 International Journal of Epidemiology 1999;**28**:1066–1072

The relationship between alcohol consumption, health indicators and mortality in the German population

Hans Hoffmeister, Frank-Peter Schelp, Gert BM Mensink, Ekkehart Dietz and Dankmar Böhning

Background	The patterns of total alcohol, beer and wine consumption were evaluated in the German National Health Surveys. The impact of these habits on cardiovascular and all-cause mortality as well as cardiovascular risk factors and liver disease parameters was estimated.
Methods	Independent representative samples of the German population (15 400 people), and regional samples of the Berlin-Spandau population (2370 in total), aged 25–69 years, were analysed. The amount and frequency of alcohol consumption was assessed with standardized questionnaires. Biochemical analyses included serum lipids and gamma-glutamyl-transpeptidase (Gamma GT). Multiple analyses of variance were used to determine the relationship between alcohol intake and biochemical parameters. A mortality follow-up of about 7 years was conducted for the Berlin-Spandau population. Proportional hazard models were used to estimate hazard ratios (HR) for all-cause and cardiovascular mortality.
Results	Over 80% of men and 55% of women in Germany drink alcohol on a regular base. The majority of the consumers (65% of men, 87% of women) are light (1–20 g/day) or moderate (21–40 g/day) drinkers. Higher serum high density lipoprotein (HDL)-cholesterol and Gamma GT levels were observed with increasing alcohol intake. In light and moderate drinkers no significant relationship was seen with non-HDL-cholesterol, triglycerides, blood pressure and body mass index, compared to teetotallers. Men who consumed 1–20 g alcohol/day had a significantly lower all-cause and cardiovascular mortality. As compared to non-drinkers, the risk was almost 50% lower.
Conclusion	The results suggest that light (and possibly moderate) alcohol consumption reduces the risk of cardiovascular and total mortality risk and is favourably related to HDL-cholesterol.

Keywords	Alcohol, beer, wine, cardiovascular risk factors, Gamma GT, mortality
Accepted	22 June 1999

The daily per capita alcohol consumption in Germany is among the highest in the world. In 1995 the alcohol consumption was 43 g for men and 16 g for women.[1] These estimates are based on production data from the alcohol industry. From national representative health surveys, conducted 1984–1991, an average daily alcohol intake of 32 g for men and 15 g for women was calculated. Similar figures were found with another recall method for the German region of Augsburg.[2] After the final survey a slight decline in alcohol production was observed.

The differences in drinking patterns between men and women and beer and wine drinkers were analysed in pooled representative samples of the German population aged 25–69 years. In addition, the relationship of alcohol consumption and total serum cholesterol, high density lipoprotein (HDL)-cholesterol, triglycerides, gamma-glutamyl-transpeptidase (Gamma GT), blood pressure and body mass index was analysed.

There is evidence that light or even moderate alcohol consumption reduces overall mortality and in particular cardiovascular mortality.[3–8] Although alcohol consumption in Germany is quite high, the majority of consumers belong to the groups of light or moderate alcohol drinkers. In a sample of the Berlin-Spandau population, which has similar drinking habits to the German population, this relationship was analysed. In addition, the influence of liver diseases which might cause alcohol drinkers to quit were considered.

Freie Universität Berlin, Insititut für Soziale Medizin, Fabeckstrasse 60–62, D 14195, Berlin, Germany.

Methods

As part of the German Cardiovascular Prevention Study (GCP) independent representative samples of the former West German population (National Health Examination Surveys) and the Berlin-Spandau intervention population were examined in 1985, 1988 and 1991. Homeless people and those living in institutions, such as hospitals or homes for the elderly were excluded.[9]

A total of 7677 men and 7732 women, aged 25–69 years, participated in the National Surveys, and 1061 men and 1212 women were included in the Berlin-Spandau samples. They were interviewed and examined regarding health status, history and behaviour. Response rates were between 67% and 71%. Sub-samples of early, late and non-responders were compared for differences in main cardiovascular risk factors. No significant differences could be observed and no selection bias in relation to reported behaviour could be detected.[10] A mortality follow-up was carried out in the Berlin-Spandau samples taken in 1985 (1308 people, follow-up: 8.4 years) and 1988 (965 people, follow-up: 4.8 years) with an average follow-up duration of 6.9 years. In total, 7228 person-years for men and 8469 person-years for women were observed.

