Increased mortality related to heavy alcohol intake pattern

T Laatikainen, L Manninen, K Poikolainen, E Vartiainen

Study objective: Although moderate alcohol intake is related to decreased all cause and ischaemic heart disease mortality, intake of large amounts at a time may be harmful.

Design: A cohort study, average follow up time was 7.3 years.

Setting: Finland.

Participants: General population sample of 5092 men, aged from 25 to 64 years, who had consumed alcohol during the 12 months before the baseline examination.

Main results: The main outcome measure was death. After excluding cases with previous myocardial infarction at the baseline examination and after adjustment for age, education, smoking, and average alcohol intake in Cox proportional hazards model, subjects with heavy drinking pattern (six or more drinks at a time) still had higher mortality from all causes than drinkers without heavy drinking occasions (RR 1.57; 95% CI 1.17 to 2.10). Respective analyses showed increased risk also for ischaemic heart disease (1.77; 95% CI 1.01 to 3.08), external causes (2.90; 95% CI 1.47 to 5.72) and alcohol related causes of death (2.73; 95% CI 1.13 to 6.64). The last two risk ratios were not adjusted for smoking. Relative risk point estimates were approximately similar for drinkers with heavy drinking occasions irrespective of beverage type, although those for beer and wine did not reach significance, probably because of the small number of cases. The highest average alcohol intake was found among drinkers who consumed all three types of beverage.

Conclusions: Consuming six or more drinks at a time is related to increased mortality among working age male drinkers. The authors found no clear evidence for beverage specific differences.
considered to contain 12 grams of pure alcohol and beer 12.5 grams of pure alcohol. These average alcohol contents were used in estimating the average weekly alcohol intake. Alcohol content figures were based on the average alcohol content of beverage types sold in Finland. Both the questionnaire and the alcohol content figures used in the National FINRISK Study have been described earlier.12

A heavy drinking pattern was defined as consuming six or more drinks of the same beverage type, either beer, or wine, or spirits. Thus, the heavy pattern drinkers included heavy beer drinkers, heavy wine drinkers, heavy spirits drinkers, and a mixed group, the last group including cases consuming six or more drinks of more than one beverage type at a time. It should be noted that the questionnaire did not permit to include into the heavy pattern category those drinkers whose consumption reached the level of six or more drinks only if the number of beer, wine, and spirits drinks imbibed at a time were added up.

Blood pressure was measured from the right arm of the subject after 15 minutes of rest in a sitting position. Appearance of the Korotkoff sounds was recorded as the systolic blood pressure and fifth phase as the diastolic blood pressure.

Blood lipids were analysed from fresh serum samples in Helsinki in the National Public Health Institute’s laboratory, which is standardised with national and international reference laboratories. Serum total cholesterol and HDL cholesterol were determined using an enzymatic method (CHOD-PAP, Boehringer Mannheim, Monotest). Before analysis, HDL-cholesterol was precipitated from the sample by the PTA precipitation method.

Smoking was assessed by structured questions in the self administered questionnaire. Based on their responses, the participants were classified into two categories. Current smokers were classified as those who had smoked regularly for at least one year and had smoked daily during the previous month. Other respondents were classified as non-smokers (never smokers, occasional smokers, ex-smokers).

Education was assessed with a question asking for the total years in education. Educational categories (low, medium, and high) were calculated using birth year specific tertiles of education years.

Previous myocardial infarctions (MI) were assessed in the baseline survey asking if participants had ever had an MI diagnosed by a physician.

