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ORIGINAL PAPER

Severity of alcohol-related problems and mortality: results from a 20-year prospective epidemiological community study

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Abstract There is evidence that high alcohol use is associated with an increase in mortality. Little is known about long-term effects of problematic alcohol consumption in *non-clinical* (*community*) *populations*. The aim of our study was to obtain data on this and related issues in a *representative rural community sample* assessed longitudinally over a period of 20 years. Assessments focused on a baseline survey from 1980 to 1984 and 20-year follow-up from 2001 to 2004. Based on expert interviews and standardized self-rating scales (e.g. MALT; Munich Alcoholism Test), the following three groups were defined (a) *severe alcohol problems*, (b) *moderate alcohol problems*, and (c) *no alcohol problems*. Mortality and hazard rates were analyzed with logistic and Cox regression adjusted for several health risk factors. From an original community sample of 1,465 individuals, 448 were deceased at 20-year follow-up. Participation rates were high. Baseline prevalence according to the MALT was 1.6% for *severe alcohol problems* and 4.0% for *moderate alcohol problems*. Over the 20-year time span, individuals with *severe alcohol problems* had a significantly elevated risk for dying earlier than the group with no alcohol problems (2.4 times higher). Mortality for those with *moderate alcohol problems* at baseline had a non-significantly elevated 20-year mortality risk (1.5 times higher) compared to those with no alcohol problems. Cox survival analyses corroborate these findings from multiple sequential logistic regression analyses. In discussing the mortality risk of persons with alcohol problems, the severity of the alcohol problems must be taken into account.

Keywords Psychiatric epidemiology · Alcoholism · Mortality · Prospective longitudinal community studies

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Introduction

Patterns of risk factors and *mortality* among alcoholics appear to be well examined [1–6]. However, most prospective studies addressed samples selected for pre-defined characteristics such as medical treatment, or type of health services used, and age and gender, thus including one or several selection biases. Finney and Moos [7], for example, reported that, compared to matched community controls, patients receiving inpatient treatment for alcohol problems were almost ten times as likely to have died over a 10-year follow-up period. In another study, middle-aged and older inpatients treated for substance abuse by Department of Veterans Affairs Medical Centers showed a 2.64 times higher than expected overall mortality [8]. Another male sample from a Department of Veterans Affairs Medical Center treated for alcoholism indicated a 2.5 times greater overall mortality than controls after 10–14 years [9]. Late middle-aged individuals recruited from general health service settings, not from alcohol treatment programs, and including a wide range of drinking pattern showed a crude 4-year mortality rate of 8.7% [10].

Little is known about long-term effects of alcohol on all-cause mortality from unselected representative prospective community samples [11]. Very few studies on *representative community samples* addressed the course of alcoholism

and mortality in addicts. In the Lundby study from Sweden, 96 alcoholic men were followed up over 15 years. Ten of 49 'abusers' (20.4%), 7 of 29 'addicts' (24.1%), and 8 of 18 'chronics' (44.4%) had died after 15 years [12]. In the same time span, 18 of 41 new incident alcohol cases (44%; 27% before age 60) compared to 5 of 41 controls (12%) had died (odds ratio = 5.6) [13]. Dawson [11] examined deaths over a 7.5-year period in a representative sample of US adults and found an adjusted mortality hazard rate ratio of 1.65 for very heavy alcohol-dependent drinkers compared to past year abstainers. Another study analyzed data from a representative sample of the non-institutionalized civilian United States population of the first National Health and Nutrition Examination Survey (NHANES I) and found different pattern of relationship between alcohol consumption and all-cause mortality in different age groups [14]. Several studies addressed selected samples from the community. Vaillant studied a sample of college graduates and a core city sample of disadvantaged adolescents over more than 60 years. At age 60, 15% of alcohol abusing college graduates and 25% of alcohol abusers from the core city sample were deceased [15]. At age 70, death rates in the college sample were 58% for alcohol dependents, 28% for alcohol abusers, and 15% for non-alcoholics. In the core city sample, death rates were 54% for alcohol dependents, 37% for alcohol abusers, and 29% for non-alcoholics, indicating an impressive effect of selection bias [16]. In a representative sample of Norwegian military conscripts followed for 40 years, alcohol abusers had a 3.3 times higher mortality risk than non-abusers [17].

Analysis of the mortality rate over 13 years according to lifestyle risk factors in an unselected representative sample from our Upper Bavarian longitudinal community study's first two waves found alcohol consumption of more than 20 g of alcohol per day resulting in a 50% higher mortality rate than in individuals with less alcohol consumption [18]. Similarly, high mortality rates were associated with previously high alcohol consumption e.g. for men either more than 30 g per day or more than 1,000 g per month and for women more than 750 g per month [19, 20].

There were strong and significant associations of alcohol consumption with other health risk behaviors like cigarette smoking and inadequate levels of physical activity [18, 20–23], resulting in a higher risk for mortality. In addition, social determinants like gender, social class, social control, and social integration also demonstrated important associations with alcoholism and all-cause mortality [24, 25]. All these co-occurring risk factors are meaningful factors in a model for identification of more or less pure all-cause mortality for alcoholism.

A general approach to assessing the influence of alcohol on later illness or death is based on amount of alcohol consumed. As recent research points out this approach may suffer from un-precise reporting of the amount of alcohol habitually consumed, especially if abstinence from alcohol is reported [26]. In the light of these methodological findings, we chose an alternative approach. Our definition of subgroups was based not only on the amount of alcohol consumed but also on the symptoms and problems associated with drinking assessed by a standardized special interview and questionnaire giving less emphasis to the sole reporting of amount of alcohol or diagnostic criteria of alcohol abuse or dependence. This approach allows for a much broader spectrum of alcohol-related behaviors and consequences and appears more appropriate for an unselected sample from the community.

