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Changes in alcohol consumption in Denmark after the tax reduction on spirits

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Abstract

AIMS—This paper examines changes in alcohol consumption in Denmark between 2003 and 2006 after the excise tax on spirits in Denmark was lowered by 45% on 1. October 2003 and travelers' allowances for alcohol import were increased on 1. January 2004.

METHODS—Cross-sectional and panel data from Denmark from 2003 to 2006 were analyzed. Samples were collected by telephone interviews using random digit dialing.

RESULTS—Panel data for Denmark revealed that alcohol consumption remained relatively stable. Similar results were found in the Danish cross-sectional data. It appears that substitution rather than increased importation occurred.

CONCLUSION—We found no evidence to support earlier research stating that decreased prices and increased availability is related to higher alcohol consumption. This could be partly because Denmark has reached a "saturation" level of consumption over the past 30 years, but also because the survey mode of data collection did not capture specific sub-populations who might have increased their consumption. Other indicators of alcohol use or alcohol-related harm may be necessary to examine in order to fully assess the consequences of such changes in alcohol availability.

Keywords

alcohol consumption; Denmark; tax reduction

Introduction

In October 2003 the Danish government lowered its excise tax on spirits by 45%, leading to a price reduction of 25% on cheaper brands. This measure was taken in anticipation of a generous increase in the travellers' allowances between European Union countries for personal import of spirits which took effect in January 2004 [1]. The government's concern was that travellers' alcohol imports would increase after the change in the travellers' allowance - from 1.5 litres to 10 litres - and that total tax revenues would decline. Thus, this tax reduction was aimed at offsetting such an effect [2].

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However, it is well known that the price of alcohol can influence consumption levels [3,4], and thus increases in the price of alcoholic beverages can lead to reductions in consumption and heavy drinking as well as in alcohol-related consequences [5]. A classical example of the effects of taxes on consumption comes from Denmark where spirits taxes were increased twelve-fold during the First World War. The rise resulted in a substantial decrease in per-capita alcohol consumption and in acute and chronic health consequences of drinking [6]. Conversely, it is possible that a reduction in the price of alcohol can lead to increases in consumption. A recent example of a price decrease comes from Switzerland where in 1999 taxes on foreign spirits were lowered by 30% to 50%. This price reduction was associated with an increase in consumption among younger subgroups in the Swiss general population [7]. Recently Wagenaar et al. [8] conducted a meta analysis to address the question if alcohol prices and tax levels are related to alcohol consumption. On the basis of 112 studies they found evidence that alcohol prices and taxes are related inversely to alcohol consumption.

Research on the price elasticity of alcohol has shown that spirits is more elastic than either beer or wine, and can thus raise more concern for the consequences of a tax reduction on this beverage type.[5] The high price elasticity of spirits could be due to the fact that people who are most responsive to price changes; i.e., problem drinkers and younger people [5,7], prefer spirits.

Aggregate data for Denmark show that recorded sales of spirits rose by 16% but total recorded alcohol consumption (per inhabitants aged 15 or older) fell by 2% from 2003 to 2004 [9]. The reasons for this may be related to the phenomenon, “substitution”, meaning that people bought more spirits within their own country after the tax reduction on spirits and imported less, thus implying that people changed their shopping behaviour but not their drinking behaviour.

Aggregate level changes deserve further investigation at the subgroup level to examine how particular groups may have increased or decreased their consumption during the study period. This can be observed only with the use of survey data, which is the basis for the present analysis. Although problems with coverage of total alcohol consumption are well-known and documented with surveys [10,11], such data offer the only means for detecting changes in drinking and drinking patterns on the subgroup level because aggregate registry data, by their nature, do not allow analyses of individuals. Further, the Danish tax change on spirits also offers the unique opportunity to conduct a natural experiment and to collect longitudinal (both panel and cross sectional) data before and after the tax reduction. Most previous studies examining price differences in alcoholic beverages have been based on only cross-sectional data [5].

