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Original Contribution

Changes in Alcohol-Related Mortality and its Socioeconomic Differences After a Large Reduction in Alcohol Prices: A Natural Experiment Based on Register Data

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The authors examined the effect of a large reduction in the price of alcohol in Finland in 2004 on alcohol-related mortality by age and socioeconomic group. For this register-based study of Finns aged ≥15 years, data on independent variables were extracted from the employment statistics of Statistics Finland. Mortality follow-up was carried out for 2001–2003 (before the price reduction) and 2004–2005 (after). Alcohol-related causes were defined using both underlying and contributory causes of death. Alcohol-related mortality increased by 16% among men and by 31% among women; 82% of the increase was due to chronic causes, particularly liver diseases. The increase in absolute terms was largest among men aged 55–59 years and women aged 50–54 years. Among persons aged 30–59 years, it was biggest among the unemployed or early-age pensioners and those with low education, social class, or income. The relative differences in change between the education and social class subgroups were small. The employed and persons aged <35 years did not suffer from increased alcohol-related mortality during the 2 years after the change. These results imply that a large reduction in the price of alcohol led to substantial increases in alcohol-related mortality, particularly among the less privileged, and in chronic diseases associated with heavy drinking.

alcohol drinking; alcohol-related disorders; commerce; economics; education; income; social class; socioeconomic factors

Abbreviation: ICD-10, *International Statistical Classification of Diseases and Related Health Problems*, Tenth Revision.

Editor's note: *An invited commentary on this article appears on page 1126.*

The price of alcohol is evidently associated with alcohol consumption and alcohol-related problems on the population level: An increase in price tends to decrease consumption and related problems (1, 2). Much of the evidence on this issue is based on time-series analyses; however, such analyses do not yield information on the differential effects of a change in price on population subgroups. The need for studies based on natural experiments, which take account of both change over time and differences between subpopulations, is obvious (1). Here we report what happened to alcohol-related mortality and its socioeconomic differences in Finland after a large reduction in the price of alcohol.

Large socioeconomic differences in alcohol-related and all-cause mortality are well documented (3–5). In the United Kingdom, occupational social class has appeared to be a risk factor for alcohol-related mortality and hospitalizations, particularly in men (6, 7), while in Nordic studies, investigators have reported rates that are 1.9–3.2 times higher among male manual workers than among nonmanual employees (4, 8, 9). Additionally, in a few recent studies, researchers have reported increased inequality over time according to social class and education (10, 11). US studies on socioeconomic differences in alcohol-related mortality are sparse, but a few have found that socioeconomic differences in alcohol-related motor vehicle crashes are marked by education, income, and language group (12, 13).

Differences in alcohol consumption contribute to the socioeconomic differences in alcohol-related mortality and

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other alcohol-related problems. Consumption tends to be more adverse, in terms of the prevalence of heavy drinking and drinking patterns, in lower socioeconomic groups, but cultural and sex differences exist (14–16). However, there is little evidence on the issue of potential differential responsiveness to price. Youths and young adults have been shown to be generally more responsive to price increases than older adults (1). Correspondingly, it could be hypothesized that other groups with fewer means, such as lower socioeconomic groups, would also be more affected by the price of alcohol. Age is also, in other respects, an essential factor in the relation between socioeconomic indicators, alcohol consumption, and alcohol-related mortality. From the life-course perspective, the most crucial dividing lines can be drawn between persons who have not fully established their socioeconomic status (i.e., youths and young adults) and older persons and between persons of working age and those in retirement.

Alcohol-related mortality can be divided into acute and chronic causes. The former include deaths related to alcohol intoxication and the latter deaths due to the chronic effects of long-term heavy drinking, liver cirrhosis being the most notable example. Chronic causes have also been found to be quickly responsive to a sudden decrease in consumption (17). We expected our results on socioeconomic differences in acute versus chronic causes to be informative in terms of interpreting the process of change.

