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Does a Change Over All Equal a Change in All? Testing for Polarized Alcohol Use Within and Across Socio-Economic Groups in Germany

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Abstract

Aims: This study aimed at testing whether drinking volume and episodic heavy drinking (EHD) frequency in Germany are polarizing between consumption levels over time. Polarization is defined as a reduction in alcohol use among the majority of the population, while a subpopulation with a high intake level maintains or increases its drinking or its EHD frequency. The polarization hypothesis was tested across and within socio-economic subgroups.

Method: Analyses were based on seven cross-sectional waves of the Epidemiological Survey of Substance Abuse (ESA) conducted between 1995 and 2012 ($n = 7833\text{--}9084$). Overall polarization was estimated based on regression models with time by consumption level interactions; the three-way interaction with socio-economic status (SES) was consecutively introduced to test the stability of effects over socio-economic strata. Interactions were interpreted by graphical inspection.

Results: For both alcohol use indicators, declines over time were largest in the highest consumption level. This was found within all SES groups, but was most pronounced at low and least pronounced at medium SES.

Conclusion: The results indicate no polarization but convergence between consumption levels. Socio-economic status groups differ in the magnitude of convergence which was lowest in medium SES. The overall decline was strongest for the highest consumption level of low SES.

INTRODUCTION

Being the cause for 12.8% of all disability-adjusted life years (DALYs) in Europe, alcohol use has been shown to be one of the most important evitable risk factors for morbidity and premature death (World Health Organization, 2014a). Annual direct and indirect costs to society due to alcohol use are estimated at € 125 billion for the EU member states combined (Anderson and Baumberg, 2006). As alcohol-related physical and social consequences increase exponentially with increasing volume and frequency of episodic heavy drinking (EHD) (Kraus *et al.*, 2009; Rehm and Roerecke, 2013), a reduction in alcohol use

is highly desirable and for benefit at the individual as well as the societal level.

In Germany, sales data indicate a downward trend in per capita alcohol consumption since 1976 (World Health Organization, 2013), a development which is corroborated by survey data (Kraus *et al.*, 2013a). With regard to indicators of alcohol-related harm, however, the pattern is less consistent. For example, the influence of alcohol use has become less prevalent in car accidents within the last two decades (Statistisches Bundesamt, 2013), but is playing an increasing role in violent crimes (Bundeskriminalamt, 2013). Furthermore, the prevalence of alcohol use disorders has increased between 1997 and 2012

(Kraus *et al.*, 2013a). Diverging trends of alcohol use and alcohol-related harm have also been observed in other high-income countries such as the UK (Meier, 2010), Sweden (Norström and Svensson, 2014) and Australia (Livingston *et al.*, 2010). As a possible explanation, polarization of alcohol use has been hypothesized (Meier, 2010). Polarization describes a pattern of decreasing alcohol use among the majority of the population, while a high-risk subpopulation maintains or increases its drinking volume or heavy drinking frequency (Livingston *et al.*, 2010). More specifically, in this study we follow a series of Swedish analyses which had defined polarization as diverging trends between lower and higher consumption levels (Hallgren *et al.*, 2012; Raninen *et al.*, 2013; Norström and Svensson, 2014). Thus, in the case of polarization the upper end of the alcohol intake distribution would shift apart from the 'main body'. In order to test for such an effect, temporal changes in the mean volume of different quantile groups have been compared. Using different samples, the Swedish studies yielded mixed results. Polarization was found in an urban sample of Stockholm 9th and 11th graders (Hallgren *et al.*, 2012) as well as in adults over the age of 50 (Raninen *et al.*, 2013), while no such effect was found in adults below 50 years of age or in a national adolescent sample (Norström and Svensson, 2014).

The polarization hypothesis challenges the theory of collectivity of drinking culture which builds the rationale for a number of preventive measures (Rehm, 2014; Rossow *et al.*, 2014). The theory states that, as a consequence of social diffusion processes, changes in alcohol consumption within a population occur as a 'parallel displacement of the whole distribution' (Skog, 1985, 2001). However, it has also been pointed out that barriers between specific subpopulations such as socio-economic strata might impede crucial social exchange processes resulting in unequal developments of alcohol use in these subgroups (Skog, 2001).

