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Alcohol control policies and socioeconomic inequalities in hazardous alcohol consumption: a 22-year cross-sectional study in a Swiss urban population

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Keywords:	Socioeconomic factors, inequality, hazardous alcohol consumption, alcohol control laws, education, occupation

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3 **Alcohol control policies and socioeconomic inequalities in hazardous**
4 **alcohol consumption: a 22-year cross-sectional study in a Swiss urban**
5 **population**
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Abstract

Objective

Harmful use of alcohol represents a large socioeconomic and disease burden, and displays a socioeconomic status (SES) gradient. Several alcohol control laws were devised and implemented, but their equity impact remains undetermined.

We ascertained if a SES gradient in hazardous alcohol consumption exists in Geneva (Switzerland) and assessed the equity impact of the alcohol control laws implemented during the last two decades.

Design

Cross-sectional survey study

Setting

We used data from non-abstinent participants, aged 35 to 74 years, from the population-based cross-sectional Bus Santé study (n=16 725), between 1993 and 2014.

Outcome measures

SES indicators included educational attainment (primary, secondary and tertiary) and occupational level (high, medium and low). We defined four survey periods according to the implemented alcohol control laws, and hazardous alcohol consumption (outcome variable) as >30g/day for men and >20g/day for women.

The slope (SII) and relative (RII) indexes of inequality were used to quantify absolute and relative inequalities, respectively, and were compared between legislative periods.

Results

Lower educated men had higher frequency of hazardous alcohol (RII=1.87, $p<0.001$ and SII=0.14, $p<0.001$). Lower educated women had less hazardous consumption (RII=0.76, $p=0.026$ and SII=-0.04, $p=0.008$). Over time, hazardous alcohol consumption decreased, except in lower educated men.

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3 Education-related inequalities were observed in men in all legislative periods and did
4
5 not vary between them. Similar results were observed using occupational level as SES
6
7 indicator.
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10 **Conclusions**

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12 Population-wide alcohol control laws did not have a positive equity impact on
13
14 hazardous alcohol consumption. Targeted interventions to disadvantaged groups may be
15
16 needed to address the hazardous alcohol consumption inequality gap.
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22 **Strengths and limitations of this study**

- 23 • Relatively large cross-sectional study spanning 20 years
- 24 • Use of relative and absolute inequality regression-based measures
- 25 • Equity impact of several alcohol control measures was evaluated
- 26 • No longitudinal data to clearly assess causality
- 27 • Possible confounding by the 2008 economical crisis cannot be excluded.
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39 **Keywords:** Socioeconomic factors, inequality, hazardous alcohol consumption, alcohol
40 control laws, education, occupation.
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1 - INTRODUCTION

Harmful use of alcohol is responsible for a large social, economic and disease burden. According to the World Health Organization (WHO), harmful use of alcohol is estimated to represent 5.9% of worldwide mortality, accounting for 3.3 million deaths per year. Additionally, the global burden of disease and injury attributed to alcohol represents 5.1% of the total disability-adjusted life years, being in the origin of an excess of 200 injury and disease conditions (Poznyak and Rekke 2014). Both mortality and morbidity related to alcohol consumption have increased over time (Forouzanfar et al. 2015; GBD 2015 Risk Factors Collaborators 2016; GBD 2016 Risk Factors Collaborators 2017).

Considering the high burden of disease attributed to alcohol consumption, several legislative interventions were advocated by the WHO (WHO 2012) and by the Organisation for Economic Co-operation and Development (OECD). Many of these interventions aiming at the reduction of harmful consumption were implemented in several countries and were met with considerable success (Sassi 2015).

As in other harmful behaviours, a social gradient in alcohol consumption was identified, with higher consumption existing in individuals with lower socioeconomic status (SES) (Bloomfield et al. 2006; Kuntsche et al. 2004; Marmot et al. 2012). Also, its effects on health are socially patterned with higher alcohol-related mortality in low educated individuals and manual workers (Mackenbach et al. 2015), and alcohol-related mortality significantly associated with the raise of unemployment rates (Stuckler et al. 2009). Some institutions, as the WHO, have set practical measures to prevent the widening of alcohol-related inequalities and, ideally, to reduce them. Policies such as alcohol taxation and price rising, age limits for purchase and drink-driving, and restriction of alcohol marketing, advertising and promotion, coupled with interventions for heavy

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3 drinkers and vulnerable groups are amongst those suggested (Loring 2014). However,
4 the impact of these policies on SES inequalities in alcohol consumption remains to be
5 determined and existing studies mainly focus on the equity impact of taxation policies
6 (Holmes et al. 2014; Meier et al. 2016; Staras et al. 2014).
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13 In Geneva (Switzerland), several alcohol control laws were implemented during the last
14 two decades (Dumont et al. 2017). In 2000, an alcohol advertising ban was introduced,
15 while in 2004 there was a three-fold increase in prices of alcopop beverages (e.g.
16 premixed drinks), a decrease in the alcohol driving limit, an off-premise sale
17 interdiction between 9pm and 7am, and an alcohol sale interdiction in video stores and
18 gas stations. Smoking bans were suggested to reduce alcohol demand (Kasza et al.
19 2012; Picone et al. 2004), and such a ban was implemented in Geneva in 2009. A recent
20 study (Dumont et al. 2017) showed a decrease in overall alcohol consumption and in
21 hazardous drinking, in men and women in Geneva between 1993 and 2014,
22 independently of policy changes. Still, differential impact according to SES was not
23 assessed.
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39 In this study we aim, first, to determine if a SES gradient in hazardous alcohol
40 consumption exists in the adult population of Geneva and, second, to assess the impact
41 of the implemented alcohol control policies on this gradient, if any.
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47 **2 - METHODS**

48 **2.1 - Participants**

49 We used data from the Bus Santé study, a continuing population-based study in the
50 State of Geneva (population of approximately 490 000 inhabitants in 2016) monitoring
51 health and associated risk factors. As previously described (Guessous et al. 2012),
52 independent samples of residents were subjected to annual health examination surveys
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3 since 1993. A resident list provided by the local authorities was used to select
4 participants which were aged 35-74 years until 2011 and 20-74 years afterwards.
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6 Gender and 10-year age strata were used for stratified random sampling. Each
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8 participant was invited to a Bus Santé study unit where trained collaborators would
9
10 administer the questionnaires. One of the three study units was a mobile unit visiting
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12 different areas of the Geneva Canton while the other two were based at the Geneva
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14 University Hospitals.
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19 Individuals who did not respond to the invitation were telephoned up to seven times at
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21 different days of the week and times of the day. If contact was not established, two extra
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23 invitations were mailed. When participants were unreachable they were considered as
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25 non-responders and replaced.
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29 Participation rate varied from 50.8% for 2010-2014 to 60.1% for the 1996-2003 period.
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31 Participant recruitment decreased during the period between 2005 and 2008 due to a
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33 simultaneous study taking place with shared logistical resources but not focusing on the
34
35 same population.
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39 The Bus Santé study was conducted in accordance with the principles of the Declaration
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41 of Helsinki, was granted approval by the Institute of Ethics Committee of the University
42
43 of Geneva, and obtained written consent from all participants.
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45 **2.2 - Exclusion criteria**

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47 We included participants with ages between 35 and 74 years, the age group consistently
48
49 recruited during the entirety of the Bus Santé study. We excluded abstinent participants
50
51 (n=3059, 15.2%) and those with missing data on educational attainment (n=368, 2.2%),
52
53 assumed to be missing completely at random. For occupational level analysis,
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55 participants that were not working (unemployed n=789, 4.7%; retired n=2753, 16.4%
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3 and housewives/househusbands n=1635, 9.7%) or with missing for this variable (n=257,
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5 1.5%) were also excluded.
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7 8 **2.3 - Outcome variable**

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10 The main outcome variable was hazardous alcohol consumption (>30g/day for men and
11 >20g/day for women) established based on data from total daily alcohol intake in g/day
12
13 and according to the International Alliance for Responsible Drinking guidelines
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15 defining hazardous consumption in Switzerland at the time of the study
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17 (<http://www.iard.org/policy-tables/drinking-guidelines-general-population/>). Total daily
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19 alcohol intake was determined using a validated food frequency questionnaire (FFQ), as
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21 previously described (Dumont et al. 2017), taking into account consumption frequency,
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23 type of alcoholic beverage (wine, champagne, beer, aperitifs such as anisette or martini,
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25 and spirits like liqueur, brandy or whisky) and average serving size compared to a 10g
26
27 alcohol standard for each beverage (similar, bigger or smaller). The same FFQ was used
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29 throughout the totality of the study, with the resulting data having incorporated large
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31 international consortia (Micha et al. 2014).
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37 38 **2.4 - Covariates**

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40 We created a categorical variable identifying participants who were surveyed during
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42 periods that differed in the implemented alcohol control laws: period 1 (before
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44 20/10/2000, baseline), period 2 (from 20/10/2000 to 01/02/2004 - introduction of
45
46 advertising ban), period 3 (from 02/02/2004 to 31/10/2009 - 300% increase in alcopop
47
48 price, decrease of legal alcohol driving limit, off-premise sale interdiction of alcoholic
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50 beverages from 9pm to 7am and gas stations and video stores are no longer allowed to
51
52 sell alcohol) and period 4 (from 01/11/2009 onwards – implementation of a public
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54 smoking ban).
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3 As in Huisman et al (Huisman et al. 2005) we considered educational attainment in 3
4 levels: i) Primary - no end of school certification (“Maturité”) or no professional
5 apprenticeship, ii) Secondary - obtaining “Maturité” or professional apprenticeship and
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Current occupation was categorised into three categories according to the British Registrar General’s Scale (Leete and Fox 1977): high (professional and intermediate professions), medium (non-manual occupations) and low (manual or lower occupations).

Age was used as a continuous variable; smoking status was classified into never smokers, current smokers and ex-smokers, and nationality as Swiss or other.

2.5 - Statistical analysis

Continuous variables are presented as mean \pm standard deviation (SD) while categorical ones as absolute and relative frequencies.

Chi-squared test of independence and one-way ANOVA were used to assess the significance of group differences in categorical and continuous variables, respectively.

All analyses were stratified by gender. Outcome proportions in different survey years, as displayed in Figure 1 and Supplementary Figure 2, were age-adjusted using the age distribution of the Swiss population in 2014 (<https://www.bfs.admin.ch/bfs/en/home/statistics/population.html>).

Time-series analyses were performed (overall and stratified by educational attainment or occupational level), using adjusted linear (for total consumption) or binomial (for hazardous consumption) regression models. Coefficients for the calendar year variable are reported.

Poisson regression models were used to test the association between exposure (educational attainment and occupational level) and outcome variables (hazardous

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3 alcohol consumption and total daily alcohol consumption), and to estimate prevalence
4 ratios (PR). Besides age, nationality and smoking status, models were also adjusted for
5 survey date in calendar years to take secular trends into account (Agaku et al. 2014;
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10 Becker et al. 1994; Regidor et al. 2015).

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12 We used the STATA package *RIIGEN* (Kroll 2013; Mackenbach and Kunst 1997) to
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14 calculate the slope index of inequality (SII) and the relative index of inequality (RII)
15
16 which quantify absolute and relative differences between SES-defined strata,
17
18 respectively.
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21 These regression-based indexes describe differences between the SES extremes taking
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23 into account the intermediate categories (Mackenbach and Kunst 1997). For instance,
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25 RII=1.3 represents an added 30% outcome prevalence in the lowest SES group
26
27 compared to the highest, similar to a prevalence ratio. SII, an impact measure, indicates
28
29 the absolute difference in outcome prevalence between lowest and highest SES groups.
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31 For example, SII=0.3 indicates 30 more individuals with the outcome per 100
32
33 individuals in the lowest SES group compared to the highest one. When used with
34
35 continuous variables, as total alcohol consumption, SII=4 would indicate an excess
36
37 consumption of 4g/day in the lowest SES group when compared to the highest.
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41 Both indexes were calculated for each of the four periods and compared between them
42
43 using pairwise Wald tests.
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47 Sensitivity analyses of the educational attainment and the occupational level-based
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49 models were performed through adjustment for a second SES indicator (occupational
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51 level or educational attainment, respectively). Adjustment of educational attainment
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53 model by occupational level included non-working individuals: retired, unemployed and
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55 housewives/househusbands. Reciprocal adjustment did not change the overall trends
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(sensitivity analyses can be found in Supplementary Tables 5-7). Data were analysed using STATA 13.1 and R 3.2.2.

3 - RESULTS

3.1 - Characteristics of participants

The participant characteristics stratified by gender and educational attainment can be found in Table 1. For education-based analyses we included 16 725 participants of which 18.0% had primary education, 45.0% secondary education and 37.0% tertiary education. The mean daily consumption of alcohol was 15.9 ± 18.9 g/day and 18.2% were found to have hazardous alcohol consumption. When stratified by gender and educational attainment, higher educated participants of both genders were younger, more often Swiss and less probably current smokers. Furthermore, daily alcohol consumption and proportion of participants with hazardous alcohol consumption were higher in lower educated men, while no differences could be observed in women.

For the occupational level analysis, we included 11 659 working participants and their characteristics are reported in Supplementary Table 1. Similarly to the educational attainment stratification, lower alcohol consumption and lower proportion of consumption at risk were found in men with high occupational level and no differences were observed amongst women.

3.2 - Time trends of hazardous alcohol consumption

Alcohol consumption (Supplementary Figure 1a) and the proportion of drinkers with hazardous consumption (Supplementary Figure 1b) have decreased in both genders between 1993 and 2014 (Supplementary Table 2). Yet, when time trends were stratified by educational attainment, we observed that the decrease has not occurred similarly across all educational attainment-related groups, since men with primary education did not display a reduction in hazardous alcohol consumption like their counterparts with

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3 secondary and tertiary education (Figure 1a). However, when using occupational level
4 as an SES indicator, after an initial increase in hazardous consumption in participants
5 with low occupational level, a decrease could be observed in later periods (Figure 1b).
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7 To test if the observed time trends were not due to differences in participant
8 characteristics other than educational attainment and occupational level, data were fitted
9 into multivariable binomial models to obtain adjusted time trends (Supplementary Table
10 2). We identified negative adjusted time trends for both outcomes, in both genders
11 ($\beta_{\text{hazardous consumption in men}} = -0.04 [-0.04; -0.03]$ $p < 0.001$, $\beta_{\text{hazardous consumption in women}} = -0.04 [-$
12 $0.05; -0.03]$ $p < 0.001$). As suggested by Figure 1a and Supplementary Table 2, adjusted
13 time trend analysis stratified by educational attainment showed that hazardous
14 consumption did not change among men with primary education ($\beta_{\text{primary}} = -0.00 [-$
15 $0.02; 0.02]$ $p = 0.75$), while it decreased among men with secondary or tertiary education
16 ($\beta_{\text{secondary}} = -0.04 [-0.06; -0.03]$ $p < 0.001$; $\beta_{\text{tertiary}} = -0.05 [-0.06; -0.03]$ $p < 0.001$). For women,
17 the time trends were all negative. Analyses stratified by occupational level revealed a
18 harmonious decrease in hazardous alcohol consumption in all levels and for both
19 genders (Supplementary Table 2).

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21
22 Similar results were observed when total daily alcohol intake was used as outcome
23 variable (Supplementary Figure 1a-b, Supplementary Table 2).

24 25 26 **3.3 - Association between educational attainment, occupational level and 27 hazardous alcohol consumption**

28
29 We observed more hazardous consumption in lower educated men ($PR_{\text{primary vs}}^{\text{tertiary}} = 1.58 [1.39; 1.80]$ $p < 0.001$, $PR_{\text{secondary vs tertiary}} = 1.32 [1.18; 1.47]$ $p < 0.001$) with this
30 being reflected in the relative and absolute indexes of inequality ($RII = 1.87 [1.57; 2.22]$
31 $p < 0.001$ and $SII = 0.14 [0.11; 0.17]$ $p < 0.001$, respectively) (Table 2). On the other hand,
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3 lower education was associated with less hazardous consumption in women (RII=0.76
4 [0.60;0.97] $p=0.026$ and SII=-0.04 [-0.07;-0.01] $p=0.008$) (Table 2).

