35 Cummings SR, Nevitt NC, Browner WS, Stone S, Fox KM, Ensrud KE, et al. Risk factors for hip fracture in white women. *N Engl J Med* 1995;332:767-73.
36 Forsén L, Bjørndal A, Bjartveit K, Edna T, Holmen J, Jessen V, et al. Interaction between current smoking, leanness, and physical inactivity in the prediction of hip fracture. *J Bone Miner Res* 1994;9:1671-8.
37 Paganini-Hill A, Chao A, Ross RK, Henderson BE. Exercise and other factors in the prevention of hip fracture: the Leisure World study. *Epidemiol* 1991;2:16-25.
38 Wickham CAC, Walsh K, Cooper C, Barker DJP, Margetts BM, Morris J, et al. Dietary calcium, physical activity, and risk of hip fracture: a prospective study. *BMJ* 1989;299:889-92.
39 La Vecchia C, Negri E, Levi F, Baron JA. Cigarette smoking, body mass and other risk factors for fractures of the hip in women. *Int J Epidemiol* 1991;20:671-7.
40 Williams AR, Weiss NS, Ure CL, Ballard J, Daling JR. Effect of weight, smoking, and estrogen use on the risk of hip and forearm fractures in postmenopausal women. *Obstet Gynecol* 1982;60:695-9.
41 Kreiger N, Hilditch S. Cigarette smoking and estrogen-dependent diseases. *Am J Epidemiol* 1986;123:200.
42 Kreiger N, Kelsey JL, Holford TR, O'Connor T. An epidemiological study of hip fracture in postmenopausal women. *Am J Epidemiol* 1982;116:141-8.
43 Michaëlsson K, Holmberg L, Mallmin H, Sörensen, Wolk A, Bergström R, et al. Diet and hip fracture risk: a case-control study. *Int J Epidemiol* 1995;24:771-82.
44 Kreiger N, Gross A, Hunter G. Dietary factors and fracture in postmenopausal women: a case-control study. *Int J Epidemiol* 1992;21:953-8.
45 Grisso JA, Kelsey JL, Strom BL, O'Brien LA, Maislin G, La Pann K, et al. Risk factors for hip fracture in black women. *N Engl J Med* 1994;330:1555-9.
46 Paganini-Hill A, Ross RK, Gerkins VR, Henderson BE, Arthur M, Mack TM. Menopausal estrogen therapy and hip fractures. *Ann Intern Med* 1981;95:28-31.
47 Jaglal SB, Kreiger N, Darlington G. Past and recent physical activity and risk of hip fracture. *Am J Epidemiol* 1993;138:107-18.
48 Lau E, Donnan S, Barker DJP, Cooper C. Physical activity and calcium intake in fracture of the proximal femur in Hong Kong. *BMJ* 1988;297:1441-3.
49 Cooper C, Barker DJP, Wickham C. Physical activity, muscle strength, and calcium intake in fracture of the proximal femur in Britain. *BMJ* 1988;297:1443-6.
50 Cumming RG, Klineberg RJ. Case-control study of risk factors for hip fractures in the elderly. *Am J Epidemiol* 1994;139:493-503.
51 Lindsay R. The influence of cigarette smoking on bone mass and bone loss. In: DeLuca HF, Frost HM, Jee WSS, Johnston CC, Parfitt AM (eds). *Osteoporosis: recent advances in pathogenesis and treatment. Proceedings of the 10th Steenbock Symposium.* Baltimore: University Park Press, 1981:481.
52 Johnell O, Gullberg B, Kanis JA, Allander E, Elffors L, Dequeker J, et al. Risk factors for hip fracture in European women: the MEDOS study. *J Bone Miner Res* 1995;10:1802-15.
53 Cummings SR, Black DM, Nevitt MC, Browner W, Cauley J, Ensrud K, et al. Bone density at various sites for prediction of hip fractures. *Lancet* 1993;341:72-5.
54 Melton L J, Atkinson E J, O'Fallon M, Wahner HW, Riggs B L. Long-term fracture prediciton by bone mineral assessed at different skeletal sites. *J Bone Miner Res* 1993;8:1227-33.
55 Marshall D, Johnell O, Wedel H. Meta-analysis of how well measures of bone mineral density predict occurrence of osteoporotic fractures. *BMJ* 1996;312:1254-9.
56 Government Statistical Service. *Hospital episode statistics. 1: Finished consultant episodes by diagnosis, operation and specialty—England: 1992-93.* London: Department of Health, 1994.
57 Bennett N, Dodd T, Flatley J, Freeth S, Bolling K. *Health survey for England 1993.* London: HMSO, 1995.
58 May H, Murphy S, Khaw K-T. Cigarette smoking and bone mineral density in older men. *Q J Med* 1994;87:625-30.
59 Riebel GD, Boden SD, Whitesides TE, Hutton WC. The effect of nicotine on incorporation of cancellous bone graft in an animal model. *Spine* 1995;20:2198-202.
60 Baron JA, Comi RJ, Cryns V, Brinck-Johnsen T, Mercer NG. The effect of cigarette smoking on adrenal cortical hormones. *J Pharmacol Exp Ther* 1995;272:151-5.
61 Baron JA, La Vecchia C, Levi F. The antiestrogenic effect of cigarette smoking in women. *Am J Obstet Gynecol* 1990;162:502-14.
62 Ensrud KE, Nevitt MC, Yunis C, Cauley JA, Seeley DG, Fox KM, et al. Correlates of impaired function in older women. *J Am Geriatr Soc* 1994;42:481-9.
63 Nelson HD, Nevitt MC, Scott JC, Stone KL, Cummings SR. Smoking, alcohol, and neuromuscular and physical function of older women. *JAMA* 1994;272:1825-31.
64 Cassidenti DL, Pike MC, Vijod AG, Stanczyk FZ, Lobo RA. A reevaluation of estrogen status in postmenopausal women who smoke. *Am J Obstet Gynecol* 1992;166:1444-8.
65 Mazess RB, Barden HS, Ettinger M, Johnston C, Dawson-Hughes B, Baran D, et al. Spine and femur density using dual-photon absorptiometry in US white women. *Bone Miner* 1987;2:211-9.