In addition to social processes, other reasons for unequal time trends in alcohol use between groups of different socio-economic status (SES) might exist. One of the most influential factors for alcohol consumption is affordability. In Germany, alcohol prices have remained relatively stable (Rabinovich *et al.*, 2009), while real disposable income has been polarizing since the 1980s. With welfare state reforms in the late 1990s accelerating this trend, Germany is currently the OECD country with the fastest growing income inequality (van Treeck and Sturn, 2012). It can therefore be assumed that alcohol has become more affordable for those of high SES and less affordable for those of low SES.

Changes of legal regulations to reduce the availability of alcohol within the last two decades were few in number. Against the background of a highly permissive alcohol policy (Brand *et al.*, 2007), they are unlikely to have had a substantial impact on alcohol consumption (Müller *et al.*, 2010). However, it has been argued that restrictions in alcohol availability and informal societal responses to alcohol problems as well as social drinking norms usually co-develop in an interactive, circular process (Room *et al.*, 2009). In line with this, a general increase in health awareness has been discussed (Jordan and von der Lippe, 2013; Krug *et al.*, 2013). Changes in health concerns tend to first occur within high SES groups and then spread to low SES groups, as it has been observed in tobacco smoking (Mackebach, 2012; Pampel *et al.*, 2015).

The literature on socio-economic inequalities in alcohol use from industrialized countries draws a general picture of low compared with high SES being associated with lower drinking frequency, but more detrimental drinking patterns during drinking occasions (Casswell *et al.*, 2003; Grittner *et al.*, 2012). Furthermore, it has been shown that time trends of alcohol use and alcohol-related harm may vary

between SES groups (Huckle *et al.*, 2010). For example, the increase in alcohol-attributable mortality after a price reduction in Finland was strongest among individuals of low SES (Hertrua *et al.*, 2008). Despite the theoretical as well as empirical indications, the role of SES as a moderator of polarization between consumption levels has been neglected so far. Using data from a repeated cross-sectional, representative survey covering a period of almost 20 years, this study aims at testing the hypothesis of polarization in alcohol use in the German general population. In particular, it is examined whether the reduction in self-reported alcohol volume and frequency of EHD in the general adult population is consistent over consumption levels, across the sample as a whole as well as within SES groups.

METHODS

Sample

Data come from seven cross-sectional waves of the Epidemiological Survey of Substance Abuse (ESA) conducted between 1995 and 2012 (Pabst *et al.*, 2010; Kraus *et al.*, 2013b). The ESA examines substance use and misuse in the German general population. Each wave consists of a representative sample of non-institutionalized adults aged 18–64 years (until 2003: 18–59 years). A self-administered paper-pencil survey was used for data collection. In 2006, telephone interviews were added, and in 2009, online completion of the survey was introduced as a third mode of administration. One case from the 2012 survey has been eliminated from the analyses for reporting an implausible alcohol intake of more than twice the volume than any other respondent. The final analytical samples across all surveys for alcohol volume and frequency of EHD as outcome comprised $n = 52,095$ and $n = 51,620$ individuals, respectively. Net response rates vary between 45 and 65%. Sample sizes and response rates by survey year are presented in Table 1.

Measures

Outcome variables

Alcohol volume was assessed with a beverage specific quantity-frequency measure asking separately for beer, wine, distilled spirits, alcopops (2006 only) and mixed alcoholic beverages (since 2009). Respondents were asked, (a) on how many days during the last 30 days they had drunk a specific beverage, and (b) on a day they had drunk that beverage, how many glasses they had had on average. Grams of pure ethanol, corresponding to the reported amounts, were calculated, assuming ethanol contents of 4.8 vol% (beer), 11.0 vol% (wine), 33.0 vol% (distilled spirits) and 5.5 vol% (alcopops) (Bühninger *et al.*, 2002). For mixed alcoholic beverages, an amount of 0.04 l of distilled spirits was assumed.