7 An occupational level-related gradient was observed in men, those with lower
8 occupational level having a higher proportion of hazardous consumption (RII=1.68
9 [1.38;2.06] $p<0.001$ and SII=0.11 [0.07;0.15] $p<0.001$) (Table 2). Conversely, no such
10 gradient was found in women (Table 2).

13 Similar findings were obtained for total daily alcohol intake, except for women with
14 lower occupational level which displayed lower daily alcohol consumption
15 (Supplementary Table 3).

24 **3.4 - Alcohol laws, alcohol consumption, and SES inequalities**

25 In men, we identified absolute and education-related inequalities in hazardous alcohol
26 consumption in all periods and favouring the most educated (Figure 2a, Supplementary
27 Table 4). No differences between periods were observed ($p>0.05$) (Figure 2a). In
28 women, no education-related inequalities were observed during the various legislative
29 periods (Figure 2a, Supplementary Table 4).

30 Occupational level-related inequalities in men were also observed in absolute and
31 relative terms, and increased between period 1 and 2 ($p<0.05$), remaining constant
32 thereafter (Figure 2b, Supplementary Table 4). In women, inequalities in favour of those
33 with lower occupational level were only observed in period 2, with an increase being
34 observed between period 1 and 2 ($p<0.05$) (Figure 2b, Supplementary Table 4).

35 Similar results were obtained concerning daily alcohol intake (Supplementary Figure
36 3a-b, Supplementary Table 4).

4 - DISCUSSION

We identified a social gradient in alcohol drinking patterns among men, with lower SES being associated with higher proportion of hazardous consumption and higher total daily alcohol consumption. In women, a less pronounced inverse gradient was observed with higher SES being associated with higher hazardous consumption and higher total daily consumption.

These patterns were also found in other studies: low education and manual occupation males tend to have higher prevalence of alcohol consumption, contrarily to women (Bloomfield et al. 2006; Sassi 2015).

We observed a discrepancy between time trends when educational attainment or occupational level were used as SES indicators. Sensitivity analyses showed that this was not due to the educational attainment-based analysis including non-working participants. SES indicators such as education and occupational level often display low to moderate correlations and cannot be used interchangeably (Geyer et al. 2006; Muller 2002; Sandoval et al. 2017). Furthermore, each indicator may be related to different causal mechanisms and can be differentially associated with a specific health-related outcome (Geyer et al. 2006). It is thus possible that lower education has a wider impact on other SES-related determinants of persistent alcohol consumption than occupation, justifying the observed discrepancies in alcohol consumption trends.

Differently from previous studies, we studied the evolution of alcohol drinking patterns during a 22-year period. Though hazardous consumption decreased in both genders, inequalities in alcohol consumption remained stable among men. No specific inequality patterns were identified for the periods with different legislative alcohol control measures (advertising ban, three-fold increase in alcopop price, decrease of legal

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3 alcohol driving limit, and ban of off-premise sale of alcoholic beverages from 9pm to
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5 7am and at gas stations and video stores). The lack of equity impact of these measures
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7 can potentially be explained in light of the recommendations and reports by the WHO
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9 (Loring 2014) and OECD (Sassi 2015). Though these institutions recommend raising
10
11 the taxes of all alcoholic products, the OECD described Switzerland as having mild
12
13 alcohol taxation with some of lowest taxes on beer and wine (Sassi 2015). Moreover,
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15 the raise on the tax of an alcoholic product does not directly reduce consumption, since
16
17 it does not guarantee an increase in the final price of the product, or a relevant price
18
19 increase considering the populations' purchasing power. A recent report pointed out that
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21 price increases due to taxation were regressive measures in nature, with a bigger
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23 financial burden on individuals with low SES, thus with a potential positive equity
24
25 impact (Sassi et al. 2018). However, this study was mainly based on data from
26
27 low/middle income countries where the majority of consumers belong to high SES
28
29 strata. Lack of data concerning high income countries precluded the same analysis in
30
31 this context. Our results suggest that the increase in tax on alcopop beverages did not
32
33 have a positive equity impact in hazardous alcohol consumption and further increases in
34
35 taxation of other alcoholic products are probably needed. Also, easy circulation between
36
37 neighbouring regions and countries may have allowed smuggling of beverages with a
38
39 lower price. This is particularly relevant for regions like Geneva due to its proximity to
40
41 the France-Switzerland border. Finally, and even though our study covered a relatively
42
43 long period, legislative measures may have a delayed impact in time, not observable in
44
45 the time span of this study.

4.1 - Strengths

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47 We analysed a population-based sample of participants from a single region spanning a
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49 22-year period. This relatively homogeneous sample allowed us not only to measure
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3 alcohol consumption and its inequalities in this population, but also to follow them in
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5 different periods according to which alcohol control laws were implemented. We used
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7 two SES indicators (educational attainment and occupational level) and the lack of
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9 effect of alcohol control measures on inequalities based on both indicators further
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11 increases the robustness of our findings. Furthermore, we measured inequalities and
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13 their trends complementing the relative with absolute measures in order to determine the
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15 impact that interventions to reduce inequalities could have had on the outcomes
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17 (Charafeddine et al. 2013; Mackenbach and Kunst 1997).
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22 **4.2 - Limitations**

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24 Our study has several limitations. First, it was based on self-reported repeated cross-
25
26 sectional data instead of longitudinal, not allowing the follow-up of alcohol
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28 consumption and its inequalities at the individual level. Second, participation rate, as in
29
30 another cross-sectional survey studies, ranged between 51% and 60%, and, accordingly,
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32 selection bias cannot be excluded. Third, strong enforcement and coordinated multi-
33
34 level approach are capital for an effective implementation of alcohol control laws.
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36 Unfortunately, we could not evaluate the degree of law enforcement as no data on
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38 measure adoption were available, and we were not able to control for the price trends of
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40 the alcoholic products. Moreover, the time span of this study included the 2008
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42 economic crisis, which may have impacted on alcohol consumption and its inequalities,
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44 as noted by Stuckler et al (Stuckler et al. 2009). Finally, besides confounding by other
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46 unrecorded factors, our study is based on a single region of a high income country,
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48 probably limiting the generalisability of the findings to settings that differ greatly from
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50 Geneva.
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5 - CONCLUSION

In the adult population of Geneva, SES inequalities in hazardous alcohol consumption were identified. The successive anti-alcohol legislations implemented in the last 20 years were unable to reduce them. To close the inequality gap in this harmful behaviour in settings similar to Geneva, evaluating the equity impact of legislative interventions and using adjuvant targeted measures could be of great importance.

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Ethics approval: Institute of Ethics Committee of the University of Geneva. The study complies with the ethical standards established by the Declaration of Helsinki and informed consent was obtained from all participants.

Author contributions: José Luis Sandoval and Teresa Leão: conceptualisation, analysis and interpretation of results, manuscript writing and revision. Jean-Marc Theler, Thierry Favrod-Coune, Barbara Broers, Jean-Michel Gaspoz, Pedro Marques Vidal: data collection, interpretation of results, manuscript reviewing and final editing the final manuscript. Idris Guessous: conceptualisation, data collection, interpretation of results, manuscript writing and revision.

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Data sharing statement: please contact the corresponding author for the dataset and statistical code

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Figure Legends

Fig. 1 Age-adjusted proportions of participants with hazardous alcohol consumption stratified by gender and a) educational attainment and b) occupational level.

Footnote: Trends were obtained using locally weighted scatterplot smoothing. Each shaded period represents one of the periods with different alcohol control laws

Fig. 2 Absolute (SII) and relative (RII) inequalities in hazardous alcohol consumption for men (red) and women (blue) for a) educational attainment and b) occupational level.

Footnote: Estimates and 95% confidence intervals are presented as well as level of significance. Wald test p values comparing indexes between groups are presented when <0.05 . $p < *0.05$, $**0.01$ and $***0.001$

Supplementary fig. 1 Evolution of age-adjusted mean alcohol consumption and percentage of drinkers with hazardous alcohol consumption from 1993 to 2014 for men (red) and women (blue).

Footnote: Trends were obtained using locally weighted scatterplot smoothing. Each shaded period represents one of the periods with different alcohol control laws

Supplementary fig. 2 Age-adjusted mean daily alcohol consumption alcohol consumption (g/day) stratified by gender and a) educational attainment and b) occupational level

Footnote: Trends were obtained using locally weighted scatterplot smoothing. Each shaded period represents one of the periods with different alcohol control laws

Supplementary fig. 3 Absolute (SII) inequalities in total daily alcohol consumption for men (red) and women (blue) for a) educational attainment and b) occupational level.

Footnote: Estimates and 95% confidence intervals are presented as well as level of significance. Wald test p values comparing indexes were all $p > 0.05$. $p < *0.05$, $**0.01$ and $***0.001$

Table 1 – Participants’ characteristics according to educational attainment and gender (1993-2014, Bus Santé study, State of Geneva, Switzerland)

	Overall	Men				Women			
		Primary education	Secondary Education	Tertiary education	p-value	Primary education	Secondary Education	Tertiary education	p-value
N (%)	16725 (100%)	1257 (14.7%)	4119 (48.2%)	3173 (37.1%)		1750 (21.4%)	3414 (41.8%)	3012 (36.8%)	
age, mean ± SD	52.1 ± 10.6	52.8 ± 10.9	52.8 ± 10.7	51.0 ± 10.6	<0.001	54.6 ± 10.6	52.9 ± 10.4	49.8 ± 10.1	<0.001
Swiss nationality					<0.001				<0.001
No	4704 (28.1%)	690 (54.9%)	964 (23.4%)	1054 (33.2%)		561 (32.1%)	568 (16.6%)	867 (28.8%)	
Yes	12013 (71.9%)	567 (45.1%)	3152 (76.6%)	2116 (66.8%)		1189 (67.9%)	2846 (83.4%)	2143 (71.2%)	
Total alcohol consumption (g/day), mean ± SD	15.9 ± 18.9	26.3 ± 24.7	22.3 ± 23.2	17.8 ± 18.1	<0.001	10.7 ± 13.3	10.0 ± 12.7	10.2 ± 12.7	0.22
Hazardous alcohol consumption					<0.001				0.62
No	13676 (81.8%)	840 (66.8%)	3089 (75.0%)	2641 (83.2%)		1510 (86.3%)	2979 (87.3%)	2617 (86.9%)	
Yes	3049 (18.2%)	417 (33.2%)	1030 (25.0%)	532 (16.8%)		240 (13.7%)	435 (12.7%)	395 (13.1%)	
Smoking status					<0.001				<0.001
Never smoker	6812 (42.5%)	379 (30.2%)	1356 (33.0%)	1403 (44.3%)		819 (53.1%)	1441 (46.2%)	1414 (50.1%)	
Current smoker	3829 (23.9%)	382 (30.4%)	1154 (28.0%)	625 (19.7%)		355 (23.0%)	794 (25.4%)	519 (18.4%)	
Ex-smoker	5385 (33.6%)	496 (39.5%)	1605 (39.0%)	1140 (36.0%)		368 (23.9%)	886 (28.4%)	890 (31.5%)	
Law package period					<0.001				<0.001
Period 1 (before 20 Oct 2000)	7187 (43.0%)	587 (46.7%)	1914 (46.5%)	1120 (35.3%)		1022 (58.4%)	1429 (41.9%)	1115 (37.0%)	
Period 2 (20 Oct 2000 to 1 Feb 2004)	3550 (21.2%)	269 (21.4%)	905 (22.0%)	632 (19.9%)		372 (21.3%)	707 (20.7%)	665 (22.1%)	
Period 3 (2 Feb 2004 to 31 Oct 2009)	2467 (14.8%)	178 (14.2%)	571 (13.9%)	535 (16.9%)		186 (10.6%)	501 (14.7%)	496 (16.5%)	
Period 4 (after 31 Oct 2009)	3521 (21.1%)	223 (17.7%)	729 (17.7%)	886 (27.9%)		170 (9.7%)	777 (22.8%)	736 (24.4%)	

Table 2 – Prevalence ratio, RII and SII of educational attainment and occupational level as determinants of hazardous alcohol consumption

	Men				Women			
	Unadjusted		Adjusted*		Unadjusted		Adjusted*	
	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value
Educational Attainment								
Prevalence ratio:								
primary vs tertiary	1.98 [1.74;2.25]	p<0.001	1.58 [1.39;1.80]	p<0.001	1.05 [0.89;1.23]	0.58	0.84 [0.70;1.00]	0.048
secondary vs tertiary	1.49 [1.34;1.66]	p<0.001	1.32 [1.18;1.47]	p<0.001	0.97 [0.85;1.11]	0.68	0.86 [0.74;0.99]	0.035
RII (least to most educated)	2.52 [2.13;2.98]	p<0.001	1.87 [1.57;2.22]	p<0.001	1.04 [0.83;1.30]	0.72	0.76 [0.60;0.97]	0.026
SII (least to most educated)	0.21 [0.18;0.25]	p<0.001	0.14 [0.11;0.17]	p<0.001	0.01 [-0.02;0.03]	0.7	-0.04 [-0.07;-0.01]	0.008
Occupational level								
Prevalence ratio:								
low vs high	1.56 [1.38;1.76]	p<0.001	1.4 [1.24;1.59]	p<0.001	1.09 [0.82;1.43]	0.56	1.09 [0.81;1.45]	0.58
medium vs high	1.11 [0.97;1.28]	0.12	1.07 [0.93;1.24]	0.31	0.95 [0.80;1.13]	0.57	0.83 [0.70;1.00]	0.053
RII (low to high)	1.99 [1.63;2.42]	p<0.001	1.68 [1.38;2.06]	p<0.001	1.00 [0.73;1.37]	0.99	0.86 [0.62;1.20]	0.38
SII (low to high)	0.15 [0.11;0.18]	p<0.001	0.11 [0.07;0.15]	p<0.001	0.00 [-0.03;0.03]	0.99	-0.02 [-0.05;0.02]	0.30

*adjusted for age, nationality, smoking status and survey date

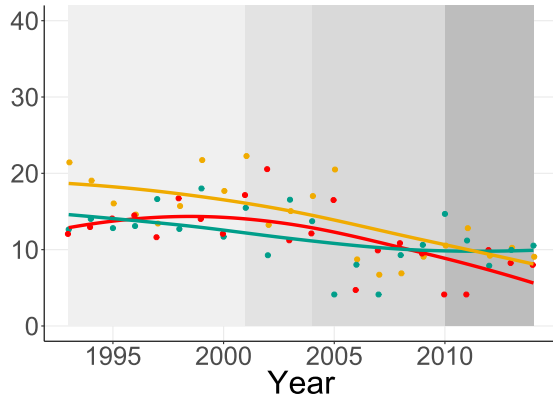
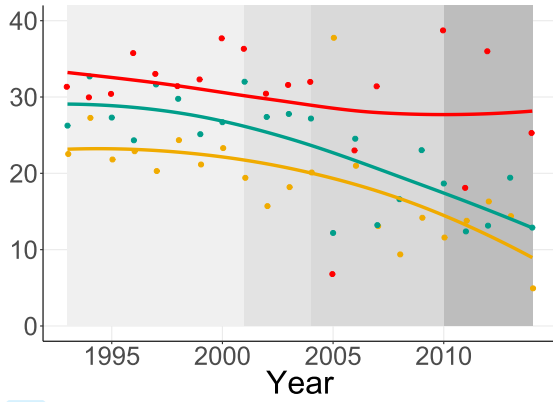
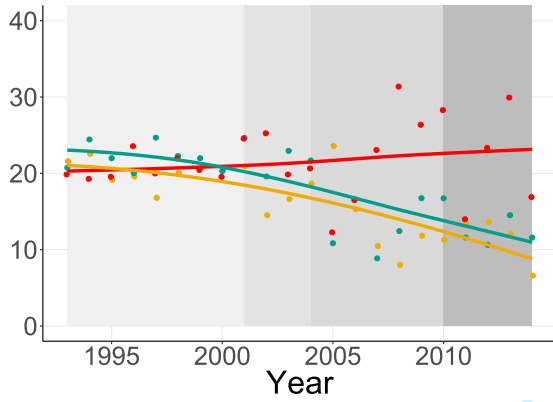
All