### Follow up

The follow up information of participants was achieved through linkage to the national mortality register, which is maintained for all Finnish citizens. The follow up was extended up to 10 years if the baseline survey was carried out in 1987 and up to five years if the baseline survey was carried out in 1992. The end date of the cohort was set as the end of the year 1997. The mean outcome measures were all cause mortality and deaths attributable to cardiovascular diseases, ischaemic heart diseases, malignant neoplasm, external causes, and alcohol related diseases. Causes of deaths were classified using the ICD-9 coding until the end of year 1995, and ICD-10 from the beginning of year 1996 as the codes have been in use in Finland. For cardiovascular disease, ICD-9 codes 390–459 and ICD-10 codes I00-I99 were used. ICD-9 codes used for ischaemic heart disease were 410–414 and ICD-10 codes I20-I25. Malignant neoplasm was classified using ICD-9 codes 140–208 and ICD-10 codes C00-C97. Codes used for external causes according to ICD-9 coding were E800-E999 and according to ICD-10 coding V01-Y99 and X60-X84 with

### Table 1 Sample and participating men in the National FINRISK Study in years 1987 and 1992

<table>
<thead>
<tr>
<th></th>
<th>1987</th>
<th>1992</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age groups</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25–34</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>35–44</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>45–54</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>55–64</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Total</td>
<td>4000</td>
<td>4000</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25–34</td>
<td>978</td>
<td>982</td>
</tr>
<tr>
<td>35–44</td>
<td>994</td>
<td>981</td>
</tr>
<tr>
<td>45–54</td>
<td>994</td>
<td>993</td>
</tr>
<tr>
<td>55–64</td>
<td>996</td>
<td>996</td>
</tr>
<tr>
<td>Total</td>
<td>3962</td>
<td>3962</td>
</tr>
<tr>
<td><strong>Participation rate (%)</strong></td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td><strong>Number of eligible [n]</strong></td>
<td>637</td>
<td>637</td>
</tr>
<tr>
<td><strong>Final number of subjects [n]</strong></td>
<td>632</td>
<td>632</td>
</tr>
</tbody>
</table>

*Those who had died or moved out from the survey area between sampling and survey period were excluded from the original sample. †Men who have consumed alcohol during the past 12 months. ‡Number of subjects with full information on drinking habit.

### Table 2 Characteristics of study participants according to drinking pattern

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Drinkers with heavy pattern</th>
<th>No heavy drinking occasions</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of men</td>
<td>1528</td>
<td>3564</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Age (SD) [y]</td>
<td>42.1 (10.5)</td>
<td>45.5 (11.2)</td>
<td></td>
</tr>
<tr>
<td>Alcohol intake [g/week] [%]</td>
<td>41.3</td>
<td>81.7</td>
<td></td>
</tr>
<tr>
<td>0–95.9</td>
<td>29.9</td>
<td>12.1</td>
<td></td>
</tr>
<tr>
<td>96–199.9</td>
<td>28.8</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td>200+</td>
<td>58.6 (889)</td>
<td>57.9 (75.9)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Prevalence of smokers [%]</td>
<td>202.0 (261.5)</td>
<td>29.3 (1027)</td>
<td>0.001†</td>
</tr>
<tr>
<td>Education (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>30.9</td>
<td>21.6</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>36.7</td>
<td>31.2</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>32.3</td>
<td>47.2</td>
<td></td>
</tr>
<tr>
<td>Mean (SD) cholesterol (mmol/l)</td>
<td>5.95 (1.22)</td>
<td>5.92 (1.16)</td>
<td>0.36*</td>
</tr>
<tr>
<td>Mean (SD) high density lipoprotein (mmol/l)</td>
<td>1.30 (0.34)</td>
<td>1.28 (0.31)</td>
<td>0.045*</td>
</tr>
<tr>
<td>Mean (SD) systolic blood pressure (mm Hg)</td>
<td>141.3 (17.4)</td>
<td>139.9 (17.7)</td>
<td>0.012*</td>
</tr>
</tbody>
</table>

* t test. †χ² test.
the exception that alcohol induced poisonings (E85) were excluded from this category. Alcohol related diseases (including the poisonings) comprises ICD-9 codes 291, 303, 375, 4255, 5353, 5710–5713, 5770D–5770F, 5771C–5771D, 607A, 7792A and E85. Respective ICD-10 codes are F10.0-F10.9 (perturbations mentis et modi se gerendi ex usu alcohol), G31.2 (degeneration systematis nervosi ex alcohol), G72.1 (myopathy alcoholica), I42.6 (cardiomyopathia alcoholica), K29.2 (gastritis acuta et chronic alcoholica), O35.4 (cura matris propter laesionem fetus ex abusu alcohol matris) and X45 (alcohol poisoning).