Frequency of EHD was assessed by the number of days within the last 30 days on which a respondent drank five or more alcoholic drinks, regardless of the beverage.

Predictor variables

Education as indicator for SES was assessed by applying an established adaptation of the United Nations' International Standard Classification of Education (ISCED) to the German educational system (Schroedter *et al.*, 2006; United Nations Educational, Scientific and Educational Classification, 2006). It allows for the categorization of individuals into six levels according to their highest educational achievement, i.e. schooling and vocational education. For analytical purposes, the original ISCED classes were collapsed into three categories. Low SES was assumed for individuals holding up to a medium

Table 1. Methodological, socio-demographic and alcohol use characteristics by survey year

	1995 ^a	1997 ^b	2000 ^c	2003 ^d	2006 ^e	2009 ^f	2012 ^g
Sample size (<i>n</i>)	7833	8020	8139	8061	7912	8030	9084
Net response rate (%)	65	65	51	55	45	50	54
Gender: male (%)	50.2	50.2	51.0	50.7	50.8	50.7	50.8
Age (<i>M</i>)	39.0	39.0	38.8	39.4	41.8*	41.6*	42.2*
SES (%)							
High	24.8	25.2	33.0*	34.8*	33.8*	36.2*	37.0*
Medium	62.3	62.5	56.5*	54.8*	54.3*	53.8*	53.0*
Low	12.9	12.3	10.5*	10.4*	11.9	10.0*	10.0*
Abstention (%)	20.3	21.3	13.7*	16.9*	25.1*	23.6*	25.3*
Volume in grams (<i>M</i>)	388.5	364.5	416.7*	336.9*	317.7*	305.4*	286.2*
0–50% quantile	40.7	38.5	64.9*	49.5*	36.2*	37.9*	30.3*
51–80% quantile	326.6	314.6*	390.5*	302.3*	284.9*	279.7*	250.4*
81–90% quantile	800.6	748.5*	835.0*	689.2*	644.4*	613.3*	568.1*
91–95% quantile	1268.3	1162.1*	1245.1*	1065.9*	999.7*	968.3*	897.9*
96–100% quantile	2554.0	2384.6	2431.6	2008.6*	2031.4*	1872.3*	1826.2*
Number of EHD days (<i>M</i>)	2.0	1.8	1.2*	1.3*	1.2*	1.1*	1.1*
0–50% quantile	0.2	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*
51–80% quantile	1.5	1.3	0.8*	0.9*	0.9*	0.9*	0.9*
81–90% quantile	3.3	3.2	2.2*	2.3*	2.1*	2.0*	2.0*
91–95% quantile	6.5	4.7*	3.5*	4.1*	3.0*	3.1*	3.5*
96–100% quantile	14.2	13.5	8.7*	10.4*	10.8*	7.4*	7.5*

^aHerbst *et al.* (1996).

^bKraus and Bauernfeind (1998).

^cKraus and Augustin (2001).

^dKraus and Augustin (2005).

^eKraus and Baumeister (2008).

^fKraus and Pabst (2010).

^gKraus *et al.* (2013b).

* $P < 0.05$ for comparison with the year 1995.

schooling level (10th grade) but no vocational education. Medium SES included individuals with a vocational education and/or a qualification for admission to higher education. The high SES group comprised individuals with (a) a college/university degree or (b) a highly qualified vocational education leading to a master craftsman diploma (German *Meister*) or an equivalent.

To obtain relative consumption levels, interquartile ranges of alcohol volume were calculated. First, the 50th, 80th, 90th and 95th quantiles were estimated for each survey year. Second, each respondent was assigned to the corresponding interquartile group according to his or her personal intake. This resulted in five groups, of which the first one contained 50% of the respondents with the lowest consumption per survey year and socio-economic level, and the last one contained the respective upmost 5%. The procedure was repeated twice; (a) for the pooled sample, to test for polarization across SES groups; (b) stratified by SES, to test for polarization within these groups.