The question as to whether both a decrease in the tax on spirits within Denmark and a liberalization of the EU travellers’ allowance would contribute to an increase in spirits and overall alcohol consumption in the Danish general population is the basis of the present investigation which is a part of the larger Nordic study “Effects of major changes in alcohol availability” involving Denmark, Finland and Sweden. This collaborative project was formed to investigate alcohol consumption responses to such policy changes in all three countries because Swedes often purchase cheaper alcohol in Denmark and because taxes on alcohol were also lowered in Finland as of 1. January 2004. Mäkelä et al. [12] have recently reported on short-term consumption changes between 2003 and 2004 based on survey data collected from sampling the general population in all three countries using both panel and cross-sectional designs. Surprisingly they found no increases in consumption in any of the three countries within this period.

Further studies regarding these policy changes have since been conducted using other sources of data. Mäkelä and Österberg [13] reported that contrary to the results of the surveys, recorded per capita consumption increased in Finland from between the periods of 2001–2003 and 2004–

2006. The same was true for alcohol-related deaths and hospitalisations. The authors also observed that the increases were highest among middle-aged and older segments of the population as well as those worst off economically and socially. Based on registry data Bloomfield et al. [14] (in review) found a 26% increase in hospitalisations for alcohol intoxication among young persons below 15 years of age between 2000 and 2005 in Denmark. They attributed this increase to an intervention effect of the policy changes.

In order to examine whether any possible longer term trends based on survey data are evident in Denmark since 2003, this paper investigates changes in alcohol consumption in representative cross-sectional samples of the Danish general population surveyed in 2003, 2004, 2005 and 2006 as well as with panel data collected in 2003 and followed through 2006.

We hypothesized that given the documented price elasticity of spirits and the extent of the tax reduction, we would see over the long-term increases in spirits consumption and in total alcohol consumption in Denmark, and that this increase would be stronger among younger rather than older consumers.

Methods

The data come from a national survey of the Danish general population conducted by a public opinion survey firm, Vilstrup, on behalf of the University of Southern Denmark. Random digit dialing (RDD), which included cell phones, and computer-assisted telephone interviewing (CATI) were used and sampling within households was done with the last birthday method.

The analytical strategy chosen for the study was to employpanel samples and, independently, repeated cross sectional samples from the general population to test for changes in individual consumption as well as importing behaviour. As panel samples alone cannot separate the effects of aging from other effects associated with time, the repeated cross-sectional samples were meant to control for the effect of aging in panel samples and to allow comparisons for the whole population over time. The cross-sectional data therefore permit comparison with aggregate level statistics, such as sales data. Panel samples were included to test causal hypotheses.

The first wave was conducted in August and September 2003 and 1771 persons were interviewed. We restricted the age range to 16 to 69 in order to make samples and results comparable to the survey data collected in Finland and Sweden. The cooperation rate for the 2003 sample was 49.6% (AAPOR cooperation rate formula 4) [15]. For the panel data respondents were re-interviewed in 2004, 2005 and 2006 and the cooperation rates ranged from 82.1 to 90.7%. Additional cross-sectional samples were interviewed in 2004, 2005 and 2006. Cooperation rates for these additional cross-sectional samples ranged from 56% to 70.7%. Cross-sectional data were weighted according to age, sex and regional distributions in the Danish general population. For the panel analysis we included all persons who were interviewed at least at two time points (Table 1). A total of 634 persons were interviewed at all four time points.

It was not possible to conduct a non-response analysis as the sample was drawn from random digit dialling methods. However, an elaborate missing value analysis and missing value imputation were conducted to investigate the possible effects of attrition over the panel samples. These did not yield significant differences in results [16].

Alcohol consumption was measured with beverage-specific quantity-frequency questions. Volume (per day) is the summary of beverage-specific volume measures. These come from quantity-frequency questions for beer, wine, strong wine, spirits and “alcopops”. For frequency, the categories were: “every day or nearly every day”, “4–5 times a week”, “2–3 times a week”, “approximately once a week”, “2–3 times a month”, “approximately once a

month", "a few times during the last 12 months", "once in the last 12 months", and "never". Spirits consumption was measured with the beverage-specific quantity-frequency questions on spirits.

Information about the amount of alcohol brought in from the last trip outside Denmark and the number of adults who imported it was used to calculate the amount of imports on the last trip for every individual. Because of the skewed distribution of the individual import levels we report not only mean imported amounts but also the 75th percentiles (in centilitres of pure alcohol).

