There is considerable evidence that light-to-moderate alcohol consumption is associated with a reduced incidence of major coronary heart disease (CHD) events compared to non-drinkers\(^1,2\) although it is not necessarily associated with a reduced all cause mortality.\(^1,3\) A U-shaped relationship between alcohol and all cause mortality has been observed in the majority of studies\(^1,3\) and although some have found little or no difference in outcome between non-drinkers as a group and light-to-moderate drinkers when pre-existing disease has been taken into account,\(^4-6\) in others the increased mortality in non-drinkers has persisted.\(^7\) Non-drinkers are a heterogeneous group comprising both lifelong teetotallers and ex-drinkers. The mortality experience in these two groups may differ and the proportion of lifelong teetotallers varies considerably between studies. Few studies have separated ex-drinkers from lifelong teetotallers, and when this is done, ex-drinkers almost always show high mortality rates.\(^8-12\) Although some studies have shown increased risk of CHD mortality in lifelong teetotallers,\(^8-12\) the all cause mortality pattern in these subjects differs between studies and there is no consistent evidence that all cause mortality or overall cardiovascular mortality is increased in lifelong teetotallers.\(^8-12\) Earlier reports from the British Regional...
Heart Study showed that non-drinkers (lifelong teetotallers and ex-drinkers combined) had a somewhat higher risk of major CHD events than light or moderate drinkers, even after all men with pre-existing cardiovascular disease has been excluded, but a similar risk of all cause mortality to that of occasional and regular drinkers. Because we have shown that lifelong teetotallers and ex-drinkers in middle-aged British men have markedly different characteristics, the purpose of this paper is to examine the risk of all cause mortality and the incidence of major CHD events separately in these two disparate non-drinking groups compared with occasional and regular drinkers.

SUBJECTS AND METHODS
The British Regional Heart Study (BRHS) is a prospective study of cardiovascular disease involving 7735 men aged 40–59 selected from the age-sex registers of one group general practice in each of 24 towns in England, Wales and Scotland and examined between January 1978 and July 1980. Men with pre-existing cardiovascular disease or on regular medical treatment were not excluded. The overall response rate was 78%. The criteria for selecting the town, the general practice and the subjects as well as the methods of data collection have been reported. The practices selected for study in each town reflected the social class distribution of middle-aged men in that town and the cohort as a whole was representative of the social class distribution of middle-aged men in Great Britain. Research nurses administered to each man a standard questionnaire (Q1) which included questions on smoking habits, alcohol intake and medical history. Several physical measurements were made, and blood samples (non-fasting) were taken for measurement of biochemical and haematological variables. Details of blood lipid and other risk factors. This report is concerned with the incidence of CHD separately in lifelong teetotallers and ex-drinkers. Twenty-five biochemical and haematological measurements on a single blood sample taken at the time the questionnaire was completed by the men in this study indicated that the reported levels of alcohol consumption were valid on a group basis.

Five years later, because we had become aware of the many adverse characteristics of the non-drinking group, the men were asked about their past drinking habits in addition to questions on their current alcohol consumption. Those who said they were non-drinkers at Q5 were asked whether they had been drinkers in the past and if so, what their past alcohol consumption had been. No biochemical/haematological validation was carried out on this occasion. Complete information on alcohol consumption at both Q1 and Q5 was obtained from 7167 men. The men were classified on the basis of their estimated reported weekly intake at Q5:

1. Lifelong teetotaller. Men who were non-drinkers at Q1 and Q5 and who claimed at Q5 that they had never been drinkers. (N = 204)
2. Ex-drinkers. Non-drinkers at Q1 and Q5 who at Q5 reported previous drinking, and non-drinkers at Q5 who were occasional or regular drinkers at Q1. (N = 496)
3. Occasional (<1/week). Those who reported occasional drinking at Q5. (N = 2131)
4. Light (1–15 units/week). Weekend 1–2, 3–6 and daily 1–2 at Q5. (N = 2662)
5. Moderate (16–42 units/week). Daily 3–6 and weekend >6 at Q5. (N = 1380)
6. Heavy (>42 units/week). Daily >6 drinks/day at Q5. (N = 294)

Occasional drinkers are used as the reference group in this study, as the non-drinking groups are under specific scrutiny, and as it is the most stable of the drinking categories over the 5-year period preceding follow-up.
Confounding Variables

Smoking. From the combined information at screening and 5 years later the men were classified as those who had never smoked, ex-smokers at both Q1 and Q5, ex-smokers at Q5 only and three groups of current cigarette smokers at Q5 (1–19, 20 and ≥21/day).

