Changes in the Relationship Between Volume of Consumption and Alcohol-Related Problems in Sweden During 1979–2003

Jonas Landberg1, * and Lena Hübner2

1STAD (Stockholm Prevents Alcohol and Drug Problems), Centre for Psychiatry Research, Karolinska Institutet/Stockholm County Council Health Care Provision, Stockholm, Sweden and 2Department of Social Work, Stockholm University, Stockholm, Sweden

*Corresponding author: STAD (Stockholm Prevents Alcohol and Drug Problems), Centre for Psychiatry Research, Karolinska Institutet/Stockholm County Council Health Care Provision, Stockholm, Sweden. E-mail: jonas.landberg@sll.se

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Abstract — Aims: The aim of the study was to investigate (i) whether the strength of the relationship between self-reported volume of consumption and alcohol-related problems has become weaker in Sweden, and (ii) whether such a change can be related to temporal changes in drinking patterns or to changes in the distribution of consumption and related problems in the population. Methods: Three cross-sectional general population surveys conducted in Sweden in 1979, 1995 and 2003 yielded data on 5650 Swedish adults aged 18–69 years. The relationship between self-reported volume of consumption and self-reported alcohol-related problems was estimated using Poisson regression models. Analyses of drinking patterns focused on changes in frequency of drinking, volume per occasion and frequency of drinking to intoxication. Lorenz curves were used to analyse the distributions of consumption and alcohol-related problems. Results: Poisson regression estimates revealed that the relationship between volume of consumption and alcohol-related problems became weaker over time; a 10% per cent change in self-reported volume of consumption was associated with a smaller per cent change in the number of experienced problems in 2003 (5%) compared with 1995 (6%) and 1979 (7%). This change was not related to a hypothesized general shift towards a more southern European style of drinking, as no such tendency was found. Conclusion: The changed relationship appears to be a reflection of a redistribution of consumption and alcohol-related problems in the population, such that a larger share of all consumption and related problems occurs among light or moderate drinkers in 2003 compared with 1979.

INTRODUCTION

Experiences from the past 30 years in Sweden suggest that the population-level relationship between alcohol consumption and alcohol-related harm may have become weaker. For example, since the 1980s, mortality rates for liver cirrhosis, AAA (an index of alcohol-explicit mortality including alcohol psychosis, alcohol poisoning and alcohol dependence), suicides and fatal accidents have declined when measured per litre of per capita alcohol consumed (Landberg, 2011). Furthermore, after joining the EU in the mid-1990s and up to the mid-2000s, Sweden experienced an ~30% increase in total consumption of alcohol (Leifman and Gustafsson, 2003). Following estimations of the alcohol–harm relationship based on previous time periods, we should expect to have seen a considerable increase in various forms of alcohol-related mortality, but most mortality indicators have remained fairly stable (Andréasson et al., 2006; Ramstedt, 2007, 2010).

Several mechanisms may underlie these changes at the aggregate level, but thus far, few have been tested empirically (Norström and Ramstedt, 2006). In the present paper, we address two plausible mechanisms. The first is that Swedish drinking patterns may have changed such that drinking has become less harmful. By this we mean that the traditional ‘Nordic’ infrequent and intoxication-oriented style of drinking has been replaced, or complemented, by a more frequent and moderate southern European style of drinking, which, according to previous research (Norström, 2002; Babor et al., 2003; Rehm et al., 2004, 2006; Norström and Ramstedt, 2005), should result in less alcohol-related harm per litre of alcohol consumed. The second mechanism is that there has been a change in the shape of the consumption distribution in the population, such that the heaviest drinkers now stand for a smaller proportion of the total consumption. This implies that the total consumption of alcohol is made up to a greater extent of light or moderate drinkers who have a lower risk of experiencing serious consequences or of dying from their consumption compared with the heaviest drinkers which, hence, would result in less alcohol-related morbidity and mortality per litre of alcohol in the total consumption.