Characteristics of drinkers with heavy pattern and drinkers without heavy drinking occasions

Drinkers with heavy pattern were slightly younger, less educated, consumed on the average more alcohol, and had slightly higher HDL cholesterol and higher blood pressure than drinkers without heavy drinking occasions. Means and prevalence of background characteristics and other potential confounders are presented in table 2.

Drinking habits and beverage preferences are shown in table 3. Of all drinkers with heavy pattern (consuming six or more drinks at a time), 51.8% reported to drink only spirits, 51.8% reported to drink only wine, 7.1% only beer, 11.3% both wine and spirits, 10.3% both beer and spirits, 2.1% both beer and wine and 9.4% beer, wine, and spirits. The average alcohol intake among all spirit drinkers with heavy drinking occasions was 200.5 g/week and among beer or wine drinkers with heavy drinking occasions 209.3 g/week (table 3). Among spirit drinkers, the mean alcohol consumption was the highest among those who reported to imbibe heavily all three types of beverage and among those who reported to imbibe only spirits. The frequency of inebriation was higher among beer and wine drinkers with heavy drinking occasions compared to spirit drinkers. Although the average alcohol intake and the frequency of inebriation were lower among spirit drinkers with heavy drinking pattern than among other heavy drinkers, the amount imbibed at a time was higher among the first group.

Statistical methods

The association between mortality and the heavy drinking pattern was analysed using the Cox proportional hazards model. The analyses were carried out for all cause mortality, and mortality from ischaemic heart disease, external causes of death, and alcohol related causes of death. First analyses included only age as a covariant. Next, potential confounders were added one by one, beginning with the average alcohol intake, and followed by education. Additional covariates included smoking in the case of total mortality, and smoking, total cholesterol, HDL-cholesterol and systolic blood pressure in the case of ischaemic heart disease. We found an interaction on the baseline survey between the previous MI and a heavy drinking pattern. Therefore, separate analyses both including and excluding cases with previous MI at the baseline were made for all cause and ischaemic heart disease mortality. In addition to all drinkers with heavy drinking pattern, beverage specific analyses for drinkers with heavy drinking occasions were also carried out.

RESULTS

The cohort included 3564 drinkers without heavy drinking occasions and 1328 drinkers with heavy pattern. Of the second group, 1264 reported to drink spirits heavily (some drinking also beer or wine) and 264 only beer or wine. A total of 347 deaths were registered between years 1987 and 1997, of these
be classified into the group of drinkers with no heavy pattern. 
were subjects who used to consume six or more drinks of dif-
ted us to define persons who used to consume six or more 
without heavy drinking occasions. The questionnaire permit-
heart disease, external causes, and alcohol related causes 
DISCUSSION 
sions than in the group without heavy drinking occasions in 
mortality was higher in the group with heavy drinking occa-
s showed increased risk also for ischaemic heart disease (table 
The last two risk ratios were not adjusted for smoking. 
spirits drinkers with heavy pattern had similarly increased risk 
ratios. Likewise, relative risk point estimates were approxi-
Small number of cases, to reach significance. 
Compared with abstainers, the risk of death among heavy 
found to depend much on the actual intake, 
underestimated, 
As the underestimation has not been 
Reliability and validity 
Data on average alcohol intake are usually underestimated. 
Ambient areas also found to depend much on the actual intake, 
It is not likely to distort the observed associations. Under-estimation is mainly 
attributable to the fact that frequency of drinking is under-
reporting, probably because people tend to forget light drink-
occasions. Amounts of alcohol consumed at a time are 
reported more accurately. Therefore, we believe that our 
estimates on the effect of heavy drinking pattern on mortality 
not likely to be biased because of errors in self reporting of 
alcohol consumption. 
Although our measure of a heavy drinking pattern was the 
usual quantity of consuming six or more drinks at a time over 
the past 12 months, which is likely to give a good estimate on 
the long term heavy drinking pattern, it is possible that some 
subjects later changed their drinking pattern to a more mod-ate one or become non-drinkers. Such changes are likely to 
dilute the observed association compared with the actual one. 
Control of confounding 
The risk of death remained higher among drinkers with heavy 
pattern than drinkers without heavy drinking occasions after 
adjustment for average alcohol intake and other important 
confounders. Additional adjustments for total cholesterol, 
high density lipoprotein, and systolic blood pressure did not 
influence the risk estimates materially. We also excluded cases 
with previous myocardial infarction reported at the baseline 
examination, because they might have changed their drinking 
patterns after the onset of the disease. 
The custom of drinking six or more drinks at a time might 
be related also to other unhealthy behaviours, such as poor 
diet, low physical activity, and general tendency to reckless 
control covariates. The previous covariates remain in the model when the new one is added. Previous 
myocardial infarctions are excluded. 

