Moderate dietary supplements of potassium might be a valuable alternative to pharmacological methods for controlling blood pressure in patients who have less severe hypertension, particularly those who are not willing or able to restrict salt intake. Further studies should explore the possibility of achieving a substantial increase in potassium intake by acceptable, simple dietary modifications and confirm the long term safety and tolerability of this type of intervention.

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Alcohol intemperance and sudden death

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Abstract

Ten years after a health screening examination was offered to 50 year old men 32 of the 2322 participants and 12 of the 454 non-participants had died of ischaemic heart disease. Of these, 26 and 11 respectively had suffered sudden death, for which necropsy was performed. Half of the men who had died suddenly had been registered for alcohol intemperance up to 1973, which was four times the prevalence of such registrations in the general population. Registration at both the Swedish Temperance Board and the Bureau of Social Services was associated with an odds ratio of 3·74 for sudden death as compared with not being registered at either. Logistic analysis including the classical risk factors for ischaemic heart disease together with registration for alcohol intemperance and at the Bureau of Social Services showed only the two types of registration and systolic blood pressure to be independent risk factors. On the other hand, there was no overrepresentation of subjects entered in the registers among those surviving a myocardial infarction. For non-fatal myocardial infarction blood pressure and serum triglyceride concentration were significant risk factors and serum cholesterol concentration, smoking, and body mass index probable risk factors; the two types of registration were not independent risk factors.

Alcohol intemperance is strongly associated with an increased risk of sudden death after myocardial infarction.

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Introduction

Sudden, unexpected death has been a matter of much concern with regard to its underlying causes. Boyd in his textbook of pathology, gave four main reasons for such deaths—namely, "cerebral haemorrhage, shock, coronary artery thrombosis and visitation from God."[1] The causes of sudden death have probably changed with time. Cerebral haemorrhage, for example, was common before the 1950s but diminished rapidly when effective treatment for hypertension became available.[2] Stroke as a cause of death was still declining during the late 1970s.[2] Cerebral micro-embolism may possibly be fatal and explain some cases.[3] Coronary artery thrombosis may be difficult to diagnose after a sudden death, as histochemical signs may not have developed.[4] Coroners are not allowed to state "sudden death, cause unknown" but must specify the reason for death. Hence when evidence of other disease is lacking sudden death is usually ascribed to ischaemic heart disease, though severe narrowing of the coronary arteries may be absent.[3]

A history of alcohol abuse is more common in cases of sudden death than in people who survive a myocardial infarction.[5] Furthermore, that cardiac arrhythmia may occur during or after an alcoholic binge[6] suggests that alcohol may be a causative factor in sudden death. Few studies, however, have focused on whether alcohol consumption carries a risk independent of the conventional risk factors for ischaemic heart disease. We therefore present the findings with respect to sudden death in a population of some 2700 middle aged men who were followed up for almost 10 years. We report on the relative importance of the conventional risk factors for ischaemic heart disease, in particular for non-fatal myocardial infarction, and on registration at the Swedish Temperance Board as a risk factor for sudden death classified at necropsy as due to ischaemic heart disease.

Subjects and methods

Health screening was offered to 50 year old men in Uppsala during 1970-3[7] and 2322 (84%) of the available population of 2776 men attended. Those found to have hypertension and hyperlipidaemia began treatment for their

condition.[8][9] The effect of intervention[10] and the mortality pattern[11] recorded at follow up in 1980 have been reported, the second of these reports noting an association of different types of registration (see below) with some causes of death.

Screening procedure and registrations—Body weight and height were measured and the body mass (Quetelet's) index of weight over height (kg/(m²)) calculated. Systolic and diastolic blood pressures were measured on the right arm with a mercury manometer after 10 minutes' lying and after two minutes' standing. Blood samples were taken for determination of fasting serum triglyceride and cholesterol concentrations by a Technicon dual channel system (N 24a and N 70). Subjects also completed a questionnaire on smoking. Registers of the Temperance Board and Bureau of Social Services were examined in 1973 to see whether participants and non-participants were entered there. A person may be registered at the Temperance Board not only after heavy alcohol abuse but also after a drinking offence or driving under the influence of drink. All people receiving social assistance are entered in the registers of the Bureau of Social Services, and these registrations are thus mainly based on economic factors.