Against this background, the aim of the present paper is 2-fold. First, we will investigate whether there are signs of a weakening of the strength of the relationship between volume of consumption and alcohol-related harm when we look at individual-level data. Second, we will examine whether such a change can be related to temporal changes in drinking patterns or to changes in the distribution of consumption (and related problems) in the population. The analyses are based on three repeated cross-sectional surveys conducted in 1979, 1995 and 2003. The relationship between volume of consumption and alcohol-related problems at each point in time is estimated using Poisson regression models. The analyses of drinking patterns focus on temporal changes in the frequency of drinking, volume per drinking occasion and whether drinking to intoxication has become a less dominant feature of drinking patterns in Sweden. Finally, in our analyses of the distributions of consumption and problems we will assess how the level of alcohol-related problems is distributed across different consumption groups for each of the successive points in time and use Lorenz curves as graphic indicators of whether the shapes of the distributions have changed.

Previous research on temporal changes in alcohol consumption, drinking patterns and resultant harm in the Nordic countries includes a study by Mäkelä (2011), who investigated whether the Finnish drinking culture (since the 1950s) has become more moderate in the sense that intoxication drinking has become a less central feature of the drinking patterns, whether different forms of aggregate indicators of alcohol-related harm have...
decreased per litre of total alcohol consumed, and whether the relationship between self-reported alcohol consumption and related problems has become weaker. Although some indicators pointed in these directions (e.g., the relationship between self-reported consumption and intoxication-related problems was stronger at the beginning of the period), there was, overall, no compelling evidence that Finnish drinking has become more moderate. Moreover, a study of temporal changes in the relationship between self-reported alcohol consumption and violent behaviour among Norwegian youth by Bye and Rossow (2008) found that the association became weaker during a period when alcohol consumption was higher. The authors interpreted this finding to imply that the relationship may be relative to the level of wetness of the society; in other words, given that intoxication is to a lesser extent a deviant behaviour during periods of high overall consumption, it is also to a lesser extent associated with various problem behaviours. With regard to studies focusing on the effect of changes in the distribution of consumption, Norström (1987) found that the exceptional increase in male liver cirrhosis mortality that occurred after abolition of the Swedish rationing system in the mid-1950s was mainly attributable to a redistribution of consumption, i.e., the heaviest drinkers increased their consumption relatively more than the moderate and light drinkers, resulting in a more skewed distribution. Further, studies of British (Meier, 2010) and Australian (Livingstone et al., 2010) survey data relate diverging trends in per capita consumption and alcohol-related harm to a polarization in the distribution of consumption, i.e., consumption increased among the heaviest drinkers while it was stable or decreased among low and moderate drinkers.

**METHODS**

The empirical objects of the present study are the results from three surveys, performed in 1979, 1995 and 2003, respectively. The surveys of 1979 and 1995 were performed as part of a Nordic project, whereas in 2003 the survey was performed in Sweden only. All three surveys contain essentially identical items on alcohol consumption and its negative consequences.

All three surveys were sent by mail to a cross-sectional, randomized and representative sample (3000 persons) of the population at each point in time; the age range was 18–69 years. The response rates were ~60% for each of the surveys. Table 1 presents the descriptive characteristics of the samples for each survey year. Men, younger people and persons living in the bigger cities are somewhat underrepresented in the surveys of 1995 and 2003, but not to an extent that would seriously bias the results. Moreover, the coverage rate (the proportion that the self-reported mean yearly volume of consumption makes up of the total consumption for each year, respectively) is ~10% higher in 1995 compared with the other 2 years.

The Quantity-Frequency scale was used for estimating yearly volume of consumption in all surveys. This measure combines items on how often spirits, wine and beer were consumed during the past 12 months with items on the typical amount consumed per occasion. The items were presented separately for each beverage type and were summarized, using standardized measures of drink sizes and alcohol content, to calculate a measure of overall yearly volume of consumption (in litres of 100% ethanol).