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Beer binging and mortality: results from the Kuopio ischaemic heart disease risk factor study, a prospective population based study

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Abstract

Objective: To examine the association between beer binging (regular sessions of heavy beer drinking) and mortality.

Design: Prospective population based study with the baseline assessment of level of alcohol intake (dose), by type of drink and drinking pattern, previous and existing diseases, socioeconomic background, occupational status, involvement in organisations during leisure time, physical activity in leisure time, body mass index, blood pressure, serum lipids and plasma fibrinogen concentration, during an average of 7.7 years' follow up of mortality.

Setting: Finland.

Subjects: A population sample of 1641 men who consumed beer who were aged 42, 48, 54, or 60 years at baseline.

Main outcome measures: All cause mortality, cardiovascular mortality, death due to external causes, fatal myocardial infarctions.

Results: The risk of death was substantially increased in men whose usual dose of beer was 6 or more bottles per session compared with men who usually consumed less than 3 bottles, after adjustment for age and total alcohol consumption (relative risk 3.01 (95% confidence interval 1.54 to 5.90) for all deaths; 7.10 (2.01 to 25.12) for external deaths; and 6.50 (2.05 to 20.61) for fatal myocardial infarction). The association changed only slightly when smoking, occupational status, previous diseases, systolic blood pressure, low density lipoprotein and high density lipoprotein cholesterol concentration, plasma fibrinogen concentration, body mass index, marital status, leisure time physical activity, and involvement in organisations were controlled for.

Conclusion: The pattern of beer binging is associated with increased risk of death, independently of the total average consumption of alcoholic drinks. The relation is not explained by known behavioural, psychosocial, or biological risk factors. Death due to injuries and other external causes is overrepresented

among beer bingers, but a strong association with fatal myocardial infarction suggests that the pathway may also involve other acute triggers of severe health events.

Introduction

Heavy consumption of alcohol is known to increase mortality from all causes and especially from cardiovascular causes.[1-4] Little evidence exists, however, about the health effects of drinking pattern beyond the effects of overall consumption. We examined prospectively the relation between binge drinking (regular sessions and heavy beer drinking) of beer and all cause mortality, cardiovascular mortality, deaths from external causes (injuries, poisonings, suicides, violence), and incidence of fatal and non-fatal myocardial infarction, with adjustment for total consumption of beer and other alcoholic drinks. We compared middle aged Finnish men who usually consume six or more bottles of beer per session with men who usually have less than three bottles, and we made adjustments for several potentially confounding variables.

Subjects and methods

Subjects

The study population comprised a random, age stratified sample of middle aged men living in the city of Kuopio, Finland, or surrounding rural communities. The men were aged 42, 48, 54, or 60 years at the baseline examination that was carried out between March 1984 and December 1989. Of 3235 eligible men, 2682 participated,[5 6] of whom 1849 reported drinking beer. Information on one or more covariables was missing in 208 men, so the analyses were based on a sample of 1641 men who drank beer.