Follow up—Information on men who had attended and not attended for health screening in 1970-3 and who had died in the period up to August 1980 was obtained from the National Central Bureau of Statistics, Stockholm. The hospital records and necropsy and medicolegal details of the deceased men were studied; necropsy or a medicolegal investigation was conducted in all cases. Sudden death is defined as unwitnessed death or death without previous symptoms or occurring within 24 hours after the onset of cardiac symptoms. By the time of follow up (September 1980) 101 of the participants and 52 of the non-participants in the health screening had died. All subjects (participants and non-participants) alive in 1980 were asked by letter or telephone if they had suffered a definite or suspected myocardial infarction since the health screening. One hundred and six confirmed that they had and their hospital and doctors' records were therefore requested for evaluation. All electrocardiograms were reviewed by one of us (HÅ) using recommendations for diagnosis of myocardial infarction.[12] Electrocardiograms were available in all cases except those in which the subject had died suddenly outside hospital. Serum aspartate and alanine aminotransferase activities (available for 90% of the subjects who had not died suddenly) were reassessed in accordance with the recommendations above.[12]

Control group—All subjects who had not died of myocardial infarction (including sudden deaths), had not reported a definite or suspected myocardial infarction since the health screening, and did not have a history of myocardial infarction before the survey (1970) served as controls.

Statistics—The hypothesis that means should be equal in the sudden death group and group surviving myocardial infarction versus the controls was tested for each variable by one way analysis of variance followed (if differences were significant) by multiple t comparisons.[13] p Values for univariate association are for a model including only the indicated variable and are presented with appropriate accuracy. The hypothesis of equal proportions of cigarette smokers in the above two subgroups versus the control group was tested by the usual normal approximation for proportions.[14] A stepwise logistic regression program (BMDPLR) was used to test the importance of the conventional risk factors for ischaemic heart disease, the registration factors, and the participation factor for sudden death or non-fatal myocardial infarction.[15] The odds of an event is defined as $p/(1-p)$, where p is the probability of the event. The ratio $(p_1/(1-p_1))/(p_2/(1-p_2))$—where, for example, p_1 is the probability of sudden death when the subject was registered at the Temperance Board and p_2 is the probability of sudden death for an unregistered subject—is the odds ratio. Odds ratios and their 95% confidence intervals for all variables found significant (or nearly significant) in the logistic analysis after allowing for the other included variables are presented in the tables. The odds ratio was approximately equal to the risk ratio on all occasions. When calculating the odds ratio for a given change of a variable the differences in mean values between the respective groups were used. Default values for inclusion and exclusion of variables and for tolerance (0·10, 0·15, and 0·0001) were as listed in the BMDPLR program.[15]

Results

By the time of follow up 42 of the participants and 18 of the non-participants in the health screening survey had died of diseases of the circulatory system. In 32 and 12 of these respectively death was classified as due to ischaemic heart disease. Twenty six of the 32 ischaemic heart disease deaths among participants were sudden deaths, and among the non-participants all but one were sudden deaths. Of the subjects in the two groups who suffered sudden death, 12 and six respectively were registered at the Temperance Board—that is, 49% of all sudden deaths were in subjects so registered. The prevalence of registration was over four times higher in this group than in the population at large (11·1%).

The odds ratio for sudden death was 2·20 for a man registered at the Temperance Board (that is, compared with a man not so registered) and 1·70 for a man registered at the Bureau of Social Services (table I). Men registered at both the Temperance Board and the Bureau of Social Services had a ratio of 3·74 compared with men without such registrations. The larger proportion of sudden death among non-participants (11/454; 2·4%) than among participants (26/2322; 1·1%) was explained by their greater frequency of registrations at the Temperance Board.