Men

Women

a)

% with hazardous alcohol consumption

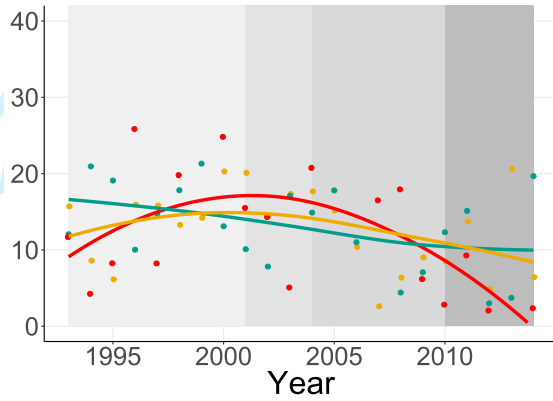
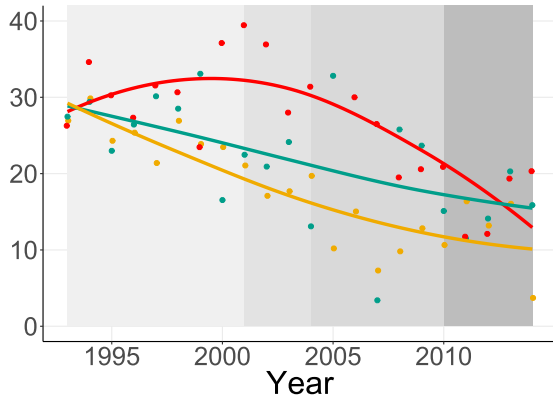
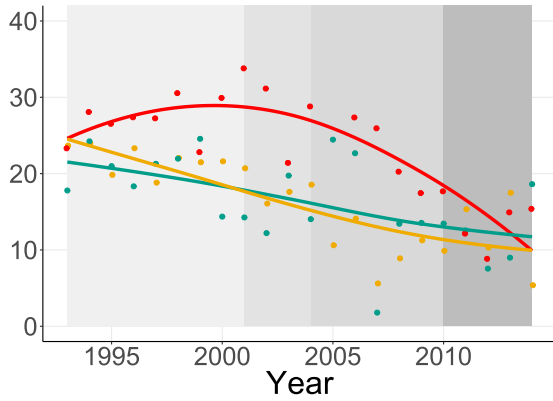


Education

Primary Secondary Tertiary

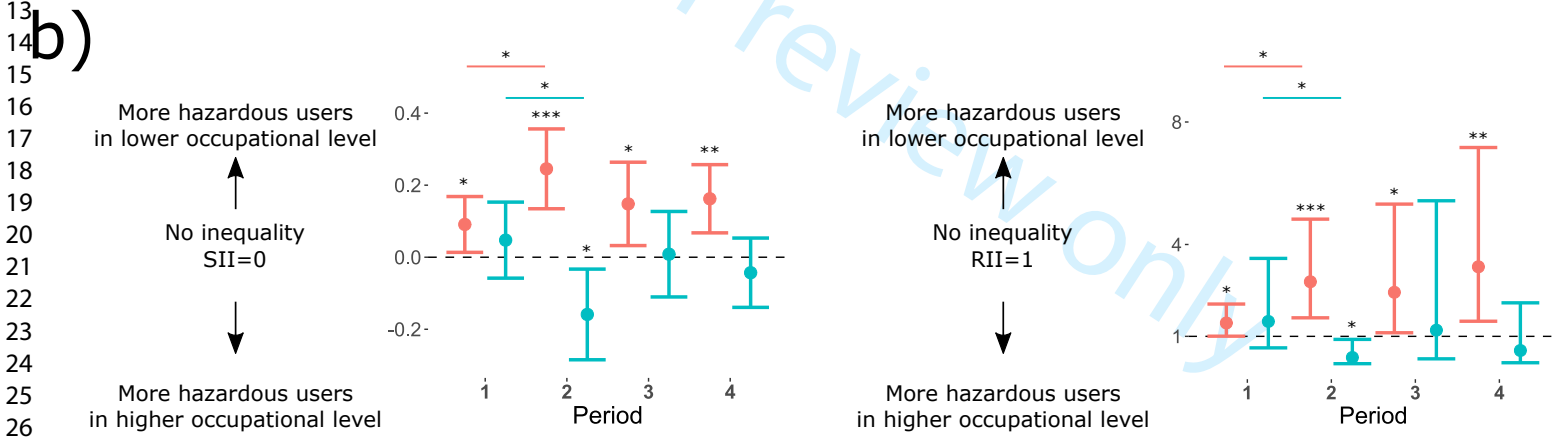
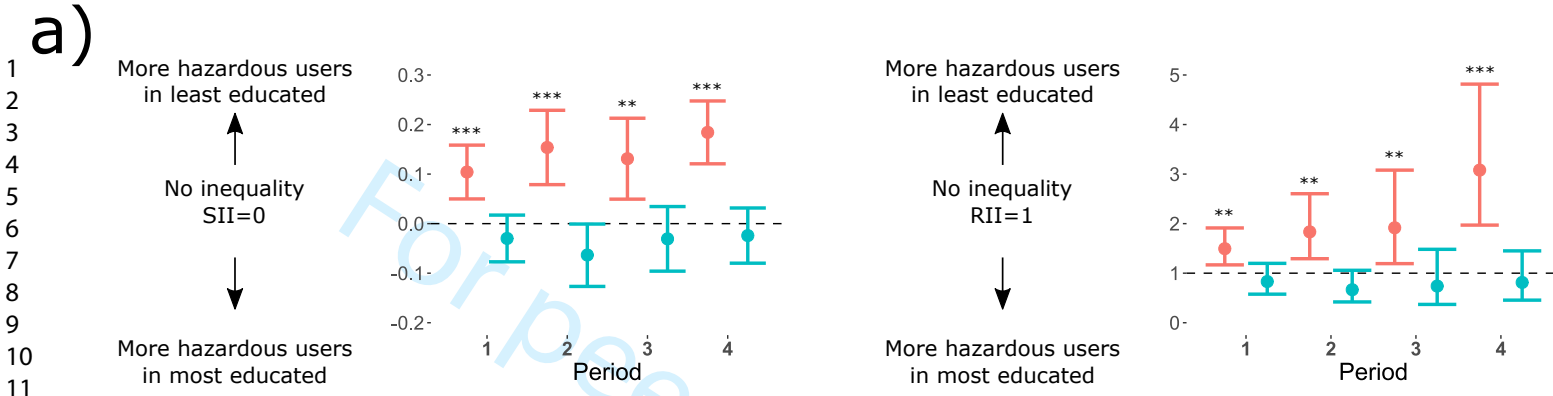
b)

% with hazardous alcohol consumption



Occupational level

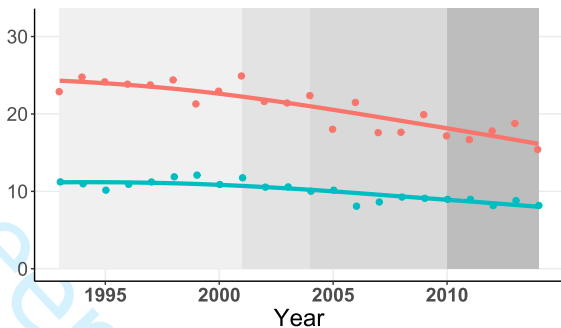
Low Medium High



Gender
● Men ● Women

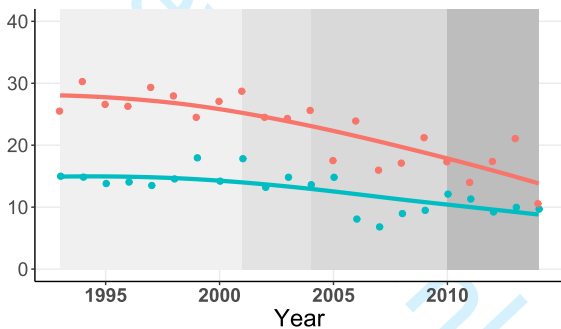
a)

Mean alcohol
consumption
(g/day)



b)

%
with hazardous
alcohol
consumption



Gender

Men Women

All

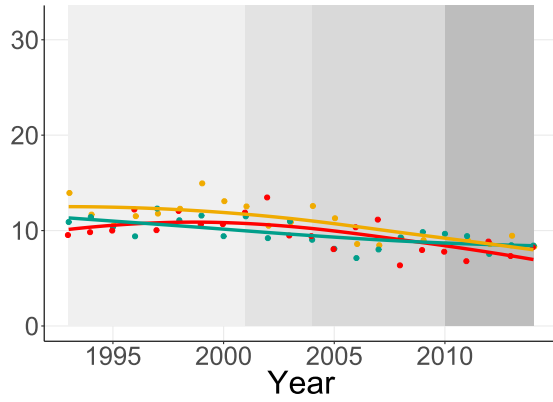
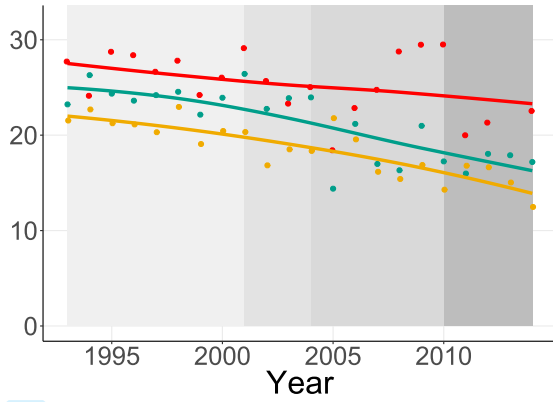
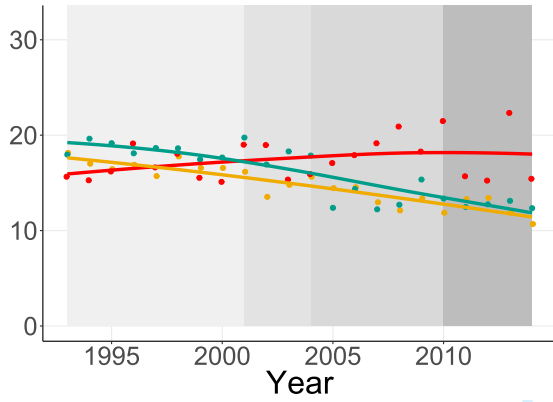
Men

Women

a)

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Mean alcohol consumption (g/day)

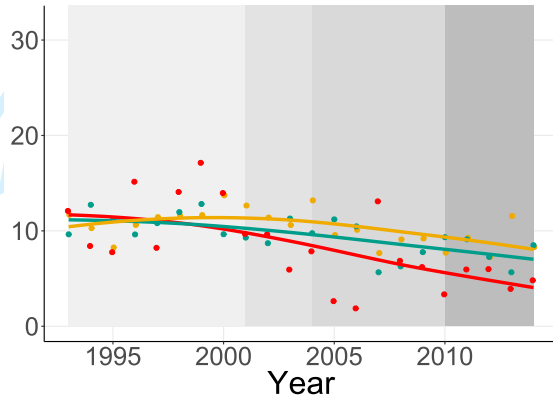
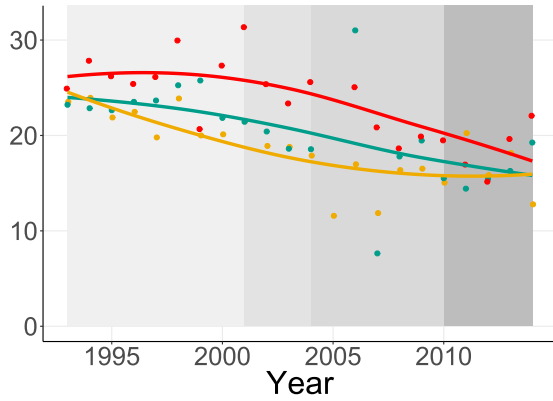
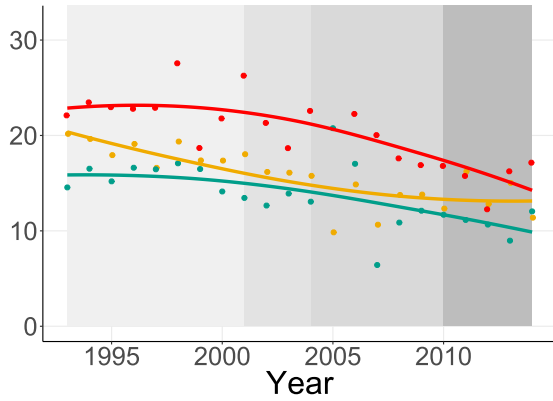


Education
 Primary Secondary Tertiary

b)

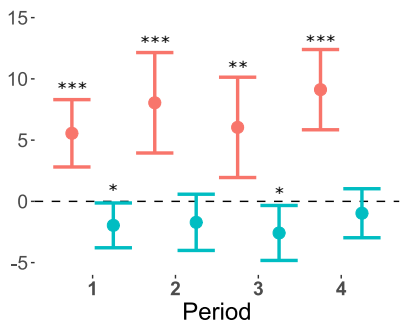
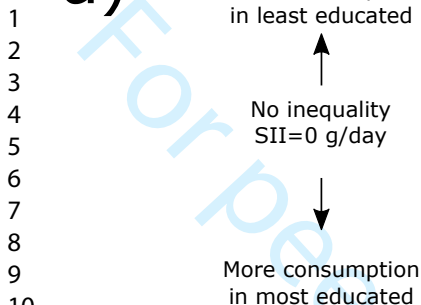
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Mean alcohol consumption (g/day)

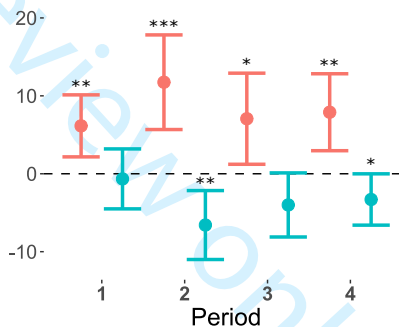
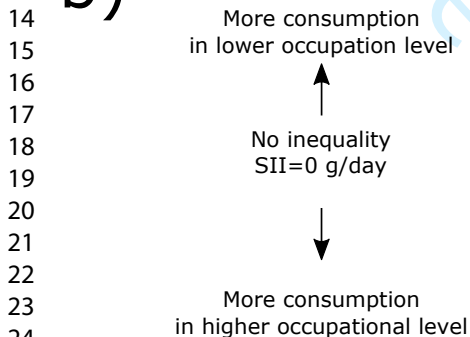


Occupational level
 Low Medium High

a)



b)



Gender

● Men ● Women

Supplementary table 1 – Participants' characteristics according to occupational level and gender (1993-2014, Bus Santé study)