The Upper Bavarian representative prospective longitudinal study's third wave assessment offered the unique opportunity to explore the associations of alcoholism, social parameters, and health risks over a very long (20 year) time period within a non-clinical population. We report on mortality risk and premature death within the follow-up period while controlling for social and health influences.

Methods

Sample

The Upper Bavarian Study (UBS) is a longitudinal prospective investigation of mental health in a representative community sample in rural Bavaria started in 1975 [27]. The study population and methods have been described in detail elsewhere [28, 29]. In brief, in 1975 and again 5 years later, random samples were drawn from the community registers in three selected townships in a rural county in Upper Bavaria. The second recruitment constituted a new representative sample of people aged 15 years and older and represented the baseline assessment for the present paper. In this baseline assessment, 1,666 of 1,979 (84.2%) individuals were interviewed. Twenty years later, 448 individuals (26.9% of those interviewed at baseline) of the representative 1980s sample had died. Eighty-nine individuals (5.3%) refused participation, and 70 (4.2%) persons could not be contacted. Forty-two participants (2.5%) had missing data concerning the criteria for alcoholism at baseline or follow-up and were excluded from this study. This resulted in a mortality study sample of $N = 1{,}465$, including 448 deceased individuals and 1,017 still alive at 20-year follow-up.

Design

Data were gathered prospectively from the same individuals during two assessment periods in 1980–1984

(baseline) and 2001–2004 (follow-up). Three subgroups were defined as described below.

Instruments

Alcohol consumption and associated problems were assessed using the Munich Alcoholism Test (MALT) [30]. The MALT is a screening test of alcohol use disorders and consists of a self-rating questionnaire (MALT-S, 24 items) and an expert-interviewer rating scale (MALT-F, 7 items). The MALT-F includes questions on the presence of hazardous alcohol intake (quantity and frequency of alcohol use, 2 items), alcohol-related medical conditions (alcohol-induced hepatopathy, alcoholic polyneuropathy, and delirium tremens, 3 items), foetor alcoholicus at the time of the interview, and friends or family seeking help for the person's alcoholism (1 item). The questionnaire assesses diagnostic criteria of drinking behavior, alcohol-related psychological and social impairment, and physiological symptoms. In order to account for the higher validity a combined MALT sum score was computed, in which the MALT-F was weighted four times and the MALT-S once (as outlined in the MALT test manual). The MALT criteria for alcoholism include but do not directly reflect DSM or ICD diagnoses. DSM-III diagnoses were derived from the MALT and the 'Standardized Psychiatric Interview'. An external validity of $r = .85$ concerning clinical diagnosis [31] and a split-half reliability of $r = .94$ for the self-report were reported [32]. Its strength lies in being specific in avoiding false-positive classification [33]. Alcohol consumption was reported by the participant and recorded as daily average pure alcohol intake by the clinically experienced interviewers. Details on the 'Standardized Psychiatric Interview' as used in this study have been described elsewhere [28, 29].

Based on the MALT, three groups were defined: "severe alcohol problems", "moderate alcohol problems", and "no alcohol problems". A combined MALT score of 10 and above signified "severe alcohol problems", scores between 6 and 9 described "moderate alcohol problems". Although the MALT is a good indicator of alcoholism in clinical settings, it may underestimate sub-threshold alcoholism in community samples [34]. To account for that, in individuals with a combined MALT score below 10, we included the combination of current hazardous alcohol consumption according to WHO (more than 60 g for men and 40 g of pure alcohol for women on average per day) and the presence of a diagnosis of alcohol abuse or dependence diagnosed by the research physician at baseline assessment in the home of the participant as additional criterion for inclusion into the "moderate alcohol problems" group.

Somatic illness was assessed by a checklist for somatic diseases in the expert interview; results were documented by medical doctors according to ICD-9 based on self-report. The number of serious somatic illnesses during the 5 years preceding baseline assessment was used as a measure.

Several health risk factors were assessed at baseline: (a) blood pressure indicating hypertension measured by clinicians, (b) body mass index (BMI), (c) average number of cigarettes per day, and (d) physical activity ("In leisure time, how often do you exercise causing you to be short of breath") ('more than one time in a month' and 'one time or less in a month').

Social class was determined according to Kleining and Moore [35]. The number of categories of employment status was condensed referring to criteria of managerial and qualified positions.

Mortality and date of death was assessed through feedback from relatives and community officials. We have no information about the mortality of persons whom we could not reach mainly because of unknown address (4.2% of the baseline sample). Therefore, only persons with ascertained survival or death status have been included in the mortality analyses.

In a large psychiatric–epidemiologic field study, it is not possible to conduct extensive diagnostic procedures for ascertaining physical illness. Baseline assessment was made by experienced medical doctors who, using a checklist, discussed with the participants their physical health including all information available (medical reports, medication, prescriptions), recording their final assessment on the interview. The ethics committee of the medical faculty at the University of Munich (LMU) approved the study, and informed consent was obtained from all participants before data collection.