Baseline examination

The extensive examination protocol and measurements have been described in detail.[5-11] The subjects completed a self administered questionnaire and participated in a clinical examination. They were instructed that before the baseline examinations they should abstain from drinking alcohol for 3 days, smoking for 12 hours, and eating for 12 hours. The collection of blood specimens and the measurement of serum lipids and plasma fibrinogen concentrations were carried out as described previously.[7 9-11]

Alcohol consumption—We assessed alcohol consumption with a structured quantity and frequency method using the Nordic alcohol consumption inventory.[12 13] Usual frequency of intake and usual dose (in glasses or bottles) were recorded for each type of drink (beer, wine, strong wine, spirits) with a structured response form. We calculated the measure for average weekly intake of various drinks on the basis of known alcohol content. A third of a litre bottle of ordinary beer (class III in Finland) contains 12 g of ethanol, and strong beer (class IV) 14 g. The usual dose of beer was determined according to the following scale: <1 bottle, 1 bottle, <2 bottles, 2 bottles, 3 bottles, 4 or 5 bottles, 6-9 bottles, >9 bottles. We used the total mean consumption all alcoholic drinks (grams of ethanol/week) as the covariate in adjusted models.

Health—We evaluated baseline health on the basis of the questionnaire, which was checked in an interview, and on the basis of an examination by a physician. Current coronary heart disease was defined as (*a*) a history of acute myocardial infarction, (*b*) angina pectoris, (*c*) positive angina pectoris on effort in the Rose interview[14] (part of the questionnaire), or (*d*) the use of nitroglycerin tablets at least once a week. The diagnosis of other cardiovascular diseases (stroke, cardiac insufficiency, claudication) was based on the questionnaire and the physician's examination. The criteria for diabetes were diagnosed non-insulin dependent or insulin dependent diabetes, or fasting blood glucose concentration >11 mmol/l (WHO criteria), or both.

Psychosocial factors—We classified the occupational status of the participants as white collar, blue collar, or farmer on the basis of self reported main lifetime occupation.[9] Information on marital status and unemployment was obtained from the questionnaire. Involvement in organisations during leisure time, which we have earlier reported to be associated with mortality,[15] was used as the indicator of social contacts. For the assessment of depression, we included the Minnesota multiphasic personality inventory depression subscale with T score conversion.[16]

Behavioural and biological risk factors—We estimated the lifelong exposure to smoking ("cigarette years") as the product of years smoked and the number of cigarettes (or other tobacco equivalents) smoked daily at the time of examination. We assessed physical activity in leisure time from a 12 month history, modified from the Minnesota leisure time physical activity questionnaire; the intensity of physical activity was expressed in metabolic equivalents of oxygen consumption.[8 10] We calculated body mass index as the ratio of weight (kg) to height $(m)^2$. The measurement protocol of resting blood pressure has been described in detail.[7 9]

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Table 1 Background characteristics and risk factors by pattern of beer drinking in 1641 middle aged Finnish men

Characteristic	Usual No of bottles of beer/session		
	6 or more	3-5	Less than 3 (reference group)
No of men	70	420	1151
Age (SD) (years)	50.4 (6.0)	51.2 (5.6)	52.4 (5.0)
No (%) of married men	54 (77.1)	340 (81.9)	1034 (89.8)
Mean weekly alcohol intake (pure ethanol, g/week)	278.9	161.3	62.0
Mean (SD) No of cigarette-pack years	559 (386)	585 (377)	710 (432)
No (%) involved in organisations	12 (17.1)	71 (16.9)	107 (9.3)
No (%) other than white collar occupation	42 (60.0)	249 (59.3)	613 (53.3)
No (%) with previous or existing cardiovascular disease	17 (24.3)	120 (28.6)	289 (25.1)
No (%) with diabetes or glucose intolerance	5 (7.14)	14 (3.33)	57 (4.95)
Leisure time physical activity (mean (SD) No hours/year)	106 (118)	120 (158)	105 (130)
Mean (SD) body mass index (kg/m^2)	26.6 (3.4)	27.3 (3.8)	27.4 (4.0)
Mean (SD) systolic blood pressure (mm Hg)	134.1 (19.7)	132.3 (16.7)	129.5 (17.4)
Mean (SD) cholesterol (mmol/l):			
Low density lipoprotein	4.05 (1.02)	4.04 (0.97)	4.07 (1.04)
High density lipoprotein	1.33 (0.33)	1.32 (0.35)	1.30 (0.29)
Mean fibrinogen (g/l)	3.15 (0.57)	3.09 (0.54)	3.00 (0.54)
Mean (SD) depression score*	67.6 (12.7)	67.5 (14.2)	66.8 (12.4)

*According to Minnesota multiphasic personality inventory depression subscale (the higher the score the worse the depression).

