive statistics by country.
Table S6 Weighted average of the consumption-change score by gender and age group.
Table S7 Multilevel linear regression of changes in alcohol consumption (outcome variable) for (a) gender and (b) age group.
Table S8 Weighted average of the consumption-change score and individual consumption change variables by country.
Table S9 Complete results of multilevel linear regressions of changes in overall alcohol consumption (outcome).
Table S10 Sensitivity analyses of changes in alcohol consumption (outcome variable) for income (model 1).

Table S11 Sensitivity analyses of changes in alcohol consumption (outcome variable) for experiencing financial distress (model 2).

Table S12 Sensitivity analyses of changes in alcohol consumption for distress due to changes in everyday life (model 3).

Table S13 Multilevel linear regression for the interaction effect of financial distress and income group on changes in overall alcohol consumption (outcome, model 4).

Figure S1 Distribution of the individual change indicators (drinking frequency, quantity of alcohol per occasion, frequency of HED events) and the mean change based on the calculated continuous variable (white circle).

Figure S2 Distribution of the change indicator for frequency of drinking and the weighted mean change (white circle) by country.

Figure S3 Distribution of the change indicator for quantities of alcohol per occasion and the weighted mean change (white circle) by country.

Figure S4 Distribution of the change indicator for frequency of heavy episodic drinking events and the weighted mean change (white circle) by country.

Figure S5 Median *per capita* income by country based on external data (World Population Review) [7], unweighted survey data and weighted survey data. Data were not available for Iceland.

Figure S6 Prevalence of past-year drinkers assessed in the survey and prevalence estimates based on a global modelling study by country.

Figure S7 The distribution of responses for each AUDIT-C item from the present survey (Norway, total sample excluding Norway) and a general population survey from 2012/2013 (Norway).