Means and medians of pure alcohol consumption in centilitres per day were calculated to describe overall consumption in all four years and also separately for men and women and for different age and sex groups. For further analysis, the logarithm (base 10) was taken. To obtain valid values also for non-drinkers 1 was added to the original values before taking the log.

We tested the change in consumption in two different ways. First we tested whether the interventions (price change for spirits and change in travellers' allowance) had an effect. Therefore we included a dummy variable with the value of 0 for 2003 and 1 for 2004, 2005 and 2006. Additionally we tested for a linear trend over the four survey years. Tests for the intervention effect and univariate linear trend tests for the panel data were calculated by using a multilevel model where the different time points are level 1 measures nested in the individuals, who are level 2. The advantage of these models is that they account for heterogeneity in the population as well as for the covariance between the different time points. Further, it is not required to have the same number of observations on each subject [17]. We used a model with random intercept and random slope, which has the following equation: $Y_{it} = \beta_{0i} + \beta_{1i}t + \varepsilon_{it}$, and where Y_{it} is the logarithm of consumption for an individual i at time t, β_{0i} is the random intercept, β_{1i} is the random regression coefficient for time, and ε_{it} is the "error" for subject i at time t.

For analyzing consumption changes in the cross-sectional samples we used linear regression models with the survey year variable as independent variable similar to Rehm and Arminger [18]. This strategy is legitimate because samples for the different years are representative for the Danish population and questionnaires did not differ between the survey years.

The value for linear trend was recalculated from the coefficient for time from the model for logged consumption to obtain change in centilitres over time.

The panel data were analyzed additionally by using multivariate multilevel models. The dependent variable was overall consumption (logged). Models were analyzed separately for men and women. Time was coded with 0 for 2003, 1 for 2004, 2 for 2005 and 3 for 2006. Further independent variables for the multivariate analyses were age (centered), age squared, education (three categories, low: less than upper secondary level, middle: upper secondary level, high: tertiary level, reference category was low educational achievement), personal monthly income (used as quasi-metric variable, seven categories, 0: up to 10,000 Danish crowns, 1: 10,000–14,999 crowns, 2: 15,000–19,999 crowns, 3: 20,000–29,999 crowns, 4: 30,000–39,999 crowns, 5: 40,000–49,999 crowns, 6: 50,000 crowns or more). All independent variables were measured in the associated survey year. We first estimated a baseline model (M1) in order to assess the intra-class correlation which indicates the relation of the different time point measures for the same individual. Then the survey year (time) was added to the model (M2). For the third model (M3) we added variables at the individual level, but only variables with significant coefficients remained in the model. Only for the model of overall consumption of women did we also include the non-significant coefficient for age because of the significant coefficient for age squared. Additionally we tested a random slope for the time variable and cross-level interactions. For the income variable there were 11% missing values

for women and 7% missing values for men. Therefore we also calculated a model where we estimated the coefficients after multiple imputations for the missing income values. Multiple imputation was done by using a MLwiN macro offered by the London School of Hygiene and Tropical Medicine [19]. The coefficients for the model after multiple imputations are not shown in the tables because they differ only slightly from the model without imputed values.

Results

Table 2 displays mean alcohol consumption from the four waves of the survey. The overall mean of daily average alcohol consumption ranges from 1.4 to 1.7 centilitres of pure alcohol for the panel and the cross-sectional data. (For illustrative purposes, 1.5 centilitres of pure alcohol is equivalent to approximately one small bottle of beer (0.33 litres), one glass of wine (0.12 litres) or one glass of spirits (0.04 litres) in Denmark). With regard to the panel data few statistically significant changes in consumption (based on linear trend tests and on tests of the intervention effect) could be found over the four years for the total population sample as well as for men and women and age subgroups. For the entire sample, a statistically significant decreasing trend in consumption could be observed, even if the difference is relatively small. Consumption among men remained stable over the study period. Analysis based on the data from the cross-sectional samples show similar results. For younger women, though, there is a decrease of consumption over time while for older women consumption increases.