Table 2 Number of deaths and acute myocardial infarctions, and corresponding mortality and incidence, by pattern of beer consumption in 1641 middle aged Finnish men

	Usual No of bottles of beer/session		
	6 or more (n=70)	3-5 (n=420)	Less than 3 (reference group) (n=1151)
All deaths:	15	44	77
Mortality/100 000 person years	2985	1402	853
Cardiovascular deaths:	7	20	32
Mortality/100 000 person years	1393	637	355
Deaths from external causes:	4	6	15
Mortality/100 000 person years	796	191	166
Myocardial infarctions:	7	41	89
Incidence rate/ 100.000 person years	1807	1822	1348
Fatal myocardial infarctions (% of all infarctions)	6 (86)	10 (24)	12 (13)

Follow up

The follow up of all cause mortality and deaths due to cardiovascular and external causes was achieved through linkage to the national death registry, which is maintained for all Finnish citizens. We classified cardiovascular deaths and deaths due to external causes according to codes 390-459 and 800 and above, respectively, of the ICD-9 (international classification of diseases, 9th revision). We ascertained the incidence of acute myocardial infarctions, both fatal and non-fatal, by linkage to the registry of acute myocardial infarctions, established for the MONICA project (an international study conducted under the auspices of the World Health Organisation to monitor trends in and determinants of mortality from cardiovascular disease).[17] The coverage of this registry was virtually 100% of the coverage of the national death registry.[7] The mean follow up time for all cause mortality was 7.7 (maximum 10.8) years and for acute myocardial infarction 5.6 years (maximum 8.8 years). The end date for the whole cohort was set as the end of the last year from which registry information was available.

Statistical analysis

We analysed the associations between dose of beer and all cause mortality, cardiovascular mortality, deaths from external causes, and fatal and non-fatal acute myocardial infarction using the Cox proportional hazards model.[18] To control for the possible non-linearity of the relation, we grouped the beer variable into <3 bottles (reference group), 3-5 bottles, 6 bottles or more. The first analyses included only age as a covariate. To check the changes in the risk estimates when total amount of alcohol was adjusted for, we added the weekly intake of beer, spirits, and wine (total alcohol intake) to the model. We then adjusted for a number of potential confounders. We controlled for smoking, leisure time physical activity, occupational status, marital status, social contacts, and depression in one model, and for previous diseases (diagnosed coronary heart disease, stroke, other cardiovascular disease, diabetes) in the second. We then added, in turn, systolic blood pressure, serum low density and high density lipoprotein cholesterol concentrations, plasma fibrinogen concentration, and body mass index in a series of separate models to show possible sources of confounding. Finally, we fitted a full model including all covariates.

Table 3 Adjusted relative risks (95% confidence interval) relating to beer drinking pattern and all cause mortality in 1641 Finnish men

	Usual No of bottles of beer/session	
Adjustments	3-5	6 or more
Age	1.80 (1.24 to 2.61)*	4.01 (2.30 to 6.98)*
Age, total alcohol consumption	1.64 (1.12 to 2.41)*	3.01 (1.54 to 5.90)*
Age, total alcohol, occupational status, marital status, involvement in organisations, smoking, leisure time physical activity, depression	1.32 (0.88 to 1.96)	2.00 (1.00 to 3.98)*
Age, total alcohol, previous diseases	1.67 (1.13 to 2.46)*	3.49 (1.76 to 6.93)*
Age, total alcohol, systolic blood pressure	1.61 (1.09 to 2.36)*	2.88 (1.47 to 5.67)*
Age, total alcohol, low and high density lipoprotein cholesterol	1.62 (1.10 to 2.38)*	2.94 (1.50 to 5.75)*
Age, total alcohol, fibrinogen	1.58 (1.07 to 2.31)*	2.45 (1.25 to 4.81)*
Age, total alcohol, body mass index	1.60 (1.09 to 2.36)*	2.99 (1.52 to 5.86)*
Age, total alcohol, all covariates	1.31 (0.88 to 1.96)	2.05 (1.01 to 4.14)*

Reference group=less than 3 bottles.
Previous diseases: coronary heart disease, stroke, other cardiovascular disease, diabetes.
*P<0.05.

Results

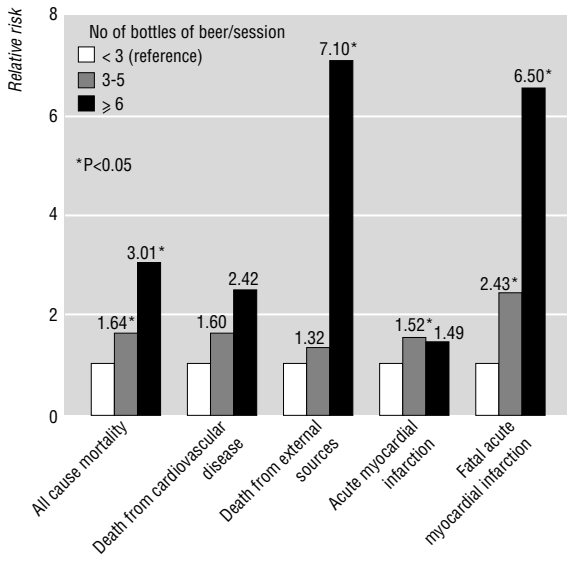
Between March 1984 and December 1994, 136 deaths were registered in the study population. Of these, 59 deaths were due to cardiovascular disease and 25 to external causes. Of the 137 new acute myocardial infarctions, 28 were fatal. Table 1 shows the distribution of beer drinkers by the usual dose per session and the background characteristics of these groups. The number of outcome events and the corresponding mortality and incidence in each category are presented in table 2.