<table>
<thead>
<tr>
<th>1979</th>
<th>1995</th>
<th>2003</th>
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<tr>
<td>n</td>
<td>%</td>
<td>n</td>
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<tr>
<td>High</td>
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<td>24</td>
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<tr>
<td>Total consumption*</td>
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<td>Mean consumption in survey</td>
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</tr>
<tr>
<td>Coverage rate</td>
<td>36%</td>
<td>45%</td>
</tr>
</tbody>
</table>

*Source: CAN (2010).

Frequency of intoxication was measured using a subjective question: ‘During the past 12 months, approximately how often did you drink so much beer, wine or spirits that you felt intoxicated?’

The following eleven questions on alcohol-related problems were posed in all three surveys:

**Have you ever, during the past 12 months…**

1. Worried about becoming dependent on alcohol?
2. Thought it was difficult to stop drinking once you started?
3. Thought it would be better to drink less often?
4. Felt tense and nervous the day after drinking?
5. Had a headache, felt nauseous or felt bad in some other way the day after drinking?
6. Failed to get up in time because of a hangover the next day?
7. Stayed at home from work and studies because of a hangover?
8. Regretted something you said or did while drinking?
9. Been louder than otherwise while drinking?
10. Got into a quarrel while drinking?
11. Got into a fight while drinking?

The response options ‘No’, ‘Yes, 1–2 times’ and ‘Yes, several times’ were coded as 0, 1 and 3, respectively. The 11 variables were then summed to form an ‘overall problem index’ with values ranging from 0 to 33. The problem index can be regarded as a rough estimate of the number of alcohol-related problems experienced by the respondent during the past 12 months. In addition, we constructed two sub-indexes. The first was called ‘intoxication-related problems’ and included problems often linked to single intoxication occasions, i.e., questions number 1–8. The second sub-index was called dependence-related problems and included questions number 9–11. The internal consistency of these questions was found to be reasonable (Chronbach’s alpha = 0.70 in 1979) and all problems loaded to one factor. The second sub-index was called dependence-related problems and included questions number 1–3. The internal consistency of these questions was found to be satisfactory (Chronbach’s alpha = 0.70 in 1979) and all problems loaded to one factor.
alpha = 0.73), and all problems loaded to one factor. If the alcohol–harm relationship has become weaker due to changes in drinking patterns, it would be expected to affect the index for intoxication-related problems more strongly.

Poisson regression models were used to estimate the relationship between volume of consumption and alcohol-related problems. The models were estimated separately for each problem index and survey year and included the problem index as the outcome variable and the log transformed yearly volume of consumption (as a continuous variable) as the main explanatory variable. In addition, all models included the following control variables: age, age squared, sex and education level (low and medium education levels were coded as 0 and high education level as 1). The parameter estimates express the elasticity of the relationship, which is interpreted as the percent change in the number of problems given a 1% change in the yearly consumption. To assess whether the effect of consumption on problems was significantly different in 1 year compared with another, we tested a model that included survey year (as a categorical variable) and log transformed volume of consumption as well as their interaction term as explanatory variables.

The analyses of drinking patterns considered the following four indicators: (1) average frequency of drinking occasions during the past 12 months (based on the beverage that had the highest frequency for the respondent); (2) average amount per drinking occasion (for beer, wine and spirits, respectively); (3) average frequency of intoxication occasions during the past 12 months; (4) the proportion of drinking occasions resulting in intoxication during the past 12 months (i.e. the ratio of indicator 3 and 1). The analyses consisted of simple means and frequency counts. Significant changes between means were tested using pair-wise t-tests. If a general shift towards a southern European style of drinking has occurred, we would expect to find a tendency towards an increase in the frequency of drinking occasions and a decrease (or stasis) in the three remaining indicators.