The year 2004 was a milestone in Finnish alcohol policy. On January 1, it became legal to import from other European Union countries virtually unlimited amounts of alcoholic beverages for one's own use, because of the deregulation of import quotas within the European Union. On March 1, taxes on alcohol were reduced by an average of 33%. The off-premise retail price of spirits went down by an average of 36%, the price of wine by 3%, the price of beer by 13%, and the price of other alcoholic beverages by 17%–25% (18). The reason for the tax cuts was that Estonia joined the European Union on May 1; this had a great impact on the Finnish alcohol market because of the proximity of the two countries and the significantly lower price of alcohol in Estonia.

In 2003, estimated total per capita alcohol consumption (recorded and unrecorded) in Finland was 9.4 L per inhabitant. The increase in consumption was estimated to be 10% in 2004 and a further 2% in 2005 (19). Thus, this unique natural experiment involving a large reduction in the full price of alcohol (including the retail price and indirect costs, both of which were lowered by the abolishment of travelers' allowances) gave us the opportunity to directly assess what happens to alcohol-related mortality and its socioeconomic differences when prices fall and consumption increases.

Earlier studies had raised expectations that the reduction of alcohol prices would increase alcohol-related mortality, particularly in lower socioeconomic groups and possibly among youth and young adults, and that this increase would be due to acute causes rather than chronic causes. We investigated the extent to which the reduction in alcohol prices and the subsequent increase in consumption affected alcohol-related mortality overall and in different age and socioeconomic groups. Specifically, we examined whether the effect varied with 1) sex, age, and cause of death; 2) education and occupational social class; and 3) household income and economic activity.

MATERIALS AND METHODS

Study population

The data were obtained from Statistics Finland. Two study periods were defined: 2001–2003 for the period before the price reduction and 2004–2005 for the period after the price reduction. The data were longitudinal register data from employment statistics for 2000 and 2003 and were linked individually by means of personal identification codes to records from the death register. The analysis comprised all Finns aged 15 years or more. Altogether, the men in the study population lived approximately 10.4 million person-years and the women 11.1 million person-years.

Alcohol-related mortality

Deaths were classified according to the Finnish Edition of the *International Statistical Classification of Diseases and Related Health Problems*, Tenth Revision (ICD-10). Alcohol-related deaths were defined as those in which alcohol was referred to as the underlying cause or one of the contributory causes on the death certificate. Estimating alcohol-related mortality on this basis yields more comprehensive data than the standard method, which is based solely on the underlying cause—particularly in Finland, where death certificates record alcohol intoxication as a contributory cause more frequently and accurately than in most other countries (20, 21). The frequent use of medicolegal autopsy in Finland is one of the major factors enabling the proper attribution of alcohol intoxication as a contributory cause of death. Medicolegal autopsies were carried out for 98% of all accidental and violent deaths occurring among people under age 65 years in 2005 (20) and for more than 60% of all deaths occurring in 1987–2003 (10). In general, Finnish mortality data are assessed to be exceptionally reliable and valid due to functional legislation and death certification practices (20, 21).

The total pool of alcohol-related deaths used here consisted of the following two main categories: 1) the underlying cause of death was an alcohol-attributable disease (see below) or fatal alcohol poisoning and 2) the underlying cause was not alcohol-related, but an alcohol-attributable disease or alcohol intoxication was a contributory cause (ICD-10 code F100) (the underlying cause was then a disease of the circulatory system in 29% of the cases in 2001–2005, suicide in 22%, and an accidental fall in 10%). Alcohol-attributable diseases were: alcohol dependence syndrome (ICD-10 code F102), other mental and behavioral disorders due to alcohol use (ICD-10 codes F101 and F103–109), alcoholic cardiomyopathy (ICD-10 code I426), alcoholic liver disease (ICD-10 code K70), and alcoholic diseases of the pancreas (ICD-10, Finnish Edition, code K860), as well as a few rarely occurring additional categories (ICD-10 codes K292, G312, G4051, G621, and G721). We used alcoholic liver diseases instead of all liver diseases because there does

not seem to be any strong tendency to underreport alcoholic cases in Finland: For example, in 2005, among men under age 65 years, 99% of deaths due to liver cirrhosis were classified as alcoholic on the death certificate (22). It is also unlikely that illicit drug use and hepatitis C virus infection could significantly contribute to socioeconomic differences in mortality due to liver cirrhosis because of their internationally low levels in Finland (23).