All cause mortality

The age adjusted Cox survival model showed a positive dose-response relation between the beer dose per session and all cause mortality (table 3). Even after adjustment for the total alcohol intake the relative risk of death was three times higher in the high dose group than in the low dose (reference) group and was also raised in the moderate dose group (table 3, figure). The difference in relative risk between the high and the low dose groups remained significant in the Cox models that further adjusted for behavioural, social, and psychosocial factors, disease history, and current diseases, depression, systolic blood pressure, serum low density and high density lipoprotein cholesterol concentrations, plasma fibrinogen concentration, and body mass index (table 3). After simultaneous adjustment for all covariates, the relation between six or more beers per session and all cause mortality was still significant (2.05 (1.01 to 4.14)).

Cardiovascular mortality

The relative risk of cardiovascular death was higher in the high dose group than in the low dose group, but the difference was not significant when adjusted for age and total alcohol intake (2.42 (0.87 to 6.72)) (figure). In a model with additional adjustment for previous diseases the estimated relative risk was significantly increased (3.64 (1.28 to 10.35)), but in the full model the relative risk decreased to 2.08 (0.69 to 6.27). The estimated relative risks in the moderate dose group varied between 1.60 (0.88 to 2.89) in the first model to 1.27 (0.70 to 2.39) in the full model.



Relative risks of all cause mortality, cardiovascular mortality, death from external causes, acute myocardial infarction, and death from acute myocardial infarction associated with usual beer dose, with adjustment for age and total consumption of alcohol

External deaths

In the age adjusted model the risk of death due to external causes (violence, suicides, injuries, poisonings) was seven times as high as that of the low dose group, and further adjustment for total alcohol intake did not notably change the relative risk estimate (table 4, figure). The association remained significant in every model, and, with all covariates included, the relative risk was still 5.78 (1.40 to 23.91) (table 4). The risk was not significantly increased in the moderate dose group.

Myocardial infarctions

We found no significant relation between the usual beer dose and myocardial infarctions (table 5). In fatal myocardial infarction, however, there was a clear gradient. In the high dose group the risk of fatal myocardial infarction was more than six times that of the low dose group when age and total alcohol consumption were controlled for (figure). Adjustments for other covariates had no appreciable effect on the relative risk, except in the fibrinogen model. The raised risk of fatal myocardial infarction remained significant when all covariates were included in the same model (table 5). In the moderate dose group the raised risk relative to the low dose group was marginally significant.

Table 4 Relative risk (95% confidence interval) for external causes of death (injuries, poisonings, violence, and suicides) by pattern of beer consumption in 1641 middle aged Finnish men

	Usual No of bottles of beer/session	
Adjustments	**3-5**	**6 or more**
Age	1.19 (0.46 to 3.07)	5.04 (1.66 to 15.29)*
Age, total alcohol consumption	1.32 (0.50 to 3.50)	7.10 (2.01 to 25.12)*
Age, total alcohol, occupational status, marital status, involvement in organisations, smoking, leisure time physical activity, depression	1.09 (0.40 to 2.96)	5.95 (1.52 to 23.23)*
Age, total alcohol, previous diseases	1.34 (0.51 to 3.55)	6.68 (1.82 to 24.49)*
Age, total alcohol, systolic blood pressure	1.36 (0.51 to 3.59)	7.37 (2.08 to 26.17)*
Age, total alcohol, low and high density lipoprotein cholesterol	1.34 (0.51 to 3.55)	7.48 (2.11 to 26.56)*
Age, total alcohol, fibrinogen	1.25 (0.47 to 3.30)	6.27 (1.77 to 22.18)*
Age, total alcohol, body mass index	1.34 (0.51 to 3.55)	7.19 (2.03 to 25.40)*
Age, total alcohol, all covariates	1.09 (0.40 to 3.00)	5.78 (1.40 to 23.91)*

Reference group=less than 3 bottles.
*P<0.05.