Since prices for spirits changed in Denmark, we also explored more specific potential changes in spirits consumption only (data not shown). No statistically significant changes could be seen except for women aged 50–69 in the panel samples where consumption increased over the study period from 0.04 centilitres per day in 2003 to 0.10 centilitres in 2006. And although not statistically significant (probably due to small numbers), young women aged 16–29 years in the panel samples decreased their spirits consumption by half over the study period: from 0.44 to 0.21 centilitres per day. A decrease could also be seen in the cross-sectional data, but was not statistically significant for either men or women.

Table 3 shows that levels of consumption for the same individual in different years are in general highly correlated with each other. This is indicated by the high coefficient of the intra-class correlation of 71.6% for women and 73.8% for men (model 1). The results of model 2 indicate that there is a slight decrease in consumption for both men and women over the study period. The decrease is statistically significant for women. Model 3 shows that among women overall consumption is higher among younger and older women in comparison to middle aged women. For women with higher income and for women with middle or high educational achievement consumption is also higher in comparison to those with lower educational achievement and lower income. For men overall consumption decreases with age in a nonlinear manner and is also higher for those with higher income. Model 4 allows the slope for individuals to vary according to different rates of change over the study period. For both men and women the rates of change differ significantly between individuals as indicated by the significant coefficient for τ_{11}. In Model 5 cross level interactions were tested. Only for women is there a significant interaction between time and age, which means that younger women decreased their levels of consumption more steadily than older women.

Multivariate analysis of the cross sectional data (Table 4) revealed no significant changes in overall consumption levels over time for men and women. For both men and women only the age squared coefficient was significant which indicates that younger and older men or women have higher rates of consumption than middle aged men or women. Among women those with higher income and those with middle or high educational achievement have higher levels of consumption in comparison to those with lower income and lower educational achievement.

Among men, only income had a significant effect in that those with higher income have higher levels of consumption than those with lower income.

We also examined changes in spirits consumption with multivariate analyses (data not shown). Levels of spirits consumption differed more than levels of overall consumption for the same individual over the study period (in the panel samples) as was indicated by an intra-class coefficient of 47.9% for women and 63.3% for men. But there were no significant changes over the study period for either men or women. As regards the cross-sectional data there was also no significant time trend over the study period.

Because the tax reduction on spirits coincided with the liberalization of the travellers' import allowances, we were interested to see if this measure had an effect on Danes' importing behaviour. Figure 1 displays self-reported imports based on both cross-sectional and panel data. An increasing trend of 40 to 50 centilitres in mean total import in the years 2003–2005 is followed by a decrease to 30 cl in 2006 for the panel and for the cross-sectional data. But the distribution for alcohol import is skewed: more than half of respondents imported no alcohol and another 25% report stable or decreasing amounts of alcohol import. That means that only few people increased their import levels over time.

Discussion

This paper has examined four years of data, in both panel and cross-sectional form, to investigate changes in alcohol consumption after the introduction of the tax reduction on spirits in Denmark in 2003 and the liberalization of travellers' imports in 2004. The expectation was that total alcohol consumption in general and spirits consumption in particular would increase over the study period, and especially among young consumers. The hypotheses could not be confirmed: in general no relevant changes in drinking behaviour were found.

Offering possible reasons for the lack of detectable increases in consumption over the study period is challenging. The following discussion presents initial ideas to further pursue as potential reasons. Firstly, it can be observed that consumption in Denmark has remained stable at approximately 12 litres of pure alcohol per capita (population 15 years and older) over the past 30 years. Beginning in 2001 and 2002, a dip to close to 11 litres per capita occurred, then a rise to 12 litres in 2003, and a dip again to 11 litres in 2004 through 2006 [20]. Only spirits sales rose in 2004 but decreased again by 2005 [21]. This long-term stability may lend support to the argument that alcohol consumption in Denmark has reached a saturation point [22] and that any price decreases are not incentive enough to consume more.

Considering sales statistics for spirits only, we could say that spirits sales have behaved as predicted based on its price elasticity – at least in the first year after the tax decrease. Spirits sales statistics demonstrate an increase of approximately 16% from 2003 to 2004. Yet, we could not detect this increase in our survey data for reported spirits consumption. As mentioned above we hypothesize that this is due to "substitution": people import less alcohol, buy more in their own country but drink at the same level. This hypothesis is also supported by our import level analysis where imports did not noticeably rise, except for a small minority of the sample. Another possible explanation that has been offered is that petrol prices increased by about 25% in Denmark between 2002 and 2006, and this could have discouraged some importation of alcohol and other products from across the southern border [23].