Statistical analysis

Means with standard deviations and frequencies of categorical variables are presented. Comparisons between groups were made using analysis of variance or χ^2-tests, depending on the scaling of the variables. Fisher's exact test was used to compare proportions between groups when any cell had less than five counts. To identify significant differences in cross-tabulations, significant z-values are reported, representing adjusted standardized residuals. To examine the relevance of statistical significance, the standardized population effect size ω^2 [36] was calculated with Omega 3.1 [37]. The value of ω^2 can be interpreted analogous to Kirk's (2006) suggestion of small (>.01), medium (>.06), and large (>.14) effects. The t-tests and analyses of variance with post hoc Scheffé-tests were computed for comparing means.

Multiple sequential logistic regression analyses with block-wise enter were used regarding the mortality outcome.

The blocks were entered sequentially (1. demographic control variables, 2. other health risk control variables, 3. alcohol problem group). Final models after entering all three blocks are reported. Cox and Snell's R^2 and the adjusted Nagelkerke's R^2 are reported for estimation of variance explained by the complete model. Considering the fact that odds ratios differ from relative risk ratios especially for occasion probabilities over 10%, we estimated the relative risk ratio according to the formula of Zhang and Yu [38].

Additionally, right censored survival analysis using Cox regression with the same covariates adjusting mortality were computed for determining the yearly hazard ratios for the different alcoholism status during the 20 years. The hazard function marks the probability for each time unit until the time of death will be reached. The time span until death is identical to the survival time. The time period exceeding 20 years after baseline assessment in our study was pooled to avoid bias caused by individuals who could be reached only after much effort and very late in the assessment period of this follow-up. The reader should keep in mind that the yearly hazard rate of the survival analysis, the odds ratio of the logistic regression analysis, and the relative risk ratio are not directly comparable and because of different computation methods will produce different values and meanings.

For inclusion as predictor in logistic regression analysis, amount of alcohol consumed was categorized according to the *WHO alcohol risk classification* [39] with low risk representing alcohol consumption of ≤20 g/day pure alcohol for women and ≤40 g/day for men, medium risk for >20 and ≤40 g/day (women) and >40 and ≤60 g/day (men), high risk for >40 and ≤60 g/day (women) and >60 and ≤100 g/day (men), and very high risk for >60 g/day (women) and >100 g/day (men). Additionally, a 'no consumption' category included those with current abstinence.

Missing data varied slightly between measures, and numbers of cases are reported for each analysis. The statistical software used was SPSS for Windows, version 15.

Results

Of the 1,465 participants (648 men and 817 women) at baseline assessment, 1,017 individuals (444 men and 573 women) were reassessed 19.1 ± 1.2 years (mean ± standard deviation) after baseline. A total of 448 individuals (30.4%; 204 men and 244 women) had died in the interval between baseline and follow-up. Age of all baseline participants including deceased persons was 46.7 ± 19.6 years, and age of those still alive at follow-up ($N = 1{,}017$) was 37.9 ± 15.2 years at baseline and 57.6 ± 15.7 years at follow-up. At baseline, 24 (1.6%) of the 1,465 participants suffered from "severe alcohol problems", and 59 (4.0%) had "moderate alcohol problems". All others ($N = 1{,}382$, 94.3%) belonged into the "no alcohol problems" group.

Concerning DSM-III alcohol-related diagnoses at baseline the "severe alcohol problems" group included 13 (54.2%) individuals with alcohol abuse and 11 (45.8%) individuals with alcohol dependence. In the "moderate alcohol problems" group, alcohol abuse was found in 49 (83.1%) and alcohol dependence was found in 10 (16.9%) individuals. In the "no alcohol problems" group, alcohol abuse was found 15 (1.1%) individuals and none had alcohol dependence. Thus, in both groups with alcohol problems, each individual was given an alcohol-related diagnosis, and additional alcohol abuse diagnoses were found in the group with no alcohol problems.

A drop-out analysis of the sample assessed at 20-year follow-up (including deceased) versus those who refused participation or could not be reached at follow-up was conducted to identify systematic attrition with regard to the original representative sample of $N = 1{,}666$ at baseline. No differences could be found for the frequency of the three alcohol-related groups, gender, education, and social class at baseline. Significant differences were found for age, resulting in a younger drop-out sample (37.2 ± 16.9 years vs. 46.7 ± 19.6 years; $F = 43.2$, $df = 1/1{,}664$, $P < .001$) and also for family status, with more singles dropping out (35.3% vs. 24.5%; $\chi^2 = 11.1$, $df = 2$, $P < .01$).

Frequency of defined alcohol problem groups at baseline differed significantly between men and women (Table 1). "Severe alcohol problems" and "moderate alcohol problems" were more frequent in men than in women. Concerning family status "moderate alcohol problems" were more frequent in married persons, with a generally small effect size. Significant differences were found for the occupational categories, with higher proportions of alcohol problems in unemployed individuals and individuals in unskilled occupations. People with a qualified employment showed relatively high rates of "moderate alcohol problems" (7.2%). The frequency of "severe alcohol problems" and "moderate alcohol problems" was higher in persons from the lower classes than in persons from the middle and upper classes. No significant differences between groups were found for age, education, and original place of residence at baseline.