In order to describe changes in alcohol use at the population level, abstainers were included in the analysis (Rehm, 2014). This way, a (*ceteris paribus*) shift from very low consumption to abstinence would decrease the mean intake of the 0–50% consumption level only. A (*ceteris paribus*) shift from very high consumption to abstinence would decrease the mean intake of the highest consumption levels as well.

Statistical analyses

Descriptive statistics on demographics and alcohol consumption are reported for each survey year. Volume and frequency of EHD are additionally reported by consumption level. Bivariate time differences were tested using regression analyses. To estimate polarization effects,

two multivariate regression models were calculated for each of the two alcohol use indicators (alcohol volume, frequency of EHD). The first model contained the predictors time, SES and (pooled) consumption level as well as the time*consumption_level interaction. The interaction indicates whether time trends differ between lower and higher consumption levels. In the second model, the three-way interaction of time*consumption_level*SES was added (using SES-stratified consumption levels), indicating whether differences in time trends between lower and higher consumption levels vary between SES groups.

For the analysis of alcohol volume, generalized linear regression models with a Gamma distribution and a log link were applied. This has been shown to be appropriate for highly skewed data (Manning *et al.*, 2005). For the analysis of frequency of EHD, negative-binomial regression models were used. All regression outcomes were adjusted for gender, age (continuous), marital status (single, married, divorced/widowed), survey mode (paper-pencil, telephone, online), the consumption level*SES interaction and the time*SES interaction. Exponentiated regression coefficients are reported, which can be interpreted as incidence rate ratios. All predictors in the regression models were dummy coded, with the year 1995, the consumption level 0–50% and the low SES group as reference groups. Overall main and interaction effects were tested using Wald χ^2 -test statistics. Significant interactions were further examined by graphical inspection using descriptive data. In order to maximize sample size, the analyses were not separated by gender. Gender-stratified analyses revealed similar patterns, but weaker effects among women.

Data were analysed using Stata 12.1 SE (Stata Corp LP, College Station, TX, USA). All statistical analyses were conducted using

redressment weights in order to enhance the distribution fit between sample and population regarding gender, birth cohort, federal state and community size. To adjust for cluster effects due to stepwise sampling, standard errors were calculated based on Taylor series.

RESULTS

Descriptive statistics

The lower part of Table 1 depicts socio-demographic as well as consumption data by year. Gender was evenly distributed in each survey. The uplift in the maximum age in 2006 led to a moderate but significant increase in mean age. Furthermore, there was a shift from low and medium to high SES after the year 1997. With regard to consumption characteristics, the abstention rate was lower in the years 2000 and 2003 compared with 1995 and higher in the following years. Mean alcohol volume and mean frequency of EHD declined significantly and almost steadily.

Alcohol volume

Changes in alcohol volume over time differed between consumption levels as indicated by the significant interaction term in model 1.1 (Table 2).

Additional to the mean volume stratified by consumption level in Table 1, the interaction effect is demonstrated graphically in Fig. 1a.

Except the time span from 1997 to 2000, in which mean alcohol volume increased, there was an almost steady decline in volume within all consumption levels. However, the declining trend is least intense in the lowest level of consumption and most pronounced in the highest one.

Adding the three-way interaction (Table 2, model 1.2) reveals that trend differences between consumption levels varied by SES. To explore the pattern of these effects, two-way time*consumption level graphs are presented stratified by SES (Fig. 1b–d). All SES groups showed a similar pattern with decreases between 1995 and 2012 in all consumption level groups, whereas the strongest decline was at the highest consumption level and the weakest decline was at the lowest level. This pattern was most pronounced in the lowest SES group and least pronounced in the medium SES group. At the same time, the trend in the upmost consumption level of medium and low SES was less steady than in lower consumption levels. While the decrease in the high and medium SES groups primarily took place after 2000, mean volume at higher consumption levels of the low SES group also decreased between 1995 and 1997.