We formed 2 mutually exclusive cause-of-death categories for the analysis: acute and chronic alcohol-related causes. Deaths due to chronic causes consisted of deaths for which the underlying cause was alcoholic or for which an alcohol-attributable disease was a contributory cause; deaths due to acute causes were those for which the underlying cause was not alcoholic but alcohol intoxication was a contributory factor. Deaths for which one contributory cause was intoxication and another was an alcohol-attributable disease were included in the acute-causes category.

Independent variables

The independent variables derived from employment statistics were sex, 5-year age group (15–19, . . ., 75–79, and ≥80 years), and socioeconomic characteristics. The 4 educational categories were based on the highest level of education achieved, obtained from the national Register of Completed Education and Degrees: basic education, secondary education, lower tertiary education, and higher tertiary education. Occupational social class was divided into 6 categories: upper white-collar, lower white-collar, skilled worker, unskilled worker, self-employed, and other. Unemployed and retired persons were classified according to their previous occupation, and persons running households were categorized according to the occupation of the head of the household. Income was measured as household disposable income per consumption unit and was divided into quintiles, with quintile boundaries defined for men and women combined in the year 2000. Income comprised all taxable income received by family members after taxes had been subtracted, including wages, capital income, and taxable income transfers. Different weights were used for adults and children in the calculation of household consumption units: for the first adult, 1.0; for other adults, 0.7; and for children, 0.5. Economic activity included 5 categories: employed, unemployed for a period of 25 months or more during the previous 3 years, unemployed for less than 25 months, pensioner, and other. The information on different sources of income came from the registers of the Finnish Tax Administration and the Social Insurance Institution.

Statistical analysis

Mortality ratios and 95% confidence intervals obtained by means of Poisson regression (Stata, version 8; Stata Corporation, College Station, Texas) were used to assess the relative differences between the age groups and the different socioeconomic characteristics. We also experimented with negative binomial regression to account for any overdispersion in our data. However, the point estimates and the test values and confidence intervals were very similar to those obtained from Poisson regression. Since the crude mortality rates and their ratios more closely corresponded to those obtained from Poisson regression, we preferred to use it. In order to determine the relative effect of the price reduction on alcohol-related mortality according to any one socioeconomic variable, we included calendar period–social class interaction terms in the models, and we used likelihood ratio tests to derive the *P* values.

RESULTS

Between 2001–2003 and 2004–2005, numbers of alcohol-related deaths increased by approximately 16% (95% confidence interval: 12.1, 19.4) (or 22 deaths per 100,000 person-years) among men and by 31% (95% confidence interval: 22.0, 40.0) (or 8 deaths per 100,000 person-years) among women. In 2001–2003, chronic deaths made up 81% of all alcohol-related deaths among men and 86% among women. This was an increase of 21% among men and 32% among women, whereas the increases in acute deaths were 7% and 27%, respectively. Chronic deaths constituted 82% of the total increase in alcohol-related mortality, and alcoholic liver diseases alone constituted 39%. Numbers of deaths due to alcoholic liver diseases increased by 38% and 41% among men and women, respectively. The increase in intoxication-related causes was mostly due to cases in which the underlying cause of death was a disease of the circulatory system or an accidental fall.

Before the reduction in the price of alcohol, alcohol-related mortality was clearly highest among men aged 45–74 years (Figure 1). Following it, the increase was highest (more than 25%) in the age groups 55–59 years and 65–69 years, while among males under age 35 years, the observed number of alcohol-related deaths was slightly smaller after the price reduction.

Among persons aged 30 years or more, both age-adjusted alcohol-related mortality rates in 2001–2003 and the change in mortality rates were clearly higher in absolute terms in the lower educational and social-class categories (Table 1). Interaction analysis revealed that the proportional changes differed by age but not by education or social class. Changes by education and social class were quite similar in the age groups 30–59 years and 60 years or more (results not shown).

Among persons aged 30–59 years, the rates varied strongly by economic activity in 2001–2003 (Table 2): The male and female long-term unemployed had 12-fold and 17-fold rates of age-adjusted alcohol-related mortality, respectively, compared with those who had a job. The price reduction had no effect on mortality rates among employed persons, while the long-term unemployed and early-age pensioners suffered a large increase.