Amount of alcohol consumed at the time of baseline assessment was 114.1 ± 86.2 g/day in the "severe alcohol problems" group, 87.5 ± 26.5 g/day in the "moderate alcohol problems" group, and 12.4 ± 18.2 g/day in the "no alcohol problems" group ($F_{(2,1{,}449)} = 580.9$; $P < .001$; groups differed significantly from each other). Maximum amount in the five years preceding baseline assessment was 295.0 ± 136.7 g/day in the "severe alcohol problems" group, 211.2 ± 120.2 g/day in the "moderate alcohol

Table 1 Sample characteristics at baseline assessment

	Alcohol problem status at baseline			Statistics		
	"Severe alcohol problems" *n* (%)	"Moderate alcohol problems" *n* (%)	"No alcohol problems" *n* (%)	χ^2-test[a] χ^2 (*df*)	*P*	ω^2
Total sample	24 (1.6%)	59 (4.0%)	1,382 (94.3%)			
Gender				88.33 (2)	<.001	.057
Male	22*** (3.4%)	56*** (8.6%)	570*** (88.0%)			
Female	2*** (0.2%)	3*** (0.4%)	812*** (99.4%)			
Family status				20.88 (4)	<.001	.011
Single	9 (2.5%)	5** (1.4%)	345 (96.1%)			
Married	12 (1.4%)	50*** (5.9%)	780*** (92.6%)			
Separated, divorced, widowed	3 (1.1%)	4* (1.5%)	257* (97.3%)			
Qualified and managerial occupations				57.17 (12)	<.001	.040
In education	0 (0.0%)	0** (0.0%)	163*** (100.0%)			
General manager/self-employed	0 (0.0%)	4 (5.5%)	69 (94.5%)			
Managerial position/executive employee	1 (2.0%)	3 (6.0%)	46 (92.0%)			
Qualified employment	8 (2.3%)	25** (7.2%)	314** (90.5%)			
Unskilled worker	7* (3.4%)	14 (6.9%)	182** (89.7%)			
Housewife (without employment)[b]	0* (0.0%)	1 (0.4%)	240*** (99.6%)			
Unemployed	4*** (10.8%)	2 (5.4%)	31** (83.8%)			
Social class				19.62 (2)	<.001	.012
Upper and middle class	5** (0.7%)	18** (2.4%)	720*** (96.9%)			
Lower class	19** (2.7%)	41** (5.7%)	656*** (91.6%)			

$N = 1{,}465$

* $P \leq .05$; ** $P \leq .01$; *** $P \leq .001$ for significant adjusted standardized residuals

[a] Fisher's exact test for $n \leq 5$

[b] Housewives with employment were assigned primarily to occupational categories

problems" group, and 56.5 ± 66.4 g/day in the "no alcohol problems" group ($F_{(2,1,340)} = 242.6$; $P < .001$; groups differed significantly from each other).

Eleven of 24 individuals with "severe alcohol problems" (45.8%), 21 of 59 individuals with "moderate alcohol problems" (35.6%), and 416 of 1,382 individuals with "no alcohol problems" (30.1%) were deceased at follow-up. Thus, crude mortality rate was the highest for individuals with "severe alcohol problems", lower for those with "moderate alcohol problems" but not significantly so ($\chi^2 = 3.5$; $df = 2$; $P = .176$), and lowest for those with "no alcohol problems" at baseline assessment. While mortality in the 20-year following baseline assessment was significantly elevated in those with "severe alcohol problems" at baseline, the difference in mortality rates between those with "moderate alcohol problems" and those with "no alcohol problems" was non-significant.

Logistic regression on death controlling for age and gender and including alcohol problem groups as predictor resulted in an odds ratio (reference group was the "no alcohol problems" group) of 2.8 (95% CI = 1.4–6.0; $P < .01$) for "moderate alcohol problems" and 13.6 (95% CI = 4.4–40.2; $P < .001$) for "severe alcohol problems". A similar analysis including amount of alcohol consumed categorized according to the WHO risk classification and also controlling for age and gender resulted in an odds ratio (reference group was the no risk group) of 0.8 (95% CI = 0.5–1.2; ns) for low risk, 1.2 (95% CI = 0.7–2.3; ns) for medium risk, 2.7 (95% CI = 1.2–6.4; $P < .05$) for high risk, and 6.3 (95% CI = 2.2–18.2; $P < .01$) for very high risk.

A more sophisticated logistic regression analysis was computed controlling for (a) socio-demographic variables: age (39.5 ± 12.5, 45.3 ± 14.1, 46.9 ± 19.9, "severe alcohol problems", "moderate alcohol problems", and "no alcohol problems", respectively; $F = 1.8$; $df = 2/1{,}462$; $P = .164$), gender, family status, and social class at baseline and (b) other health risk variables at baseline: number of somatic illnesses (including obesity and hypertension) in the 5 years preceding assessment (2.8 ± 1.5, 2.4 ± 1.5, 2.6 ± 1.6, "severe alcohol problems", "moderate alcohol problems", and "no alcohol problems", respectively; $F = 0.5$; $df = 2/1{,}462$; $P = .592$), number of cigarettes per day (16.1 ± 11.8, 13.9 ± 15.0, 4.2 ± 8.9, "severe

alcohol problems", "moderate alcohol problems", and "no *alcohol problems*", respectively; $F = 49.0$; $df = 2/1{,}457$; $P < .001$) and low physical activity (59.1, 52.1, 47.7%; "severe alcohol problems", "moderate alcohol problems", and "no alcohol problems", respectively; $\chi^2 = 1.4$, $df = 2$, $P = .491$), and with (c) alcohol problem groups as predictor. Blood pressure and BMI did not contribute additional significant effects to the regression and were excluded from mortality analysis.

After adjusting for the above variables, individuals with "severe alcohol problems" at baseline carried an odds ratio of 6.37 of dying in comparison with persons having "no alcohol problems" at baseline (Table 2). The estimated relative risk (RR) according to the formula of Zhang and Yu [38] was 2.4 (CI 1.53–2.91). "Moderate alcohol problems" non-significantly increased the odds ratio for dying prematurely (1.95; ns) with an estimated RR of 1.51 (CI 0.87–2.18). Singles carried a higher mortality rate than married individuals. The same was true for older persons and men. People with somatic illnesses and cigarette smokers died earlier. Individuals with low physical activity (not more than once a month) had a slightly but still significantly higher risk of dying than people who reported regular physical activity (more than once a month), although, as reported above, the differences in percentages between alcohol problem groups did not reach significance in simple comparison.