Frequency of EHD

The frequency of EHD increased with increasing consumption level (Table 2, model 2.1). Furthermore, changes in the frequency of EHD over time varied by consumption level, as indicated by the time*consumption level interaction. Consumption level-stratified

Table 2. Results of regression analyses for two-way interactions time*consumption level (models 1.1. and 2.1) and three-way interactions time*consumption level*SES (models 1.2 and 2.2) on alcohol volume and frequency of EHD

	Alcohol volume				Frequency of EHD			
	Model 1.1		Model 1.2		Model 2.1		Model 2.2	
	exp(b) ^a	(SE)	exp(b) ^a	(SE)	exp(b) ^a	(SE)	exp(b) ^a	(SE)
Time								
1995	Ref.	(–)	Ref.	(–)	Ref.	(–)	Ref.	(–)
1997	0.9	(0.1)	1.0	(0.1)	0.6*	(0.1)	0.7	(0.3)
2000	1.5*	(0.1)	1.3*	(0.2)	0.7*	(0.1)	0.7	(0.3)
2003	1.1	(0.1)	1.1	(0.1)	0.7*	(0.1)	0.7	(0.3)
2006	0.8*	(0.0)	0.5*	(0.1)	0.7*	(0.1)	0.9	(0.5)
2009	0.9*	(0.1)	0.6*	(0.1)	0.5*	(0.1)	0.5	(0.4)
2012	0.6*	(0.0)	0.3*	(0.0)	0.5*	(0.1)	0.6	(0.4)
Wald test	29.0; <i>P</i> < 0.001		28.1; <i>P</i> < 0.001		3.8; <i>P</i> < 0.001		0.4; <i>P</i> = 0.904	
Consumption level^b								
0–50%	Ref.	(–)	Ref.	(–)	Ref.	(–)	Ref.	(–)
51–80%	11.3*	(0.4)	15.8*	(1.6)	9.0*	(1.3)	13.3*	(4.4)
81–90%	28.2*	(1.0)	55.3*	(5.3)	15.8*	(2.5)	43.6*	(14.8)
91–95%	44.1*	(1.6)	118.3*	(11.2)	26.1*	(4.5)	131.2*	(40.9)
96–100%	96.9*	(5.7)	279.7*	(35.3)	58.3*	(8.3)	210.0*	(62.7)
Wald test	3484.1; <i>P</i> < 0.001		1002.7; <i>P</i> < 0.001		193.6; <i>P</i> < 0.001		109.6; <i>P</i> < 0.001	
SES								
Low	Ref.	(–)	Ref.	(–)	Ref.	(–)	Ref.	(–)
Medium	1.3*	(0.1)	3.3*	(0.3)	0.9	(0.1)	2.4*	(0.8)
High	1.7*	(0.1)	6.3*	(0.6)	0.8	(0.1)	3.6*	(1.2)
Wald test	62.0; <i>P</i> < 0.001		196.4; <i>P</i> < 0.001		0.7; <i>P</i> = 0.05		8.0; <i>P</i> < 0.001	
Time*Consumption level								
Wald test	27.0; <i>P</i> < 0.001		8.3; <i>P</i> < 0.001		2.1; <i>P</i> = 0.001		2.3; <i>P</i> < 0.001	
Time*Consumption level*SES								
Wald test			5.3; <i>P</i> < 0.001				1.8; <i>P</i> < 0.001	

Adjusted for gender, age, survey mode, marital status, consumption level*SES and time*SES. Alcohol volume was analysed using gamma regressions. Frequency of EHD was analysed using negative-binomial regressions.

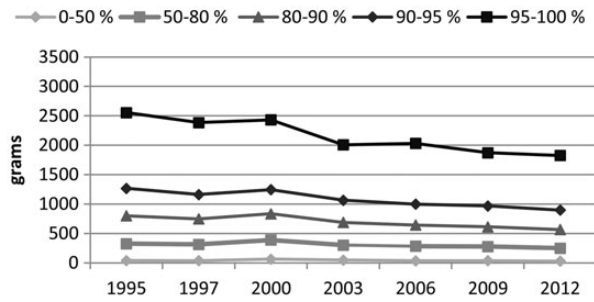
^aTo be interpreted as incidence rate ratios.