An interesting finding in the Danish data is that there was a consistent age pattern in the changes in alcohol consumption in both the panel and cross-sectional data. Younger age groups decreased their consumption over the study period more noticeably than did older age groups. This was particularly marked for women 16–29 years in both panel and cross-sectional samples, and the decrease reached statistical significance in the cross-sectional samples. The same

pattern can likewise be seen in spirits consumption for both the panel and cross-sectional data. Here, interestingly, the oldest age group increased its spirits consumption; this reached statistical significance among women aged 50–69 years. Thus, these data shed a bit of light on subgroup behaviour and indicate that if any increase in consumption could be detected by survey research methods it appears that it has occurred among the older age groups.

One general weakness of this investigation is the study design's ability to establish causality. Here, any changes or lack of change that we have detected are dependent upon the sample that was drawn and the variables chosen to be measured. Extraneous variables which were not measured or could not be measured in a general population survey remain unaccounted for, and indeed may act as confounders [24,25]. This problem has been recently addressed by Room et al [22] as a response to the lack of expected results found in the larger Nordic tax study. The authors refer to the economics literature in which predictions of changes in economic behaviour are made with the caveat *ceteris paribus*. Because it is clear that not all things remain equal, various other influencing factors must be considered. Room et al [22] developed a list of societal factors (e.g., taxes, availability controls, societal responses to problems, advertising, purchasing power, etc.) that should be included in a model if one were to isolate and test tax or availability policies in future studies. This, obviously, was not the case nor was it possible to achieve in the present study. Yet, the inspiration and point of departure for the larger study was the belief that the tax reductions were large enough to have overriden any other external factors operating simultaneously[22].

Further limitations regarding this study involve the modest survey cooperation rates, especially in the initial and later cross-sectional surveys. It is well known that willingness to cooperate in survey research is declining and telephone surveys are especially affected [26–28]. However, our 2003 survey data appear to be relatively robust in that estimates of heavy drinking and binge drinking among young people agree quite closely with estimates from surveys with higher response rates [29]. Nevertheless, surveys are the only method to investigate individual behaviour which is not reflected in aggregate registry data. An accompanying weakness is that surveys are limited in their ability to reach all segments of society; thus, usually those living on the fringes (i.e., homeless, unemployment, poor groups which can include higher proportions of heavy drinkers) may not be included in the samples [30]. Because of these methodological shortcomings, it has been desirable to supplement the present study's findings with other sources of alcohol-related data, such as registry statistics on alcohol-related hospitalizations, accidents and crimes which may include population sub-groups who have engaged in any increased consumption. This has been done in the studies of Mäkelä and Österberg [13] and Bloomfield et al. [14] and such efforts have contributed to fleshing out a picture of the full potential impact of the recent policies. Researchers should consider the whole spectrum of available variables when designing future studies of major alcohol policy changes.