Social class. The longest held occupation of each man was recorded at screening and the men were grouped into one of six social classes: I, II, III non-manual, and III manual, IV and V (manual). Those whose longest occupation was in the Armed Forces formed a separate group.

Body mass index (BMI). At Q5 the men were asked to state their weight and body mass index (BMI = weight/height$^2$) was calculated (kg/m$^2$) for each man based on their reported weight and on measured height at initial screening. Obese is defined as BMI ≥28 kg/m$^2$ which represents the top quintile of the BMI distribution in these men.

Physical activity. A physical activity score was derived for each man based on frequency and type of activity in leisure time reported at initial screening. The men were grouped into six broad categories based on their total score: inactive, occasional, light, moderate, moderately-vigorous and vigorous. Adjustment for physical activity is based on data at screening. Active is defined as those who were engaged in at least moderate levels of physical activity.

Pre-existing Disease and Medication

Doctor diagnoses. At both the initial screening (Q1) and 5 years later (Q5) men were asked whether a doctor had ever told them that they had angina or myocardial infarction (heart attack, coronary thrombosis), stroke, diabetes and a number of other disorders.

Angina. The prevalence of angina at Q5 was assessed by the WHO (Rose) standardized chest pain questionnaire. Men with angina consisted of men with possible or definite angina grade I or II on questionnaire.

Medication. The men were asked for details of any regular medication both initially (Q1) and 5 years later (Q5) and information was obtained on a number of specific treatments.

Follow-up

All men, whether or not they had evidence of CHD at initial examination, were followed up for all cause mortality and for cardiovascular morbidity from the initial screening in 1978–1980. All major CHD events (myocardial infarction, sudden cardiac death) and all deaths occurring in the period up to December 1993 have been recorded and follow-up has been achieved for 99% of the cohort. However, this report is concerned only with the men who completed the fifth-year questionnaire and thus mortality and morbidity follow-up since the fifth-year questionnaire is presented, a mean follow-up period of 9.8 years (range 8.5–11.0 years).

Confounding Variables

Statistical Methods

The Cox proportional hazards model was used to assess the independent contributions of alcohol intake to the risk of mortality and major CHD events and to obtain the relative risks (RR) adjusted for age and the other risk factors. Alcohol (six levels) was fitted as a categorical variable. In the adjustment age and BMI were fitted as continuous variables. Smoking (six levels), physical activity (six levels), social class (seven groups), recall of diabetes (yes/no), recall of CHD (yes/no), recall of stroke (yes/no), angina on WHO (Rose) questionnaire (yes/no), regular medication (yes/no) were fitted as categorical variables. Direct standardization was used to obtain age-adjusted rates per 1000 person-years using the study population as the standard.
RESULTS
During the mean follow-up time of 9.8 years after the fifth-year questionnaire there were 929 deaths from all causes (472 cardiovascular and 457 non-cardiovascular causes) and 490 major CHD events (210 fatal and 280 non-fatal heart attacks).

Alcohol Intake and Mortality
Figure 1 shows the age-adjusted rates/1000 person-years for all cause mortality, cardiovascular and non-cardiovascular mortality and Table 1 shows the age-adjusted RR using occasional drinkers as the reference group. All cause mortality was highest in the ex-drinkers followed by lifelong teetotallers, who had only slightly higher mortality than occasional drinkers. There was no significant difference in all cause mortality risk between occasional and regular drinkers—light, moderate or heavy. When deaths were separated into cardiovascular and non-cardiovascular causes, ex-drinkers showed increased risk of both cardiovascular and non-cardiovascular mortality compared to occasional drinkers. Lifelong teetotallers had the lowest risk of cardiovascular mortality and showed a significant increase in non-cardiovascular deaths which accounted for their slightly increased total mortality risk. Separate analysis for CHD mortality revealed the lowest risk in lifelong teetotallers (data not shown). Light drinkers showed a significantly lower risk of cardiovascular mortality than occasional drinkers. For non-cardiovascular mortality, no significant difference was seen between occasional drinkers and any regular drinking category.