^bConsumption level was built with the pooled sample for models 1.1 and 2.1, and SES stratified for models 1.2 and 2.2.

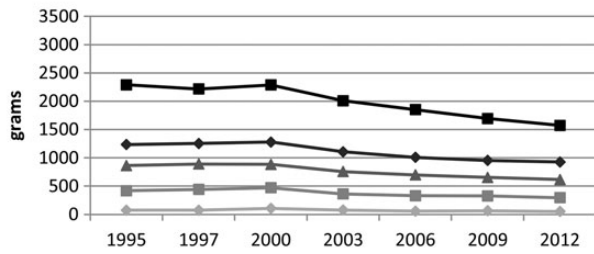
Ref., reference group.

**P* < 0.05.

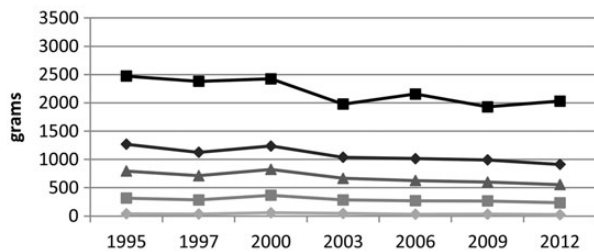
(a) across SES groups



(b) high SES



(c) medium SES



(d) low SES

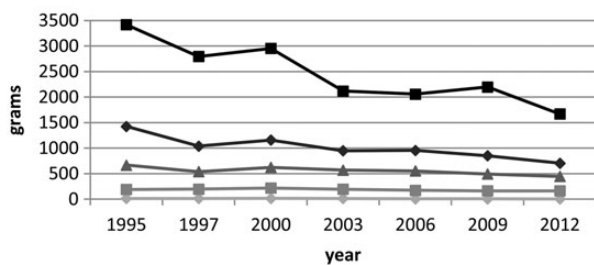
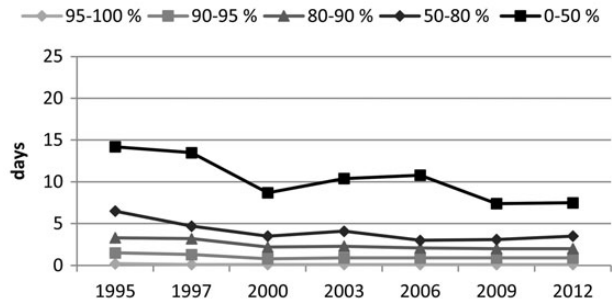


Fig. 1. (a–d) Time trends in alcohol volume by consumption level, across and within SES groups.

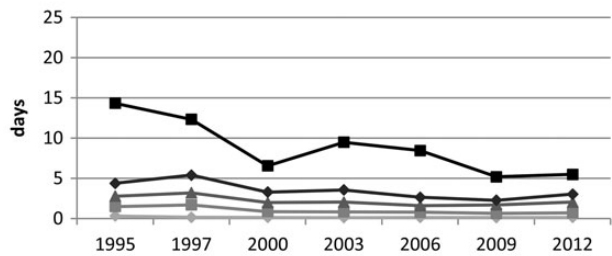
numbers of EHD days (Table 1) and the interaction graph (Fig. 2a) indicate a clear overall decline in the frequency of EHD within all consumption levels, despite sporadic temporal increases. The decline was strongest, but also least steady in the highest compared with lower consumption levels. The 90th–95th percentile group showed deviations in the trend of EHD frequency in the form of a slight incline in the last two surveys.

