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ORIGINAL ARTICLE

Mid-life alcohol consumption and survival to age 90 in men: The Tromsø Study 1979–1980 with follow-up to 2019

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Abstract

Aims: The Tromsø Study 1979–1980 collected information on alcohol (beer, wine and spirits) consumption frequency and inebriation frequency, and the oldest male participants (aged 50–54 years) were followed for all-cause mortality. This study aimed to identify the impact of habitual alcohol consumption in mid-life on reaching up to 90 years of age. *Results:* Among the study sample of 778, a total of 120 (15.4%) men reached the age of 90. The most common reported alcohol consumption frequency was 'never or a few times a year', and 18.9% of those in this group reached 90 compared with 11.9% of those who reported a more frequent beer consumption. Fifty per cent survival in these groups was 80.5 and 76.9 years, respectively. The pattern was similar for spirits consumption and for inebriation but not for wine consumption. Number of deaths increased gradually with increasing beer and spirits consumption frequency and with inebriation frequency. We observed no J-shape or pattern that revealed a beneficial influence of light alcohol consumption. Daily smoking, physical inactivity, marital status, blood pressure and total cholesterol reduced the contribution of alcohol consumption to a small degree. ***Conclusions:*** **This study shows that all beer and spirits consumption frequencies in mid-life affect later life and total lifespan. Refraining from alcohol consumption or drinking only a few times a year increases one's chances of living longer, and the chance of reaching 90 years of age is 1.6-fold higher than in those with more frequent alcohol consumption.**

Keywords: *Alcohol, mortality, longevity, epidemiology*

Introduction

Many more of us are living longer, and healthy ageing and reaching longevity have become the object of much research and media attention. Studies on the impact of various behavioural risk factors at different points in life have shown that risk factors in mid-life are associated with survival to advanced ages [1,2]. Heavy alcohol consumption is among the many lifestyle factors, including cigarette smoking, physical inactivity and unhealthy diet, that have been identified to contribute to a reduced life expectancy [3].

A systematic review of behavioural risk factors in mid-life stated, 'Evidence was mixed for association between alcohol consumption and all-cause mortality' [4]. Whereas heavy alcohol consumption is undoubtedly associated with substantial excess mortality, the association between light-to-moderate alcohol consumption and all-cause mortality has been a subject of research and debate for decades [5]. Moreover, new methodologies, including improvements in assessing causality in observational studies, are raising doubts about the protective effect of moderate alcohol drinking on health [6,7]. The type of alcoholic beverage that confers this effect is also a controversy, with wine possibly being more favourable than beer and spirits [8].

Few studies have been carried out on alcohol use and longevity. The Tromsø Study is a health survey of the general population, and the survey in 1979–1980 collected information on alcohol consumption frequency. A cross-sectional analysis of these data found favourable effects of alcohol on coronary risk factors,

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especially in women and for wine [9]. The oldest male participants in the Tromsø Study 1979–1980 were 50–54 years of age at the time of the survey [10] and have now had the chance to reach the age of 90 years, providing a rare possibility to study alcohol consumption in mid-life with follow-up to such an age. Moreover, the Tromsø Study includes a variety of potential confounders necessary to analyse the association between alcohol consumption and survival. Thus, the present study aimed to identify the impact of habitual alcohol consumption in mid-life on reaching up to 90 years of age.

Methods

Study population

The Tromsø Study 1979–1980 included a total of 8477 men aged 20–54 years, and the present analysis comprised the participants born between 1925 and 1929 (aged 50–54 years at the time of the study). All 1085 men in this age group living in Tromsø were invited, and 924 attended (attendance rate 85.2%). We excluded five men who withdrew their consent to research and 141 with missing value on the teetotaller question, resulting in a study sample of 778 and a response rate of 71.7%. During follow-up, one man emigrated, and his data were censored at the age of emigration.