The logistic regression described above considered whether a person had died at any time in the 20-year interval. Including the length of time until death into analysis provided additional insight taking into account the yearly hazard rate of mortality. A censored survival analysis with Cox regression and using the same covariates as in the logistic regression produced similar results. Subjects with "severe alcohol problems" at baseline passed away earlier (or had a shorter survival span), with a yearly hazard ratio of 3.08 ($P < .001$), than individuals with "no alcohol problems". Those with "moderate alcohol problems" at baseline had a non-significant hazard ratio of 1.37 (Table 3).

Both types of analyses indicated a similar pattern of results: an elevated not significant mortality risk in individuals with moderate alcohol problem and a significantly elevated mortality risk in individuals with severe alcohol problems.

Concerning other health risk covariates at baseline, the number of somatic illnesses, the number of cigarettes per day, and the frequency of physical activity contributed to an earlier death over a 20-year period. Singles, men and, not surprisingly, older people also had a lower probability to survive over 20 years. About 60% of the persons with "severe alcohol problems", compared to about 85% of people "without alcohol problems", survived at the end of the 20-year observation period (Fig. 1).

Discussion

Our main finding was elevated although not significant mortality risk in individuals with moderate alcohol problem, and a considerably and significantly elevated mortality risk in individuals with severe alcohol problems.

Table 2 Predictors of mortality over 20 years (multiple sequential logistic regression analysis)

Variables in the equation	Mortality at follow-up (20-year outcome)	
	Odds ratio	95% CI
Higher age	1.16***	1.13–1.18
Male gender	1.97**	1.27–3.07
Lower social class	1.46	0.98–2.16
Family status (categorical)		
Married	1[a]	
Single	2.76**	1.39–5.47
Separated, divorced, widowed	1.47	0.91–2.40
Higher number of somatic illnesses last 5 years before baseline	1.20**	1.06–1.37
Higher number of cigarettes per day	1.04***	1.02–1.06
Lower frequency of physical activity	1.61*	1.09–2.37
Alcoholism at baseline (categorical)		
No alcohol problems	1[a]	
Moderate alcohol problems	1.95	0.82–4.61
Severe alcohol problems	6.37**	2.00–20.35
Pseudo-R^2 for the model		
Cox and Snell's R^2	.460	
Nagelkerke's R^2	.646	

* $P \leq .05$; ** $P \leq .01$; *** $P \leq .001$

[a] Reference category

Table 3 Yearly hazard rates for mortality of the alcoholism group for the 20-year interval (multiple sequential Cox regression analysis for right censored data)

Variables in the equation	Yearly hazard ratio	
	Hazard ratio	95% CI
Higher age	1.11***	1.10–1.12
Male gender	1.63***	1.25–2.12
Lower social class	1.29*	1.04–1.61
Family status (categorical)		
Married	1[a]	
Single	1.47*	1.02–2.11
Separated, divorced, widowed	1.15	0.88–1.52
Higher number of somatic illnesses last 5 years before baseline	1.13***	1.05–1.22
Higher number of cigarettes per day	1.03***	1.02–1.05
Lower frequency of physical activity	1.28*	1.01–1.63
Alcoholism at baseline		
No alcohol problems	1[a]	
Moderate alcohol problems	1.37	0.83–2.26
Severe alcohol problems	3.08***	1.57–6.03
Total statistics for model		
χ^2	676.27*** ($df = 10$)	

* $P \leq .05$; ** $P \leq .01$; *** $P \leq .001$

[a] Reference category

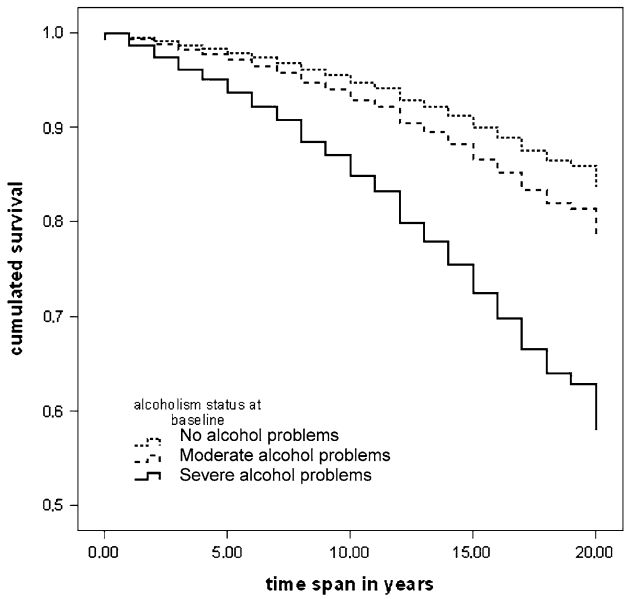

Fig. 1 Censored survival analysis for alcohol-related problems until point of death (Cox regression)

The strength of our study consists in (1) the prospective longitudinal approach with two cross-sectional assessments, (2) a long follow-up period of 20 years, (3) a large rural community sample size, (4) the combination of standardized expert ratings (MALT-F) with self-rating scales, which is more reliable than a single diagnostic procedure [33], and (5) a high participation rate of 90.5% at the 20-year follow-up (including deceased individuals; 84.4% survivors only). This participation rate is higher than commonly found in such long-term follow-ups (e.g., 70–80%; [40]). The high participation rate reduces possible selection bias. Subjects who refuse to participate in a follow-up study tend to exhibit more psychiatric disorders [34], and non-responders seem to have a strong tendency to distort results in psychiatric population studies [41].