<table>
<thead>
<tr>
<th>Adjustments</th>
<th>Total mortality Relative risk 95% Confidence intervals</th>
<th>IHD mortality Relative risk 95% Confidence intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2.27 (1.78 to 2.88)</td>
<td>2.26 (1.41 to 3.63)</td>
</tr>
<tr>
<td>+Average alcohol use*</td>
<td>1.92 (1.45 to 2.53)</td>
<td>2.14 (1.25 to 3.67)</td>
</tr>
<tr>
<td>+Smoking</td>
<td>1.63 (1.23 to 2.17)</td>
<td>1.78 (1.03 to 3.07)</td>
</tr>
<tr>
<td>+Education</td>
<td>1.57 (1.17 to 2.10)</td>
<td>1.77 (1.01 to 3.08)</td>
</tr>
</tbody>
</table>

*Average alcohol use grouped into three categories. 0–95.9 g/week, 96–199.9 g/week and 200+ g/week.

123 were attributable to ischaemic heart disease, 47 to external 
causes, and 32 to alcohol related diseases. The age adjusted 
mortality was higher in the group with heavy drinking occasions than in the group without heavy drinking occasions in all investigated mortality categories (table 4). 
After excluding cases with previous myocardial infarction reported at the baseline examination and after adjustment for age, education, smoking, and average alcohol intake in Cox proportional hazards model, drinkers with heavy pattern still had higher mortality from all causes than drinkers without heavy drinking occasions (table 5). Respective analyses showed increased risk also for ischaemic heart disease (table 5), external causes, and alcohol related causes of death (table 6). The last two risk ratios were not adjusted for smoking. 

**Table 5** Relative risk for total mortality and ischaemic heart disease mortality among drinkers with heavy pattern compared with other drinkers. Proportional hazard models are adjusted for potential confounders and other covariates. The previous covariates remain in the model when the new one is added. Previous myocardial infarctions are excluded.

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</tr>
<tr>
<td>+Education</td>
<td>1.57 (1.17 to 2.10)</td>
<td>1.77 (1.01 to 3.08)</td>
</tr>
</tbody>
</table>

*Average alcohol use grouped into three categories. 0–95.9 g/week, 96–199.9 g/week and 200+ g/week.

This weakness may dilute the observed association and the actual one might thus be stronger.

**Table 6** Relative risk for external cause mortality and alcohol related disease mortality among drinkers with heavy pattern compared with other drinkers. Proportional hazard models are adjusted for potential confounders and other covariates. The previous covariates remain in the model when the new one is added.