Measurements

All participants completed a first, self-administered questionnaire and attended a clinical examination. After the examination, they were given a second questionnaire to fill in at home and return by mail. The first questionnaire included questions on smoking status, physical activity and marital status. Participants reported smoking status as daily smoking (yes or no). Physical activity during leisure time was reported on a four-level ordinal scale (1=inactive, i.e. reading, watching TV or other sedentary activity; 2=walking, cycling or other forms of exercise at least four hours a week, including walking or cycling to place of work, Sunday walk/stroll, etc.; 3 and 4=more rigorous activities), and marital status was reported as single, married, widow/widower or separated/divorced. In the present analysis, physical activity was categorised as physically inactive (level 1) and physically active (levels 2–4), and marital status as married or unmarried (all other categories than married). During the clinical examination, trained staff recorded height, weight and blood pressure (measured by Dinamap), and collected a non-fasting venous blood sample, which was analysed for blood lipids (e.g. total cholesterol) [10].

The second questionnaire collected information on alcohol consumption using five questions. The first question asked if the participant was teetotal. If so, the participant was asked to answer no further questions on alcohol consumption; if not, they proceeded to the other four questions. The second to fourth questions asked how often the participant consumed beer, wine and spirits, respectively (never or a few times a year, 1–2 a month, about once a week, 2–3 times a week, about daily). Finally, the fifth question asked roughly how often during the past 12 months participants had drunk so much beer, wine or spirits that they became inebriated (never or not during the last year, a few times a year, 1–2 a month, 1–2 a week, 3 or more times a week).

Follow-up

Follow-up for death and emigration to 31 December 2019 was performed through linkage to the Population Register of Norway using the national 11-digit unique personal identification number. Date of birth, date of survey attendance, date of emigration from Norway and all-cause deaths were recorded. End of follow-up was defined as date of death, date of emigration from Norway or date at which the participant reached 90 years of age, whichever came first.

Statistical analysis

Percentage survival to age 90 years was computed as the number of survivors to that age divided by the total number of participants. In addition to descriptive statistics, survival analyses were performed with attained age as the time variable. Kaplan–Meier plots were used to display survival curves according to the five alcohol variables (teetotal, beer consumption frequency, wine consumption frequency, spirits consumption frequency and inebriation frequency). Differences in survival across consumption frequencies was analysed with the log-rank test with p-values reported. Cox's proportional hazards regression method providing hazard ratios (HRs) with 95% confidence intervals (CIs) was used to assess the univariate effect of each included variable and in multiple analyses of the alcohol variables adjusted for daily smoking, physical inactivity, being unmarried, blood pressure and total cholesterol as well as interaction terms. The alcohol variables were analysed as ordinal variables with values 1–5 (1–4 for wine) with increasing frequency and also as dummy variable providing HRs for each frequency category.

All variables included to adjust the alcohol variables reached the 5% level for statistical significance on survival. The hypothesis of proportional hazards was not rejected by statistical tests. Among those who answered

Table I. Baseline characteristics for the Tromsø Study 1979–1980 for all men in the study sample, men still alive at 90 years of age and men who died before reaching the age of 90.

Baseline characteristics	**All**	**Alive at 90 years**	
	(*N*=777[a,b])	**Yes (*N*=120[a])**	**No (*N*=657[a])**
Age (years), mean (range)	52.0 (50–54)	52.1 (50–54)	52.0 (50–54)
Teetotal, %	9.7	11.7	9.3
Beer consumption frequency, %			
Never or a few times a year	47.4	58.7	45.3
1–2 a month	24.7	22.9	25.0
About once a week	18.2	11.9	19.4
2–3 times a week	7.7	5.5	8.1
About daily	2.1	0.9	2.3
Wine consumption frequency, %			
Never or a few times a year	75.8	71.0	76.6
1–2 a month	14.2	17.8	13.5
About once a week	8.5	9.4	8.3
2–3 times a week	1.6	1.9	1.6
About daily[c]	–	–	–
Spirits consumption frequency, %			
Never or a few times a year	35.7	42.3	34.4
1–2 a month	34.3	30.6	34.9
About once a week	21.5	20.7	21.7
2–3 times a week	6.9	6.3	7.0
About daily	1.7	0.0	2.0
Inebriation frequency, %			
Never or not during last year	34.9	41.7	33.6
A few times a year	48.2	47.0	48.4
1–2 a month	13.1	7.8	14.1
1–2 a week or more[d]	3.8	3.5	3.9
Daily smoking, %	54.1	29.2	58.6
Physically inactive, %	22.2	14.2	23.7
Unmarried, %	17.9	11.7	19.0
Systolic blood pressure (mmHg), mean (*SD*)	136.9 (17.7)	131.7 (14.6)	137.9 (18.1)
Total cholesterol (mmol/L), mean (*SD*)	6.81 (1.15)	6.63 (1.29)	6.85 (1.12)

[a]Except for those who were teetotal, the number is smaller (see Table II).