Discussion

Many population based studies have shown a J shaped or U shaped association between use of alcohol and all cause mortality.[1-4] It is unclear, however, whether drinking pattern may have specific health consequences beyond total alcohol consumption. In this study the pattern of heavy acute intake of beer was associated with all cause mortality, deaths from external causes, and fatal myocardial infarctions in middle aged men, regardless of their total average consumption of beer, wine, and spirits. The risks were significantly higher among men who usually drank six or more beers at a time than among men who usually had less than three beers at a time. Our findings suggest that drinking pattern may have independent effects on health that are not explained by total consumption.

Pattern of alcohol intake is often considered to be more important than frequency of drinking as a

Table 5 Relative risks (95% confidence intervals) of acute myocardial infarction and fatal myocardial infarction, by pattern of beer consumption in 1641 middle aged Finnish men

	Usual No of bottles of beer/session			
	3-5		6 or more	
Adjustments	**Acute myocardial infarction**	**Fatal acute myocardial infarction**	**Acute myocardial infarction**	**Fatal acute myocardial infarction**
Age	1.45 (1.00 to 2.10)	2.62* (1.14 to 6.14)	1.47 (0.68 to 3.17)	9.29* (3.48 to 24.82)
Age, total alcohol consumption	1.52* (1.01 to 2.27)	2.43* (1.00 to 5.88)	1.49 (0.63 to 3.51)	6.50* (2.05 to 20.61)
Age, total alcohol, occupational status, marital status, involvement in organisations, smoking, leisure time physical activity, depression	1.33 (0.89 to 2.00)	2.18 (0.90 to 5.29)	1.01 (0.42 to 2.42)	4.96* (1.44 to 17.08)
Age, total alcohol, previous diseases	1.45 (0.97 to 2.17)	2.34 (0.96 to 5.71)	1.59 (0.67 to 3.78)	11.18* (3.27 to 37.03)
Age, total alcohol, systolic blood pressure	1.48 (0.99 to 2.21)	2.37 (0.98 to 5.75)	1.43 (0.60 to 3.38)	6.37* (2.00 to 20.26)
Age, total alcohol, low and high density lipoprotein cholesterol	1.46 (0.98 to 2.18)	2.38* (0.99 to 5.76)	1.32 (0.55 to 3.16)	6.07* (1.92 to 19.24)
Age, total alcohol, fibrinogen	1.47 (0.98 to 2.20)	2.39* (0.99 to 5.75)	1.22 (0.52 to 2.85)	4.89* (1.53 to 15.63)
Age, total alcohol, body mass index	1.48 (0.99 to 2.22)	2.38* (0.98 to 5.76)	1.47 (0.62 to 3.47)	6.47* (2.04 to 20.52)
Age, total alcohol, all covariates	1.28 (0.85 to 1.93)	2.40 (0.95 to 6.06)	0.96 (0.39 to 2.35)	7.05* (1.93 to 25.67)

Reference group=less than 3 bottles.
*P<0.05.

determinant of actual alcohol misuse.[19] Few studies, however, have tried to examine this in a general population, in which most individuals be classified not as misusers but as moderate drinkers. Even the most recent recommendations on alcohol use that are based on large population based studies[20 21] emphasise the limits of average weekly consumption and not the way people reach, exceed, or keep themselves within the limits.

Key messages

- The effects of drinking pattern on mortality and morbidity are less well known than the effects of total alcohol consumption
- The binging style of drinking beer was associated with the risk of death from any cause and from cardiovascular and external causes and with fatal myocardial infarctions in middle aged men in Finland
- The association was not explained by the total amount of alcohol consumption, and it remained after adjustments for several potential confounders
- Strong association of beer binging with deaths from external causes and fatal myocardial infarction suggests that this type of drinking pattern may involve triggers of severe acute events

Congruence with other studies

Our finding that average consumption and drinking pattern may have separate effects is supported by a recent case-control study, in which drinking pattern seemed to modify the risk of stroke in light to moderate drinkers, and sporadic or occasional pattern was associated with higher risk than regular and evenly distributed consumption.[22] Cross sectional analyses in the lung health study[23] showed that alcohol consumption was itself inversely related to body mass index, whereas greater modal intake (number of alcoholic drinks on a day that alcohol is consumed) was positively associated with greater body mass index.

We were especially interested in beer drinking as over half of all alcohol in Finland is consumed as beer. Wine, for example, still holds a fairly narrow share of the market.[24] Alcohol consumption per head of population in Finland is similar to many other Western countries and in 1993 was 6.8 litres pure ethanol, the same as in the United States and slightly less than in the United Kingdom.[24] Population surveys in Finland indicate that the traditional way of drinking infrequently but heavily has remained quite common.[25] Thus, beer binging was well represented in our study population.