Confounding Factors and Pre-existing Disease
We have previously shown that lifelong teetotallers have baseline (Q1) risk factor characteristics which differ

TABLE 1 Adjusted relative risk of all cause mortality by drinking behaviour at Q5

<table>
<thead>
<tr>
<th></th>
<th>Lifelong teetotaller (204)</th>
<th>Ex-drinker (496)</th>
<th>Occasional (2131)</th>
<th>Light (2662)</th>
<th>Moderate (1380)</th>
<th>Heavy (294)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cause (n = 929)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Age-adjusted</td>
<td>1.17</td>
<td>1.41</td>
<td>1.00</td>
<td>0.89</td>
<td>1.09</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>(0.81–1.66)</td>
<td>(1.11–1.77)</td>
<td>(0.76–1.05)</td>
<td>(0.91–1.31)</td>
<td>(0.62–1.32)</td>
<td></td>
</tr>
<tr>
<td>Adjusted</td>
<td>1.08</td>
<td>1.05</td>
<td>1.00</td>
<td>0.92</td>
<td>1.03</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>(0.75–1.57)</td>
<td>(0.83–1.35)</td>
<td>(0.77–1.08)</td>
<td>(0.86–1.26)</td>
<td>(0.53–1.18)</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular (n = 472)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age-adjusted</td>
<td>0.68</td>
<td>1.43</td>
<td>1.00</td>
<td>0.77</td>
<td>0.96</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>(0.37–1.26)</td>
<td>(1.04–1.95)</td>
<td>(0.62–0.97)</td>
<td>(0.74–1.25)</td>
<td>(0.47–1.34)</td>
<td></td>
</tr>
<tr>
<td>Adjusted</td>
<td>0.59</td>
<td>1.07</td>
<td>1.00</td>
<td>0.82</td>
<td>0.95</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>(0.31–1.14)</td>
<td>(0.78–1.48)</td>
<td>(0.64–1.04)</td>
<td>(0.73–1.24)</td>
<td>(0.42–1.26)</td>
<td></td>
</tr>
<tr>
<td>Non-cardiovascular (n = 457)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age-adjusted</td>
<td>1.77</td>
<td>1.38</td>
<td>1.00</td>
<td>1.04</td>
<td>1.25</td>
<td>1.01</td>
</tr>
<tr>
<td></td>
<td>(1.13–2.76)</td>
<td>(0.97–1.96)</td>
<td>(0.82–1.32)</td>
<td>(0.96–1.64)</td>
<td>(0.59–1.72)</td>
<td></td>
</tr>
<tr>
<td>Adjusted</td>
<td>1.73</td>
<td>1.02</td>
<td>1.00</td>
<td>1.03</td>
<td>1.16</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>(1.09–2.74)</td>
<td>(0.70–1.50)</td>
<td>(0.81–1.32)</td>
<td>(0.88–1.53)</td>
<td>(0.50–1.51)</td>
<td></td>
</tr>
</tbody>
</table>

* Adjusted for age, social class, physical activity at screening, smoking status at Q5, BMI at Q5, IHD/stroke (recall/GP records up to Q5), recall of diabetes (Q1/Q5), angina (Q5) and regular medication (Q5).
from those of ex-drinkers, although the two groups are usually combined as non-drinkers. In the present study, the data in Table 2 refer predominantly to characteristics present at Q5, the point from which the incidence of CHD events and mortality are determined. Physical activity, systolic blood pressure, total cholesterol and high density lipoprotein (HDL) cholesterol were only measured at the initial screening. Alcohol intake is strongly associated with all the characteristics displayed (Table 2). Ex-drinkers were older, predominantly manual workers, the least physically activity in leisure time and had the lowest rates of never smoked. They had the highest rates of recall of diabetes, CHD, regular medication, poor/fair health and angina on WHO (Rose) questionnaire. Lifelong teetotallers had slightly higher rates of recall of doctor diagnosed CHD and stroke, of regular medication and of self-assessed poor/fair perception of health than occasional or regular drinkers. They also tended to have the lowest levels of cardiovascular risk factors. Light drinkers had a very advantageous pattern of characteristics compared to occasional or regular drinkers i.e. fewer manual workers, less current smoking and obesity, more physical activity in leisure time and the lowest rates of regular medication and self-assessed poor/fair perception of health.