[b]One man emigrated during follow-up, and his potential survival to the age of 90 is unknown.

[c]No participant reported drinking wine about daily.

[d]There were four men in the consumption frequency category of '3 or more a week', and they are combined with those in the category '1–2 times a week'.

the question about being teetotal (*n*=778), 15.4% reached the age of 90 years compared with 15.6% among those not answering the question (22/141), which indicates no substantial selection bias between these two groups.

We used SAS v9.4 (SAS Institute, Cary, NC) and R (The R Foundation for Statistical Computing, Vienna, Austria) for data management and analyses.

Ethics

The Regional Committee of Research Ethics (REK Nord) approved the study from 4 December 2020 lasting until 30 September 2022 with reference number 185505.

Results

The most common reported beer, wine and spirits consumption frequencies were 'never or a few times a year' (47.4%, 75.8% and 35.7%, respectively). A total of 120 participants (15.4%) reached the age of 90, 58.7% of whom reported a beer consumption frequency of 'never or a few times a year' compared with 45.3% in this drinking category who died before the age of 90. This pattern changed with more frequent beer consumption, and death before the age of 90 was more common in the highest frequency categories of spirits and inebriation too. However, among those who reported a wine consumption frequency of 'never or a few times a year', fewer men survived to the age of 90 than died before that age. Smoking, physical inactive, unmarried, blood pressure and total cholesterol had a substantial influence on survival; 29.2% of the men still alive at the age of 90 reported daily smoking in 1979–1980 compared with 58.6% among those who died before the age of 90 (Table I).

We observed little difference in survival curves between those who were teetotal and those who were not. However, there was a statistically significant difference between frequency categories of

beer consumption, spirits consumption and inebriation but not between categories of wine consumption. Among those with a beer consumption frequency of 'never or a few times a year', 18.9% reached 90 years of age compared with 11.9% among those with more frequent beer consumption. Fifty percent survival in these two groups was 80.5 and 76.9 years, respectively. Overall, the chance of reaching 90 years of age was highest for those with the lowest alcohol consumption frequency, and that chance decreased gradually with increasing consumption frequency (Figure 1).

As could be expected from the aforementioned results, the HRs of frequencies of beer consumption, spirits consumption and inebriation were statistically significant in the univariate ordinal Cox analyses. In the dummy variables analyses, the HRs increased with increased frequency, and the most frequent consumption had the highest HRs. The adjusted HRs were not much changed. These values with their CIs reflect a linear trend of consumption frequencies on all-cause deaths (Table II).

Additional analyses of the baseline data showed that men who reported spirits consumption and those in the highest inebriation frequency category were more likely to be daily smokers (data not shown). We also included interaction terms between the alcohol variables and daily smoking, but no such terms were significant (spirits consumption and daily smoking p-value=0.65; inebriation and daily smoking p-value=0.45).

In another additional analysis, we included those who were teetotal among the 'never or a few times a year' beer and spirits drinkers. Table II HR values then changed from 1.19 to 1.15, 1.50 to 1.45, 1.36 to 1.32 and 1.85 to 1.78 for beer and from 1.11 to 1.07, 1.10 to 1.06, 1.43 to 1.37 and 1.70 to 1.64 for spirits.

Discussion

The main finding of this study was that men in their early 50s who reported a beer consumption frequency of 'never or a few times a year' had a chance of reaching 90 years of age that was 1.6 times (18.9% vs 11.9%) that of their counterparts with more frequent beer consumption. The survival curves showed increased mortality with higher alcohol consumption as early as 60 years of age. Half of those with the lowest beer consumption frequency reached 80.5 years compared with 76.9 years for the half among the more frequent beer consumers. This difference was 4.9 years for spirits and 5.7 years for inebriation. This study had 41 years of follow-up, and thus shows the unhealthy long-term influences of even modest alcohol consumption in mid-life. The World Health Organization's Global Status Report on Alcohol and Health 2018 presents a comprehensive picture of the harmful effect of alcohol [11]. A recent report estimates, for the average 50-year-old, 0.5 years of aging with a change from zero to one daily alcohol units and 1.7 years of aging with a change from one to two daily alcohol units [12]. The Global Burden of Disease Study 2016 Alcohol Collaborators concluded that the safest level of alcohol consumption is none [13]. Our conclusion for reaching longevity is identical.