Among the participants 26 had suffered sudden death and 58 a non-fatal myocardial infarction during follow up. Table II gives the characteristics of these subjects and the controls. By univariate analysis significant risk factors for sudden death were found to be registration at the Temperance Board (p<0·0001), registration at the Bureau of Social Services (p<0·0001), systolic (p<0·0001) and diastolic (p<0·0001) blood pressure, and serum cholesterol concentration (p=0·0172); body mass index (p=0·06) and cigarette smoking (p=0·10) were not significant. In the logistic analysis, however, only the two forms of registration and systolic blood pressure persisted as significant risk factors, all three of considerable magnitude (table III).

Significant risk factors found for non-fatal myocardial infarction by univariate analysis were registration at the Temperance Board (p=0·0026), smoking (p=0·03), blood pressure (p<0·0001), serum triglyceride (p<0·0001) and cholesterol (p=0·0023) concentrations, and body mass index (p=0·0008). To evaluate the risk of a certain change in one risk factor the difference between the mean values of this group and of the controls (see table II) was used as a measure of the respective risk factor. Thus by logistic analysis an increase in systolic blood pressure by 9 mm Hg, in serum triglyceride concentration by 0·94 mmol/l, and in smoking by six to 15 cigarettes a day was associated with odds ratios of 1·19, 1·12, and 1·13, respectively (table IV). The odds ratios for an increase in serum cholesterol concentration of 0·48 mmol/l and in body mass index of 1·4 were of similar power but not quite significant. Neither type of registration, however, was associated with significant odds ratios for non-fatal myocardial infarction.

Comparison of the pattern of risk factors in men who suffered sudden

TABLE I—*Odds ratios and 95% confidence intervals from logistic analysis of all subjects (participants and non-participants) suffering sudden death and survivors free of myocardial infarction*

	Odds ratio	95% Confidence interval
Temperance Board: registration v non-registration	2·20	1·49 to 3·24
Bureau of Social Services: registration v non-registration	1·70	1·15 to 2·50
Temperance Board+Bureau of Social Services: registration v non-registration	3·74	1·71 to 8·10

TABLE II—*Metabolic and other risk factors among participants suffering sudden death and among those surviving myocardial infarction compared with risk factors in controls. Except where stated otherwise values are means (SD in parentheses)*

	Sudden deaths (n=26)	All survivors of myocardial infarction (n=58)	Controls (n=2169)
Systolic blood pressure (mm Hg)	148 (23)***	142 (23)***	133 (18)
Diastolic blood pressure (mm Hg)	92 (12)***	89 (15)***	83 (11)
Serum triglycerides (mmol/l)	2·18 (1·43)	2·70 (3·72)***	1·76 (1·19)
Serum cholesterol (mmol/l)	6·50 (1·33)*	6·48 (1·06)***	6·00 (1·06)
Body mass index	26·1 (5·3)	26·4 (3·8)***	25·0 (3·2)
No (%) of cigarette smokers	11 (42)	22 (38)*	564 (26)
No of cigarettes a day	18·4 (10·7)	19·5 (9·8)**	14·5 (8·3)
No (%) of subjects registered at Temperance Board	12 (46)**	12 (20)	174 (8)
No (%) of subjects registered at Bureau of Social Services	11 (42)*	8 (14)	260 (12)

*p<0·05. **p<0·01. ***p<0·001.

TABLE III—*Odds ratios and 95% confidence intervals from logistic analysis of participants suffering sudden death and surviving participants free of myocardial infarction*

	Odds ratio	95% Confidence interval
Temperance Board: registration v non-registration	2·43	1·54 to 3·82
Bureau of Social Services: registration v non-registration	2·28	1·07 to 2·67
Systolic blood pressure 148 v 133 mm Hg	1·65	1·30 to 2·11

TABLE IV—*Odds ratios and 95% confidence intervals from logistic analysis of participants surviving myocardial infarction and surviving participants free of myocardial infarction*

	Odds ratio	95% Confidence interval
Ex-smoker v non-smoker	0·70	0·40 to 1·25
No of cigarettes a day:		
1-5 v non-smoker	0·82	0·35 to 1·88
6-15 v non-smoker	1·13	0·68 to 1·89
≥16 v non-smoker	2·07	1·25 to 3·41
Systolic blood pressure 142 v 133 mm Hg	1·19	1·06 to 1·33
Serum triglycerides 2·70 v 1·76 mmol/l	1·12	1·01 to 1·24
Serum cholesterol 6·48 v 6·00 mmol/l	1·12	0·99 to 1·26
Body mass index 26·4 v 25·0	1·11	0·99 to 1·24

death and men who survived a myocardial infarction showed only the two types of registration as discriminating between the two groups (not shown in the tables).