In our analyses of changes in the distributions of consumption and problems, we first constructed a graphic representation of the alcohol–harm relationship (as estimated by the regression models) to assess how the level of alcohol-related problems is distributed across different consumption groups for each of the successive points in time. In a second step, we analysed the data using Lorenz curves and Gini coefficients. Lorenz curves are widely used to measure inequality in the distribution of income and wealth (Shlomo, 1998), but in this case they are used as graphic measures of how the shape of the distributions of (a) consumption, (b) intoxication occasions and (c) alcohol-related problems have changed over time. The Lorenz curves for volume of consumption plot the cumulative proportion of the population ranked by level of consumption on the x-axis against the cumulative proportion of total alcohol consumption on the y-axis. If alcohol consumption is equally distributed in the population, the Lorenz curve is a diagonal line (denoted Line of Equality). The degree to which the curve deviates from the Line of Equality expresses the degree to which consumption is concentrated in the highest consumption groups and, hence, the degree of inequality/skewness of the consumption distribution. In the Lorenz curves for intoxication occasions and alcohol-related problems, the y-axis plots the cumulative proportion of all intoxication occasions and the cumulative proportion of all alcohol-related problems, respectively. The Lorenz curves can also be expressed mathematically using the Gini coefficients. This measure ranges from 0 to 1 (0 representing perfect equality and 1 total inequality) and corresponds to twice the area between the Lorenz curve and the Line of Equality.

RESULTS

Estimations of the relationship between self-reported volume of consumption and the number of alcohol-related problems experienced during the past 12 months

The outcomes of the Poisson regression models are presented in Table 2. In the model that included the overall problem index, all 3 years obtained positive and significant estimates. Moreover, the estimates show that there has been a gradual weakening in the strength of the relationship. The estimates are interpreted such that a 10% increase in the yearly volume of consumption is associated with an ~7% increase in the number of alcohol-related problems in 1979, whereas the corresponding figures for 1995 and 2003 were 6 and 5%, respectively. A test for interaction of survey year and consumption (not shown) revealed that the effect of consumption on problems differed significantly across the survey years (P < 0.001). Basically identical results were found in the models that included the intoxication problem index, and here as well the effect of consumption on problems differed significantly across survey years (P < 0.001). However, the models that included the dependence index gave a different picture; the highest estimate, with an elasticity close to one, was found for 1995, whereas the estimates for 1979 and 2003 were somewhat lower and basically on the same level. Moreover, the effect did not differ significantly across the survey years (P = 0.11).

Changes in drinking patterns

Tables 3 and 4 present our analyses of changes in drinking patterns. The yearly frequency of drinking occasions (Table 3) has increased gradually across survey years, starting with an
average of 48 drinking occasions per year in 1979 and ending with 56 drinking occasions per year in 2003. The changes between 1979 and 1995 and between 1979 and 2003 are significant. A similar pattern of increase is found for the yearly frequency of intoxication occasions (Table 3), but in this case the change is only significant between 1979 and 2003. The proportion of drinking occasions resulting in intoxication is shown in Table 3. Here too we see a gradual and significant increase across the survey years. In 1979, 15% of all drinking occasions led to intoxication, whereas the corresponding figure for 2003 was 20%. 

Table 4 presents the average quantity per drinking occasion for beer, wine and spirits, respectively. The amounts generally increased across the survey years (except for spirits). However, the increase takes place primarily between 1979 and 1995 for beer and wine, whereas for spirits, the average amount consumed per occasion actually decreases significantly between 1979 and 2003.

The observed changes in Figs 1 and 2 are in part due to an increase in the level of consumption among the lower consumption deciles (indicated by their position, which is further to the right on the x-axis), but also due to the fact that respondents in these deciles experienced higher levels of problems relative to volume in 2003 compared with 1979 (indicated by the fact that the curve for 2003 lies above that of 1979). The latter observation suggests that drinking has become more harmful among these groups, e.g. because of an increase in intoxication occasions. However, the figures do not tell us whether these changes have been large enough to affect the overall shape of the distribution of alcohol consumption, intoxication occasions and related problems in the population. We therefore proceed to the Lorenz curve and Gini coefficient analyses, which examine whether the shape of these distributions has changed across the years studied.