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References

1. European Union. Travelling in Europe - Shopping. [Accessed December 10, 2007]. Available at http://europa.eu/abc/travel/shop/index_en.htm
2. The Danish Ministry of Taxation. Spiritus, cigaretter, mineralvand - afgiftsgodtgørelse [Spirits, cigarettes, mineral water - Tax information]. [Accessed August 8, 2007]. Available at: http://www.skat.dk/SKAT.aspx?oID=168841
3. Babor, TF.; Caetano, R.; Casswell, S., et al. Alcohol no ordinary commodity research and public policy. Oxford: Oxford University Press; 2003.
4. Edwards, G.; Anderson, P.; Babor, TF., et al. Alcohol policy and the public good. Oxford: Oxford University Press; 1995. Reprinted ed
5. Chaloupka FJ, Grossman M, Saffer H. The effects of price on alcohol consumption and alcohol-related problems. Alcohol Res Health 2002;26(1):22–34. [PubMed: 12154648]
6. Bruun, K. Alcohol control policies in public health perspective. Helsinki: The Finnish Foundation for Alcohol Studies; 1975.
7. Kuo MC, Heeb JL, Gmel G, Rehm J. Does price matter? The effect of decreased price on spirits consumption in Switzerland. Alcoholism-Clinical and Experimental Research 2003;27(4):720–5.
8. Wagenaar AC, Salois MJ, Komro KA. Effects of beverage alcohol price and tax levels on drinking: A meta-analysis of 1003 estimates from 112 studies. Addiction 2009;104:179–190. [PubMed: 19149811]
9. Statistics Denmark. Danskerne drikker mindre alkohol - rettelse [Danes drink less alcohol -correction]. [Accessed December 10, 2007]. Available at: http://www.dst.dk/nytudg/7760
10. Gmel G, Rehm J. Measuring alcohol consumption. Contemporary Drug Problems 2004;31(3):467–540.
11. Midanik LT. Validity of Self-Reported Alcohol-Use - A Literature-Review and Assessment. British Journal of Addiction 1988;83(9):1019–29. [PubMed: 3066418]
12. Mäkelä P, Bloomfield K, Gustafsson NK, Huhtanen P, Room R. Changes in volume of drinking after changes in alcohol taxes and travellers' allowances: results from a panel study. Addiction 2008;103 (2):181–91. [PubMed: 18028522]
13. Mäkelä P, Österberg E. Weakening of one more alcohol control pillar: A review of the effects of the alcohol tax cuts in finland in 2004. Addiction 2009;104:554–563. [PubMed: 19335654]
14. Bloomfield K, Rossow I, Norström T. Changes in alcohol-related harm after alcohol policy changes in Denmark. European Addiction Research. 2009 (in review).
15. American Association for Public Opinion Research. Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys. 4 [Accessed March 3. 2007]. Available at: http://www.aapor.org/uploads/standarddefs_4.pdf
16. Grittner, U.; Wicki, M.; Gmel, G.; Bloomfield, K. Imputation of missing longitudinal data: different approaches. Presentation on the 54th Biometric Colloquium; Munich. 10th–13th of March, 2008;
17. Fitzmaurice, GM.; Laird, NM.; Ware, JH. Applied panel analysis. Hoboken, N.J: 2004.
18. Rehm J, Arminger G. Alcohol consumption in Switzerland 1987–93: Adjusting for differential effect of assessment techniques on the analysis of trends. Addiction 1996;91:1335–1344. [PubMed: 8854369]
19. Medical Statistics Unit, London School of Hygiene and Tropical Medicine. Missing Data. [Accessed November 2, 2008]. Available at: http://www.missingdata.org.uk/
20. Statistics Denmark. Statistikbanken [StatBank Denmark]. [Accessed August 8, 2007]. Available at: http://www.statistikbanken.dk
21. Statistics Denmark. Statistisk årbog 2006 [Statistical Yearbook 2006]. 110. København: Danmarks Statistik; 2006.
22. Room R, Osterberg E, Ramstedt M, Rehm J. Explaining change and stasis in alcohol consumption. Addiction Research & Theory 2009;99999:1–15.
23. Lhachimi, S. The combined effect of petrol prices and distance on the demand in for alcoholic beverage in Sweden after the lift of the import restrictions in 2004. unpublished. University of Essex, Department of Government; Nov. 2006

24. Rothman, KJ.; Greenland, S. Causation and causal inference. In: Rothman, KJ.; Greenland, S., editors. Modern epidemiology. 2. Philadelphia: Lippincott Williams and Wilkins; 1998. p. 7-28.

25. Rothman, KJ. Epidemiology: an introduction. Oxford: Oxford University Press; 2002.

26. Curtin R, Presser S, Singer E. Changes in telephone survey nonresponse over the past quarter century. Public Opinion Quarterly 2005;69(1):87–98.

27. Groves RM. Nonresponse rates and nonresponse bias in household surveys. Public Opinion Quarterly 2006;70(5):646–75.

28. Keeter S, Kennedy C, Dimock M, Best J, Craighill P. Gauging the impact of growing nonresponse on estimates from a national RDD telephone survey. Public Opinion Quarterly 2006;70(5):759–79.