	Overall	Men				Women			
		Low occupational level	Medium occupational level	High occupational level	p-value	Low occupational level	Medium occupational level	High occupational level	p-value
N (%)	11659 (100%)	1696 (25.7%)	1441 (21.9%)	3457 (52.4%)		502 (9.9%)	2441 (48.2%)	2122 (41.9%)	
age, mean ± SD	48.5 ± 8.4	48.3 ± 8.3	47.8 ± 8.3	49.1 ± 8.8	<0.001	48.2 ± 8.6	48.6 ± 7.9	48.0 ± 8.1	0.037
Swiss nationality					<0.001				<0.001
No	3396 (29.1%)	791 (46.7%)	432 (30.0%)	920 (26.6%)		253 (50.4%)	547 (22.4%)	453 (21.4%)	
Yes	8257 (70.9%)	904 (53.3%)	1009 (70.0%)	2534 (73.4%)		249 (49.6%)	1893 (77.6%)	1668 (78.6%)	
Total alcohol consumption (g/day), mean ± SD	15.5 ± 18.6	24.3 ± 25.2	19.3 ± 21.5	18.7 ± 18.9	<0.001	9.3 ± 12.0	9.1 ± 11.1	9.8 ± 12.1	0.12
Hazardous alcohol consumption					<0.001				0.57
No	9701 (83.2%)	1222 (72.1%)	1153 (80.0%)	2837 (82.1%)		439 (87.5%)	2173 (89.0%)	1877 (88.5%)	
Yes	1958 (16.8%)	474 (27.9%)	288 (20.0%)	620 (17.9%)		63 (12.5%)	268 (11.0%)	245 (11.5%)	
Smoking status					<0.001				<0.001
Never smoker	4663 (41.4%)	542 (32.0%)	524 (36.4%)	1439 (41.7%)		242 (52.4%)	964 (43.3%)	952 (48.0%)	
Current smoker	2865 (25.4%)	540 (31.8%)	402 (28.0%)	768 (22.2%)		116 (25.1%)	617 (27.7%)	422 (21.3%)	
Ex-smoker	3732 (33.1%)	614 (36.2%)	512 (35.6%)	1247 (36.1%)		104 (22.5%)	645 (29.0%)	610 (30.7%)	
Law package period					0.095				<0.001
Period 1 (before 20 Oct 2000)	4996 (42.9%)	715 (42.2%)	678 (47.1%)	1476 (42.7%)		203 (40.4%)	1080 (44.2%)	844 (39.8%)	
Period 2 (20 Oct 2000 to 1 Feb 2004)	2498 (21.4%)	369 (21.8%)	290 (20.1%)	736 (21.3%)		116 (23.1%)	548 (22.4%)	439 (20.7%)	
Period 3 (2 Feb 2004 to 31 Oct 2009)	1752 (15.0%)	270 (15.9%)	197 (13.7%)	520 (15.0%)		65 (12.9%)	349 (14.3%)	351 (16.5%)	
Period 4 (after 31 Oct 2009)	2413 (20.7%)	342 (20.2%)	276 (19.2%)	725 (21.0%)		118 (23.5%)	464 (19.0%)	488 (23.0%)	

Supplementary table 2 – Time-series analyses of total and hazardous consumption by gender. Overall and stratified by educational attainment or occupational level

	Educational attainment							
	All		Primary		Secondary		Tertiary	
	beta [95% CI]	P value	beta [95% CI]	P value	beta [95% CI]	P value	beta [95% CI]	P value
Educational attainment								
Men								
Alcohol consumption	-0.34 [-0.41;-0.26]	<0.001	-0.10 [-0.32;0.13]	0.40	-0.41 [-0.53;-0.30]	<0.001	-0.36 [-0.46;-0.27]	<0.001
Hazardous consumption	-0.04 [-0.04;-0.03]	<0.001	0.00 [-0.02;0.02]	0.75	-0.04 [-0.06;-0.03]	<0.001	-0.05 [-0.06;-0.03]	<0.001
Women								
Alcohol consumption	-0.20 [-0.25;-0.15]	<0.001	-0.24 [-0.37;-0.10]	<0.001	-0.16 [-0.23;-0.08]	<0.001	-0.23 [-0.31;-0.16]	<0.001
Hazardous consumption	-0.04 [-0.05;-0.03]	<0.001	-0.04 [-0.07;-0.01]	0.01	-0.03 [-0.05;-0.01]	0.002	-0.04 [-0.06;-0.02]	<0.001
Occupational level								
Men								
Alcohol consumption	-0.43 [-0.52;-0.35]	<0.001	-0.44 [-0.63;-0.25]	<0.001	-0.42 [-0.60;-0.24]	<0.001	-0.44 [-0.63;-0.25]	<0.001
Hazardous consumption	-0.05 [-0.06;-0.04]	<0.001	-0.04 [-0.06;-0.02]	<0.001	-0.05 [-0.07;-0.03]	<0.001	-0.06 [-0.08;-0.05]	<0.001
Women								
Alcohol consumption	-0.20 [-0.26;-0.15]	<0.001	-0.39 [-0.57;-0.20]	<0.001	-0.20 [-0.27;-0.12]	<0.001	-0.17 [-0.26;-0.09]	<0.001
Hazardous consumption	-0.05 [-0.06;-0.03]	<0.001	-0.08 [-0.14;-0.03]	0.002	-0.05 [-0.07;-0.02]	0.001	-0.04 [-0.06;-0.01]	0.003

Note: CI (confidence interval), analyses were adjusted for age, nationality and smoking status.

Supplementary table 3 – Linear regression coefficients and SII of educational attainment and occupational level as determinants of total alcohol consumption.

	Men				Women			
	Unadjusted		Adjusted*		Unadjusted		Adjusted*	
	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value
Educational attainment								
Regression coefficient								
primary vs tertiary education	8.46 [7.04;9.87]	p<0.001	5.48 [4.07;6.89]	p<0.001	0.46 [-0.30;1.21]	0.24	-1.13 [-1.91;-0.34]	0.005
secondary vs tertiary education	4.52 [3.51;5.52]	p<0.001	2.78 [1.78;3.77]	p<0.001	-0.20 [-0.83;0.43]	0.53	-1.25 [-1.88;-0.62]	p<0.001
SII (least to most educated)	11.14 [9.40;12.88]	p<0.001	7.10 [5.37;8.83]	p<0.001	0.44 [-0.59;1.47]	0.4	-1.90 [-2.97;-0.83]	p<0.001
Occupational Level								
Regression coefficient								
low vs high	5.59 [4.35;6.82]	p<0.001	4.33 [3.11;5.55]	p<0.001	-0.51 [-1.64;0.62]	0.38	-0.65 [-1.79;0.48]	0.26
medium vs high	0.60 [-0.71;1.90]	0.36	0.16 [-1.10;1.43]	0.8	-0.70 [-1.38;-0.03]	0.04	-1.34 [-2.01;-0.67]	p<0.001
SII (low to high)	7.98 [6.03;9.93]	p<0.001	6.02 [4.09;7.94]	p<0.001	-1.14 [-2.37;0.09]	0.07	-1.98 [-3.20;-0.76]	0.002

CI (confidence interval), *adjusted for age, nationality, smoking status and survey date

Supplementary table 4 – Absolute (SII) and relative measures (RII) of inequality for total and hazardous alcohol consumption using educational attainment or occupational level as SES indicator. Estimates are presented for each legislative period and by gender

	Period	Educational level		Occupational level	
		Estimate (95%CI)	p value	Estimate (95%CI)	p value
Men					
SII alcohol consumption	1	5.56 [2.81;8.31]	<0.001	6.15 [2.17;10.13]	0.002
	2	8.05 [3.95;12.15]	<0.001	11.75 [5.67;17.82]	<0.001
	3	6.04 [1.95;10.14]	0.004	7.06 [1.22;12.91]	0.018
	4	9.12 [5.85;12.40]	<0.001	7.90 [2.96;12.83]	0.002
RII hazardous alcohol consumption	1	1.49 [1.17;1.91]	0.001	1.44 [1.00;2.05]	0.047
	2	1.83 [1.29;2.60]	0.001	2.78 [1.61;4.83]	<0.001
	3	1.92 [1.19;3.08]	0.007	2.44 [1.12;5.32]	0.025
	4	3.08 [1.97;4.82]	<0.001	3.27 [1.49;7.17]	0.003
SII hazardous alcohol consumption	1	0.10 [0.05;0.16]	<0.001	0.09 [0.01;0.17]	0.021
	2	0.15 [0.08;0.23]	<0.001	0.25 [0.13;0.36]	<0.001
	3	0.13 [0.05;0.21]	0.002	0.15 [0.03;0.26]	0.012
	4	0.18 [0.12;0.25]	<0.001	0.16 [0.07;0.26]	0.001
Women					
SII alcohol consumption	1	-1.96 [-3.79;-0.13]	0.036	-0.66 [-4.51;3.19]	0.737
	2	-1.71 [-4.01;0.58]	0.144	-6.58 [-11;-2.16]	0.004
	3	-2.58 [-4.82;-0.33]	0.024	-4.00 [-8.11;0.11]	0.057
	4	-0.97 [-2.97;1.03]	0.342	-3.30 [-6.60;-0.01]	0.049
RII hazardous alcohol consumption	1	0.83 [0.58;1.20]	0.321	1.49 [0.62;3.55]	0.37
	2	0.67 [0.42;1.06]	0.085	0.31 [0.11;0.90]	0.031
	3	0.74 [0.37;1.48]	0.395	1.20 [0.27;5.43]	0.812
	4	0.81 [0.46;1.45]	0.483	0.54 [0.14;2.09]	0.371
SII hazardous alcohol consumption	1	-0.03 [-0.08;0.02]	0.213	0.05 [-0.06;0.15]	0.378
	2	-0.06 [-0.13;0.00]	0.05	-0.16 [-0.28;-0.03]	0.013
	3	-0.03 [-0.10;0.03]	0.355	0.01 [-0.11;0.13]	0.89
	4	-0.02 [-0.08;0.03]	0.396	-0.04 [-0.14;0.05]	0.381

Supplementary table 5 – Educational attainment as determinant of total alcohol consumption (linear regression coefficients and SII) and hazardous consumption (prevalence ratios, RII and SII). Analysis adjusted for occupational level (including retired, unemployed and housewife/househusband)

	Men				Women			
	Adjusted*		+Occupational level		Adjusted*		+Occupational level	
	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value
Consumption								
Regression coefficient								
primary vs tertiary education	5.48 [4.07;6.89]	p<0.001	4.58 [3.06;6.1]	p<0.001	-1.13 [-1.91;-0.34]	0.005	-1.08 [-1.92;-0.24]	0.012
secondary vs tertiary education	2.78 [1.78;3.77]	p<0.001	2.17 [1.08;3.26]	p<0.001	-1.25 [-1.88;-0.62]	p<0.001	-1.12 [-1.8;-0.45]	0.001
SII (least vs most educated)	7.10 [5.37;8.83]	p<0.001	5.96 [4;7.91]	p<0.001	-1.90 [-2.97;-0.83]	p<0.001	-1.80 [-2.98;-0.61]	0.003
Hazardous consumption								
Prevalence ratio:								
primary vs tertiary	1.58 [1.39;1.80]	p<0.001	1.48 [1.28;1.7]	p<0.001	0.84 [0.70;1.00]	0.048	0.81 [0.67;0.97]	0.023
secondary vs tertiary	1.32 [1.18;1.47]	p<0.001	1.26 [1.12;1.41]	p<0.001	0.86 [0.74;0.99]	0.035	0.84 [0.72;0.98]	0.028
RII (least to most educated)	1.87 [1.57;2.22]	p<0.001	1.71 [1.41;2.08]	p<0.001	0.76 [0.60;0.97]	0.026	0.72 [0.55;0.94]	0.015
SII (least to most educated)	0.14 [0.11;0.17]	p<0.001	0.12 [0.08;0.16]	p<0.001	-0.04 [-0.07;-0.01]	0.008	-0.05 [-0.08;-0.01]	0.004

*adjusted for age, nationality, smoking status and survey date

Supplementary table 6 – Occupational level as determinant of total alcohol consumption (linear regression coefficients and SII) and hazardous consumption (prevalence ratios, RII and SII). Analysis adjusted for educational attainment.

	Men				Women			
	Adjusted*		+Educational attainment		Adjusted*		+Educational attainment	
	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value
Consumption								
Regression coefficient								
low vs high	4.33 [3.11;5.55]	p<0.001	2.52 [1.13;3.91]	p<0.001	-0.65 [-1.79;0.48]	0.26	0.07 [-1.17;1.31]	0.91
medium vs high	0.16 [-1.10;1.43]	0.8	-0.60 [-1.92;0.71]	0.37	-1.34 [-2.01;-0.67]	p<0.001	-0.86 [-1.59;-0.13]	0.02
SII (low to high)	6.02 [4.09;7.94]	p<0.001	4.06 [1.16;6.95]	p<0.001	-1.98 [-3.2;-0.76]	0.002	-1.58 [-3.87;0.71]	0.18
Hazardous consumption								
Prevalence ratio:								
low vs high	1.4 [1.24;1.59]	p<0.001	1.18 [1.03;1.36]	0.02	1.09 [0.81;1.45]	0.58	1.29 [0.94;1.78]	0.12
medium vs high	1.07 [0.93;1.24]	0.31	0.99 [0.86;1.15]	.89	0.83 [0.70;1.00]	0.053	0.93 [0.76;1.14]	0.48
RII (low to high)	1.68 [1.38;2.06]	p<0.001	1.37 [1.01;1.85]	0.04	0.86 [0.62;1.20]	0.38	1.16 [0.62;2.17]	0.65
SII (low to high)	0.11 [0.07;0.15]	p<0.001	0.07 [0.02;0.13]	0.01	-0.02 [-0.05;0.02]	0.30	0.02 [-0.05;0.08]	0.56

*adjusted for age, nationality, smoking status and survey date

Supplementary table 7 – Time-series analyses of total and hazardous alcohol consumption by gender. Overall and stratified by educational attainment or occupational level.

	All		Primary		Secondary		Tertiary	
	beta [95% CI]	P value	beta [95% CI]	P value	beta [95% CI]	P value	beta [95% CI]	P value
Educational attainment*								
Men								
Alcohol consumption	-0.35 [-0.42;-0.27]	<0.001	-0.12 [-0.35;0.11]	0.29	-0.42 [-0.53;-0.30]	<0.001	-0.37 [-0.47;-0.28]	<0.001
Hazardous consumption	-0.04 [-0.04;-0.03]	<0.001	0.00 [-0.02;0.02]	0.93	-0.04 [-0.06;-0.03]	<0.001	-0.05 [-0.07;-0.03]	<0.001
Women								
Alcohol consumption	-0.20 [-0.25;-0.15]	<0.001	-0.27 [-0.4;-0.13]	<0.001	-0.15 [-0.22;-0.07]	<0.001	-0.23 [-0.31;-0.15]	<0.001
Hazardous consumption	-0.04 [-0.05;-0.02]	<0.001	-0.05 [-0.08;-0.02]	0.002	-0.03 [-0.05;-0.01]	0.006	-0.04 [-0.06;-0.02]	<0.001
Occupational level**								
Men								
Alcohol consumption	-0.40 [-0.48;-0.31]	<0.001	-0.44 [-0.63;-0.25]	<0.001	-0.38 [-0.57;-0.20]	<0.001	-0.39 [-0.49;-0.28]	<0.001
Hazardous consumption	-0.05 [-0.06;-0.04]	<0.001	-0.04 [-0.06;-0.02]	<0.001	-0.04 [-0.07;-0.02]	<0.001	-0.06 [-0.07;-0.04]	<0.001
Women								
Alcohol consumption	-0.21 [-0.27;-0.15]	<0.001	-0.38 [-0.57;-0.19]	<0.001	-0.21 [-0.29;-0.13]	<0.001	-0.18 [-0.26;-0.09]	<0.001
Hazardous consumption	-0.05 [-0.07;-0.03]	<0.001	-0.08 [-0.14;-0.03]	0.003	-0.05 [-0.08;-0.03]	<0.001	-0.04 [-0.07;-0.01]	0.002

Note: all analyses adjusted for age, nationality and smoking status. *Educational attainment analysis adjusted for occupational level (including retire, unemployed and housewives/househusbands), ** occupational analysis adjusted for educational attainment

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2- abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	6-9
Study size	10	Explain how the study size was arrived at	6-7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	6
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	9-10
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6,10
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1 & 10-11
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	Table 1
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	11-12

		which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-12 and Sup tables
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Alcohol control policies and socioeconomic inequalities in hazardous alcohol consumption: a 22-year cross-sectional study in a Swiss urban population

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3 **Alcohol control policies and socioeconomic inequalities in hazardous**
4 **alcohol consumption: a 22-year cross-sectional study in a Swiss urban**
5 **population**
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Abstract

Objective

Harmful use of alcohol represents a large socioeconomic and disease burden and displays a socioeconomic status (SES) gradient. Several alcohol control laws were devised and implemented, but their equity impact remains undetermined.

We ascertained if an SES gradient in hazardous alcohol consumption exists in Geneva (Switzerland) and assessed the equity impact of the alcohol control laws implemented during the last two decades.