Our study had an exceptionally long follow-up period for vital status until the age of 90 years. A Swedish study in which 13% of men reached 90 years of age included information on alcohol-related problems at ages 50 and 60 years, but this alcohol variable was not related to survival [14]. The Helsinki Businessmen Study included men from the upper social class, and 25.2% of the study cohort reached the age of 90. At an average age of 50 years, alcohol consumption (g/week) was significantly higher among those who had not reached 90, but in a multiple regression analysis, the odds for reaching 90 were not significant for alcohol [15]. However, unlike the Swedish study, we used self-reported data on drinking frequencies, and compared to the Finnish study, our sample comprised men from the general population based on the official population registry. These differences may explain why we found a more harmful long-term influence of alcohol.

A J-shaped association between average lifetime alcohol consumption and overall mortality was reported among participants aged 55–74 years who were asked about alcohol use from the age of 18 years and who were followed up for a median of 8.9 years [16]. Another study with a J-shape included participants aged 40–69 at baseline, asked for alcohol use for 10-year periods from the age of 20, and had a mean follow-up of 15 years [17]. A J-shape was also found in the European Prospective Investigation into Cancer and Nutrition, where participants aged 25–70 years at enrolment self-reported alcohol consumption at ages 20, 30, 40 and 50 years and were followed up for 12.6 years on average [18]. Yet another J-shape was found for 68 to 70 year-olds followed to the age of 90 [5]. Those who are teetotal may constitute a mixture of former heavy drinkers, drinkers who underreport, sick people who have stopped drinking and people with a particularly unhealthy lifestyle apart from not drinking. This group may thus distort the relationship between alcohol exposure and the follow-up outcome [7,19]. However, when those who were teetotal were included among those drinking never or a few times a year in our additional analysis, there was still no sign of a J-shape. Our lack of J-shape with gradual increasing mortality