<table>
<thead>
<tr>
<th>Adjustments</th>
<th>External cause mortality Relative risk 95% Confidence intervals</th>
<th>Alcohol related disease mortality Relative risk 95% Confidence intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>3.25 (1.81 to 5.84)</td>
<td>4.58 (2.22 to 9.46)</td>
</tr>
<tr>
<td>+Average alcohol use*</td>
<td>3.19 (1.63 to 6.24)</td>
<td>2.87 (1.20 to 6.86)</td>
</tr>
<tr>
<td>+Education</td>
<td>2.90 (1.47 to 5.72)</td>
<td>2.73 (1.13 to 6.64)</td>
</tr>
</tbody>
</table>

*Average alcohol use grouped into three categories. 0–95.9 g/week, 96–199.9 g/week and 200+ g/week.
weakening of sensorimotor coordination is a major risk of ischaemic heart disease. As to external causes of death, in homocysteine levels have played a part; there were only 15 deaths among drinkers who never heavy drinking occasions at a time is related to increased mortality among working age men independent of the total alcohol consumption.

According to this study, consuming six or more drinks of any alcoholic beverage at a time is related to increased mortality among working age men independent of the total alcohol consumption.

Policy implications

- Heavy drinking occasions are hazardous to health and should be discouraged. In prevention, screening, and counselling, special attention should also be paid to the drinking pattern.

Mechanisms

Some epidemiological studies have found that the risk of ischaemic heart disease decreases by increasing average alcohol intake. When the drinking pattern has been studied, however, high daily amounts (nine or more drinks for men, five or more for women) have been found to associate with increased risk of ischaemic heart disease, compared with both non-drinkers and never drinkers. The major mechanisms behind the ischaemic heart disease risk reduction among moderate drinkers seem to be an increase in HDL-lipoprotein cholesterol and a decrease in blood clotting tendency. These beneficial effects are counteracted by increase in blood pressure. There are three other effects of heavy drinking pattern that may at least partly explain the increase in ischaemic heart disease risk. Firstly, angiographic and epidemiological evidence suggests that a heavy drinking pattern accelerates atherosclerosis. Secondly, the alcohol withdrawal state that follows heavy drinking occasions increases the risk of cardiac arrhythmias. Thirdly, alcohol intake brings about increases in homocysteine levels and this is associated with a higher risk of ischaemic heart disease. As to external causes of death, weakening of sensorimotor coordination is a major mechanism in accidents and alcohol induced depression may play an important part in suicides.

Beverage differences

It is not clear why the earlier Finnish study found an increased risk of death among beer drinkers with a heavy drinking pattern but we did not. Both cohorts consisted of middle aged men and had about eight years of follow up. The drinkers with heavy pattern in the earlier study might have consumed notable amounts of spirits or wine in addition to beer. Although over half of all alcohol in Finland is by beer consumption, according to our data and other surveys heavy drinking in Finland is still strongly dominated by spirit drinking. The traditional drinking pattern, which still continues, has been long periods of abstinence interspersed by intoxicating spirit drinking occasions. Chance may also have played a part; there were only 15 deaths among drinkers with heavy pattern in the earlier study while we had 128. We were not able to find any clear evidence showing differences between beer, wine, and spirits in the risk of death related to heavy drinking occasions.

Conclusions

Our findings suggest that drinking six or more drinks at a time brings about an additional increase in the risk of death in working aged men, surpassing that related to average long term alcohol intake. This can be readily used in counselling men screened by the Alcohol Use Disorders Identification Test (AUDIT), as it includes a question about the frequency of drinking occasions at this level. Men should be advised to avoid heavy drinking occasions and the drinking pattern should be recognised in the recommendations on alcohol use.

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Conflicts of interest: none.

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- Hodgkins disease
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- Kidney stones
- Malignant melanoma (metastatic)
- Mesothelioma
- Myeloma
- Ovarian cyst
- Pancreatitis (acute)
- Pancreatitis (chronic)
- Polymyalgia rheumatica
- Post-partum haemorrhage
- Pulmonary embolism
- Recurrent miscarriage
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