Design

Repeated cross-sectional survey study

Setting

We used data from non-abstinent participants, aged 35 to 74 years, from the population-based cross-sectional Bus Santé study (n=16 725), between 1993 and 2014.

Methods

SES indicators included educational attainment (primary, secondary and tertiary) and occupational level (high, medium and low). We defined four survey periods according to the implemented alcohol control laws, and hazardous alcohol consumption (outcome variable) as >30g/day for men and >20g/day for women.

The slope (SII) and relative (RII) indexes of inequality were used to quantify absolute and relative inequalities, respectively, and were compared between legislative periods.

Results

Lower educated men had a higher frequency of hazardous alcohol consumption (RII=1.87 [1.57;2.22] and SII=0.14 [0.11;0.17]). Lower educated women had less hazardous consumption ((RII=0.76 [0.60;0.97] and SII=-0.04 [-0.07;-0.01]). Over time, hazardous alcohol consumption decreased, except in lower educated men.

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3 Education-related inequalities were observed in men in all legislative periods and did
4 not vary between them. Similar results were observed using occupational level as SES
5 indicator. In women, significant inverse SES gradients were observed using educational
6 attainment but not for occupational level.
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11 **Conclusions**

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14 Population-wide alcohol control laws did not have a positive equity impact on
15 hazardous alcohol consumption. Targeted interventions to disadvantaged groups may be
16 needed to address the hazardous alcohol consumption inequality gap.
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23 **Strengths and limitations of this study**

- 24 • Relatively large cross-sectional study spanning 20 years
 - 25 • Use of relative and absolute inequality regression-based measures
 - 26 • Equity impact of several alcohol control measures was evaluated
 - 27 • No longitudinal data to clearly assess causality
 - 28 • Possible confounding by the 2008 economic crisis cannot be excluded.
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41 **Keywords:** Socioeconomic factors, inequality, hazardous alcohol consumption, alcohol
42 control laws, education, occupation.
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1 - INTRODUCTION

Harmful use of alcohol is responsible for a large social, economic and disease burden. According to the World Health Organization (WHO), harmful use of alcohol is estimated to represent 5.9% of worldwide mortality, accounting for 3.3 million deaths per year. Additionally, the global burden of disease and injury attributed to alcohol represents 5.1% of the total disability-adjusted life years, being in the origin of an excess of 200 injury and disease conditions.[1] Both mortality and morbidity related to alcohol consumption have increased over time.[2-4]

Considering the high burden of disease attributed to alcohol consumption, several legislative interventions were advocated by the WHO [5] and by the Organisation for Economic Co-operation and Development (OECD). Many of these interventions aiming at the reduction of harmful consumption were implemented in several countries and were met with considerable success.[6]

As in other harmful behaviours, a social gradient in alcohol consumption was identified, with higher consumption existing in individuals with lower socioeconomic status (SES).[7-9] Also, its effects on health are socially patterned with higher alcohol-related mortality in low educated individuals and manual workers,[10] and alcohol-related mortality significantly associated with the rise of unemployment rates.[11] Some institutions, like the WHO, have set practical measures to prevent the widening of alcohol-related inequalities and, ideally, to reduce them. Policies such as alcohol taxation and price rising, age limits for purchase and drink-driving, and restriction of alcohol marketing, advertising and promotion, coupled with interventions for heavy drinkers and vulnerable groups are amongst those suggested.[12] However, the impact of these policies on SES inequalities in alcohol consumption remains to be determined. Existing studies mainly focus on the equity impact of taxation policies with results

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3 suggesting that tax increases have a strong pro-equity effect, particularly for those with
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5 higher alcohol consumption.[13-14]
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9 In Geneva (Switzerland), several alcohol control laws were implemented during the last
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11 two decades.[15] In 2000, an alcohol advertising ban was introduced, while in 2004
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13 there was a three-fold increase in prices of alcopop beverages (e.g. premixed drinks), a
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15 decrease in the alcohol driving limit, an off-premise sale interdiction between 9pm and
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17 7am, and an alcohol sale interdiction in video stores and gas stations. Smoking bans
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19 were suggested to reduce alcohol demand,[16-17] and such a ban was implemented in
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21 Geneva in 2009. A recent study [15] showed a decrease in overall alcohol consumption
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23 and in hazardous drinking, in men and women in Geneva between 1993 and 2014,
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25 independently of policy changes. Still, differential impact according to SES was not
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27 assessed.
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33 The main aim of this study was, first, to determine if an SES gradient in hazardous
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35 alcohol consumption exists in the adult population of Geneva and, second, to assess the
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37 impact of the implemented alcohol control policies on this gradient, if any. As a
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39 secondary aim, we also sought to determine the impact of the successive legislative
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41 interventions on inequalities of total daily alcohol consumption, if they existed.
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2 - METHODS

2.1 - Participants

We used data from the Bus Santé study, a continuing population-based study in the State of Geneva (population of approximately 490 000 inhabitants in 2016) monitoring health and associated risk factors. As previously described,[18] independent samples of residents were subjected to annual health examination surveys since 1993. A resident list provided by the local authorities was used to select participants who were aged 35-74 years until 2011 and 20-74 years afterwards. Gender and 10-year age strata were used for stratified random sampling. Each participant was invited to a Bus Santé study unit where trained collaborators would administer the questionnaires. One of the three study units was a mobile unit visiting different areas of the Geneva Canton while the other two were based at the Geneva University Hospitals.

Individuals who did not respond to the invitation were telephoned up to seven times at different days of the week and times of the day. If contact was not established, two extra invitations were mailed. When participants were unreachable they were considered as non-responders and replaced.

Participation rate varied with 60.1% for 1996-2003, 56.2% for 2004-2009 and 50.8% for the 2010-2014 period. Participant recruitment decreased during the period between 2005 and 2008 due to a simultaneous study taking place with shared logistical resources but not focusing on the same population.

The Bus Santé study was conducted in accordance with the principles of the Declaration of Helsinki, was granted approval by the Institute of Ethics Committee of the University of Geneva, and obtained written consent from all participants.

2.2 - Exclusion criteria

We included participants with ages between 35 and 74 years, the age group consistently recruited during the entirety of the Bus Santé study. We excluded abstinent participants (n=3059, 15.2%) and those with missing data on educational attainment (n=368, 2.2%), assumed to be missing completely at random. For occupational level analysis, participants that were not working (unemployed n=789, 4.7%; retired n=2753, 16.4% and housewives/househusbands n=1635, 9.7%) or with missing for this variable (n=257, 1.5%) were also excluded.

2.3 - Outcome variable

The main outcome variable was hazardous alcohol consumption (>30g/day for men and >20g/day for women) established based on data from total daily alcohol intake in g/day. Hazardous alcohol consumption was defined according to the Swiss Institute for Alcohol and Drug Prevention guidelines in 2017 (<http://www.iard.org/wp-content/uploads/2016/02/Drinking-Guidelines-General-Population.pdf>) and like previous studies on Swiss alcohol consumption.[19] Total daily alcohol intake was determined using a validated food frequency questionnaire (FFQ), as previously described,[15] taking into account consumption frequency, type of alcoholic beverage (wine, champagne, beer, aperitifs such as anisette or martini, and spirits like liqueur, brandy or whisky) and average serving size compared to a 10g alcohol standard for each beverage (similar, bigger or smaller). The same FFQ was used throughout the totality of the study, with the resulting data having incorporated large international consortia.[20]

2.4 - Covariates

We created a categorical variable identifying participants who were surveyed during periods that differed in the implemented alcohol control laws: period 1 (before 20/10/2000, baseline), period 2 (from 20/10/2000 to 01/02/2004 - introduction of

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3 advertising ban), period 3 (from 02/02/2004 to 31/10/2009 - 300% increase in alcopop
4 price, decrease of legal alcohol driving limit, off-premise sale interdiction of alcoholic
5 beverages from 9pm to 7am and gas stations and video stores are no longer allowed to
6 sell alcohol) and period 4 (from 01/11/2009 onwards – implementation of a public
7 smoking ban).

8
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10 As in Huisman et al., [21] we considered educational attainment in 3 levels: i) Primary -
11 no end of school certification (“Maturité”) or no professional apprenticeship, ii)
12 Secondary - obtaining “Maturité” or professional apprenticeship and iii) Tertiary
13 (university degree).

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16 Current occupation was categorised into three categories according to the British
17 Registrar General’s Scale:[22] high (professional and intermediate professions),
18 medium (non-manual occupations) and low (manual or lower occupations).

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21 Age was used as a continuous variable; smoking status was classified into never
22 smokers, current smokers and ex-smokers, and nationality as Swiss or other.

23 24 25 **2.5 - Statistical analysis**

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28 For descriptive statistics, continuous variables are presented as mean \pm standard
29 deviation (SD) while categorical ones as absolute and relative frequencies.

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31
32 Chi-squared test of independence and one-way ANOVA were used to assess the
33 significance of group differences in categorical and continuous variables, respectively.

34
35
36 All analyses were stratified by gender. Outcome proportions in different survey years,
37 as displayed in Figure 1 and Supplementary Figure 1, were age-adjusted using the age
38 distribution of the Swiss population in 2014
39 (<https://www.bfs.admin.ch/bfs/en/home/statistics/population.html>).

40
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42 Time-series analyses were performed (overall and stratified by educational attainment
43 or occupational level), using adjusted linear (for total consumption) or binomial (for
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3 hazardous consumption) regression models. Coefficients for the calendar year variable
4
5 are reported.
6

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8 Poisson regression models were used to test the association between exposure
9
10 (educational attainment and occupational level) and outcome variables (hazardous
11
12 alcohol consumption and total daily alcohol consumption), and to estimate prevalence
13
14 ratios (PR). Besides age, nationality and smoking status, models were also adjusted for
15
16 survey date in calendar years to take secular trends into account.[23-25]
17

18
19 We used the STATA package *RIIGEN* [26-27] to calculate SES variables adjusted for
20
21 group size and relative SES position using a ridity scoring method. These variables were
22
23 then used to calculate the slope index of inequality (SII) and the relative index of
24
25 inequality (RII) which quantify absolute and relative differences between SES-defined
26
27 strata, respectively. For total daily alcohol consumption, a continuous outcome variable,
28
29 we chose to only calculate the SII since it is more interpretable than a relative measure
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31 in this context and this was not the main outcome variable of the study.
32
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35 These regression-based indexes describe differences between the SES extremes taking
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37 into account the intermediate categories.[27] For instance, RII=1.3 represents an added
38
39 30% outcome prevalence in the lowest SES group compared to the highest, similar to a
40
41 prevalence ratio. SII, an impact measure, indicates the absolute difference in outcome
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43 prevalence between lowest and highest SES groups. For example, SII=0.3 indicates 30
44
45 more individuals with the outcome per 100 individuals in the lowest SES group
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47 compared to the highest one. When used with continuous variables, as total alcohol
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49 consumption, SII=4 would indicate an excess consumption of 4g/day in the lowest SES
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51 group when compared to the highest.
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55 Both indexes were calculated for each of the four periods and compared between them
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57 using pairwise Wald tests.
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3 Sensitivity analyses of the educational attainment and the occupational level-based
4 models were performed through adjustment for a second SES indicator (occupational
5 level or educational attainment, respectively). Adjustment of educational attainment
6 model by occupational level included non-working individuals: retired, unemployed and
7 housewives/househusbands. Reciprocal adjustment did not change the overall trends
8 (sensitivity analyses can be found in Supplementary Tables 1-3). A sensitivity analysis
9 for interperiod differences in SES inequalities indexes was also performed through
10 testing for significant interactions between the RIIGEN-generated SES variables and
11 legislative period (Supplementary Table 4).

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23 Data were analysed using STATA 13.1 and R 3.2.2.

24 25 26 **2.6 – Patient and public involvement**

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28 Patients and the public were not involved in developing the research question, study
29 design or outcome measures. While direct dissemination of study results has not been
30 planned, they will be communicated through our institutional media services.

31 32 33 34 35 36 **3 - RESULTS**

37 38 39 **3.1 - Characteristics of participants**

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41 Forty-three per cent of participants were surveyed in period 1, 21.2% in period 2, 14.8%
42 in period 3 and 21.1% in period 4.

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44
45 The participant characteristics stratified by gender and educational attainment can be
46 found in Table 1. For education-based analyses, we included 16 725 participants of
47 which 18.0% had primary education, 45.0% secondary education and 37.0% tertiary
48 education. The mean daily consumption of alcohol was 15.9±18.9 g/day and 18.2%
49 were found to have hazardous alcohol consumption. When stratified by gender and
50 educational attainment, higher educated participants of both genders were younger and
51 less probably current smokers. Furthermore, daily alcohol consumption and the
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3 proportion of participants with hazardous alcohol consumption were higher in lower
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5 educated men, while no differences could be observed in women.
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8 For the occupational level analysis, we included 11 659 working participants and their
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10 characteristics are reported in Supplementary Table 5. Similarly to the educational
11
12 attainment stratification, lower alcohol consumption and lower proportion of
13
14 consumption at risk were found in men with high occupational level and no differences
15
16 were observed amongst women.
17

18 19 20 **3.2 - Time trends of hazardous alcohol consumption**

21
22 Alcohol consumption (Supplementary Figure 2a) and the proportion of drinkers with
23
24 hazardous consumption (Supplementary Figure 2b) have decreased in both genders
25
26 between 1993 and 2014 (Supplementary Table 6). Yet, when time trends were stratified
27
28 by educational attainment, we observed that the decrease has not occurred similarly
29
30 across all educational attainment-related groups, since men with primary education did
31
32 not display a reduction in hazardous alcohol consumption like their counterparts with
33
34 secondary and tertiary education (Figure 1a). However, when using occupational level
35
36 as an SES indicator, after an initial increase in hazardous consumption in participants
37
38 with low occupational level, a decrease could be observed in later periods (Figure 1b).
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40 To test if the observed time trends were not due to differences in participant
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42 characteristics other than educational attainment and occupational level, data were fitted
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44 into multivariable binomial models to obtain adjusted time trends (Supplementary Table
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46 6). We identified negative adjusted time trends for both outcomes, in both genders
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48 ($\beta_{\text{hazardous consumption in men}} = -0.04 [-0.04; -0.03]$ $p < 0.001$, $\beta_{\text{hazardous consumption in women}} = -0.04 [-$
49
50 $0.05; -0.03]$ $p < 0.001$). As suggested by Figure 1a and Supplementary Table 6, adjusted
51
52 time trend analysis stratified by educational attainment showed that hazardous
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54 consumption did not change among men with primary education ($\beta_{\text{primary}} = -0.00 [-$
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0.02;0.02] $p=0.75$), while it decreased among men with secondary or tertiary education ($\beta_{\text{secondary}}=-0.04$ [-0.06;-0.03] $p<0.001$; $\beta_{\text{tertiary}}=-0.05$ [-0.06;-0.03] $p<0.001$). For women, the time trends were all negative. Analyses stratified by occupational level revealed a harmonious decrease in hazardous alcohol consumption in all levels and for both genders (Supplementary Table 6).

Similar results were observed when total daily alcohol intake was used as the outcome variable (Supplementary Figure 1a-b, Supplementary Table 6). However, contrarily to hazardous alcohol consumption for which no inequalities in women were observed in any of the periods, significant inequalities favouring the lower SES groups were observed in periods 1 and 3 (Supplementary Figure 3).

3.3 - Association between educational attainment, occupational level and hazardous alcohol consumption

We observed more hazardous consumption in lower educated men ($PR_{\text{primary vs tertiary}}=1.58$ [1.39;1.80] $p<0.001$, $PR_{\text{secondary vs tertiary}}=1.32$ [1.18;1.47] $p<0.001$) with this being reflected in the relative and absolute indexes of inequality ($RII=1.87$ [1.57;2.22] $p<0.001$ and $SII=0.14$ [0.11;0.17] $p<0.001$, respectively) (Table 2). On the other hand, lower education was associated with less hazardous consumption in women ($RII=0.76$ [0.60;0.97] $p=0.026$ and $SII=-0.04$ [-0.07;-0.01] $p=0.008$) (Table 2).