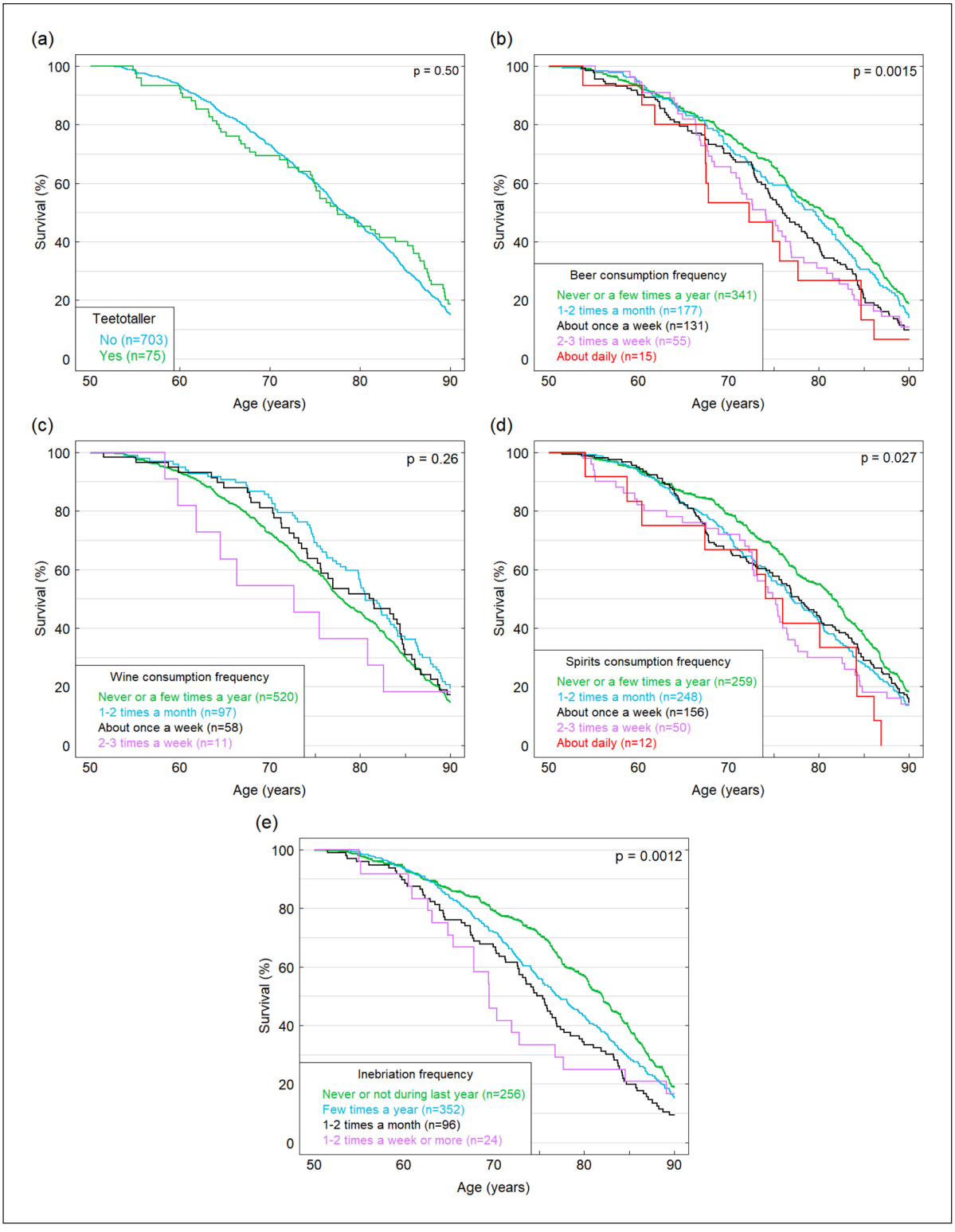

Figure 1. Survival curves with *p*-values of the log-rank test according to alcohol consumption frequencies at the Tromsø Study 1979–1980: (a) being teetotal, (b) beer consumption frequency, (c) wine consumption frequency, (d) spirits consumption frequency and (e) inebriation frequency.

from the least to the most frequent consumption frequencies underlines the harmful effect of all levels of alcohol consumption.

In the Copenhagen City Heart Study, participants aged 30–70 years were followed for 10–12 years. Compared with those who never drank a specific

Table II. Cox regression analysis with hazard ratios (HR) and confidence intervals (CI) of all-cause deaths for men aged 50–54 years in the Tromsø Study 1979–1980 and followed up to 90 years of age.

Baseline characteristics	Number alive at 90	Number dead at 90	Unadjusted HR 95% CI	Adjusted[a] HR 95% CI
Beer consumption frequency				
Ordinal variable coded 1–5, 1 unit	110	609	1.17 1.09–1.26	1.16 1.08–1.25
Dummy variables				
Never or a few times a year	65	276	1 − Reference	1 − Reference
1–2 a month	25	152	1.15 0.94–1.40	1.19 0.97–1.45
About once a week	13	118	1.41 1.14–1.75	1.50 1.21–1.87
2–3 times a week	6	49	1.53 1.13–2.08	1.36 1.00–1.85
About daily	1	14	1.85 1.08–3.16	1.85 1.08–3.18
Wine consumption frequency				
Ordinal variable coded 1–4, 1 unit	108	578	0.94 0.83–1.06	1.01 0.90–1.15
Dummy variables				
Never or a few times a year	77	443	1 − Reference	1 − Reference
1–2 a month	19	78	0.81 0.64–1.03	0.93 0.73–1.19
About once a week	10	48	0.89 0.66–1.20	0.98 0.73–1.33
2–3 times a week	2	9	1.26 0.65–2.44	1.68 0.86–3.27
Spirits consumption frequency				
Ordinal variable coded 1–5, 1 unit	112	613	1.12 1.04–1.21	1.10 1.01–1.19
Dummy variables				
Never or a few times a year	48	211	1 − Reference	1 − Reference
1–2 a month	34	214	1.25 1.04–1.51	1.11 0.92–1.35
About once a week	23	133	1.20 0.96–1.49	1.10 0.88–1.37
2–3 times a week	7	43	1.45 1.05–2.01	1.43 1.03–1.98
About daily	0	12	1.87 1.04–3.35	1.70 0.95–3.06
Inebriation frequency				
Ordinal variable coded 1–4, 1 unit	116	616	1.25 1.13–1.38	1.16 1.04–1.28
Dummy variables				
Never or not during last year	49	207	1 − Reference	1 − Reference
A few times a year	54	298	1.22 1.02–1.45	1.12 0.94–1.34
Once or twice a month	9	87	1.56 1.22–2.01	1.20 0.92–1.56
1–2 a week or more	4	24	1.58 1.00–2.51	1.92 1.63–2.28