The participants completed a self-administered questionnaire under the supervision of a trained interviewer. The customary amounts of liquids consumed per day were assessed with a set of questions including the quantities of beer, wine and liquors. The quantity was assessed with the question 'How much liquid do you consume on an average day?' Possible answer categories were: >2 l, 1–2 l, 0.5–1 l, 0.25–0.5 l, <0.25 l, (almost) never drink beer for beer; ⩾5 glasses (of 0.25 l), 3–4 glasses, 2 glasses, 1 glass, (almost) never drink wine for wine; ⩾10 small glasses (of 2 cl), 5–9 small glasses, 3–4 small glasses, 2 small glasses, 1 small glass, <1 small glass, (almost) never drink hard liquors for hard liquors.

A reproducibility study of the instrument was conducted among 598 German men and women aged 20–75 years with a time-interval of 3 weeks. The observed test-retest Pearson correlation coefficients were 0.86 for beer and 0.71 for both wine and hard liquors. The average alcohol intake obtained with our instrument was similar to that observed in a German Monica sample using another recall instrument.[2] This instrument was validated with a 7-day food protocol.[11]

The average amount (g) of alcohol consumed per day by each individual was calculated. This was realized with an algorithm, which assumed beer to contain 5.0% vol., wine and champagne 10% vol. and spirits 40% vol. of alcohol. Grams of alcohol were obtained by multiplying the volume percentages by the factor 0.794. With this method total alcohol intake as well as the alcohol consumed from beer, wine and spirits was calculated. Individuals drinking 1–20 g alcohol/day were classified as light drinkers, those drinking 21–40 g as moderate drinkers and those drinking 41–80 g as heavy drinkers. People reporting that they almost never drank alcoholic beverages were classified as teetotallers. This scoring may explain the high proportion of teetotallers compared to other studies.

An additional score asked for the frequency of drinking alcoholic beverages. The results obtained using this score are presented in Table 3.

Physical examination included measurement of height, weight, systolic (SBP) and diastolic blood pressure (DBP). Blood was drawn and serum was analysed under internal and external quality control conditions in a central laboratory at the Institute of Social Medicine and Epidemiology of the former German Federal Health Office. This laboratory was involved in a lipid standardization programme conducted by the WHO Lipid Reference Center in Prague, Czechoslovakia. Serum cholesterol and HDL-cholesterol levels were analysed enzymatically using the CHOD-PAP method.[12,13] In addition, serum triglycerides and Gamma GT were determined.[14,15] Details of pre-analytical and analytical procedures are described elsewhere.[10]

Statistical analyses were performed by using the following programs: EpiInfo (version 6.02), BMDP (version 7.0), SPSS (version 7.5.2), Minitab (version 10 extra on IBM compatible PC), SAS (version 6.11). Proportions were presented in combination with the 95% CI calculated by using the exact binomial method for categorical numbers, which gives the appropriate CI for binomial parameters.[16] For comparison of differences in continuous variables between groups, the F-test was applied. As indicated in the Tables, the results were adjusted for age, smoking and social status. The proportional hazard model was used to estimate the hazard rate ratios (HR) for all-cause mortality and cardiovascular mortality.[17]

Results

Table 1 presents the distribution of teetotallers, alcohol consumers and people reporting that they mainly drank beer, wine or hard liquors. Preference for alcoholic beverages was different for men and women, with men having a preference for beer and women for wine. Only a small proportion of the observed population reported drinking mainly hard liquors. These results are given for the pooled national surveys.