An occupational level-related gradient was observed in men, those with lower occupational level having a higher proportion of hazardous consumption ($RII=1.68$ [1.38;2.06] $p<0.001$ and $SII=0.11$ [0.07;0.15] $p<0.001$) (Table 2). Conversely, no such gradient was found in women (Table 2).

Similar findings were obtained for total daily alcohol intake, except for women with a lower occupational level which displayed lower daily alcohol consumption (Supplementary Table 7).

3.4 - Alcohol laws, alcohol consumption, and SES inequalities

In men, we identified absolute and relative education-related inequalities in hazardous alcohol consumption in all periods and favouring the most educated (Figure 2a, Supplementary Table 8). No differences between successive periods were observed ($p>0.05$) (Figure 2a). In women, no education-related inequalities were observed during the various legislative periods (Figure 2a, Supplementary Table 8).

Occupational level-related inequalities in men were also observed in absolute and relative terms and increased between period 1 and 2 ($p<0.05$), remaining constant thereafter (Figure 2b, Supplementary Table 8).

In women, inequalities in favour of those with lower occupational level were only observed in period 2, with an increase being observed between period 1 and 2 ($p<0.05$) (Figure 2b, Supplementary Table 8).

Similar results were obtained concerning daily alcohol intake (Supplementary Figure 3a-b, Supplementary Table 8).

Time trend interaction-based sensitivity analysis for education-related inequalities identified a difference in relative inequalities in period 4 (compared to the reference period 1), which seemed to increase (interaction=2.2 [1.3;3.6], $p=0.002$, Supplementary Table 4). The same analysis using occupation level as SES indicator identified the differences mentioned above between period 1 and 2 in both genders, but also an increase in relative inequalities in men in period 4 (interaction=2.6 [1.1;6.2], $p=0.02$, Supplementary Table 4).

4 - DISCUSSION

We identified a social gradient in alcohol drinking patterns among men, with lower SES being associated with higher proportion of hazardous consumption and higher total daily alcohol consumption. In women, a less pronounced inverse gradient was observed with higher SES being associated with higher hazardous consumption and higher total daily consumption. Differently from men for whom the inequalities in hazardous consumption were observed using both SES indicators, in women the inequalities were only related to educational attainment.

These patterns were also found in other studies: low education and manual occupation males tend to have a higher prevalence of alcohol consumption, contrarily to women.[6-7] This gender discrepancy in inequalities suggests that different mechanisms, other than those related to SES, are behind hazardous alcohol consumption in each of the genders. While the reasons behind this discrepancy are still elusive, it is possible that like tobacco smoking,[28] among women, alcohol consumption started to be seen as a symbol of increased socioeconomic status and emancipation.[29-30] Like the tobacco industry, the alcohol industry seems to be exploiting this fact.[31] As such, policies to address inequalities in alcohol consumption should be gender-adapted and informed by further studies on their nature.

We also observed a discrepancy between time trends when educational attainment or occupational level were used as SES indicators. Sensitivity analyses showed that this was not due to the educational attainment-based analysis including non-working participants. SES indicators such as education and occupational level often display low to moderate correlations and cannot be used interchangeably.[32-34] Furthermore, each indicator may be related to different causal mechanisms and can be differentially associated with a specific health-related outcome.[32] It is thus possible that lower

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3 education has a wider impact on other SES-related determinants of persistent alcohol
4 consumption than occupation, justifying the observed discrepancies in alcohol
5 consumption trends.
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10 Differently from previous studies, we studied the evolution of alcohol drinking patterns
11 during a 22-year period. Though hazardous consumption decreased in both genders,
12 inequalities in alcohol consumption remained stable among men, with relative
13 inequalities in men potentially increasing during the latter period of the study when
14 compared to earlier ones. No specific inequality patterns were identified for the periods
15 with different legislative alcohol control measures (advertising ban, a three-fold
16 increase in alcopop price, a decrease of legal alcohol driving limit, and ban of the off-
17 premise sale of alcoholic beverages from 9pm to 7am and at gas stations and video
18 stores). The lack of equity impact of these measures can potentially be explained in light
19 of the recommendations and reports by the WHO [12] and OECD.[6] Though these
20 institutions recommend raising the taxes of all alcoholic products, the OECD described
21 Switzerland as having mild alcohol taxation with some of the lowest taxes on beer and
22 wine.[6] Moreover, increasing the tax on an alcoholic product does not directly reduce
23 consumption, since it does not guarantee an increase in the final price of the product, or
24 a relevant price increase considering the populations' purchasing power. A recent report
25 pointed out that price increases due to taxation were regressive measures in nature, with
26 a bigger financial burden on individuals with low SES, thus with a potential positive
27 equity impact.[35] However, this study was mainly based on data from low/middle-
28 income countries where the majority of consumers belong to high SES strata. Lack of
29 data concerning high-income countries precluded the same analysis in this context. Our
30 results suggest that the increase in tax on alcopop beverages did not have a positive
31 equity impact in hazardous alcohol consumption and further increases in taxation of
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3 other alcoholic products are probably needed. Also, easy circulation between
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5 neighbouring regions and countries may have allowed smuggling of beverages with a
6
7 lower price. This is particularly relevant for regions like Geneva due to its proximity to
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9 the France-Switzerland border. Finally, and even though our study covered a relatively
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11 long period, legislative measures may have a delayed impact in time, not observable in
12
13 the time span of this study.
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16 17 18 **4.1 - Strengths**

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20 We analysed a population-based sample of participants from a single region spanning a
21
22 22-year period. This relatively homogeneous sample allowed us not only to measure
23
24 alcohol consumption and its inequalities in this population but also to follow them in
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26 different periods according to which alcohol control laws were implemented. We used
27
28 two SES indicators (educational attainment and occupational level) and the lack of
29
30 effect of alcohol control measures on inequalities based on both indicators further
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32 increases the robustness of our findings. Furthermore, we measured inequalities and
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34 their trends complementing the relative with absolute measures in order to determine the
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36 impact that interventions to reduce inequalities could have had on the outcomes.[27, 36]
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41 42 **4.2 - Limitations**

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44 Our study has several limitations. First, it was based on self-reported repeated cross-
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46 sectional data instead of longitudinal, not allowing the follow-up of alcohol
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48 consumption and its inequalities at the individual level. Second, the participation rate, as
49
50 in another cross-sectional survey studies, ranged between 51% and 60%, and,
51
52 accordingly, selection bias cannot be excluded. Third, strong enforcement and
53
54 coordinated multi-level approach are capital for effective implementation of alcohol
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56 control laws. Unfortunately, we could not evaluate the degree of law enforcement as no
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58 data on measure adoption were available, and we were not able to control for the price
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3 trends of the alcoholic products. Also, the implemented laws could have had a
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5 differential effect on population subgroups defined by factors other than SES indicators.
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7 The mental and general health status of the participants was also not taken into account
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9 and confounding by these variables cannot be excluded. The effects of each legislative
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11 package could have been delayed in time and appeared on subsequent periods or even
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13 beyond the time frame of this study. Moreover, the time span of this study included the
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15 2008 economic crisis, which may have impacted on alcohol consumption and its
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17 inequalities, as noted by Stuckler et al.[11] Finally, besides confounding by other
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19 unrecorded factors, our study is based on a single region of a high-income country,
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21 probably limiting the generalisability of the findings to settings that differ greatly from
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23 Geneva.
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29 5 - CONCLUSION

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31 In the male adult population of Geneva, SES inequalities in hazardous alcohol
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33 consumption were identified, favouring the better off. An inverse, but less pronounced
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35 SES gradient was observed in women. The successive anti-alcohol legislation
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37 implemented in the last 20 years was unable to reduce the SES inequalities in men. To
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39 close the inequality gap in this harmful behaviour in settings similar to Geneva,
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41 evaluating the equity impact of legislative interventions and using adjuvant targeted
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43 measures could be of great importance.
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49
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51

52
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54
55 complies with the ethical standards established by the Declaration of Helsinki and
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57 informed consent was obtained from all participants.
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3 **Author contributions:** José Luis Sandoval and Teresa Leão: conceptualisation,
4 analysis and interpretation of results, manuscript writing and revision. Jean-Marc
5 Theler, Thierry Favrod-Coune, Barbara Broers, Jean-Michel Gaspoz, Pedro Marques
6 Vidal: data collection, interpretation of results, manuscript reviewing and final editing
7 the final manuscript. Idris Guessous: conceptualisation, data collection, interpretation of
8 results, manuscript writing and revision.
9

10
11
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13
14

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16
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22
23 **Data sharing statement:** Consent has not been obtained to share the data publicly.
24 However, data may be accessed upon contacting the corresponding author. The same
25 principle applies for statistical analysis scripts.
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For peer review only

Figure Legends

Fig. 1 Age-adjusted proportions of participants with hazardous alcohol consumption stratified by gender and a) educational attainment and b) occupational level.

Footnote: Trends were obtained using locally weighted scatterplot smoothing. Each shaded period represents one of the periods with different alcohol control laws

Fig. 2 Absolute (SII) and relative (RII) inequalities in hazardous alcohol consumption for men (red) and women (blue) for a) educational attainment and b) occupational level.

Footnote: Estimates and 95% confidence intervals are presented as well as the level of significance. Wald test p values comparing indexes between groups are presented when <0.05 . $p < *0.05$, $**0.01$ and $***0.001$

Supplementary fig. 1 Age-adjusted mean daily alcohol consumption alcohol consumption (g/day) stratified by gender and a) educational attainment and b) occupational level.

Footnote: Trends were obtained using locally weighted scatterplot smoothing. Each shaded period represents one of the periods with different alcohol control laws

Supplementary fig. 2 Evolution of age-adjusted mean alcohol consumption and percentage of drinkers with hazardous alcohol consumption from 1993 to 2014 for men (red) and women (blue).

Footnote: Trends were obtained using locally weighted scatterplot smoothing. Each shaded period represents one of the periods with different alcohol control laws

Supplementary fig. 3 Absolute (SII) inequalities in total daily alcohol consumption for men (red) and women (blue) for a) educational attainment and b) occupational level.

Footnote: Estimates and 95% confidence intervals are presented as well as the level of significance. Wald test p values comparing indexes were all $p > 0.05$. $p < *0.05$, $**0.01$ and $***0.001$

Table 1 – Participants’ characteristics according to educational attainment and gender (1993-2014, Bus Santé study, State of Geneva, Switzerland)

	Overall	Men				Women			
		Primary education	Secondary Education	Tertiary education	p-value	Primary education	Secondary Education	Tertiary education	p-value
N (%)	16725 (100%)	1257 (14.7%)	4119 (48.2%)	3173 (37.1%)		1750 (21.4%)	3414 (41.8%)	3012 (36.8%)	
age, mean ± SD	52.1 ± 10.6	52.8 ± 10.9	52.8 ± 10.7	51.0 ± 10.6	<0.001	54.6 ± 10.6	52.9 ± 10.4	49.8 ± 10.1	<0.001
Swiss nationality					<0.001				<0.001
No	4704 (28.1%)	690 (54.9%)	964 (23.4%)	1054 (33.2%)		561 (32.1%)	568 (16.6%)	867 (28.8%)	
Yes	12013 (71.9%)	567 (45.1%)	3152 (76.6%)	2116 (66.8%)		1189 (67.9%)	2846 (83.4%)	2143 (71.2%)	
Total alcohol consumption (g/day), mean ± SD	15.9 ± 18.9	26.3 ± 24.7	22.3 ± 23.2	17.8 ± 18.1	<0.001	10.7 ± 13.3	10.0 ± 12.7	10.2 ± 12.7	0.22
Hazardous alcohol consumption					<0.001				0.62
No	13676 (81.8%)	840 (66.8%)	3089 (75.0%)	2641 (83.2%)		1510 (86.3%)	2979 (87.3%)	2617 (86.9%)	
Yes	3049 (18.2%)	417 (33.2%)	1030 (25.0%)	532 (16.8%)		240 (13.7%)	435 (12.7%)	395 (13.1%)	
Smoking status					<0.001				<0.001
Never smoker	6812 (42.5%)	379 (30.2%)	1356 (33.0%)	1403 (44.3%)		819 (53.1%)	1441 (46.2%)	1414 (50.1%)	
Current smoker	3829 (23.9%)	382 (30.4%)	1154 (28.0%)	625 (19.7%)		355 (23.0%)	794 (25.4%)	519 (18.4%)	
Ex-smoker	5385 (33.6%)	496 (39.5%)	1605 (39.0%)	1140 (36.0%)		368 (23.9%)	886 (28.4%)	890 (31.5%)	
Law package period					<0.001				<0.001
Period 1 (before 20 Oct 2000)	7187 (43.0%)	587 (46.7%)	1914 (46.5%)	1120 (35.3%)		1022 (58.4%)	1429 (41.9%)	1115 (37.0%)	
Period 2 (20 Oct 2000 to 1 Feb 2004)	3550 (21.2%)	269 (21.4%)	905 (22.0%)	632 (19.9%)		372 (21.3%)	707 (20.7%)	665 (22.1%)	
Period 3 (2 Feb 2004 to 31 Oct 2009)	2467 (14.8%)	178 (14.2%)	571 (13.9%)	535 (16.9%)		186 (10.6%)	501 (14.7%)	496 (16.5%)	
Period 4 (after 31 Oct 2009)	3521 (21.1%)	223 (17.7%)	729 (17.7%)	886 (27.9%)		170 (9.7%)	777 (22.8%)	736 (24.4%)	

Table 2 – Prevalence ratio, RII and SII of educational attainment and occupational level as determinants of hazardous alcohol consumption. Adjusted for age, nationality, smoking status and survey date.