The three-way interaction indicates that trend differences between consumption levels depended on SES (Table 2, model 2.2). For a graphical inspection of this effect, two-way time*consumption level graphs are presented stratified by SES (Fig. 2b–d). The pattern of a stronger decline in higher compared with lower consumption levels

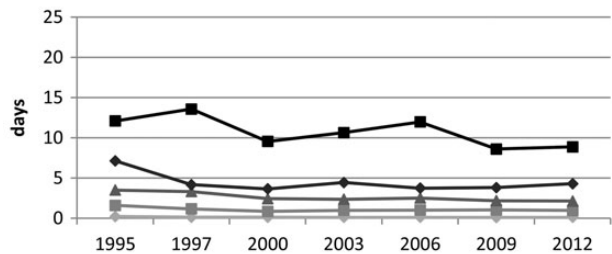
(a) across SES groups



(b) high SES



(c) medium SES



(d) low SES

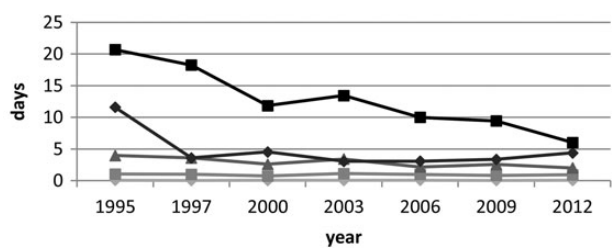


Fig. 2. (a–d) Time trends in EHD frequency by consumption level, across and within SES groups.

was found in all SES groups, but was most pronounced in the low SES group and least pronounced in the medium SES group.

DISCUSSION

The present study investigated whether alcohol consumption in Germany has polarized between 1995 and 2012. Contrary to the polarization hypothesis, results point to a larger decline in mean alcohol volume and mean frequency of EHD at higher compared with lower levels of alcohol use. This convergence of drinking across levels of consumption was found in all levels of SES, but was most pronounced in the low SES group and least pronounced in the medium SES group.

The mismatch between declines in alcohol use and increases in alcohol-related harm indicators such as prevalence of alcohol use disorders or the number of crimes committed under the influence of alcohol (Bundeskriminalamt, 2013; Kraus *et al.*, 2013a; World Health Organization, 2013) can therefore not be explained by more polarized drinking across or within SES groups.

The results contradict predictions derived from the theory of collective drinking behaviour (Skog, 1985, 2001). While the theory assumes that changes in alcohol consumption in a population occur as a shift of the distribution as a whole, temporal changes between consumption levels in this study were unequal, indicating that the shape of the distribution has changed. It has been argued that collective displacement does not occur in case of barriers for social influences and that SES groups might be separated by such barriers (Skog, 2001). However, SES cannot explain the different trends between consumption levels in our case, as the same pattern was found within each SES group.

The greatest overall declines both in alcohol volume and in frequency of EHD were found among top level drinkers of low SES, a group combining two major risk factors for alcohol-related problems (van Oers *et al.*, 1999; Casswell *et al.*, 2003; Herttua *et al.*, 2008; Probst *et al.*, 2014). An explanation can only be speculative, but against the background that income is strongly determined by education (Galobardes *et al.*, 2006), economic affordability might play a role. High-level drinkers and individuals of low SES are most likely to reduce their consumption with increases in price (World Health Organization, 2014b). Even though alcohol prices in Germany have been stable, real disposable income among low SES groups has been decreasing substantially (Rabinovich *et al.*, 2009; van Treec and Sturm, 2012).

Albeit a decline in alcohol use especially in high-risk groups with high consumption and low SES seems beneficial from a public health perspective, two aspects should be stressed which might indicate worrisome developments within certain subpopulations. First, the medium SES group showed lower variability over time than the other SES groups, especially at high consumption. This suggests that factors influencing the observed decrease in alcohol use have affected this group to a lesser extent. Unlike tobacco use, where consumption has been diffusing from high to low SES (Piontek *et al.*, 2010; Pampel *et al.*, 2015), trends in alcohol use do not seem to follow the same pattern. Instead, the upper quantiles of medium SES became the subgroup with the highest values for both outcomes in the year 2012.

Second, attention should be given to the quantile group 91–95% which showed increasing frequency of EHD between 2006 and 2012 despite a decline in volume. As the number of EHD episodes is associated with a high risk for alcohol use disorders as well as other alcohol-related problems (Single and Leino, 1998; Greenfield *et al.*, 2014), this result might indicate the existence of a subpopulation which is developing an increasingly problematic drinking pattern without necessarily increasing its total intake.