Before the price reduction, alcohol-related mortality rates were inversely related to household income. The patterns of change were similar, with the exception of the lowest quintile (the age-adjusted model in Table 2). When household income, age, and economic activity were introduced into the same model, the association between income and mortality was greatly reduced: For example, the relative rate in the lowest quintile decreased from 6.26 to 1.66 (data not shown).

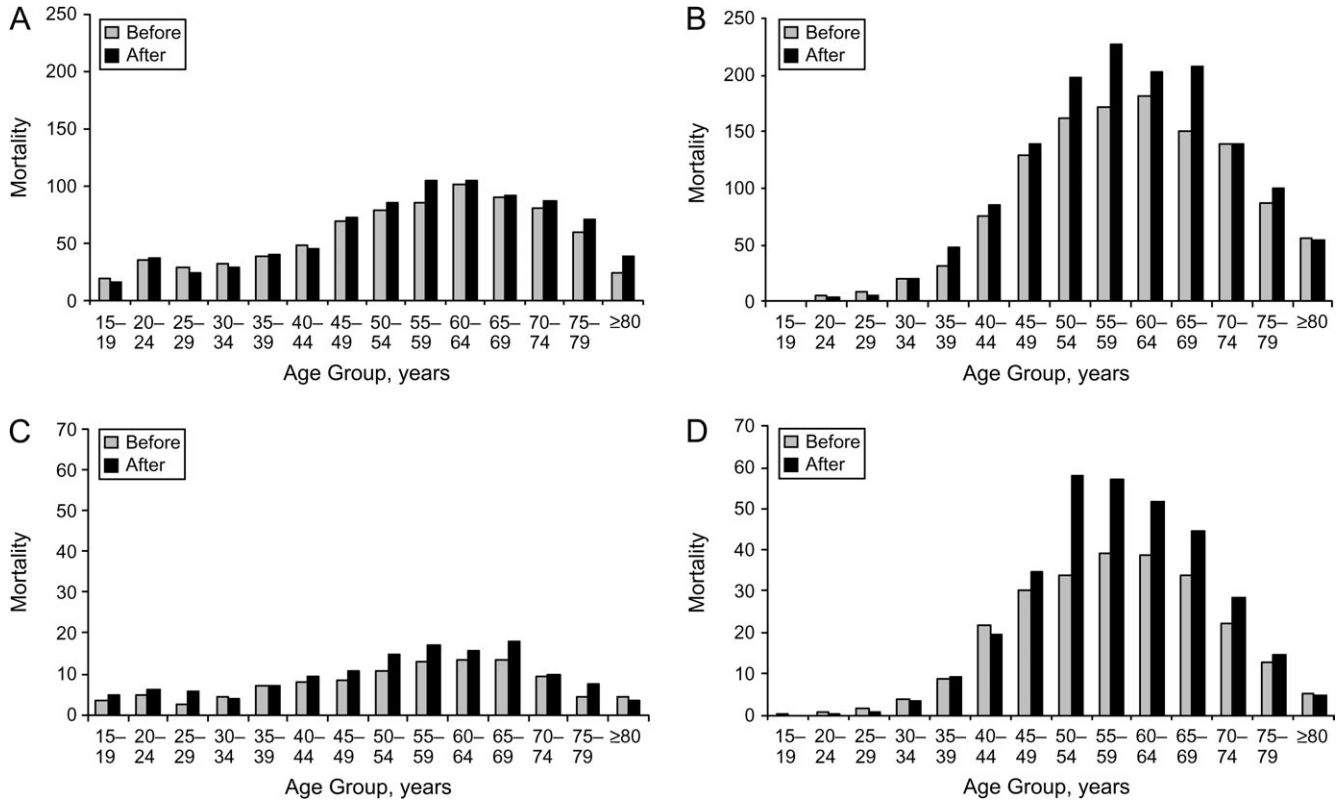

Figure 1. Numbers of acute and chronic alcohol-related deaths per 100,000 person-years among men and women aged ≥15 years, by age group, before (2001–2003) and after (2004–2005) a reduction in the price of alcohol, Finland, 2001–2005. A) acute mortality among men; B) chronic mortality among men; C) acute mortality among women; D) chronic mortality among women.