Adjustment for Confounding Factors and Pre-existing Cardiovascular Disease

We have examined the alcohol-mortality relationships adjusting for factors shown to be associated with alcohol intake and which may influence the association between alcohol intake and mortality, in particular—smoking, social class, physical activity, BMI, angina on WHO questionnaire, recall of CHD/stroke or GP diagnosis of non-fatal myocardial infarction/stroke up to Q5, diabetes and regular medication (Table 1). No adjustments were made for biological factors e.g. blood lipids or blood pressure, as these may be the pathways by which alcohol exerts an effect on mortality. Evidence of pre-existing CHD was included in the adjustment as it has been established as a major reason for alteration in alcohol intake. Adjustment markedly attenuated the increased risk of all cause mortality in ex-drinkers and the increased risk was no longer significantly different from occasional drinkers and was similar to lifelong teetotallers. There was now no significant difference in all cause mortality risk between non-drinkers, occasional drinkers and regular drinkers. Cardiovascular mortality was lowest in lifelong teetotallers and there was no significant difference in overall cardiovascular mortality between the other alcohol groups after adjustment. The increased risk of both cardiovascular and

---

**Table 2 Characteristics of drinking groups**

<table>
<thead>
<tr>
<th></th>
<th>TTa (204)</th>
<th>Ex (496)</th>
<th>Occasional (2131)</th>
<th>Light (2662)</th>
<th>Moderate (1380)</th>
<th>Heavy (294)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>56.5</td>
<td>56.6</td>
<td>55.1</td>
<td>55.1</td>
<td>54.6</td>
<td>53.9</td>
</tr>
<tr>
<td>% current smoking</td>
<td>22.1</td>
<td>38.9</td>
<td>31.1</td>
<td>27.5</td>
<td>38.0</td>
<td>48.0</td>
</tr>
<tr>
<td>% never smoked</td>
<td>44.6</td>
<td>19.8</td>
<td>27.3</td>
<td>26.3</td>
<td>16.1</td>
<td>12.6</td>
</tr>
<tr>
<td>% manual</td>
<td>65.3</td>
<td>73.3</td>
<td>58.6</td>
<td>53.3</td>
<td>61.1</td>
<td>62.7</td>
</tr>
<tr>
<td>% active</td>
<td>35.5</td>
<td>29.2</td>
<td>35.6</td>
<td>43.0</td>
<td>36.1</td>
<td>35.3</td>
</tr>
<tr>
<td>% obese</td>
<td>20.6</td>
<td>18.9</td>
<td>19.9</td>
<td>20.1</td>
<td>25.8</td>
<td>24.2</td>
</tr>
<tr>
<td>SBPb (mmHg)</td>
<td>143.4</td>
<td>146.4</td>
<td>144.3</td>
<td>144.9</td>
<td>146.8</td>
<td>148.2</td>
</tr>
<tr>
<td>Cholesterol (mmol/l)</td>
<td>6.20</td>
<td>6.24</td>
<td>6.32</td>
<td>6.30</td>
<td>6.31</td>
<td>6.34</td>
</tr>
<tr>
<td>HDLc (mmol/l)</td>
<td>1.08</td>
<td>1.07</td>
<td>1.09</td>
<td>1.16</td>
<td>1.23</td>
<td>1.27</td>
</tr>
<tr>
<td>% diabetes</td>
<td>2.5</td>
<td>5.0</td>
<td>2.9</td>
<td>2.0</td>
<td>1.5</td>
<td>2.4</td>
</tr>
<tr>
<td>% recall IHDd</td>
<td>9.8</td>
<td>14.9</td>
<td>8.5</td>
<td>8.1</td>
<td>7.0</td>
<td>5.8</td>
</tr>
<tr>
<td>% stroke</td>
<td>2.5</td>
<td>3.8</td>
<td>1.6</td>
<td>0.9</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>% poor/fair health</td>
<td>27.9</td>
<td>39.3</td>
<td>22.5</td>
<td>19.0</td>
<td>23.1</td>
<td>28.9</td>
</tr>
<tr>
<td>% angina (Q)e</td>
<td>12.8</td>
<td>16.9</td>
<td>9.0</td>
<td>10.1</td>
<td>11.2</td>
<td>9.2</td>
</tr>
</tbody>
</table>