There are some limitations of our study. (1) Due to the long interval of 20 years between baseline and follow-up, we may have missed some relevant information. Only for deaths was it possible to obtain in-between data concerning date of death. (2) Limited information (especially on the reason of death) is available on the 448 individuals who died before the follow-up. There are two reasons for this. (a) At 20-year follow-up, the participants were spread all over Germany and data protection laws would have made it next to impossible to obtain a copy of the death certificate from each county. (b) In an earlier study on mortality and alcoholism of our research group (Rehm et al. [18]), we did get the death certificate from the original county (Traunstein), but the reasons for death given there were too general and not helpful (e.g. general weakness of the heart). (3) As our sample was followed over 20 years, our study participants grew older and at follow-up were no longer representative for the general population of Upper Bavaria. A cohort that was originally selected to be representative of a population may develop in a different direction than the population at large with respect to socioeconomic stratum or other demographic characteristics [42]. (4) All communities involved in this study had at the time of recruitment less than 20,000 inhabitants and, according to Dekker et al. [43], qualify for a rural sample. While the rural–urban distinction may be relevant for mood and anxiety disorders, a recent meta-analysis concluded

that no differences between rural and urban samples could be found for substance abuse extending the generalizability of our findings [44]. (5) There are findings concerning different onset of alcoholism in men and women with conflicting findings from clinical and population samples [45]. Our sample of individuals with severe alcohol problems was small and included just a few women, so we were unable to contribute to issues like this. Low sample size in the severe alcohol problem category limits the power of statistical analysis. This point is inherent to all representative population studies defining extreme categories for rare behavior, and we applied considerable caution in interpreting our findings. A larger number of cases taken from a clinical sample could contribute to clarify the role of problems deriving from alcoholism.

Adjusting for relevant socio-demographic and health variables, problematic alcohol consumption increased significantly the long-term risk of death in the community. However, based on our community data, a statistically significant elevation of the 20-year mortality was only observed in those with "severe alcohol problems" and not among those with "moderate alcohol problems".

In a clinical sample of alcoholics, Lewis et al. [3] found that 57.3% of the men and 47.8% of the women had died after 22 years. For a shorter follow-up period of about 10 years, mortality rates between 17 and 27% were reported in medically treated alcoholics [1, 2, 4, 7]. These data are quite similar to the rate of deceased people with "severe alcohol problems" in our study (45.8%) after 20 years. In the Lundby study [13]—a longitudinal community study in Sweden—the results were also quite similar to our study: an odds ratio of 5.6 was found for a 35-year interval compared to matched controls. Two population studies found somewhat lower mortality rates associated with alcoholism. Rossow and Amundsen [17] reported that male alcohol abusers in Norway incurred an increased relative mortality risk of 3.3 after 40 years. The study by Fillmore et al. [46] is not quite comparable to ours, since they in a meta-analysis of three population surveys analyzed only women. These authors computed an odds ratio of 2.4 for death in women with heavy alcohol consumption over 7–20 years. Dawson [11] found in a large population study (National Health Interview Survey 1988: Alcohol Supplement) a yearly hazard ratio of 1.65 for very heavy, dependent drinkers when compared to lifetime abstainers. Large population studies [11, 17] have the merits of high numbers, but also the problem of thoroughly assessing this high number of participants validly for a matter (e.g. alcoholism) that is difficult to assess with a few questions in a general health survey.

According to a recent review [47], average volume of consumption and pattern of drinking were the two major dimensions of alcohol use linked to disease. Rehm et al. stated that additional dimensions of alcohol consumption influence the occurrence of disease. Our data point out that the mere presence of any alcohol-related problems is not a significant long-term risk factor for premature death in itself. However, an accumulation of more severe problems associated with high alcohol consumption is significantly associated with an increased mortality. One possible explanation is that in our sample severe physical symptoms rated in the MALT could have been signs of advanced body deterioration causing death. This, however, seems less likely as the survival curve (Fig. 1) shows a balanced course over the years. In the literature, there is an ongoing discussion of the positive effects of moderate drinking on health and well-being. Some authors (e.g. Castelnuovo et al. [48]; Chen and Hardy [49]; Lee et al. [50]) propose that moderate drinking evolves into a more favorable risk factor profile than non-drinking or excessive drinking, while other authors (e.g. Norström and Ramstedt [51]; and with more differentiation, Fillmore et al. [52]) reported no conclusive evidence on this issue. In the last decade, several meta-analyses included data on the effect of moderate drinking on a variety of physical diseases (dementia [53], stroke [54], coronary heart disease [55], and liver cirrhosis [56]. Protective levels of daily alcohol consumption varied according to physical disease. 'Protective' daily alcohol consumption ranged from as low as 1 drink [53] to as high as 72 g/day [55]. One meta-analysis found a protective effect in morbidity studies only, but not in mortality studies [56]. About 20% in our "moderate alcohol problems" group and nearly 40% in our (small!) "severe alcohol problems" group were below the high threshold of 72 g/day, confirming the usefulness of our classification according to problems for identifying mortality risk.