The Lorenz curves for volume of consumption are presented in Fig. 4. As can be seen, the curve for 1979 lies below those for 1995 and 2003, implying that the consumption distribution is more skewed this year than in the latter 2 years. It is evident that the change is driven by a relative increase in consumption among the lower consumption deciles. For example, the curves show that the respondents up to the 7th decile (the same category of respondents that had increased problem levels between 1979 and 2003 in Fig. 1) account for 19% of all consumption in 1979 and 24% in 2003, i.e. an increase of 26%. Likewise, the share of the consumption accounted for by the 10% heaviest drinkers has decreased from 51% in 1979 to 48% in 2003. The Gini coefficient decreased by 7% between 1979 and 2003 (from 0.68 to 0.63), suggesting that the overall change in the shape of the consumption distribution is rather small. However, the finding of a change in the consumption distribution was also supported by Levene’s test for equality of variance, showing that the variance of the distributions differed significantly between 1979 and 2003 (F 47.2, P < 0.0001).

In Fig. 5, the Lorenz curves for alcohol-related problems show that there has been a gradual redistribution of alcohol-related problems in the population such that a larger proportion of all problems is now experienced among low and moderate consumers. For example, as a category, respondents up to the 7th decile accounted for 32% of all problems in 1979.
and 46% in 2003. Regarding the 10% heaviest drinkers, their share of all problems decreased by approximately one fifth, from 33% in 1979 to 27% in 2003. This pattern is also confirmed by the Gini coefficient, which decreased by a total of 30% (from 0.52 to 0.36) between 1979 and 2003, indicating a marked change towards a less skewed distribution of problems along the consumption scale.

Finally, the Lorenz curves and Gini coefficients for the distribution of intoxication occasions (Fig. 6) also show a gradual decrease in the skewness of the distribution; the Gini

Fig. 1. Predicted mean number of overall alcohol-related problems experienced in consumption deciles during the past 12 months.

Fig. 2. Predicted mean number of intoxication-related problems experienced in consumption deciles during the past 12 months.
coefficient decreases by 17% between 1979 and 2003 (from 0.65 to 0.57) and, as a category, respondents up to the 7th decile increased their share of all intoxication occasions by 76% (from 17 to 30%), whereas the top 10% heaviest drinkers decreased their proportion of all intoxication occasions by 14% (from 49 to 56%).

DISCUSSION

Overall, our findings provide a fairly consistent picture. First, the results suggest that the relationship between self-reported yearly volume of consumption and self-reported alcohol-related problems has become gradually weaker in Sweden,
such that the same per cent change in volume of consumption is associated with a smaller per cent change in the number of problems in 2003 compared with 1979 and 1995. The result is thus consistent with the population-level development of decreasing alcohol-related mortality per litre consumed in the per capita consumption.

Second, this change does not seem to be due to a general softening of drinking patterns in the sense that they have become more moderate or south European. Even if the frequency of drinking did increase gradually across the survey years, so did the frequency of intoxication occasions, and more importantly, also the share of intoxication occasions among all drinking occasions. Thus, as we see in Figs 1 and 2, the changed alcohol–harm relationship rather appears to be a reflection of a redistribution of alcohol-related problems in the population (concentrated to intoxication-related problems).

Fig. 5. Lorenz curves of the distribution of alcohol-related problems.

Fig. 6. Lorenz curves of the distribution of intoxication occasions.
which in turn can be related to an increase in the volume of consumption and the number of intoxication occasions among low and moderate consumption groups. This finding was also supported by the Lorenz curves, which revealed that a larger proportion of all consumption, intoxication occasions and resultant problems occurred among low and moderate consumers in 2003 than in 1979. For example, the category of respondents up to the 7th decile increased their share of all consumption by 26%, of all intoxication occasions by 76% and of all alcohol-related problems by 44%.