	Men		Women	
	Estimate (95%CI)	p value	Estimate (95%CI)	p value
Educational Attainment				
Prevalence ratio:				
primary vs tertiary	1.58 [1.39;1.80]	p<0.001	0.84 [0.70;1.00]	0.048
secondary vs tertiary	1.32 [1.18;1.47]	p<0.001	0.86 [0.74;0.99]	0.035
RII (least to most educated)	1.87 [1.57;2.22]	p<0.001	0.76 [0.60;0.97]	0.026
SII (least to most educated)	0.14 [0.11;0.17]	p<0.001	-0.04 [-0.07;-0.01]	0.008
Occupational level				
Prevalence ratio:				
low vs high	1.4 [1.24;1.59]	p<0.001	1.09 [0.81;1.45]	0.58
medium vs high	1.07 [0.93;1.24]	0.31	0.83 [0.70;1.00]	0.053
RII (low to high)	1.68 [1.38;2.06]	p<0.001	0.86 [0.62;1.20]	0.38
SII (low to high)	0.11 [0.07;0.15]	p<0.001	-0.02 [-0.05;0.02]	0.30

CI (confidence interval)

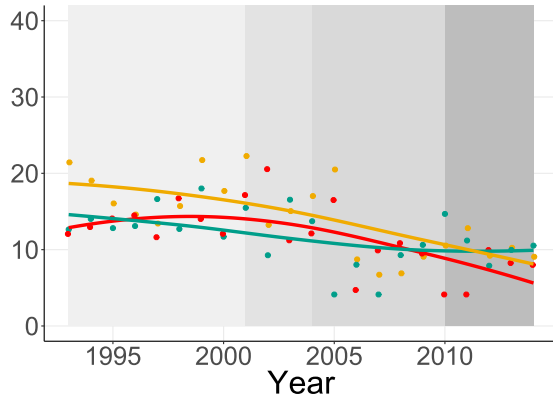
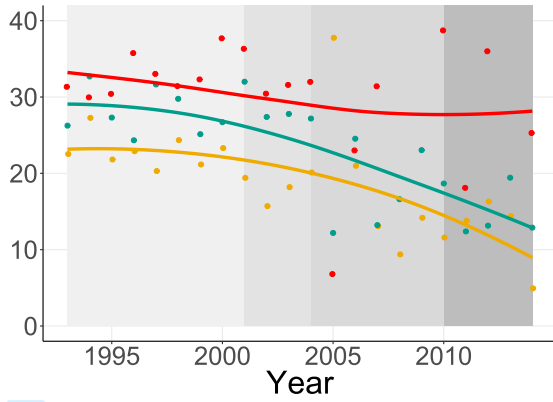
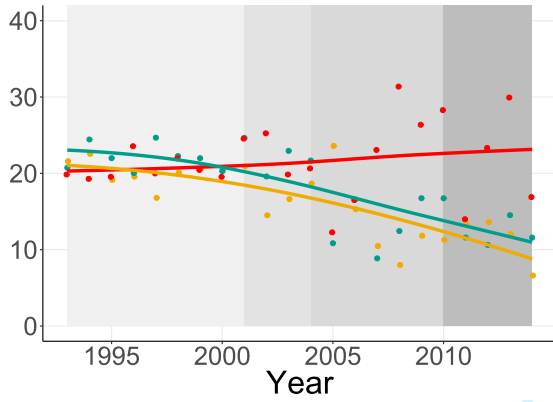
All

Men

Women

a)

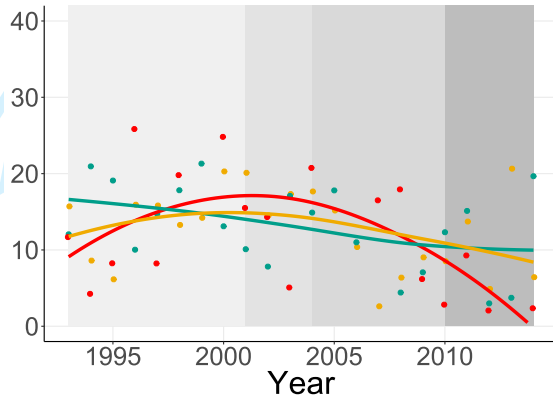
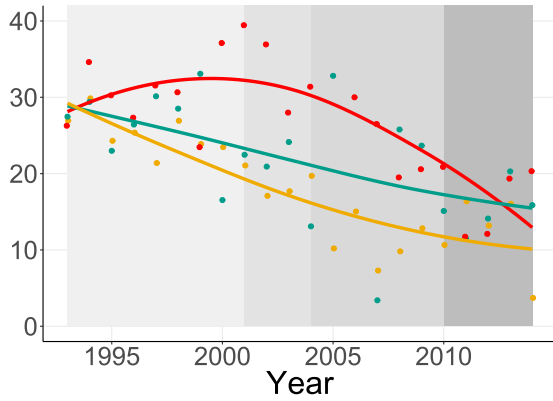
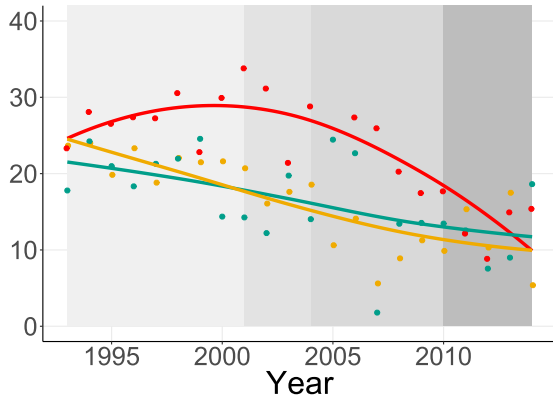
% with hazardous alcohol consumption



Education
 Primary Secondary Tertiary

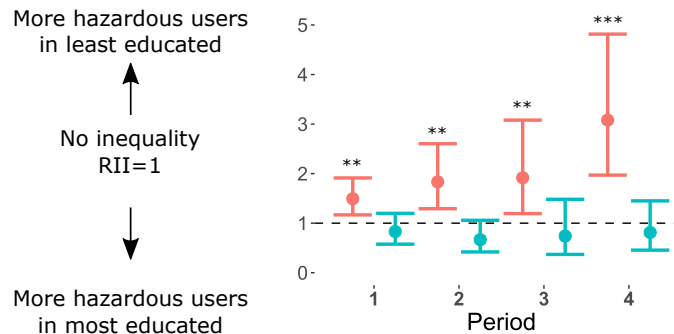
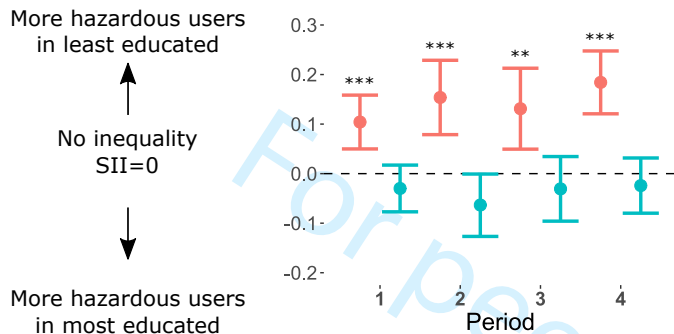
b)

% with hazardous alcohol consumption

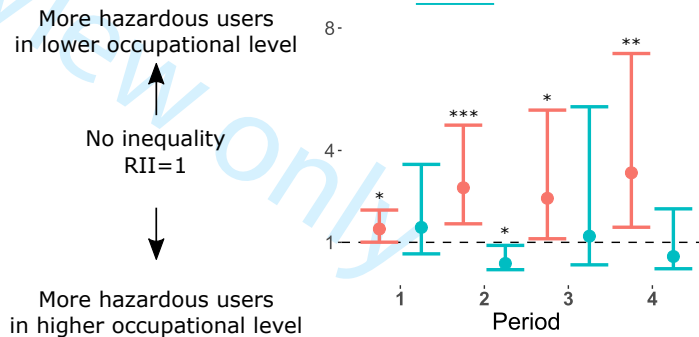
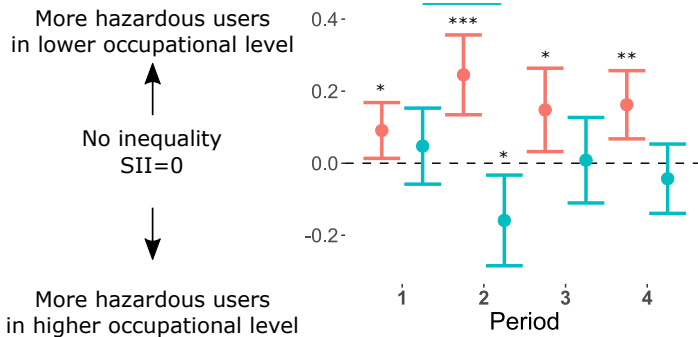


Occupational level
 Low Medium High

a)



b)



Gender

Men Women

All

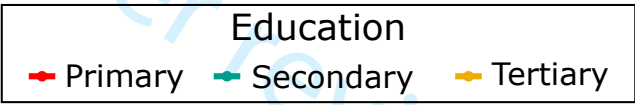
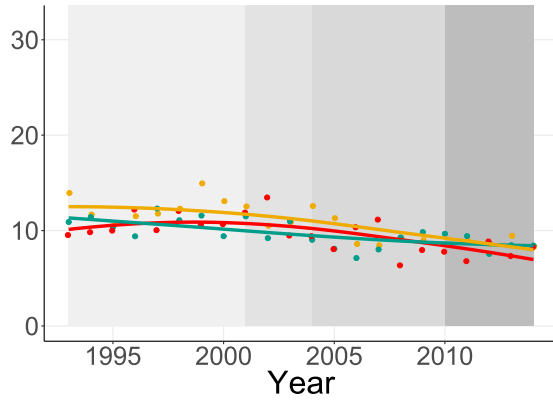
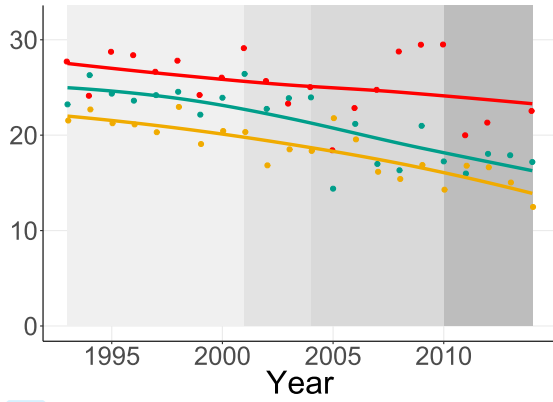
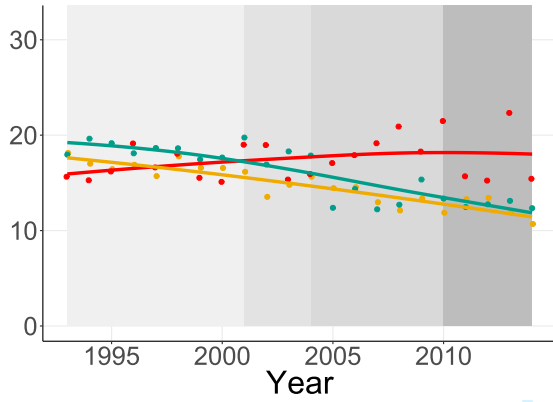
Men

Women

a)

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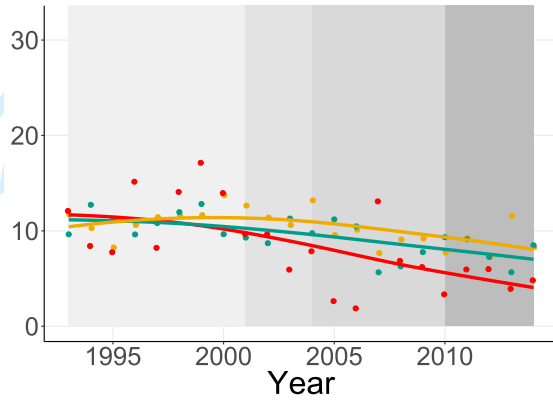
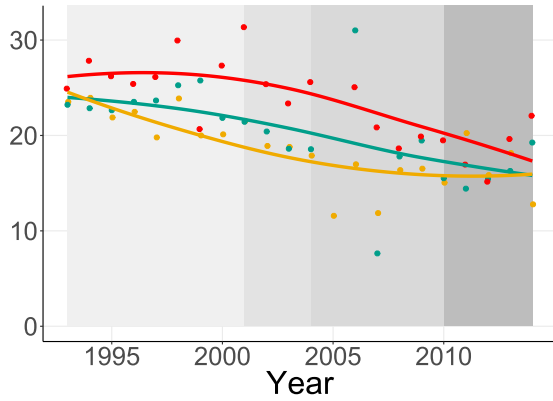
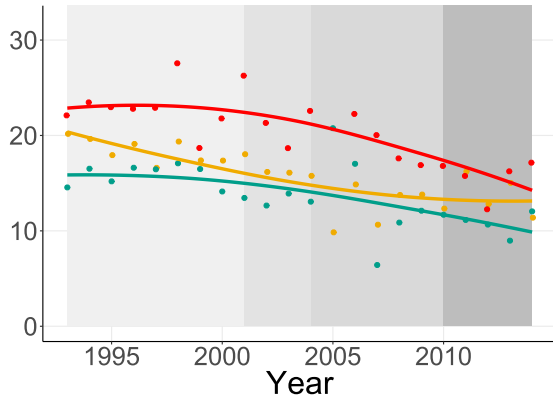
Mean alcohol consumption (g/day)



b)

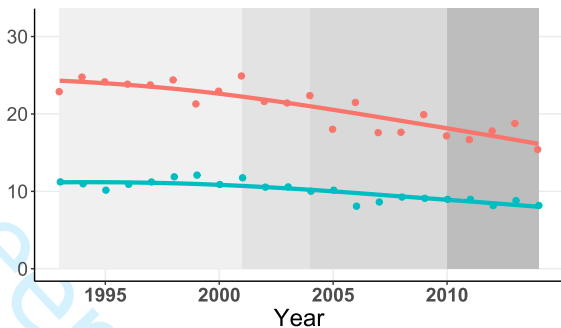
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Mean alcohol consumption (g/day)



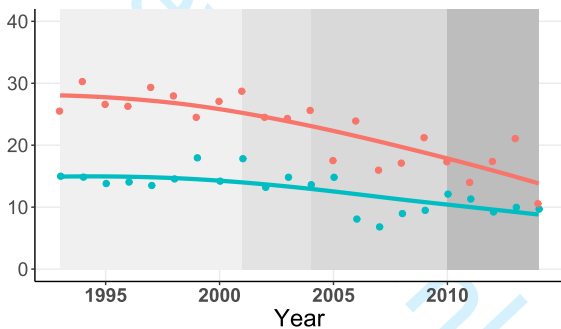
a)

Mean alcohol
consumption
(g/day)



b)

%
with hazardous
alcohol
consumption



Gender

Men Women

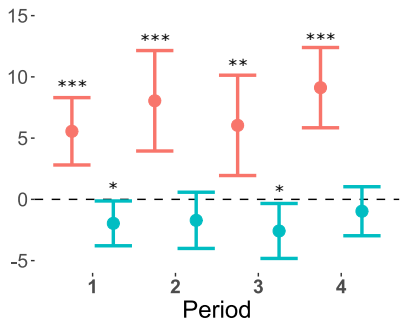
a)

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More consumption
in least educated

No inequality
SII=0 g/day

More consumption
in most educated

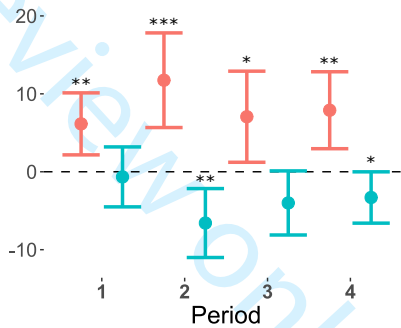


b)

More consumption
in lower occupation level

No inequality
SII=0 g/day

More consumption
in higher occupational level



Supplementary table 1 – Educational attainment as determinant of total alcohol consumption (linear regression coefficients and SII) and hazardous consumption (prevalence ratios, RII and SII). Analysis adjusted for occupational level (including retired, unemployed and housewife/househusband)

	Men				Women			
	Adjusted*		+Occupational level		Adjusted*		+Occupational level	
	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value
Consumption								
Regression coefficient								
primary vs tertiary education	5.48 [4.07;6.89]	p<0.001	4.58 [3.06;6.1]	p<0.001	-1.13 [-1.91;-0.34]	0.005	-1.08 [-1.92;-0.24]	0.012
secondary vs tertiary education	2.78 [1.78;3.77]	p<0.001	2.17 [1.08;3.26]	p<0.001	-1.25 [-1.88;-0.62]	p<0.001	-1.12 [-1.8;-0.45]	0.001
SII (least vs most educated)	7.10 [5.37;8.83]	p<0.001	5.96 [4;7.91]	p<0.001	-1.90 [-2.97;-0.83]	p<0.001	-1.80 [-2.98;-0.61]	0.003
Hazardous consumption								
Prevalence ratio:								
primary vs tertiary	1.58 [1.39;1.80]	p<0.001	1.48 [1.28;1.7]	p<0.001	0.84 [0.70;1.00]	0.048	0.81 [0.67;0.97]	0.023
secondary vs tertiary	1.32 [1.18;1.47]	p<0.001	1.26 [1.12;1.41]	p<0.001	0.86 [0.74;0.99]	0.035	0.84 [0.72;0.98]	0.028
RII (least to most educated)	1.87 [1.57;2.22]	p<0.001	1.71 [1.41;2.08]	p<0.001	0.76 [0.60;0.97]	0.026	0.72 [0.55;0.94]	0.015
SII (least to most educated)	0.14 [0.11;0.17]	p<0.001	0.12 [0.08;0.16]	p<0.001	-0.04 [-0.07;-0.01]	0.008	-0.05 [-0.08;-0.01]	0.004

*adjusted for age, nationality, smoking status and survey date

Supplementary table 2 – Occupational level as determinant of total alcohol consumption (linear regression coefficients and SII) and hazardous consumption (prevalence ratios, RII and SII). Analysis adjusted for educational attainment.