Table 1 Proportion of teetotallers, beer, wine and spirit consumers in the German population, aged 25–69 years. Combined data of the National Health Surveys 1983, 1988 and 1991

	Men[a]			Women[a]		
	N	%	95% CI	N	%	95% CI
All individuals	7677	49.8	49.0–50.6	7732	50.2	49.4–51.0
Teetotallers	1387	18.1	17.2–18.9	3435	44.4	43.3–45.5
Alcohol drinkers	6290	81.9	81.1–82.8	4297	55.5	54.4–56.7
Mainly beer consumers	3799	49.5	48.4–50.6	902	11.7	10.9–12.4
Mainly wine consumers	2312	30.1	29.1–31.2	3248	42.0	40.9–43.1
Mainly spirit consumers	179	2.3	2.0–2.7	147	1.9	1.6–2.2

[a] Denominators were all males and females respectively.

Table 2 Proportion of intake of total alcohol and alcohol from beer and wine. German population aged 25–69 years. Adjusted for age, smoking and social status

	All beverages		Beer		Wine	
Alcohol (g/day)	N	%	N	%	N	%
Men						
0	1378	18.1				
1–20	1550	20.2	1023	26.0	408	17.6
21–40	2564	33.4	1359	35.8	1170	50.6
41–80	1686	22.0	1114	29.3	553	23.9
>80	490	6.4	303	8.0	181	7.8
Total	7677	100.0	3799	100.0	2312	100.0
Women						
0	3435	44.4				
1–20	2091	27.0	578	64.1	1385	42.6
21–40	1629	21.1	247	27.4	1367	42.1
41–80	510	6.6	69	7.6	437	13.5
>80	67	0.9	8	0.9	59	1.8
Total	7732	100.0	902	100.0	3248	100.0

Table 3 Frequency of alcohol consumption in the German population, aged 25–69 years. Adjusted for age, smoking and social status

	Men		Women	
	N	%	N	%
Almost daily	1725	27.9	437	10.5
Several times a week	2120	34.2	909	21.9
Once a week	1275	20.6	1185	28.6
Two to three times a month	625	10.1	792	19.1
Not more than once a month	446	7.2	827	19.9

The alcohol intake of most individuals was <40 g per day (Table 2). Distinct gender differences in beer and wine consumption were observed. The majority of female beer drinkers reported light intake, but the proportion of male beer drinkers consuming >20 g alcohol per day was rather high. Almost 40% of all male beer drinkers drank >40 g alcohol per day. Compared to women who prefer to drink beer, a larger proportion of women preferring to drink wine are moderate or even heavy alcohol consumers. Among mainly wine drinking men, 50% drank 20–40 g alcohol and 30% >40 g alcohol/day.

The frequency of alcohol consumption is presented in Table 3. Over 60% of the male alcohol drinkers consumed alcohol daily or at least several times a week. This was true for only 30% of the female alcohol drinkers. Among females, 70% drank alcohol rather irregularly. This percentage was only 40% among males.

Adjusted mean serum lipid levels for alcohol consumption categories are presented in Table 4. Total serum cholesterol was slightly higher in men with an alcohol consumption >40 g alcohol per day but not among women drinking similar amounts. Women had higher serum HDL-cholesterol levels than men. The increase in HDL-cholesterol concentrations related to alcohol consumption was, however, similar in both genders. Serum triglyceride levels were almost similar in the lower alcohol consumption categories, but higher in heavy and very heavy drinkers.

Both DBP and SBP were higher among men and women with higher alcohol consumption, most notably for those consuming >40 g alcohol per day (Table 5). Among males, body mass index (BMI) was not associated with increasing consumption of alcohol, except for the group of very heavy drinkers. In general, female alcohol drinkers had a lower BMI than female teetotallers (Table 5).

Increasing levels of Gamma GT were seen for groups with higher alcohol consumption. This was more pronounced among men than among women. There was no linear relationship of Gamma GT concentrations with alcohol consumption (Table 6).

An attempt was made to identify the threshold amount of alcohol consumption for an increase in Gamma GT. The model assumes that a linear relationship of alcohol consumption and Gamma GT concentration can be found before the threshold level. The results of these tests are given in Table 7. With this model a threshold level of 26 g total alcohol consumed per day was estimated for men. This threshold level was elevated to 42 g alcohol/day for beer drinkers. No statistically significant threshold level was detected for male wine drinkers as well as for all categories of female alcohol drinkers.