The differences between the income groups clearly decreased as well, but they did not disappear, nor did they become linear (Table 2, model adjusted for age and economic activity). We also examined the changes by income separately among the employed on the one hand and the unemployed and pensioners on the other (data not shown). Among males, the patterns of relative change were not substantially different in these groups, even if the absolute changes were much higher among the unemployed and pensioners. Among females, as well, the absolute changes were much higher among the unemployed and pensioners, but there were no observable differences in the patterns of relative change between these groups.

The change in mortality due to chronic causes by socioeconomic characteristics in men and women aged 30 years or more (data not shown) was very similar to the pattern of change due to all alcohol-related causes as shown in Tables 1 and 2. Similarly, for mortality from acute alcohol-related causes, the patterns of change by social class and income among men and by economic activity among men and women were similar to those reported in Tables 1 and 2. In contrast, the changes did not differ by education among men or women or by social class or income among women.

DISCUSSION

Our study produced evidence of a substantial increase in alcohol-related mortality, among both men and women, after the reduction in the price of alcohol in Finland. These findings are in accordance with a study on the Finnish alcohol tax cuts and alcohol-positive sudden deaths in which blood-alcohol concentration data were subjected to time-series analysis: There was a 17% increase in alcohol-positive deaths in 2004 as compared with 2003 (24). This increase in mortality could be seen as the continuation of a 30-year trend associated with rising alcohol consumption (10, 20). However, the increase after the price reduction clearly exceeded the average annual increase of 0.8% in males and 2.6% in females that was observed in 1998–2003. Since the level of alcohol-related mortality was so much lower in women than in men, the increase in relative—but not absolute—terms exceeded that of men.

The mortality impact in the first 2 years after the price reduction was highest in subpopulations that already had the highest rates: Even in 2001–2003, the rates were highest among men and women aged 50–69 years, and the increase in absolute terms was highest in this age group as well. Among persons aged 35 years or less, the level of alcohol-related

Table 1. Crude and age-adjusted rates of alcohol-related mortality among men and women aged ≥30 years before (2001–2003) and after (2004–2005) a reduction in the price of alcohol, according to socioeconomic indicators, Finland, 2001–2005