Prospective findings from the Copenhagen city heart study showed that the frequency of drinking beer was not associated with all cause mortality, but three to five beers a day implied a reduction in cardiovascular mortality compared with those who never drank beer.[26] Drinking three to five glasses of spirits a day was associated with an increased risk of both all cause and cardiovascular deaths, whereas daily intake of wine was related to significantly lower mortality. That study, however, focused on frequency of intake and type of drink, and not on drinking pattern. To enhance the validity of the measurement we used a detailed quantity and frequency scale that included separate questions on each type of drink. As in other population studies self reported use of alcohol is still likely to underestimate the real consumption level.[3]

Possible mechanisms

The reason that the men who indulged in heavy drinking sessions had an increased risk of death in our follow up study might come from beer itself, from the pattern of heavy acute intake, or from other characteristics that are associated with men who prefer to drink six or more beers at a time. After adjustment for total beer consumption, the pattern of heavy acute intake remained a significant predictor of mortality. Thus, the total average amount of beer drinking, or intake of other types of alcohol, did not explain the association. Regarding potential confounding, the Kuopio ischaemic heart disease risk factor study[15] allowed us to adjust for several known risk factors and background variables. In general the observed associations did not change after adjustment for smoking, physical activity, occupational status, marital status, social contacts, depression, or previous and existing diseases. Systolic blood pressure, obesity, and serum lipids and plasma fibrinogen concentrations did not, however, explain the effect. After simultaneous adjustment for all the covariates, the risk of any death, death from external causes, and fatal myocardial infarction remained significantly raised.

Association with sudden events

The magnitude of the relation was strongest with deaths from external causes and fatal myocardial infarctions. Risks of injuries, poisoning, violence, and suicide apparently increase with acute intoxication. Thus, six or more bottles of beer may well imply greater likelihood of these events. Our results on fatal myocardial events suggest that heavy acute intake of beer may involve acute triggers of severe pathophysiological events in the myocardium or the coronary arteries, or both. These events might include arrhythmia, ischaemia, and possibly thrombotic processes.

Although relative risks in the group of men drinking six or more beers seem to be high, the attributable risk in the population becomes important only if this drinking pattern becomes sufficiently common. In our study only 4% of men drank six or more beers .

The literature on possible differential effects of various types of alcoholic drink is growing.[26-28] Our findings show that it is equally important to examine carefully the relation between drinking patterns—especially occasional heavy intake—and health outcomes.

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1 Klatsky AL, Armstrong MA, Friedman GD. Risk of cardiovascular mortality in alcohol drinkers, ex-drinkers and nondrinkers. *Am J Cardiol* 1990;66:1237-42.