a Teetotaller.
b Systolic blood pressure.
c High density lipoprotein.
d Ischaemic heart disease.
e On Rose questionnaire.
non-cardiovascular mortality in ex-drinkers was considerably attenuated. Lifelong teetotallers still showed a significant increase in risk of non-cardiovascular deaths compared to occasional drinkers but there was no significant difference in non-cardiovascular mortality rates between the other alcohol categories. When non-cardiovascular deaths were separated into cancer (n = 327) and other non-cardiovascular causes (n = 130), lifelong teetotallers showed the highest risk for both cancer and other non-cardiovascular causes (lifelong teetotallers versus occasional drinkers: adjusted RR for cancer and other non-cardiovascular causes were 1.62 [95% CI: 0.9–2.9] and 2.05 [95% CI: 0.94–4.48] respectively).

Exclusion of men with a recall of a doctor diagnosis of CHD or stroke at Q1 or Q5 and those who had suffered a major non-fatal stroke or myocardial infarction event prior to Q5 based on the surveillance of GP’s records including all hospital reports and correspondence (n = 728 men), made only minor differences to the relationships seen.

**Alcohol Intake and Major Coronary Heart Disease Events**

We have also examined the relationship between alcohol intake and risk of major CHD events during follow-up from Q5, excluding the 728 men with a history of CHD/stroke up to and including Q5. Table 3 shows the age-adjusted rates/1000 person-years and the adjusted RR for major CHD events by the six alcohol categories using occasional drinkers as the reference group. The highest rates of major CHD events are seen in lifelong teetotallers and ex-drinkers and the lowest rates in light drinkers. The increased age-adjusted RR in each of the non-drinking categories was not significantly higher than occasional drinkers but they were significantly higher than in regular drinkers. All regular drinkers combined showed significantly lower risk than occasional drinkers (RR = 0.80, 95% CI: 0.67–0.96; P = 0.04) and significantly lower risk than ex-drinkers and lifelong abstainers combined (RR = 0.64, 95% CI: 0.49–0.85; P = 0.0008). Further adjustment for the potential confounders made little difference to the increased risk in lifelong teetotallers and reduced the risk in ex-drinkers and in regular drinkers. After adjustment, all regular drinkers (combined) showed significantly lower risk than occasional drinkers (RR = 0.78, 95% CI: 0.64–0.96) and all non-drinkers (RR = 0.69, 95% CI: 0.52–0.91).

Viewed in absolute terms, regular drinking (combined) was associated at most with about two fewer major CHD events/1000 person-years than occasional drinkers and about three fewer events/1000 person-years than non-drinkers.

**DISCUSSION**

The purpose of this study has been to determine the risk of mortality (all causes, cardiovascular and non-cardiovascular) and the incidence of major CHD events in lifelong teetotallers and in ex-drinkers compared with occasional and regular drinkers. These two categories of non-drinkers have been separated as it has become clear that they had different characteristics and as the reason for their non-drinking were likely to be different. As non-drinkers are the standard group against which drinking groups are compared when assessing the clinical outcome of drinking, it seemed important to clarify whether lifelong teetotallers and ex-drinkers had similar outcomes in term of mortality and the incidence.
of major CHD events. The lifelong teetotallers, who constitute only 3% of the cohort, showed slightly higher all cause mortality rates than occasional and regular drinkers even after adjustment for age and other confounding variables, largely due to a significant but inadequately explained increase in non-cardiovascular mortality. Their cardiovascular mortality was low (although not significantly so) compared to occasional or regular drinkers, despite an increased incidence of CHD events. Ex-drinkers showed the highest mortality for all causes, cardiovascular and non-cardiovascular causes but this was largely due to their higher levels of cardiovascular risk factors and the presence of pre-existing disease. There was no significant difference in all cause mortality, cardiovascular or non-cardiovascular mortality between occasional and regular drinkers.