[a]Adjusted for daily smoking, physical inactivity, unmarried, systolic blood pressure and total cholesterol.

type of alcohol, the risk of dying for those who drank three to five glasses of wine a day was 0.51 (95% CI 0.32–0.81); it was 1.34 (1.05–1.71) for those who drank three to five drinks of spirits a day, and no trend was seen for beer [8]. The possible mechanisms behind the different effects of the three types of alcohol, especially wine, are still being investigated in observational studies, as well as in experimental and randomised controlled settings [20]. The lack of association between wine consumption and reaching 90 years of age in our study may be partly due to the low frequency of wine consumption among men in Norway in the 1970s [21]. Furthermore, at that time in Norway, subjects with a high level of education were found to drink wine more frequently than men and women with a low level of education [22], and education is a strong protective factor for all-cause mortality [23]. We analysed level of education with all-cause mortality in our data and found no significant association. The reason for this may be due to the old ages of the study sample with reduced access to education during World War II and that the university in Tromsø was established in 1968. Thus, healthy user bias may explain at least some of the beneficial risk factor levels reported in the baseline data [9], as well as the lack of significant associations between wine drinking and longevity in the present study.

Our findings that physical inactivity and being unmarried reduced the chance of reaching 90 years of age are consistent with the unfavourable health effects documented in the literature [3]. Smoking has been reported as the strongest risk factor associated with survival in these men [24], and the association between alcohol and mortality may be confounded by smoking. Moreover, alcohol use has been found to be strongly associated with number of cigarettes smoked per day [25]. Smoking and drinking 15 or more units per week have been found to be the riskiest behaviours related to all-cause mortality [26], and tobacco smoking and alcohol drinking have been reported to have a joint effect on all-cause mortality [27]. Based on the regression analyses that included the insignificant results of alcohol and smoking as interaction terms, we conclude that alcohol is an independent risk factor for death before the age of 90 years.

The sale of alcohol (litres of pure alcohol) in Norway was 5.98 in 1980 and 6.05 in 2019 [28]. Based on these similar values, the survival results of our study

may be relevant today for men 50–54 years of age. From 1995–1997 to 2006–2008, the prevalence of frequent drinking increased from 1.7% to 4.7% among men aged ⩾54 years [29], and between 1994 and 2016, a significant increase of current drinkers among older adults has been reported [30]. We can speculate that the more frequent the alcohol consumption was among the 50 to 54 year-old men in our study, the more frequent was their consumption later in life. If so, the drinking pattern in mid-life is especially important, as it may serve as an indicator of increased use in later life and thereby reduced longevity.

Strengths and limitations

A strength of this study is that it is population based with high attendance and that standardised methods were used. Because a clinical examination was performed at baseline, we have objective measures of blood pressure and lipids, whereas most studies in this field use questionnaire information.

Our study has some limitations. We cannot rule out the possibility of a confounding effect by other exposures that may accompany alcohol drinking. One such example is mental factors, which have been documented to be important for survival [1]. Moreover, measurement errors may be inevitable in the assessment of lifestyle variables, as alcohol consumption frequencies were self-reported and alcohol use is known to be strongly underreported [19]. We had inebriation frequency, but no direct information on units of alcohol consumed. This reduces the value of the study along with the few participants in the highest frequency categories. Finally, another limitation of this study is that we could not include women; the Tromsø Study 1979–1980 included women born from 1930 and thus few of them had had the chance to reach the age of 90.

Conclusions

The present study underlines the harmful association between alcohol consumption and all-cause mortality. We have shown that alcohol consumption in men aged 50–54 years reduces the chance of a long life. Not only did those who reported to drink or be inebriated never or a few times a year live longer, but the chance of reaching 90 years of age was 1.6-fold higher compared with those who drank more frequently.

Declaration of conflicting interests

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