2 Dyer AR, Stamler J, Oglesby P, Lepper M, Shekelle RB, McKean H, et al. Alcohol consumption and 17-year mortality in the Chicago Western Electric Company study. *Prev Med* 1980;9:78-90.
3 Poikolainen K. Alcohol and mortality: a review. *J Clin Epidemiol* 1995;48:455-65.
4 Beaglehole R, Jackson R. Alcohol, cardiovascular diseases and all causes of mortality: a review of the epidemiological evidence. *Drug Alcohol Rev* 1992;II:275-90.
5 Salonen JT, Nyyssönen K, Korpela H, Tuomilehto J, Seppänen K, Salonen R. High stored iron levels are associated with excess risk of myocardial infarction in eastern Finnish men. *Circulation* 1992;86:803-11.
6 Salonen JT. Is there a continuing need for longitudinal epidemiologic research? The Kuopio ischaemic heart disease risk factor study. *Ann Clin Res* 1988;20:46-50.
7 Salonen JT, Seppänen K, Nyyssönen K, Korpela H, Kauhanen J, Kantola M, et al. Intake of mercury from fish and lipid peroxidation and excess risk of myocardial infarction and coronary, cardiovascular and any death in eastern Finnish men. *Circulation* 1995;91:645-55.
8 Lakka TA, Venäläinen JM, Rauramaa R, Salonen R, Tuomilehto J, Salonen JT. Relation of leisure-time physical activity and cardiorespiratory fitness to the risk of acute myocardial infarction in men. *N Engl J Med* 1994;330:1549-54.
9 Wilson TW, Kaplan GA, Kauhanen J, Cohen RD, Wu M, Salonen R, et al. Association between plasma fibrinogen concentration and five socioeconomic indices in the Kuopio ischemic heart disease risk factor study. *Am J Epidemiol* 1993;137:292-300.
10 Lakka TA, Salonen JT. Physical activity and serum lipids: a cross-sectional population study in eastern Finnish men. *Am J Epidemiol* 1992;136:806-18.
11 Salonen JT, Salonen R, Seppänen K, Rauramaa R, Tuomilehto J. HDL, HDL_2 , and HDL_3 subfractions, and the risk of acute myocardial infarction: a prospective population study in eastern Finnish men. *Circulation* 1991;84:129-39.
12 Hauge R, Irgens-Jensen O. *Scandinavian drinking survey: sampling operations and data collections*. Oslo: National Institute for Alcohol Research (SIFA), 1981. (SIFA-stensilserie No 44.)
13 Kauhanen J, Julkunen J, Salonen JT. Coping with inner feelings and stress: heavy alcohol use in the context of alexithymia. *Behav Med* 1992;18:121-6.
14 Rose GA, Blackburn H, Gillum RF, Prineas RJ. *Cardiovascular survey methods*. Geneva: World Health Organisation, 1982:162-5.
15 Kaplan GA, Wilson TW, Cohen RD, Kauhanen J, Wu M, Salonen JT. Social functioning and overall mortality: prospective evidence from the Kuopio ischemic heart disease risk factor study. *Epidemiology* 1994;5: 495-500.
16 Dahlstrom WG, Welsh GS, Dahlstrom LE. *MMPI-handbook. Research applications*. Vol 2. Revised ed. Minneapolis: University of Minnesota Press, 1975.
17 World Health Organisation Monica Project. WHO Monica Project: assessing CHD mortality and morbidity. *Int J Epidemiol* 1989;18:S38-45.
18 Cox DR, Oakes D. Analysis of survival data. New York: Chapman and Hall, 1984.
19 Greenfield TK. Quantity per occasion and consequences of drinking: a reconsideration and recommendation. *Int J Addict* 1986;21:1059-79.
20 Gaziano JM, Hennekens C. Royal Colleges' advice on alcohol consumption: maintaining existing limits seems justified on current evidence. *BMJ* 1995;311:3-4.
21 Jackson R, Beaglehole R. Alcohol consumption guidelines: relative safety vs absolute risks and benefits. *Lancet* 1995;346:716.
22 Palomäki H, Kaste M. Regular light-to-moderate intake of alcohol and the risk of ischemic stroke. Is there a beneficial effect? *Stroke* 1993;24:1828-32.
23 Istvan J, Murray R, Voelker H. The relationship between patterns of alcohol consumption and body weight. *Int J Epidemiol* 1995;24:543-6.
24 *Alcohol statistical yearbook 1994*. Helsinki: Oy ALKO Ab (Finnish State Alcohol Company), 1995.
25 Simpura J, ed. *Finnish drinking habits: results from interview surveys held in 1968, 1976, 1984*. Vol 35. Helsinki: Finnish Foundation for Alcohol Studies, 1987.
26 Grønbæk M, Deis A, Sørensen TIA, Becker U, Schnohr P, Jensen G. Mortality associated with moderate intakes of wine, beer, or spirits. *BMJ* 1995;310:1165-9.
27 Klatsky AL. Armstrong MA. Alcoholic beverage choice and risk of coronary heart diseae mortality: do red wine drinkers fare best? *Am J Cardiol* 1993;71:467-9.
28 Renaud S, De Lorgeril M. Wine, alcohol, platelets, and the French paradox for coronary heart disease. *Lancet* 1992;339:1523-6.

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Time since childbirth and prognosis in primary breast cancer: population based study

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Abstract

Objective: To investigate whether time since birth of last child was of prognostic importance in women with primary breast cancer.
Design: Retrospective cohort study based on a population based database of breast cancer diagnoses with detailed information on tumour characteristics, treatment regimens, reproductive factors, and vital status.
Setting: Denmark.
Subjects: 5652 women with primary breast cancer aged 45 years or less at the time of diagnosis.
Main outcome measures: 5 and 10 year survival; relative risk of dying.
Results: Women diagnosed in the first 2 years after last childbirth had a crude 5 year survival of 58.7% and 10 year survival of 46.1% compared with 78.4% and 66.0% for women whose last childbirth was more than 2 years before their diagnosis. After adjustment for age, reproductive factors, and stage of disease (tumour size, axillary nodal status, and histological grading), a diagnosis sooner than 2 years since last childbirth was significantly associated with a poor survival (relative risk 1.58, 95% confidence interval 1.24 to 2.02) compared with women who gave birth more than 5 years previously. Further analyses showed that the effect was not modified by age at diagnosis, tumour size, and nodal status.
Conclusion: A diagnosis of breast cancer less than 2 years after having given birth is associated with a particularly poor survival irrespective of the stage of disease at debut. Therefore, a recent pregnancy should be regarded as a negative prognostic factor and should be considered in counselling these patients and in the decisions regarding adjuvant treatment.

Introduction

An early first delivery and a large number of childbirths are among the best established factors conferring a low risk of breast cancer.[1] Recent studies have described a dual effect of full term pregnancy on the risk of breast cancer, with a transiently increased risk immediately after childbirth followed by a long term reduction in the risk .[2-4]

Although these findings relate to the risk of developing breast cancer, they could also have implications for the prognosis of this disease. A breast cancer that is established before or during pregnancy might accelerate its growth under the influence of high

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