In men free of a history of CHD and stroke, the highest risk for major CHD events was seen in lifelong teetotallers and ex-drinkers. All regular drinkers showed significantly lower risk of major CHD events than occasional drinkers and significantly lower risk than all non-drinkers combined even after adjustment for possible confounding factors. Within the regular drinking categories, no dose-response relationship was observed. Having acknowledged this apparent protective effect of regular drinking on the risk of major CHD events, the burden of further discussion will be concerned with the patterns of risk observed in the two non-drinking groups, lifelong teetotallers and ex-drinkers.

**Other Prospective Studies**

The proportion of lifelong teetotallers varies considerably between studies, from 3% in the present study to 7.2% in the Kaiser Permanente Study, 10 17% in Japanese physicians 9 and in US adults in the National Mortality Study 25 and 36% in the Honolulu Study of Japanese-Americans. 26 Few studies have examined the mortality experience of lifelong teetotallers and ex-drinkers separately, and in the ones that have done so the findings are inconsistent, although most find an increased mortality in ex-drinkers. While some studies report an excess risk of cardiovascular mortality in lifelong teetotallers, others show them to have the lowest rate of cardiovascular mortality. In a study of 129 170 people participating in a health insurance scheme (Kaiser Permanente), lifelong teetotallers (7.2%) had increased mortality from cardiovascular and CHD deaths but not from non-cardiovascular deaths. Total mortality was only slightly higher than occasional or light drinkers (RR = 1.1). 10 In a study of Japanese physicians, lifelong teetotallers had low rates of cardiovascular mortality but death from CHD slightly higher than in light drinkers. 9 In the Tecumseh study, lifelong teetotallers had low rates of cardiovascular mortality. 27

**Teetotal Societies**

In the US, lower mortality from both cancer and cardiovascular causes has been reported in Seventh-day Adventists and Mormons than the general US population. 28,29 In a study of about 4000 Seventh-day Adventists in the Netherlands, total mortality and deaths from cancer and cardiovascular causes were also reported to be lower than the Dutch population. 30 Smoking rates in these groups are very low and it was suggested that smoking may account for the lower rates seen. However, active Mormons have been shown to have lower standardized mortality ratios for cancer, cardiovascular and for all causes than religious non-Mormon non-smokers in whom a large proportion were drinkers. 31 In a study of Norwegian teetotallers, cancer mortality was lower than in the total Norwegian population. 32 Lifelong teetotallers in the present study also had relatively low rates of current smoking but total mortality was slightly higher than in occasional and regular drinkers, and non-cardiovascular mortality was significantly higher than the rest of the study population for both cancer and other non-cardiovascular causes.

In a society where drinking is the ‘norm’, the reasons for being a lifelong teetotaller and the associated characteristics are essential to understanding the mortality patterns of these people. The reasons for being a teetotaller may be determined by genetic, environmental, social, religious or health conditions. The characteristics of teetotallers may well differ between studies and between societies where drinking patterns tend to differ. In societies where abstention is the ‘norm’ mortality is relatively low.