In our study, we drew a clear distinction between "moderate alcohol problems" and "severe alcohol problems" according to the MALT interview and self-rating questionnaire. This distinction was corroborated by the unequivocal and significant differences between these categories in our study with regard to socio-demographic variables, course of alcoholism status, and mortality over 20 years. Our community data show that including the spectrum and intensity of alcohol-related problems is more informative than focusing only on severe alcoholism or severe alcohol consumption. We applied this approach to a rural community sample. Further research should explore this issue in urban community samples.

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References

1. Cross GM, Morgan CW, Mooney AJ, Martin CA, Rafter JA (1990) Alcoholism treatment: a ten-year follow-up study. Alcohol Clin Exp Res 14:169–173
2. Längle G, Mann K, Mundle G, Schied HW (1993) Ten years after: the post-treatment course of alcoholism. Eur Psychiatry 8:95–100
3. Lewis CE, Smith E, Kercher C, Spitznagel E (1995) Assessing gender interactions in the prediction of mortality in alcoholic men and women: a 20-year follow-up study. Alcohol Clin Exp Res 19:1162–1172
4. Lundquist GAR (1973) Alcohol dependence. Acta Psychiatr Scand 49:332–340
5. Romelsjö A, Karlsson G, Henningsohn L, Jakobsson SW (1993) Prevalence of alcohol-related mortality in both sexes: variation between indicators, Stockholm 1987. Am J Public Health 83:838–844
6. Wells JE, Walker ND (1990) Mortality in a follow-up study of 616 alcoholics to an inpatient alcoholism clinic 1972–1976. N Z Med J 103:1–3
7. Finney JW, Moos RH (1991) Long-term course of alcoholism: I. Mortality, relapse and remission rates and comparisons with community controls. J Stud Alcohol 52:44–54
8. Moos RH, Brennan PL, Mertens JR (1994) Mortality rates and predictors of mortality among late-middle-aged and older substance abuse patients. Alcohol Clin Exp Res 18:187–195
9. Liskow BI, Powell BJ, Penick EC, Nickel EJ, Wallace D, Landon JF, Campbell J, Cantrell PJ (2000) Mortality in male alcoholics after ten to fourteen years. J Stud Alcohol 61:853–861
10. Mertens JR, Moos RH, Brennan PT (1996) Alcohol consumption, life context, and coping predict mortality among late-middle-aged drinkers and former drinkers. Alcohol Clin Exp Res 20:313–319
11. Dawson DA (2000) Alcohol consumption, alcohol dependence, and all-cause mortality. Alcohol Clin Exp Res 24:72–81
12. Öjesjö L (1981) Long-term outcome in alcohol abuse and alcoholism among males in the Lundby general population, Sweden. Br J Addict 76:391–400
13. Öjesjö L, Hagnell O, Otterbeck L (1998) Mortality in alcoholism among men in the Lundby community cohort, Sweden: A forty-year follow-up. J Stud Alcohol 59:140–145
14. Rehm J, Sempos CT (1995) Alcohol consumption and all-cause mortality. Addiction 90:471–480
15. Vaillant GE (1996) A long-term follow-up of male alcohol abuse. Arch Gen Psychiatry 53:243–249
16. Vaillant GE (2003) A 60-year follow-up of alcoholic men. Addiction 98:1043–1051
17. Rossow I, Amundsen A (1997) Alcohol abuse and mortality: a 40-year prospective study of Norwegian conscripts. Soc Sci Med 44:261–267
18. Rehm J, Fichter MM, Elton M (1993) Effects on mortality of alcohol consumption, smoking, physical activity, and close personal relationships. Addiction 88:101–112
19. Andreasson S, Brandt L (1997) Mortality and morbidity related to alcohol. Alcohol 32:173–178
20. Romelsjö A, Leifman A (1999) Association between alcohol consumption and mortality, myocardial infarction, and stroke in 25 years follow-up of 49618 young Swedish men. BMJ 319:821–822
21. Flensborg-Madsen T, Knop J, Mortensen EL, Becker U, Grønbæk M (2007) Amount of alcohol consumption and risk of developing alcoholism in men and women. Alcohol 42:442–447
22. Jensen MK, Sørensen TIA, Andersen AT, Thorsen T, Tostrup JS, Gotfredsen NS, Grønbæk M (2003) A prospective study of the association between smoking and later alcohol drinking in the general population. Addiction 98:355–363
23. Thun MJ, Peto R, Lopez AD, Monaco JH, Henley SJ, Heath CW, Doll R (1997) Alcohol consumption and mortality among middle-aged and elderly U.S. adults. N Engl J Med 337:1705–1714
24. Öjesjö L, Hagnell O, Lanke J (1983) Class variations in the incidence of alcoholism in the Lundby study, Sweden. Soc Psychiatry 18:123–128
25. Umberson D (2003) Gender, marital status and the social control of health behavior. Soc Sci Med 37:907–917
26. Rehm J, Irving H, Ye Y, Kerr WC, Bond J, Greenfield TK (2008) Are lifetime abstainers the best control group in alcohol epidemiology? On the stability and validity of reported lifetime abstention. Am J Epidemiol 168:866–871
27. Dilling H, Weyerer S (1984) Psychische Erkrankungen in der Bevölkerung bei Erwachsenen und Jugendlichen [Mental illness in the community for adults and adolescents]. In: Dilling H, Weyerer S, Castell R (eds) Psychische Erkrankungen in der Bevölkerung [Mental illness in the community]. Enke, Stuttgart, pp 1–122
28. Fichter MM, Narrow WE, Roper MT, Rehm J, Elton M, Rae DS, Locke BZ, Regier DA (1996) Prevalence of mental illness in Germany and the USA: comparison of the Upper Bavarian Study and the epidemiologic catchment area program. J Nerv Ment Dis 184:598–606
29. Fichter MM, Quadflieg N, Kohlböck G, Dilling H, Niedermeier T (2008) The Upper Bavarian longitudinal community study on psychopathology 1975–2004: 1. Methods and first results. Eur Arch Psychiatry Clin Neurosci 258:476–488
30. Feuerlein W, Ringer C, Küfner H, Antons K (1977) Diagnose des Alkoholismus: Der Münchener Alkoholismustest (MALT) [Diagnosis of alcoholism: the Munich Alcoholism Test (MALT)]. Munch Med Wochenschr 119:1275–1282
31. Feuerlein W, Küfner H, Ringer C, Antons-Volmerg K (1999) Münchner Alkoholismus-Test. 2. Ergänzte Auflage. Manual. Beltz Test, Göttingen
32. Feuerlein W, Ringer C, Küfner H, Antons K (1979) The diagnosis of alcoholism—the Munich Alcoholism Test (MALT). Int J Rehabil Res 2:533–534
33. Hiller W (2009) Alcohol dependence in ICD-9 and DSM-III-R: a comparative polydiagnostic study. Eur Arch Psychiatry Neurol Sci 239:101–108
34. Fichter MM (1990) Verlauf psychischer Erkrankungen in der Bevölkerung [Course of mental illness in the community]. Springer, Heidelberg
35. Kleining G, Moore H (1968) Soziale Selbsteinstufung (SSE): Ein Instrument zur Messung sozialer Schichten [Social self-assessment: an instrument for the assessment of social classes (SSE)]. Köln Z Soziol Sozialpsychol 20:502–552
36. Hays WL (1973) Statistics for the social sciences, 2nd edn. Holt, Rinehart and Winston, New York
37. Fischer UC, Wolf B (2001) Omega 3.1. Statistical software. Zepf, Landau, Germany (computer program)
38. Zhang J, Yu KF (1998) What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. JAMA 280:1690–1691
39. WHO World Health Organization (2000) International guide for monitoring alcohol consumption and related harm. Geneva
40. Rothman KJ, Greenland S (1998) Modern epidemiology, 2nd edn. Lippincott-Raven Publishers, Philadelphia
41. Hagnell O (1989) Repeated incidence and prevalence studies of mental disorders in a total population followed during 25 years. The Lundby Study, Sweden. Acta Psychiatr Scand 348:61–77