Discussion

In our study population every second subject who suffered a sudden death was registered at the Temperance Board. This was four times the prevalence of such registrations among the population at large. The odds ratio for sudden death for a person registered at both the Temperance Board and the Bureau of Social Services was 3·74. Registration at the Bureau of Social Services, however, may be an indicator of advanced alcoholism[16] rather than a factor carrying a risk of its own. Our finding corresponds well with the risk ratio of 3·99 for death from coronary heart disease among problem drinkers as compared with non-problem drinkers in an American population.[17] The 26 participants in our study who suffered sudden death differed from the controls with respect to the classical risk factors for ischaemic heart disease. Nevertheless, multiple logistic analysis including registration at the Temperance Board showed that this factor accounted for much of the variation and effect of the classical risk factors, so that only systolic blood pressure and registration at the Bureau of Social Services were included as independent of registration at the Temperance Board. Registration for alcohol intemperance has been shown to be overrepresented among men with an increased risk of ischaemic heart disease[16 18 19] and of sudden death in particular.[19] Raised systolic blood pressure reportedly characterises subjects with fatal ischaemic heart disease as compared with those with non-fatal ischaemic heart disease,[16] and our results confirm this.

Measuring the blood alcohol concentration at necropsy has also been used as an aid to deciding whether alcohol may have contributed to death. After excluding cases of sudden death in which ethanol was found in the blood the prevalence of subjects with known alcohol abuse was no longer significantly increased among those with ischaemic heart disease and sudden death.[20] Subjects in whom ethanol was detected at necropsy accounted for 40% of all cases of sudden death,[20 21] which corresponds well with our finding that 49% of subjects who died suddenly were registered for alcohol intemperance. In an American study the risk of sudden death was increased by a factor of 2·3 among people of poor education as compared with highly educated people.[22] This effect of poor education was not accounted for by differences in conventional risk factors, electrocardiographic findings, access to medical care, or other variables.[22] Sudden death and death from coronary heart disease were more common in low than in high social classes in Norway.[23] Alcohol intake was not taken into account in either study, however, so we cannot exclude the possibility that poor education and low social class may have substituted for alcohol abuse. In our study non-attendance at the screening examinations was no longer a risk factor for sudden death when registration at the Temperance Board was taken into account.

The pattern of the classical risk factors in the sudden death group and the group with non-fatal myocardial infarction was strikingly similar. In the Framingham study the pattern of risk factors for sudden death was very much the same as for ischaemic heart disease.[24] In our study the only factors discriminating between the sudden death group and the group with non-fatal myocardial

infarction were the two types of registration. The relative unimportance of the classical risk factors may have been due to the active treatment of hypertension and hyperlipidaemia in this population. Very few of the sudden deaths, however, occurred in men in the treatment groups. Our findings agree with other epidemiological studies suggesting that sudden death is more likely among alcoholics who suffer myocardial infarction.[25] Alcohol abuse may cause intracellular electrolyte disturbances[25] which may result in cardiac arrhythmias[26] and may explain why sudden deaths occur even in subjects without severe narrowing of the coronary arteries.[27]

Our results show that among middle aged men a large proportion of sudden deaths occur in those with known alcohol intemperance. This was the main factor discriminating this group from survivors of myocardial infarction. It has been suggested that the key to preventing sudden death may be reduction of the risk of coronary heart disease.[24] Our data show that preventing alcohol abuse is an essential part of that strategy.

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Correction

What are health authorities doing about the health problems caused by unemployment?

An error occurred in this paper by Christiane Harris and Richard Smith (25 April, p 1076). The percentages on lines 8 and 9 of the introduction were transposed and should have read: "Those who are threatened with losing their jobs consult their general practitioner 20% more often than controls who are in work and are referred 60% more often for hospital outpatient appointments."