**Occasional and Regular Drinking**

Although regular drinkers (light, moderate, heavy) showed significantly lower risk of major CHD events than occasional drinkers and non-drinkers, which is consistent with the contention that alcohol decreases the risk of major CHD events, there was no significant difference in all cause mortality between non-drinkers, occasional drinkers and any of the regular drinking groups. In particular, there was no evidence that light or moderate drinking is beneficial in terms of all cause mortality. This is consistent with our earlier findings using alcohol intake at screening (Q1) based on 9.5 years follow-up. 6 In contrast to our earlier report which showed heavy drinkers at screening to have the highest all cause mortality during follow-up after pre-existing disease had been taken into account, 6 the lower all cause mortality risk in heavy drinkers in this
study may be due to a ‘selection’ effect i.e. the movement of heavy drinkers (at Q1) who develop ill health into lighter drinking categories by Q5. Only 34% of heavy drinkers at initial screening remained heavy drinkers 5 years later and two-thirds of the ex-heavy drinkers had become moderate drinkers at Q5.\textsuperscript{20} Heavy drinkers at screening who had reduced their intake and were no longer heavy drinkers at Q5 were older and more likely to have developed cardiovascular or other disease diagnoses and to have started regular medication between screening and Q5 than those who remained heavy drinkers. The lack of benefit for total mortality in light or moderate drinkers (Q5) is not due to the inclusion of ex-heavy drinkers at Q5 i.e. heavy drinkers at Q1 who had moved into these groups at Q5, as their exclusion from the occasional, light and moderate drinking groups at Q5 did not make major differences to the mortality patterns seen.

**Use of Non-drinkers as Baseline Comparison**

Since Pearl first showed a shallow U-shaped mortality curve\textsuperscript{33} in relation to alcohol consumption it has been customary to use non-drinkers as the baseline against which the effects of alcohol on health and disease have been determined. Although attention has been drawn for over 20 years to the possibility that the increased risk in non-drinkers may be due to the increased risk in ex-drinkers,\textsuperscript{34} it is only in recent years that attempts have been made to take account of the characteristics of the various drinking categories.\textsuperscript{3,6,7,10,35,36} With few exceptions, non-drinkers remain the baseline category although various statistical adjustments have been made to eliminate the effects of differences in the prevalence of risk factors and pre-existing disease in the various alcohol intake categories. There is considerable evidence that ex-drinkers have characteristics which increase their risk of total, cardiovascular and non-cardiovascular mortality. In this study we have shown that lifelong teetotallers have an inadequately explained increased risk of non-cardiovascular mortality. Although they have slightly higher rates of recall of doctor diagnosis of CHD, stroke and regular medication and of self-assessed poor/fair perception of health, they also tended to have the lowest levels of cardiovascular risk factors. In a recent report from this study, teetotallers were also shown to have an increased risk of stroke, whereas ex-drinkers showed similar risk of stroke to light and moderate drinkers after adjustment and there was no evidence that light to moderate drinking was beneficial for stroke compared to occasional drinking.\textsuperscript{37} For all these reasons, non-drinkers are unsuitable as a baseline group in studies of the effects of alcohol on death or disease. Lifelong teetotallers are also unsuitable as a baseline, both because their proportion is usually small in most populations and because they have undefined characteristics which affect their mortality and morbidity patterns as observed in this study.

**CONCLUSION**

The significantly lower RR of major CHD events in regular drinkers compared with occasional or non-drinkers supports other findings that alcohol has a protective effect on major CHD events. As in most other studies, no dose-response relationship was observed within the regular drinking categories. The absolute benefit relating to the incidence of major CHD events which might result from all non-drinkers or occasional drinkers becoming regular drinkers is small. We observed a similar increased risk of major CHD events in both lifelong teetotallers and ex-drinkers compared with regular drinkers, even after adjustment for confounding factors and pre-existing cardiovascular disease. However, lifelong teetotallers have the lowest risk of overall cardiovascular mortality and an inadequately explained increased risk of non-cardiovascular mortality. The increased risk of mortality in ex-drinkers is almost entirely explained by their risk factor status and their pre-existing disease. There was no significant difference in total mortality between occasional and regular drinkers. The use of non-drinkers (unspecified) or lifelong teetotallers as a baseline in studying the effects of alcohol on health and disease may lead to an exaggeration of the benefits of alcohol and we suggest that occasional or even light drinkers may provide a more acceptable reference group. Overall there is no convincing evidence that consumption of alcohol has a protective effect on all cause mortality or overall cardiovascular mortality in this representative cohort of middle-aged British men.

**ACKNOWLEDGEMENTS**

The British Regional Heart Study is a British Heart Foundation Research Group and receives support from The Stroke Association. SGW is a British Heart Foundation Research Fellow.

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(Revised version received December 1996)