In the questionnaire the participants also reported past or present liver inflammation, fatty liver or liver cirrhosis. A rather high proportion of male and female teetotallers reported suffering from liver inflammation. Table 8 presents these proportions for the participants of the national surveys. The same was observed in the Berlin-Spandau population. The inclusion of such teetotallers may therefore bias the observed relationship between alcohol consumption and cardiovascular mortality and total mortality. To account for this possible bias, additional mortality analyses were performed with liver disease cases excluded.

In Tables 9 and 10, the cardiovascular and total mortality HR were calculated for participants of the Berlin-Spandau follow-up study. Data are also presented with people who reported having or having had liver diseases excluded. The cardiovascular mortality and all-cause mortality risk of alcohol drinkers compared to abstainers is given in Tables 9 and 10. A statistically significant lower risk for alcohol drinkers was observed for men

Table 4 Alcohol consumption and serum lipids. Adjusted for age, smoking, social status. All differences between groups of alcohol consumption were statistically significant with $P < 0.01$ except for total cholesterol among females

		Men			Women		
	Alcohol (g/day)	N	Mean	SE	N	Mean	SE
Total cholesterol (mmol/l)	0	1361	5.9	0.04	3285	6.1	0.03
	1–20	1522	6.0	0.03	2020	6.0	0.03
	21–40	2513	6.0	0.02	1583	6.0	0.03
	41–80	1659	6.2	0.03	489	6.1	0.05
	⩾80	484	6.3	0.05	63	6.0	0.14
HDL[a]-cholesterol (mmol/l)	0	1303	1.2	0.01	3162	1.6	0.01
	1–20	1474	1.3	0.01	1944	1.7	0.01
	21–40	2417	1.3	0.01	1526	1.8	0.01
	41–80	1573	1.4	0.01	473	1.8	0.02
	>80	462	1.4	0.02	63	1.9	0.05
Triglycerides (mmol/l)	0	1350	2.3	0.03	3278	1.7	0.02
	1–20	1518	2.3	0.03	2017	1.7	0.02
	21–40	2494	2.3	0.02	1582	1.6	0.02
	41–80	1645	2.4	0.03	489	1.7	0.04
	>80	474	2.6	0.06	64	1.9	0.12

[a] High density lipoprotein.

Table 5 Alcohol consumption, body mass index (BMI) and blood pressure. Adjusted for age, smoking, social status. All differences between groups of alcohol consumption were statistically significant with $P < 0.01$ except for systolic blood pressure for females

		Men			Women		
	Alcohol (g/day)	N	Mean	SE	N	Mean	SE
BMI (kg/m^2)	0	1377	26.5	0.09	3417	26.1	0.08
	1–20	1545	26.6	0.09	2082	25.8	0.10
	21–40	2555	26.5	0.07	1626	25.6	0.11
	41–80	1679	26.7	0.08	508	25.6	0.20
	>80	488	27.4	0.15	66	25.5	0.56
SBP[a] (mmHg)	0	1378	135.0	0.46	3422	131.3	0.30
	1–20	1545	135.7	0.44	2084	130.9	0.38
	21–40	2555	136.1	0.34	1628	131.2	0.43
	41–80	1681	137.4	0.42	508	132.4	0.77
	>80	489	141.1	0.78	67	135.5	2.12
DBP[b] (mmHg)	0	1378	86.3	0.32	3422	82.8	0.19
	1–20	1545	87.3	0.30	2084	83.3	0.24
	21–40	2555	87.1	0.23	1626	83.7	0.27
	41–80	1681	88.3	0.29	508	84.9	0.49
	>80	489	90.7	0.53	67	88.4	1.35

[a] Systolic blood pressure.

[b] Diastolic blood pressure.