29. Bloomfield K, Grittner U, Rasmussen H, Petersen HC. Socio-demographic Determinants of Alcohol Consumption in the Danish General Population. Scandinavian Journal of Public Health 2008;36:580–8. [PubMed: 18775814]

30. Pernanen, K. Validity of survey data on alcohol use. In: Gibbens, R.; Israël, Y.; Kalant, H.; Popham, RE.; Schmidt, W.; Smart, RG., editors. Research advances in alcohol and drug problems. Vol. 1. New York: John Wiley & Sons; 1974. p. 355-74.

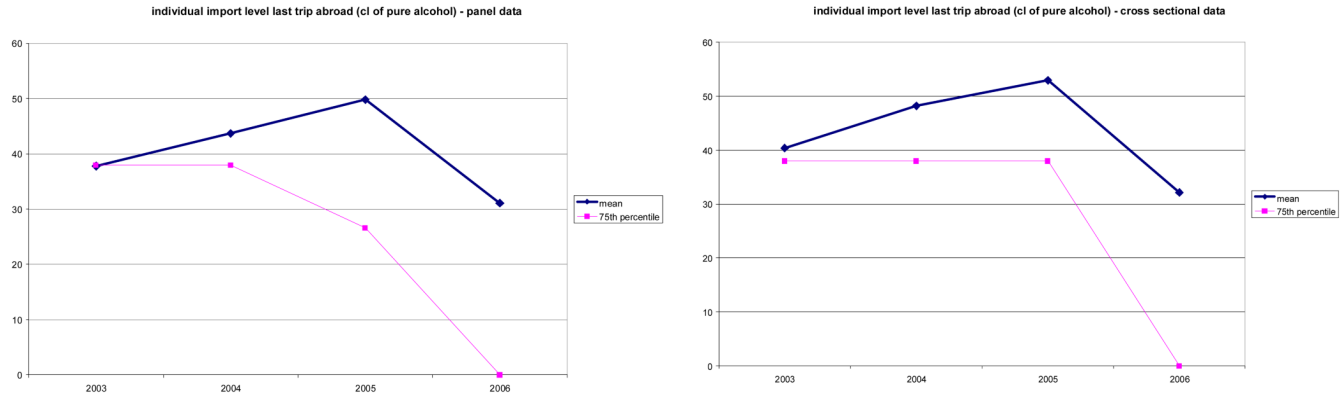

Figure 1.
Mean and 75th percentile of imported alcohol per year in centiliters pure alcohol

Table 1

Sample n's of all four waves for Denmark: panel samples (re-interviewed respondents) and new cross-sectional samples

	Panel*	Cross sectional
2003	1488	1771[a]
2004	1247	894
2005	1064	955
2006	855	883
Sum[b]	**1488**	**4503**

* at least interviewed at two time points

[a] 283 only 2003 + 1488 panel

[b] of individuals

Table 2

Alcohol consumption in 2003, 2004, 2005 and 2006 in cl of pure alcohol per day (mean, median) and by sex and age (age at baseline)