	2001–2003					Change from 2001–2003 to 2004–2005		
	% of Person-Years	No. of Deaths per Year	Deaths per 100,000 Person-Years[a]	Age-Adjusted Relative Rate	95% CI	%[b]	95% CI	Deaths per 100,000 Person-Years[c]
Men								
Age group, years						0.012[d]		
30–39	22.8	217	60.9	1.00		13.5	0.8, 27.8	8.2
40–49	24.9	630	161.3	2.65	2.42, 2.90	6.3	0.0, 14.1	10.2
50–59	24.4	951	248.5	4.08	3.75, 4.44	23.9	17.4, 30.8	59.4
60–69	15.0	621	264.4	4.34	3.97, 4.75	15.4	7.8, 23.5	40.7
70–79	9.7	290	190.2	3.12	2.82, 3.46	6.0	−4.3, 17.4	11.4
≥80	3.3	40	78.6	1.29	1.07, 1.57	16.9	−9.9, 51.7	13.3
Education						0.625[d]		
Upper tertiary	7.9	76	61.4	1.00		7.8	−11.3, 31.1	4.8
Lower tertiary	18.2	270	94.5	1.48	1.28, 1.71	16.0	4.7, 28.5	15.1
Secondary	35.8	921	164.2	2.71	2.37, 3.10	20.3	13.9, 27.0	33.3
Basic	38.2	1,483	247.7	3.52	3.08, 4.03	16.1	11.0, 21.5	39.9
Social class						0.777[d]		
Upper white-collar	16.5	212	82.0	1.00		8.4	−3.7, 22.0	6.9
Lower white-collar	18.4	360	124.7	1.54	1.40, 1.70	14.2	4.4, 24.9	17.7
Skilled worker	25.5	854	213.5	2.56	2.35, 2.79	17.0	10.4, 24.0	36.3
Unskilled worker	19.7	879	285.1	3.43	3.14, 3.74	18.2	11.6, 25.1	51.9
Self-employed	9.1	200	139.9	1.57	1.40, 1.76	14.9	1.8, 29.6	20.8
Other	10.8	245	144.0	1.79	1.61, 1.99	11.1	−0.5, 23.9	16.0
Total	100	2,749[e]	175.3			17.1	13.4, 21.0	30.0
Women								
Age group, years						0.002[d]		
30–39	19.9	42	12.2	1.00		1.8	−23.0, 34.5	0.2
40–49	22.1	131	34.5	2.82	2.30, 3.44	7.3	−8.0, 25.1	2.5
50–59	22.0	183	48.0	3.93	3.24, 4.77	52.7	36.0, 71.5	25.3
60–69	15.1	130	49.9	4.08	3.34, 4.98	30.6	13.1, 50.8	15.3
70–79	13.1	56	24.8	2.03	1.61, 2.56	23.8	0.0, 55.1	5.9
≥80	7.8	13	9.4	0.77	0.53, 1.11	−16.1	−50.0, 40.9	−1.5
Education						0.288[d]		
Upper tertiary	6.4	12	10.8	1.00		56.0	0.4, 142.3	6.0
Lower tertiary	21.3	63	17.1	1.49	1.04, 2.13	11.5	−9.9, 38.0	2.0
Secondary	31.9	166	30.2	2.51	1.79, 3.52	39.8	23.5, 58.3	12.0
Basic	40.5	314	44.9	4.13	2.95, 5.77	34.2	22.0, 47.6	15.4
Social class						0.571[d]		
Upper white-collar	13.8	41	17.2	1.00		31.9	2.3, 70.1	5.5
Lower white-collar	38.7	182	27.2	1.52	1.25, 1.84	34.9	19.5, 52.2	9.5
Skilled worker	9.8	81	47.8	3.06	2.46, 3.80	10.6	−9.0, 34.5	5.1
Unskilled worker	21.4	179	48.4	2.72	2.23, 3.31	33.5	18.0, 51.1	16.2
Self-employed	5.4	32	34.5	1.88	1.44, 2.46	17.6	−12.9, 58.7	6.1
Other	10.9	41	21.7	1.51	1.18, 1.95	38.4	7.4, 78.1	8.3
Total	100	555[e]	32.1			30.6	21.7, 40.0	9.8

Abbreviation: CI, confidence interval.
[a] Unstandardized.
[b] Derived from the age-adjusted interaction term for the interaction between each variable and period.
[c] Obtained by multiplying the mortality rate before the change by the percentage of change.
[d] *P* value for difference in change obtained from a model that included an interaction term for the interaction between each variable and period.
[e] Differences result from rounding.

Table 2. Rates of alcohol-related mortality among men and women aged 30–59 years before (2001–2003) and after (2004–2005) a reduction in the price of alcohol, according to economic activity and household disposable income per consumption unit, Finland, 2001–2005