Table 6 Alcohol consumption and gamma-glutamyl-transpeptidase (Gamma GT). Adjusted for age, smoking, social status. All differences between groups of alcohol consumption were statistically significant with $P < 0.01$

		Men			Women		
	Alcohol (g/day)	N	Mean	SE	N	Mean	SE
Gamma GT (U/l)	0	996	20.4	1.13	2310	14.7	0.52
	1–20	1024	24.2	1.11	1449	15.0	0.65
	21–40	1774	24.4	0.85	1072	16.5	0.76
	41–80	1070	31.8	1.09	334	20.3	1.35
	>80	317	48.3	2.10	43	26.6	3.77

Table 7 Threshold value[a] of gamma-glutamyl-transpeptidase (Gamma GT) in relation total alcohol consumption per day, as well as alcohol from beer and wine consumption

	Men		Women	
	Alcohol g/day	Likelihood Ratio Test[b]	Alcohol g/day	Likelihood Ratio Test[b]
Alcohol (unspecified)	26.3	8.9	5.0	0.0
Beer	41.6	22.2	7.8	0.0
Wine	50.8	1.2	14.7	0.0

[a] The threshold value is defined as the point within a model at which gamma GT concentrations start to rise after a linear performance before.

[b] Statistical significance level: 4.6.

Table 8 Liver diseases reported in relation to alcohol consumption. Adjusted for age, smoking, social status. All differences between male groups of alcohol consumption were statistically significant with $P < 0.01$. Among females only for liver inflammation ($P < 0.03$)

	Liver inflammation, fatty liver				Liver cirrhosis			
Alcohol (g/d)	Total N	N	%	95% CI	Total N	N	%	95% CI
Men								
0	1376	204	14.8	13.0–16.8	1373	32	2.3	1.6–3.3
1–20	1544	122	7.9	6.6–9.4	1543	22	1.4	0.9–2.1
21–40	2554	227	8.9	7.8–10.0	2553	25	1.0	0.6–1.4
41–80	1673	164	9.8	8.4–11.3	1678	30	1.8	1.2–2.5
>80	484	8	1.6	0.7–3.2	485	14	2.9	1.6–4.8
Women								
0	3418	277	8.1	7.2–9.1	3412	3	0.1	0.01–0.25
1–20	2083	144	6.9	5.9–8.1	2078	2	0.1	0.01–0.34
21–40	1623	97	6.0	4.9–7.2	1621	2	0.1	0.01–0.44
41–80	507	28	5.5	3.7–7.9	506	0	0.0	–
>80	67	3	4.5	0.9–12.5	67	0	0.0	–

Table 9 Cardiovascular mortality hazard ratio (HR) from proportional hazard models for alcohol intake categories with teetotallers as the reference (with and without people who reported having or having had liver diseases). Adjusted for age, smoking and social status

	All individuals in survey			Individuals with liver diseases excluded		
Alcohol (g/d)	No. of deaths	Adjusted HR	95% CI	No. of deaths	Adjusted HR	95% CI
Men						
0	15	1		15	1	
1–20	13	0.42	0.2–0.9	12	0.41	0.19–0.87
21–40	14	0.72	0.34–1.53	14	0.75	0.36–1.60
41–80	8	0.73	0.31–1.74	8	0.75	0.32–1.79
>80	1	0.35	0.05–2.67	1	0.35	0.05–2.66
Women						
0	11	1		10	1	
1–20	6	0.68	0.25–1.86	5	0.63	0.21–1.85
21–40	4	1.62	0.51–5.16	4	1.72	0.53–5.54
41–80	2	1.38	0.30–6.28	2	1.57	0.34–7.23
>80	–	–	–	–	–	–

consuming 1–20 g alcohol/day. This was seen for all-cause mortality and cardiovascular mortality and also after the exclusion of those reporting liver diseases. The risk for light alcohol drinkers as compared to teetotallers was almost reduced to 50%. For cardiovascular mortality, the adjusted HR was estimated to be 0.42, and 0.41 after exclusion of those reporting liver diseases.