		panel data (unweighted)						cross-sectional data (weighted)					
		2003	**2004**	**2005**	**2006**	**linear trend**	**Test of intervention effect**	**2003**	**2004**	**2005**	**2006**	**linear trend**	**Test of intervention effect**
all	Mean	1.5	1.4	1.5	1.4			1.6	1.7	1.5	1.7		
	Median	0.9	0.8	0.7	0.7	**−0.03****	***↓	0.9	0.9	0.8	0.9	**−0.03**	**n.s.**↓
men	Mean	2.1	1.9	2.2	2.1			2.2	2.5	2.1	2.4		
	Median	1.4	1.3	1.4	1.4	**−0.02**	**n.s.**↓	1.4	1.4	1.2	1.5	**−0.05**	**n.s.**↓
women	Mean	0.9	0.8	0.8	0.8			1.0	1.0	0.9	0.9		
	Median	0.5	0.5	0.4	0.5	**−0.03****	***↓	0.6	0.5	0.5	0.5	**−0.02**	**n.s.**↓
men													
16–29 years	Mean	3.4	2.5	3.4	3.0			3.2	2.7	2.2	3.3		
	Median	2.2	1.7	2.0	1.9	**−0.18**	**n.s.**↓	2.0	1.6	1.2	2.0	**−0.33***	*↓
30–49 years	Mean	1.8	1.6	2.0	1.9			1.8	2.5	1.8	1.9		
	Median	1.3	1.2	1.3	1.3	**−0.002**	**n.s.**↓	1.3	1.3	0.9	1.1	**−0.09**	**n.s.**↓
50–69 years	Mean	1.9	2.0	2.0	2.0			1.8	2.2	2.4	2.4		
	Median	1.4	1.2	1.3	1.2	**−0.002**	**n.s.**↑	1.3	1.6	1.6	1.6	**0.17***	*↑
women													
16–29 years	Mean	1.3	1.1	1.0	0.7			1.3	1.3	1.2	0.9		
	Median	0.7	0.6	0.5	0.2	**−0.09****	**n.s.**↓	0.8	0.7	0.6	0.7	**−0.06**	**n.s.**↓
30–49 years	Mean	0.8	0.8	0.6	0.7			0.8	0.7	0.8	0.8		
	Median	0.5	0.5	0.4	0.5	**−0.03****	*↓	0.5	0.5	0.5	0.4	**−0.01**	**n.s.**↓
50–69 years	Mean	0.9	0.8	0.9	1.0			0.9	1.3	0.8	1.1		
	Median	0.5	0.4	0.4	0.5	**−0.01**	**n.s.**↓	0.5	0.5	0.5	0.5	**−0.02**	**n.s.**↓

** p<0.01;

*** p<0.001,

n.s. (not significant), ↓ (decrease in consumption), ↑ (increase in consumption)

Table 3

Hierarchical regression for total consumption, panel data

			Women		
			N=778 individuals/2237 observations		
Model	**M1 (random intercept)**	**M2 (+ time)**	**M3 (+ variables on the individual level)**	**M4 (+ random slope)**	**M5 (+ cross level interaction)**
Fixed part					
Constant	0.219***	0.229***	0.170***	0.169***	0.175***
Time		−0.008***	−0.008***	−0.008***	−0.009***
Age			0.0002	0.0002	−0.0003
Age^2			0.0001***	0.0001***	0.0001*
Income			0.006*	0.006*	0.005*
Education middle			0.036**	0.036**	0.035**
Education high			0.027*	0.028*	0.028*
Time* age					0.0004*
Random part					
τ_{00}	0.027***	0.027***	0.027***	0.028***	0.028***
τ_{01}				−0.0006	−0.0007
τ_{11}				0.0004*	0.0004*
σ_2	0.011***	0.011***	0.011***	0.010***	0.010***
ICC	71.6%				
AIC	−2164.3	−2166.9	−2132.5	−2132.7	−2121.7
R^2time		0.008	0.011	0.067	0.069
R^2ind			0.026		
			Men		
			N=674 individuals/1990 observations		
Fixed part					
constant	0.398***	0.403***	0.323***	0.321***	
time		−0.004	−0.006	−0.006	
Age			−0.002*	−0.002*	
Age^2			0.0002***	0.0002***	

Women					
N=778 individuals/2237 observations					
Model	**M1 (random intercept)**	**M2 (+ time)**	**M3 (+ variables on the individual level)**	**M4 (+ random slope)**	**M5 (+ cross level interaction)**
Income			0.012***	0.013***	
Education middle			---	---	
Education high			---	---	
Time * age				---	
Random part					
τ_{00}	0.051***	0.051***	0.048***	0.049***	
τ_{01}				−0.0009	
τ_{11}				0.001**	
σ2	0.018***	0.018***	0.018***	0.016***	
ICC	73.8%				
AIC	−846.8	−839.0	−840.2	−847.0	
R^2time		0.001	0.003	0.101	
R^2ind			0.058		

* p<0.05

** p<0.01

*** p<0.001

Table 4

Models for cross-sectional data (time was forced into the models)

	women	men
Overall consumption	**N=2116**	**N=1952**
constant	0.110***	0.326***
time	−0.008	−0.002
age	0.0001	−0.0004
Age2	0.0002***	0.0002***
income	0.016***	0.012**
Education middle	0.086***	---
Education high	0.062***	---
Time* age	---	---
Corrected r2	0.041	0.023

* p<0.05

** p<0.01

*** p<0.001