42. Nettelbladt P, Bogren M, Mattison C, Öjesjö L, Hagnell O, Hofvendahl E, Toraker P, Phugra D (2005) Does it make sense to do repeated surveys?—The Lundby Study, 1947–1997. Acta Psychiatr Scand 111:444–452
43. Dekker J, Peen J, Koelen J, Smit F, Schoevers R (2008) Psychiatric disorders and urbanization in Germany. BMC Public Health 8:17
44. Peen J, Schoevers RA, Beekman AT, Dekker J (2009) The current status of urban-rural differences in psychiatric disorders. Acta Psychiatr Scand (in print)
45. Diehl A, Croissant B, Batra A, Mundle G, Nakovics H, Mann K (2007) Alcoholism in women: is it different in onset and outcome compared to men? Eur Arch Psychiatry Clin Neurosci 257: 344–351
46. Fillmore KM, Golding JM, Graves KL, Kniep S, Leino EV, Romeljö A, Shoemaker C, Ager CR, Allebeck P, Ferrer HP (1998) Alcohol consumption and mortality III. Studies of female population. Addiction 93:219–229
47. Rehm J, Greenfield TK, Kerr W (2006) Patterns of drinking and mortality from different diseases—an overview. Contemp Drug Probl 33:205–235
48. Castelnuovo AD, Costanzo S, Bagnardy V, Donati MB, Iacoviello L, de Gaetano G (2006) Alcohol dosing and total mortality in men and women. An updated meta-analysis of 34 prospective studies. Arch Intern Med 166:2437–2445
49. Chen LY, Hardy CL (2009) Alcohol consumption and health status in older adults. A longitudinal analysis. J Aging Health 21:824–847
50. Lee SJ, Sudore RL, Williams BA, Lindquist K, Chen HL, Covinsky KE (2009) Functional limitations, socioeconomic status, and all-cause mortality in moderate alcohol drinkers. J Am Geriatr Soc 57:955–962
51. Norström T, Ramstedt M (2005) Mortality and population drinking: a review of the literature. Drug Alcohol Rev 24:537–547
52. Fillmore KM, Stockwell T, Chikritzhs T, Bostrom A, Kerr W (2007) Moderate alcohol use and reduced mortality risk: systematic error in prospective studies and new hypotheses. Ann Epidemiol 17:S16–S23
53. Anstey KJ, Mack HA, Cherbuin N (2009) Alcohol consumption a sa risk factor for dementia and cognitive decline: meta-analysis of prospective studies. Am J Geriatr Psychiatry 17:542–555
54. Reynolds K, Lewis LB, Nolen JDL, Kinney GL, Sathya B, He J (2003) Alcohol consumption and risk of stroke. A meta-analysis. JAMA 289:579–588
55. Corrao G, Rubbiati L, Bagnardi V, Zambon A, Poikolainen K (2000) Alcohol and coronary heart disease: a meta-analysis. Addiction 95:1505–1523
56. Rehm J, Taylor B, Mohapatra S, Irving H, Baliunas D, Patra J, Roerecke M (2010) Alcohol as a risk factor for liver cirrhosis: a systematic review and meta-analysis. Drug Alcohol Rev 29:437–445