Hence, instead of the hypothesized general shift towards a more southern European style of drinking, the results suggest that there has been a normalization of drinking and related harm in the population, in the sense that a larger share of all consumption, intoxication occasions and problems is found among low and moderate consumers. These results may serve as one piece of the larger puzzle, which involves understanding the development at the aggregate level. Because a larger proportion of the total consumption is now made up of low or moderate drinkers, who usually do not experience as serious consequences or die as often from alcohol consumption as do the heaviest drinkers, we should also expect less alcohol-related mortality and morbidity per litre consumed in the per capita consumption.

This conclusion may appear to contradict the prevention paradox, which states that—although low and moderate drinkers have less risk of experiencing negative consequences compared with the heaviest drinkers, they account for the majority of all alcohol-related problems simply because they are more numerous (Kreitman, 1986; Skog, 1999, 2006). However, the prevention paradox is generally assumed to primarily be applicable to outcomes associated with single intoxication occasions, such as violence and accidents, and not to mortality outcomes linked to chronic heavy drinking, e.g., liver cirrhosis, alcohol psychosis and alcohol dependence (Skog, 1999, 2006). Considering this in the light of our results—that it is primarily consumption and problems related to intoxication that have increased among lower consumption groups—we would expect to have seen a closer match between the total consumption and mortality outcomes related to intoxication occasions. This expectation is in fact supported in a study by Andréasson et al. (2006), who showed that mortality due to accidents and assaults has had a better fit with total consumption since 1995 than has an index of alcohol-related mortality including, e.g., liver cirrhosis and alcohol psychosis.

The results should also be discussed in relation to Skog’s theory of the collectivity of drinking cultures (Skog, 1985). According to Skog, changes in per capita consumption tend to reflect a collective shift by drinkers at all levels of the consumption distribution. Moreover, this shift is assumed to occur in relative terms, so that a change in per capita consumption reflects a proportional change across all levels of the consumption distribution. Our finding that low and moderate drinkers have increased their consumption relative to the heaviest drinkers thus appears to be at odds with one of the basic assumptions of Skog’s theory. However, it should be mentioned that Skog, in his analyses of survey data, also noted that the relative changes in consumption tend to be somewhat larger among low and moderate drinkers compared with those who drank the most heavily, which is in line with our findings.

Moreover, our findings support Bye and Rossow’s (2008) notion that the alcohol and harm relationship is relative to the wetness of the society, but also add that this may apply to a broader range of alcohol-related problems besides violence.

Some limitations of the present study should be noted. First, we cannot determine whether the observed changes in the consumption distribution have been large enough to actually influence the population-level alcohol–harm relationship. Second, numerous other developments in society as a whole may also have influenced the relationship in the same direction, for example improved treatment of alcohol dependency, liver cirrhosis and other alcohol-related outcomes and, with regard to fatal accidents and suicides, improved road and work safety as well as more effective emergency treatment and suicide prevention. Lastly, considering the long time frame of the study, it is possible that respondents have become more (or less) inclined to report their actual consumption and related problems due to changes in the norms and attitudes surrounding alcohol. Thus, one possible source of bias could be that more restrictive norms and attitudes in 1979 have caused respondents to underreport their consumption and problems to a larger degree in 1979 than in 2003. However, our analyses of changes in the relationship between volume of consumption and related problems should be less easily affected by changes in the tendency to underreport in alcohol surveys, because such changes most likely push both reported consumption and the number of experienced alcohol-related problems in the same direction. Thus, in order to confound our results, the tendency to underreport consumption and problems would have to have changed differently across the consumption groups, such that it decreased more among light and moderate drinkers than among the heaviest drinkers. Naturally, the likelihood of this scenario is very hard to assess. Nevertheless, it is also possible that our findings showing that both consumption and problems have increased relatively more among light and moderate drinkers also reflect increased social acceptance of being open about consumption and related harm in these consumption groups. Regardless of which interpretation is more accurate, when speaking in broader terms of more general changes in the Swedish drinking culture, both these scenarios suggest that the period covered by our data has seen a normalization of drinking and related problems in the population (either in terms of ‘real life’ experiences or as reported in surveys) in the sense that they are now less confined to a small group of heavy drinkers.

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