Discussion

Our observations confirm previous findings on the relationship of alcohol consumption and cardiovascular risk factors as well as indicators of liver disease for a representative sample of the (former West) German population. Recent investigations show that alcohol consumption and drinking habits are similar

Table 10 All-cause mortality hazard ratio (HR) from proportional hazard models for alcohol intake categories with teetotallers as the reference (with and without people who reported having or having had liver diseases). Adjusted for age, smoking and social status

	All individuals in survey			Individuals with liver diseases excluded		
Alcohol (g/d)	No. of deaths	Adjusted HR	95% CI	No. of deaths	Adjusted HR	95% CI
Men						
0	24	1		22	1	
1–20	24	0.51	0.29–0.90	22	0.51	0.28–0.91
21–40	27	0.90	0.51–1.56	25	0.86	0.48–1.55
41–80	17	0.93	0.49–1.76	17	0.99	0.52–1.89
>80	1	0.44	0.10–1.86	1	0.45	0.11–1.93
Women						
0	33	1		27	1	
1–20	18	0.83	0.47–1.47	18	0.84	0.46–1.54
21–40	9	1.29	0.61–2.72	8	1.30	0.59–2.89
41–80	5	0.81	0.25–2.65	4	0.96	0.29–3.16
>80	1	4.20	1.23–14.30	1	3.40	0.78–14.9

in the populations of the former East and West Germany.[18] The described results are therefore assumed to be representative for Germany in total.

In Germany, females less often consume alcohol and in lower amounts than males. Females prefer to drink wine rather than beer. They also have a more irregular alcohol consumption pattern than males. This should be considered when interpreting differences in the health effects of alcohol consumption between men and women.

The beneficial effect of light and moderate alcohol consumption on cardiovascular mortality can partly be explained by the increase in HDL-cholesterol concentrations.[19] In the observed population, HDL-cholesterol was remarkably enhanced in all groups of alcohol consumers compared to teetotallers. When comparing these data with total cholesterol levels it becomes evident that the non-HDL-cholesterol fraction has equal or even lower values in alcohol consumers as compared to teetotallers. The average intake of alcohol in the German population is almost twice as high as in the US.[20] It seems plausible that the higher HDL-cholesterol levels in the German population as compared to the US population are due to this higher alcohol intake.[8] This may partly explain the lower cardiovascular mortality figures in Germany compared to the US, despite the fact that other risk factors like high blood pressure and smoking are more common in the German population.[9,21]

The kind of alcoholic beverage has no major influence on blood lipid levels. However, we observed some association of beer and wine consumption with blood pressure and Gamma GT levels. Male beer drinkers may have a slight advantage over drinkers of other alcoholic beverages. Their liver enzyme Gamma GT was elevated significantly at an alcohol consumption of 42 g per day, which is markedly higher compared to 26 g for total alcohol consumed per day (Table 7). Such a threshold level could not be detected for females. The low proportion of women drinking large amounts of alcohol might be responsible for this result. Further research is needed to find out whether gender differences in drinking patterns contribute to these findings.

The amount of alcohol from wine was less strongly associated with blood pressure and with Gamma GT than the same amount from beer. These statistical significant effects could be observed in all consumption groups of men and women. The differences were of the magnitude of 1–2% for blood pressure and 15–30% for Gamma GT.

The lower risk for moderate alcohol drinkers against teetotallers for cardiovascular mortality and all-cause mortality has been observed in many previous studies.[3–8] The values estimated in this investigation are similar in magnitude to those of the population in the German region of Augsburg.[2] The fact that the results remained the same when people reporting liver inflammation, fatty liver or liver cirrhosis were excluded suggests that, the findings are not biased by liver diseases. We additionally adjusted our analyses for leisure time physical activity without seeing an influence on the relationship between alcohol consumption and mortality. The lack of effects among females may be explained by the low number of deaths among females in this age group, as indicated by the wide 95% CI. For men consuming 21–40 g alcohol/day and women consuming 1–20 g alcohol/day, the adjusted HR are below 1. It may be that a longer observation time for this cohort will show a beneficial effect for light as well as moderate alcohol consumption on cardiovascular health for both genders.