	2001–2003					Change from 2001–2003 to 2004–2005					
						Age-Adjusted			Adjusted for Age and Economic Activity		
	% of Person-Years	No. of Deaths per Year	Deaths per 100,000 Person-Years[a]	Age-Adjusted Relative Rate	95% CI	%[b]	95% CI	Deaths per 100,000 Person-Years[c]	%[b]	95% CI	Deaths per 100,000 Person-Years[c]
Men											
Economic activity						0.001[d]					
Employed	78.4	530	59.9	1.00		2.9	−4.7, 11.1	1.7			
Unemployed for ≥25 months	5.4	477	783.7	12.11	11.28, 13.01	21.2	11.7, 31.5	166.1			
Unemployed for <25 months	4.0	153	336.9	5.54	4.99, 6.15	30.1	14.2, 48.1	101.4			
Pensioned	6.9	482	619.1	8.15	7.58, 8.76	27.1	18.0, 36.9	167.8			
Other	5.3	156	259.5	4.50	4.06, 4.99	21.5	6.3, 38.8	55.8			
Income quintile[e]						<0.001[d]			<0.001[d]		
1 (highest)	28.7	222	68.6	1.00		17.2	5.6, 30.1	11.8	13.5	2.3, 26.0	9.3
2	22.8	250	96.7	1.56	1.40, 1.73	17.5	5.3, 31.0	16.9	2.5	−8.1, 14.4	2.4
3	18.1	257	125.9	2.19	1.97, 2.43	78.8	61.7, 97.7	99.2	44.8	30.9, 60.1	56.4
4	14.1	380	238.0	4.18	3.80, 4.60	64.0	50.6, 78.6	152.3	37.4	26.6, 49.6	89.0
5 (lowest)	14.2	586	365.7	6.26	5.72, 6.84	19.4	10.4, 29.2	70.9	22.1	12.8, 32.1	80.8
Total	100	1,798	159.1			19.2	14.6, 24.1	30.5			
Women											
Economic activity						0.011[d]					
Employed	75.5	97	11.7	1.00		8.0	−9.4, 28.7	0.9			
Unemployed for ≥25 months	3.7	89	218.3	16.68	14.12, 19.70	49.9	24.8, 79.9	108.9			
Unemployed for <25 months	5.7	36	57.1	5.03	4.03, 6.28	81.3	39.8, 135.1	46.4			
Pensioned	5.5	98	162.1	11.11	9.43, 13.09	36.6	16.3, 60.5	59.3			
Other	9.7	36	33.3	3.41	2.73, 4.26	54.0	18.3, 100.4	18.0			
Income quintile[e]						0.063[d]			0.409[d]		
1 (highest)	26.6	43	14.7	1.00		17.8	−6.8, 48.9	2.6	19.9	−6.8, 49.0	2.9
2	23.4	48	18.6	1.41	1.11, 1.79	61.2	28.3, 102.5	11.4	47.1	17.1, 84.9	8.7
3	19.1	55	26.1	2.23	1.77, 2.81	81.5	46.2, 125.3	21.2	50.6	21.2, 87.0	13.2
4	15.4	84	49.0	4.42	3.57, 5.47	78.2	49.1, 112.9	38.3	58.2	32.4, 89.1	28.5
5 (lowest)	14.5	113	70.2	6.60	5.38, 8.09	48.4	25.1, 76.1	34.0	57.3	32.5, 86.7	40.2
Total	100	356	32.2			33.6	22.4, 45.8	10.8			

Abbreviation: CI, confidence interval.

[a] Unstandardized.

[b] Derived from the age-adjusted interaction term for the interaction between each variable and period.

[c] Obtained by multiplying the mortality rate before the change by the percentage of change.

[d] *P* value for difference in change obtained from a model that included an interaction term for the interaction between each variable and period.

[e] One category ("income unknown") is not shown.

mortality did not increase; if anything, it decreased. This is very noteworthy, because alcohol consumption is generally more responsive to increases in price among young adults than among older adults (1); this has raised expectations that this is also true when the price of alcohol goes down. This gap between older and younger persons could additionally be seen as the continuation of a previous trend (10): There was a favorable trend in the 1990s and early 2000s among men under age 45 years, mainly due to a decrease in intoxication-related accidents and violence, while total alcohol-related mortality increased among older men. The different developments would appear to be accounted for by increased alcohol consumption among men aged 45 years or more after the mid-1990s, and also after 2004, whereas consumption was stable or decreased among younger Finns (25). Drinking habits on the population level change slowly, but these results suggest that younger generations may be adopting less damaging alcohol consumption patterns. The phenomenon at hand seems to be rather more an accentuation of a longer-term change than an isolated consequence of the price reduction. However, one must be cautious when making inferences about alcohol consumption on the basis of alcohol-related mortality data.