	Men				Women			
	Adjusted*		+Educational attainment		Adjusted*		+Educational attainment	
	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value	Estimate (95%CI)	p value
Consumption								
Regression coefficient								
low vs high	4.33 [3.11;5.55]	p<0.001	2.52 [1.13;3.91]	p<0.001	-0.65 [-1.79;0.48]	0.26	0.07 [-1.17;1.31]	0.91
medium vs high	0.16 [-1.10;1.43]	0.8	-0.60 [-1.92;0.71]	0.37	-1.34 [-2.01;-0.67]	p<0.001	-0.86 [-1.59;-0.13]	0.02
SII (low to high)	6.02 [4.09;7.94]	p<0.001	4.06 [1.16;6.95]	p<0.001	-1.98 [-3.2;-0.76]	0.002	-1.58 [-3.87;0.71]	0.18
Hazardous consumption								
Prevalence ratio:								
low vs high	1.4 [1.24;1.59]	p<0.001	1.18 [1.03;1.36]	0.02	1.09 [0.81;1.45]	0.58	1.29 [0.94;1.78]	0.12
medium vs high	1.07 [0.93;1.24]	0.31	0.99 [0.86;1.15]	.89	0.83 [0.70;1.00]	0.053	0.93 [0.76;1.14]	0.48
RII (low to high)	1.68 [1.38;2.06]	p<0.001	1.37 [1.01;1.85]	0.04	0.86 [0.62;1.20]	0.38	1.16 [0.62;2.17]	0.65
SII (low to high)	0.11 [0.07;0.15]	p<0.001	0.07 [0.02;0.13]	0.01	-0.02 [-0.05;0.02]	0.30	0.02 [-0.05;0.08]	0.56

*adjusted for age, nationality, smoking status and survey date

Supplementary table 3 – Time-series analyses of total and hazardous alcohol consumption by gender. Overall and stratified by educational attainment or occupational level.

	All		Primary		Secondary		Tertiary	
	beta [95% CI]	P value	beta [95% CI]	P value	beta [95% CI]	P value	beta [95% CI]	P value
Educational attainment*								
Men								
Alcohol consumption	-0.35 [-0.42;-0.27]	<0.001	-0.12 [-0.35;0.11]	0.29	-0.42 [-0.53;-0.30]	<0.001	-0.37 [-0.47;-0.28]	<0.001
Hazardous consumption	-0.04 [-0.04;-0.03]	<0.001	0.00 [-0.02;0.02]	0.93	-0.04 [-0.06;-0.03]	<0.001	-0.05 [-0.07;-0.03]	<0.001
Women								
Alcohol consumption	-0.20 [-0.25;-0.15]	<0.001	-0.27 [-0.4;-0.13]	<0.001	-0.15 [-0.22;-0.07]	<0.001	-0.23 [-0.31;-0.15]	<0.001
Hazardous consumption	-0.04 [-0.05;-0.02]	<0.001	-0.05 [-0.08;-0.02]	0.002	-0.03 [-0.05;-0.01]	0.006	-0.04 [-0.06;-0.02]	<0.001
Occupational level**								
Men								
Alcohol consumption	-0.40 [-0.48;-0.31]	<0.001	-0.44 [-0.63;-0.25]	<0.001	-0.38 [-0.57;-0.20]	<0.001	-0.39 [-0.49;-0.28]	<0.001
Hazardous consumption	-0.05 [-0.06;-0.04]	<0.001	-0.04 [-0.06;-0.02]	<0.001	-0.04 [-0.07;-0.02]	<0.001	-0.06 [-0.07;-0.04]	<0.001
Women								
Alcohol consumption	-0.21 [-0.27;-0.15]	<0.001	-0.38 [-0.57;-0.19]	<0.001	-0.21 [-0.29;-0.13]	<0.001	-0.18 [-0.26;-0.09]	<0.001
Hazardous consumption	-0.05 [-0.07;-0.03]	<0.001	-0.08 [-0.14;-0.03]	0.003	-0.05 [-0.08;-0.03]	<0.001	-0.04 [-0.07;-0.01]	0.002

Note: all analyses adjusted for age, nationality and smoking status. *Educational attainment analysis adjusted for occupational level (including retire, unemployed and housewives/househusbands), ** occupational analysis adjusted for educational attainment

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Supplementary table 4 – Assessment of RII and SII differences across time using statistical interaction between SES indicators (educational attainment and occupational level) and legislative period. Interaction terms with 95% confidence intervals and p values are presented. Analysis stratified by gender and Period 1 was used as reference

	Men			Women		
	Period 2	Period 3	Period 4	Period 2	Period 3	Period 4
Educational attainment						
RII hazardous consumption	1.3 (0.8;.02), p=0.25	1.4 (0.8;2.3), p=0.26	2.2 (1.3;3.6), p=0.002	1.3 (0.9;1.9), p=0.13	1.0 (0.5;1.7), p=0.90	1.2 (0.6;2.4), p=0.61
SII hazardous consumption	0.1 (0.0;0.1), p=0.18	0.0 (-0.1;0.1), p=0.61	0.1 (0.0;0.2), p=0.12	0.0 (0.0;0.1), p=0.12	0.0 (-0.1;0.1), p=0.94	0.0 (-0.1;0.1), p=0.57
SII total consumption	3.1 (-1.4;7.6), p=0.18	0.5 (-4.6;5.6), p=0.86	3.2 (-1.4;7.7), p=0.17	0.6 (-2.0;3.3), p=0.64	-0.5 (-3.6;2.6), p=0.76	0.4 (-2.4;3.1), p=0.80
Occupational level						
RII hazardous consumption	2.3 (1.2;4.3), p=0.012	1.9 (0.8;4.5), p=0.13	2.6 (1.1;6.2), p=0.02	0.2 (0.1;0.9), p=0.035	0.6 (0.1;3.5), p=0.60	0.3 (0.1;1.7), p=0.20
SII hazardous consumption	0.2 (0.1;0.3), p=0.003	0.1 (-0.1;0.2), p=0.35	0.1 (-0.1;0.2), p=0.24	-0.2 (-0.3;0.0), p=0.01	-0.1 (-0.2;0.1), p=0.46	-0.1 (-0.2;0.0), p=0.18
SII total consumption	6.8 (0.3;13.3), p=0.042	2.0 (-5.5;9.5), p=0.60	2.3 (-4.7;9.2), p=0.52	-6.1 (-11.5;-0.8), p=0.025	-4.5 (-10.3;1.4), p=0.13	-3.4 (-8.7;1.9), p=0.21

Supplementary table 5 – Participants' characteristics according to occupational level and gender (1993-2014, Bus Santé study)

	Overall	Men				Women			
		Low occupational level	Medium occupational level	High occupational level	p-value	Low occupational level	Medium occupational level	High occupational level	p-value
N (%)	11659 (100%)	1696 (25.7%)	1441 (21.9%)	3457 (52.4%)		502 (9.9%)	2441 (48.2%)	2122 (41.9%)	
age, mean ± SD	48.5 ± 8.4	48.3 ± 8.3	47.8 ± 8.3	49.1 ± 8.8	<0.001	48.2 ± 8.6	48.6 ± 7.9	48.0 ± 8.1	0.037
Swiss nationality					<0.001				<0.001
No	3396 (29.1%)	791 (46.7%)	432 (30.0%)	920 (26.6%)		253 (50.4%)	547 (22.4%)	453 (21.4%)	
Yes	8257 (70.9%)	904 (53.3%)	1009 (70.0%)	2534 (73.4%)		249 (49.6%)	1893 (77.6%)	1668 (78.6%)	
Total alcohol consumption (g/day), mean ± SD	15.5 ± 18.6	24.3 ± 25.2	19.3 ± 21.5	18.7 ± 18.9	<0.001	9.3 ± 12.0	9.1 ± 11.1	9.8 ± 12.1	0.12
Hazardous alcohol consumption					<0.001				0.57
No	9701 (83.2%)	1222 (72.1%)	1153 (80.0%)	2837 (82.1%)		439 (87.5%)	2173 (89.0%)	1877 (88.5%)	
Yes	1958 (16.8%)	474 (27.9%)	288 (20.0%)	620 (17.9%)		63 (12.5%)	268 (11.0%)	245 (11.5%)	
Smoking status					<0.001				<0.001
Never smoker	4663 (41.4%)	542 (32.0%)	524 (36.4%)	1439 (41.7%)		242 (52.4%)	964 (43.3%)	952 (48.0%)	
Current smoker	2865 (25.4%)	540 (31.8%)	402 (28.0%)	768 (22.2%)		116 (25.1%)	617 (27.7%)	422 (21.3%)	
Ex-smoker	3732 (33.1%)	614 (36.2%)	512 (35.6%)	1247 (36.1%)		104 (22.5%)	645 (29.0%)	610 (30.7%)	
Law package period					0.095				<0.001
Period 1 (before 20 Oct 2000)	4996 (42.9%)	715 (42.2%)	678 (47.1%)	1476 (42.7%)		203 (40.4%)	1080 (44.2%)	844 (39.8%)	
Period 2 (20 Oct 2000 to 1 Feb 2004)	2498 (21.4%)	369 (21.8%)	290 (20.1%)	736 (21.3%)		116 (23.1%)	548 (22.4%)	439 (20.7%)	
Period 3 (2 Feb 2004 to 31 Oct 2009)	1752 (15.0%)	270 (15.9%)	197 (13.7%)	520 (15.0%)		65 (12.9%)	349 (14.3%)	351 (16.5%)	
Period 4 (after 31 Oct 2009)	2413 (20.7%)	342 (20.2%)	276 (19.2%)	725 (21.0%)		118 (23.5%)	464 (19.0%)	488 (23.0%)	

Supplementary table 6 – Time-series analyses of total and hazardous consumption by gender. Overall and stratified by educational attainment or occupational level

	Educational attainment							
	All		Primary		Secondary		Tertiary	
	beta [95% CI]	P value	beta [95% CI]	P value	beta [95% CI]	P value	beta [95% CI]	P value
Educational attainment								
Men								
Alcohol consumption	-0.34 [-0.41;-0.26]	<0.001	-0.10 [-0.32;0.13]	0.40	-0.41 [-0.53;-0.30]	<0.001	-0.36 [-0.46;-0.27]	<0.001
Hazardous consumption	-0.04 [-0.04;-0.03]	<0.001	0.00 [-0.02;0.02]	0.75	-0.04 [-0.06;-0.03]	<0.001	-0.05 [-0.06;-0.03]	<0.001
Women								
Alcohol consumption	-0.20 [-0.25;-0.15]	<0.001	-0.24 [-0.37;-0.10]	<0.001	-0.16 [-0.23;-0.08]	<0.001	-0.23 [-0.31;-0.16]	<0.001
Hazardous consumption	-0.04 [-0.05;-0.03]	<0.001	-0.04 [-0.07;-0.01]	0.01	-0.03 [-0.05;-0.01]	0.002	-0.04 [-0.06;-0.02]	<0.001
Occupational level								
Men								
Alcohol consumption	-0.43 [-0.52;-0.35]	<0.001	-0.44 [-0.63;-0.25]	<0.001	-0.42 [-0.60;-0.24]	<0.001	-0.44 [-0.63;-0.25]	<0.001
Hazardous consumption	-0.05 [-0.06;-0.04]	<0.001	-0.04 [-0.06;-0.02]	<0.001	-0.05 [-0.07;-0.03]	<0.001	-0.06 [-0.08;-0.05]	<0.001
Women								
Alcohol consumption	-0.20 [-0.26;-0.15]	<0.001	-0.39 [-0.57;-0.20]	<0.001	-0.20 [-0.27;-0.12]	<0.001	-0.17 [-0.26;-0.09]	<0.001
Hazardous consumption	-0.05 [-0.06;-0.03]	<0.001	-0.08 [-0.14;-0.03]	0.002	-0.05 [-0.07;-0.02]	0.001	-0.04 [-0.06;-0.01]	0.003

Note: CI (confidence interval), analyses were adjusted for age, nationality and smoking status.

Supplementary table 7 – Linear regression coefficients and SII of educational attainment and occupational level as determinants of total alcohol consumption. Adjusted for age, nationality, smoking status and survey date.

	Men		Women	
	Estimate (95% CI)	p value	Estimate (95% CI)	p value
Educational attainment				
Regression coefficient				
primary vs tertiary education	5.48 [4.07;6.89]	p<0.001	-1.13 [-1.91;-0.34]	0.005
secondary vs tertiary education	2.78 [1.78;3.77]	p<0.001	-1.25 [-1.88;-0.62]	p<0.001
SII (least to most educated)	7.10 [5.37;8.83]	p<0.001	-1.90 [-2.97;-0.83]	p<0.001
Occupational Level				
Regression coefficient				
low vs high	4.33 [3.11;5.55]	p<0.001	-0.65 [-1.79;0.48]	0.26
medium vs high	0.16 [-1.10;1.43]	0.8	-1.34 [-2.01;-0.67]	p<0.001
SII (low to high)	6.02 [4.09;7.94]	p<0.001	-1.98 [-3.20;-0.76]	0.002

CI (confidence interval)

Supplementary table 8 – Absolute (SII) and relative measures (RII) of inequality for total and hazardous alcohol consumption using educational attainment or occupational level as SES indicator. Estimates are presented for each legislative period and by gender

	Period	Educational level		Occupational level	
		Estimate (95%CI)	p value	Estimate (95%CI)	p value
Men					
SII alcohol consumption	1	5.56 [2.81;8.31]	<0.001	6.15 [2.17;10.13]	0.002
	2	8.05 [3.95;12.15]	<0.001	11.75 [5.67;17.82]	<0.001
	3	6.04 [1.95;10.14]	0.004	7.06 [1.22;12.91]	0.018
	4	9.12 [5.85;12.40]	<0.001	7.90 [2.96;12.83]	0.002
RII hazardous alcohol consumption	1	1.49 [1.17;1.91]	0.001	1.44 [1.00;2.05]	0.047
	2	1.83 [1.29;2.60]	0.001	2.78 [1.61;4.83]	<0.001
	3	1.92 [1.19;3.08]	0.007	2.44 [1.12;5.32]	0.025
	4	3.08 [1.97;4.82]	<0.001	3.27 [1.49;7.17]	0.003
SII hazardous alcohol consumption	1	0.10 [0.05;0.16]	<0.001	0.09 [0.01;0.17]	0.021
	2	0.15 [0.08;0.23]	<0.001	0.25 [0.13;0.36]	<0.001
	3	0.13 [0.05;0.21]	0.002	0.15 [0.03;0.26]	0.012
	4	0.18 [0.12;0.25]	<0.001	0.16 [0.07;0.26]	0.001
Women					
SII alcohol consumption	1	-1.96 [-3.79;-0.13]	0.036	-0.66 [-4.51;3.19]	0.737
	2	-1.71 [-4.01;0.58]	0.144	-6.58 [-11;-2.16]	0.004
	3	-2.58 [-4.82;-0.33]	0.024	-4.00 [-8.11;0.11]	0.057
	4	-0.97 [-2.97;1.03]	0.342	-3.30 [-6.60;-0.01]	0.049
RII hazardous alcohol consumption	1	0.83 [0.58;1.20]	0.321	1.49 [0.62;3.55]	0.37
	2	0.67 [0.42;1.06]	0.085	0.31 [0.11;0.90]	0.031
	3	0.74 [0.37;1.48]	0.395	1.20 [0.27;5.43]	0.812
	4	0.81 [0.46;1.45]	0.483	0.54 [0.14;2.09]	0.371
SII hazardous alcohol consumption	1	-0.03 [-0.08;0.02]	0.213	0.05 [-0.06;0.15]	0.378
	2	-0.06 [-0.13;0.00]	0.05	-0.16 [-0.28;-0.03]	0.013
	3	-0.03 [-0.10;0.03]	0.355	0.01 [-0.11;0.13]	0.89
	4	-0.02 [-0.08;0.03]	0.396	-0.04 [-0.14;0.05]	0.381

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2- abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	6-9
Study size	10	Explain how the study size was arrived at	6-7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	6
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	9-10
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6,10
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1 & 10-11
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	Table 1
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	11-12

		which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-12 and Sup tables
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.