References

[1] Hüllinghorst H. *Alkohol-Zahlen und Fakten zum Konsum.* Deutsche Hauptstelle gegen die Suchtgefahren (Hrsg) Jahrbuch Sucht 97, Geesthacht 1996, pp.9–18.

[2] Keil U, Chambless I, Filipiak B, Härtel U. Alcohol and blood pressure and its interaction with smoking and other behavioral variables: results from the MONICA Augsburg survey 1984–1985. *J Hypertens* 1991;**9:**491–98.

[3] Renaud S, Criqui MH, Farchi G, Veenstra J. Alcohol drinking and coronary heart disease. In: Verschuren PM (ed.). *Health Issues Related to Alcohol Consumption*. Brussels: International Life Science Institute Europe, 1993, pp.81–123.

[4] Rimm EB, Klatzky AL, Grobbee D, Stampfer MJ. Review of moderate alcohol consumption and reduced risk of coronary heart disease: is the effect due to beer, wine or spirits? *Br Med J* 1996;**312:**731–36.

[5] Boffeta P, Garfinkel A. Alcohol drinking and mortality among men enrolled in an American Cancer Society prospective study. *Epidemiology* 1990;**1:**342–48.

[6] Duffy JC. Alcohol consumption and all-cause mortality. *Int J Epidemiol* 1995;**24:**100–05.

[7] Klatsky AL. Epidemiology of coronary heart disease—influence of alcohol. *Alcohol Clin Exp Res* 1994;**18:**88–96.

[8] Poikolainen K. Alcohol and mortality: a review. *J Clin Epidemiol* 1995; **48:**455–65.

[9] Hoffmeister H, Mensink GBM, Stolzenberg H. National trends in risk factors for cardiovascular disease in Germany. *Prev Med* 1994;**23:** 197–205.

[10] Hoffmeister H, Mensink GBM, Stolzenberg H *et al*. Reduction of coronary heart disease risk factors in the German cardiovascular prevention study (GCP). *Prev Med* 1996;**25:**135–45.

[11] Schaeffler V, Döring A, Winkler G, Keil U. Erhebung der Alkoholaufnahme: Vergleich verschiedener Methoden. *Ernährungs-Umschau* 1991;**38:**490–94.

[12] Siedel J, Schlumberger H, Klose S *et al.* Improved reagent for the enzymatic determintion of serum cholesterol. *J Clin Chem Clin Biochem* 1981;**19:**838–39.

[13] Lopes Virell MF, Stone P, Ellis S *et al.* Cholesterol determination in high-density lipoproteins separated by three different methods. *Clin Chem* 1977;**23:**882–84.

[14] Bucolo G, David H. Quantitative determination of serum triglycerides by use of enzymes. *Clin Chem* 1973;**19:**475–83.

[15] Persign JP, van der Silk W. A new method for the determination of Gamma-glutamyltransferase in serum. *J Clin Chem Clin Biochem* 1976;**14:**421–24.

[16] Böhning D. Better approximate confidence intervals for binomial parameter. *Can J Stat* 1994;**22:**207–18.

[17] Cox DR, Oakes D. *Analysis of Survival Data*. London: Chapman and Hall, 1984.

[18] Stolzenberg H. Alkoholkonsum. In: Hoffmeister H (ed.). Die Gesundheit der Deutschen. Ein Ost-West-Vergleich. Federal Health Office, Berlin. *Soz Ep Hefte* 1994;**4:**177–81.

[19] Langer RD, Criqui MH, Reed DM. Biologic pathways for the effect of moderate alcohol consumption on coronary heart disease. *Am J Epidemiol* 1988;**128:**916.

[20] Produktschap voor Gedistilleerde Dranken in association with NTC Publications Ltd. (eds). *World Drink Trends* 1994; Oxfordshire 1994.

[21] Kohlmeier L, Hoffmeister H. Consequences of current lipid guidelines for the Federal Republic of Germany. *Klin Wochenschr* 1990;**68:** 454–59.