It is noteworthy that the groups which showed the largest decline, namely high drinking levels, obviously had the most scope for reduction. If the focus was on relative instead of absolute change, the larger decrease in high compared with low consumption levels would only hold for some of the observed subgroups. Especially the lowest consumption group can be assumed to have undergone a comparably larger relative change due to increased abstinence rates as presented in the descriptive statistics.

Concerning the population subgroups analysed in our study there was no indication of a polarization of alcohol use. However, there might be factors other than SES (or even other SES indicators such

as employment status) associated with trend differences between consumption levels. It might be useful to look at population subgroups whose drinking has shifted in ways that diverge from the general population. As an example, birth cohorts have been discussed as differing in time trends of mean alcohol volume and frequency of EHD (Kerr *et al.*, 2009; Pabst *et al.*, 2010; Harkonen and Mäkelä, 2011; Kraus *et al.*, 2015).

This is one of only few up to date studies describing trends in alcohol use regarding changes in the distribution rather than overall means. Furthermore, it is the first study considering SES as a moderator in this context. The analyses are based on representative national samples large enough to study quantile groups which are composed of only 5% of an SES group. Still, albeit response rates are comparable to those of similar surveys (Medway and Fulton, 2012), biases due to systematic non-response cannot be ruled out. Explicitly, a shift in response from low to high SES might confound time trends. However, as SES-stratified consumption groups were used whenever SES effects were tested, these results are not affected by the shift in response. Adaptations in sampling, age limits, mode of administration and adjustments of the surveys (e.g. replacing ready-to-drink by mixed beverages) are further challenges to the comparability of data sets. Where possible, these variables have been statistically controlled for, i.e. age and mode of administration. Another concern is the underestimation of alcohol intake in self reports. Although underestimation might vary between consumption levels (Stockwell *et al.*, 2014), there is no evidence that underestimation overall or in single consumption levels has changed over time and it should therefore not affect trend analyses.

There are constraints on the variables that could be included in the analysis. For example, participants' health status comprises a potential confounder, as ill health is associated with low SES (Richter *et al.*, 2009; Probst *et al.*, 2014), and at the same time is often a motivator to quit drinking (Fillmore *et al.*, 2006). Furthermore, a choice had to be made which SES indicator to use. We opted for education because it is a robust determinant of other SES components later in life, such as occupation or income (Mäkelä, 1999; Galobardes *et al.*, 2006). Beyond that, education as an indicator has the advantages that it can be applied to everyone, regardless of current employment, it is stable, and it can be assessed in highly standardized, reliable and valid ways (Winkleby *et al.*, 1992). Yet, although different SES indicators usually have similar effects on health, they cannot be used interchangeably (Adler and Ostrove, 1999; Geyer *et al.*, 2006), and other indicators might have yielded different results.

In most EU member states a decline in per capita consumption has been observed (Rabinovich *et al.*, 2009). Such trends can be highly influenced by a small proportion of high-level consumers, as they are responsible for the major part of all alcohol consumed (Ruhm and Black, 2002; Rossow *et al.*, 2014). The results show that this is the case for the observed decline in alcohol use in Germany. Therewith, although we could not affirm the hypothesis of polarization, this study illustrates that looking at different consumption levels as well as investigating the role of potential moderator variables can be useful in order to gather a better understanding of overall changes. Further influences such as cohorts are worth to be studied as a potential moderator of polarization in order not to oversee risk populations with increasing alcohol use. As we could not identify such a risk population, implications for targeted intervention can hardly be derived from this study. At the same time, the results are encouraging for showing that the population level decline in drinking incorporates vast subgroups. As a consequence, the trend could be reinforced by global measures to reduce the availability of alcohol. Yet it is unknown whether the

downward trend is accompanied by an increasing readiness to accept such measures.

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CONFLICT OF INTEREST STATEMENT

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