Alcoholic liver diseases alone constituted 39% of the increase in total alcohol-related mortality after the price reduction. The recorded increase in liver-disease deaths with a concurrent increase of 1.2 L in per capita alcohol consumption is clearly higher than would be expected on the basis of a time-series analysis of the longer-term connection between liver cirrhosis mortality and per capita consumption in Finland, but it is in line with the effect size observed for Sweden in 1950–1995 (26). With regard to the relation between alcohol consumption and disease, one must consider that not only present consumption but also past consumption impinges on the risk of alcohol-attributable disease. It has been suggested that the latency period for liver cirrhosis could be very long—20 years of excessive drinking may be needed (27). However, there is also previous evidence on an instantaneous response to changes in consumption on the aggregate level in cirrhosis mortality—for example, in France during World War II and in Russia after 1990 (17, 28). This seeming contradiction in the case of a rapid increase in cirrhosis mortality is best understood in terms of the water-glass analogy: Persons who died from cirrhosis during that short period after the price reduction already had their water glass almost full, and the increased consumption took an increased number of previous heavy drinkers over the rim.

As far as the impact of the price reduction on subpopulation differences in alcohol-related mortality is concerned, the most salient finding is a huge chasm between the employed and the unemployed among people aged 30–59 years. Mortality increased strongly after the price reduction, particularly among the long-term unemployed and pensioners. This was mostly due to chronic causes, but deaths due to acute causes also increased to some extent. At least two relevant but interlaced explanations for this divergence should be taken into account. Firstly, because of both selection and causal processes (29), heavy drinkers are overrepresented in the population of unemployed and early-age pensioners, and chronic conditions may more quickly respond to an increase in consumption among them. Secondly, the unemployed and early-age pensioners include more poor persons whose drinking may have previously been restricted by the higher price of alcohol.

The change in alcohol-related mortality due to acute causes as opposed to chronic causes was slight. Here, too, the most salient differentials were for economic activity: The mortality rates of the long-term unemployed increased, but rates remained almost unchanged for the employed. This may indicate that hazardous alcohol consumption has not increased substantially among employed persons.

The finding that the increase in alcohol-related mortality was higher, in absolute terms, in the lower educational and socioeconomic groups was not a surprise, given the preexisting adverse trend for persons of lower socioeconomic and educational status in Finland in 1987–2003 (10, 18). Additionally, men with the lowest level of education increased their alcohol consumption in the 2000s, while the more highly educated kept it stable (25).

The observed results concerning changes in alcohol-related mortality according to socioeconomic indicators may be partly attributable to beverage preferences. It was the price of spirits in particular, and to some extent the price of beer (but not of wine), that went down. According to survey-based results, men with a basic education consumed 61% of their total ethanol intake as beer, 26% as spirits, and only 4% as wine, while the corresponding proportions for the highly educated were 51%, 15%, and 25% (30). These results indicate that the beverages consumed by the less educated were affected by the price changes to a greater extent than the beverages consumed by the more highly educated.

The finding that the effect of the price reduction was not greatest among the poorest in household-income terms, although they had the highest mortality rates before the price reduction, was undoubtedly at odds with expectations. One might assume that if, on the whole, alcohol-related mortality were to increase because of the price reduction, it would happen among poor people, since their alcohol consumption may have previously been restricted by the higher price. Finally, the lack of a perfect gradient in change according to household income could be attributed to the possibility that alcohol is still too expensive for the poorest persons in Finland. This peculiarity in the results decreased when we controlled for economic activity.

Earlier studies yielded contradictory results on whether price responsiveness differs in various alcohol user groups: Manning et al. (31) concluded on the basis of cross-sectional data that heavy (and light) drinkers were much less responsive to prices than were moderate drinkers, while a more recent study produced evidence of substantial price responsiveness among heavy drinkers with symptoms of alcohol abuse or dependence (32). In the current study, the large increase in mortality due to liver diseases indicates that heavy drinkers, at least, were very responsive to the price reduction.

This unique natural experiment has shown that the relation between changes in the price of alcohol and alcohol-related mortality in Finland is not the same in all subpopulations. It

appears that the socially disadvantaged and heavy drinkers have been most sensitive to the price decreases, whereas grievous problems measured in terms of mortality have not increased among those better positioned in society. Hence, it may be claimed that high prices protect the worst-off members of the population against alcohol-related problems and that alcohol price cuts may impose the biggest burden on persons who already suffer the most from alcohol-related harm. More time is needed, however, to assess the full effect of the reduction in the price of alcohol on alcohol-related mortality.

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