Hospital admissions and mortality in the 15 years after a first-time hospital contact with an alcohol problem: a prospective cohort study using the entire Danish population

Gro Askgaard*, PhD,[1,2] David A Leon, professor[3,4] Thomas Deleuran, PhD,[5] Janne S Tolstrup, professor[1]

[1]National Institute of Public Health, University of Southern Denmark, DK-1353 Copenhagen K, Denmark

[2]Gastro Unit, Copenhagen University Hospital, Bispebjerg Hospital, DK-2200 Copenhagen N, Denmark

[3]Department of Non-Communicable Disease Epidemiology, Faculty of Epidemiology and Population Sciences, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, UK

[4]Department of Community Medicine, UiT Arctic University of Norway, 9019 Tromsø, Norway

[5]Department of Hepatology and Gastroenterology, Aarhus University Hospital, DK-8000 Aarhus C, Denmark

Corresponding author:

Gro Askgaard, MD, PhD

gask@dadlnet.dk

National Institute of Public Health, University of Southern Denmark, DK-1353 Copenhagen K, Denmark

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Abstract

Background

Potential benefits of preventing continued alcohol intake in individuals presenting at the hospital with an alcohol problem can be highlighted by studying their excess risk of subsequent morbidity and mortality

Methods

All Danish residents with a first-time hospital contact with alcohol problems (intoxication, harmful use, or dependence) in 1998-2002 were followed through 2012 using healthcare registries. We compared their cause-specific rates of hospital admission and mortality to the expected rates derived from the general population by calculating standardized incidence rate ratios.

Results

The 26 716 men and 12 169 women who were hospitalized with alcohol problems (median age 44 years) had more than ten times the rate of subsequent admission to psychiatric departments and three times the rate of subsequent admission to somatic departments compared to the general population. In particular hospital admission rate for gastroenterological disease and injuries were high. The cumulative all-cause 10-year mortality risk was 29% (95% CI, 28-30) in men and 26% (95%CI, 24-27) in women with alcohol problems. The ratios of observed to expected death rate for all-cause mortality was 4.0 (95%CI, 3.8-4.1) in men and 4.3 (95%CI, 4.0- 4.7) in women, and for causes of death fully attributable to alcohol 16 (95%CI, 15-17) in men and 33 (95%CI, 29-38) in women.

Conclusions

Individuals hospitalized with alcohol problems have much higher rates of subsequent alcohol-related hospital admission and mortality than the general population. Increased focus on preventing continued alcohol consumption in these individuals may reduce their subsequent morbidity and mortality.

Keywords: Alcohol problems, public health, hospital admission, mortality, cohort study

Key messages

Men and women with a first-time hospital contact with obvious alcohol problems had a much higher rate of subsequent hospital admission and mortality due to a range of medical causes compared to the general population when followed-up for more than 10 years.

Much of this excess in subsequent hospital admission and mortality was from alcohol-related causes (mental and gastroenterological disease, injuries, fractures, and poisonings).

Overall, nearly a third of all deaths in men and one quarter of all deaths in women were fully attributed to alcohol (caused by alcoholic liver disease, alcohol poisoning, etc.) in individuals with a hospital contact with alcohol problems.

These findings show the ongoing alcohol problems among individuals hospitalized with alcohol problems in the years after a hospital contact. Interventions to reduce alcohol consumption at initial hospital contact should be prioritised.

Introduction

Alcohol use is estimated to result in more than two million deaths and 85 million disability-adjusted life-years lost globally each year (1). Alcohol problems and dependency are often untreated (2–4), though reduction in alcohol consumption among problem drinkers decreases morbidity, mortality, and healthcare costs (5,6).

Around 2% of all Danish hospital contacts involve alcohol diagnoses reflecting obvious alcohol problems (7–9). Despite the fact that the hospital setting is acknowledged as a unique opportunity for brief interventions and initiation of alcohol treatment (10–12), healthcare providers do not exploit this opportunity (13–17). A US study revealed that only half of hospital patients with recognized alcohol problems received alcohol intervention or referral for treatment (18). In the UK, where some hospitals even have alcohol care teams, only 60% of patients with recognized alcohol-related liver disease were given advice or support for alcohol problems (19).

The potential benefit of actively targeting intervention and treatment towards patients that present with alcohol problems at the hospital is best understood by quantifying their subsequent risk of morbidity and mortality. If such patients are at especially high risk, the argument speaks in favor of a much more directed as an alternative to the prevalent more passive approach.

Therefore, we conducted a nationwide study of all men and women in Denmark who had a first-time hospital contact with alcohol problems between 1998 and 2002. We followed them for up to 15 years, and estimated incidence rates of cause-specific hospital admission and mortality compared to the general Danish population.

Material and methods

This was a nationwide, registry-based, prospective cohort study of all individuals with an initial hospital contact with alcohol problems between 1998 and 2002 in Denmark. The cohort was followed for subsequent hospital admissions and mortality until 2012.

Individuals with a hospital contact with alcohol problems

We included all individuals aged 20-84 years who went to the hospital for the first time with obvious alcohol problems during 1998-2002 in Denmark (alcohol intoxication [ICD-10:

F10.0], harmful alcohol use [ICD-10: F10.1], or alcohol dependence [ICD-10: F10.2, F10.3, F10.4, and F10.5]) (8,9). We identified hospital contacts with alcohol problems from all hospital departments (psychiatric, somatic, admission, emergency room, and outpatient clinics). The diagnosis of alcohol problems could be the primary diagnosis or any other diagnosis listed for the hospital contact. Patients were excluded if they had a recorded hospital contact with alcohol problems prior to 1998 (identified from psychiatric hospital records 1970-1998 and somatic hospital records from 1977-1998). We also excluded patients over 85 years of age because we lacked comparative data in five-year age groups for individuals over 85 years.

All 5.6 million Danish citizens have access to universal, tax-financed healthcare (20). Data on hospital contacts and diagnoses was obtained from The National Patient Register and The Danish Psychiatric Central Research Register. The National Patient Register was established in 1977 and contains data on all somatic admissions, with emergency and outpatient contacts added in 1995 (21). The Danish Psychiatric Central Research Register was established in 1970 and contains data on all psychiatric hospital admissions (22). Emergency and outpatient contacts were added to both hospital registers in 1995. Information on causes of death was obtained from The Danish Register of Causes of Death established in 1970 (23). In Danish healthcare registries, diagnoses are recorded according to the eighth and, since 1994, the tenth International Classification of Diseases (ICD) (21).

Level of comorbidity was computed from hospital diagnoses given prior to or at the time of the first-time hospital contact with alcohol problems. Somatic comorbidity was estimated according to the Charlson comorbidity index score (24). Psychiatric comorbidity was estimated as the number of the major psychiatric disease categories: dementia and organic disorders not caused by alcohol (ICD-8: 290, 292, 294; ICD-10: F00-09), schizophrenia (ICD-8: 295, 298; ICD-10: F20-29), mood disorders (ICD-8: 296; ICD-10: F30-39), neurotic and stress-related disorders (ICD-8: 300; ICD-10: F40-49), behavioral syndromes associated with physiological disturbances (ICD-10: F50-59), personality disorders (ICD-8: 301; ICD-10: F60-69), mental retardation (ICD-10: F70-79), psychological development disorders (ICD-10: F80-89), and behavioral and emotional disorders (ICD-10: F90-99).

Information on marital status, vital status, and migration was obtained from The Danish Civil Registration System (20) and information on education level came from Statistics Denmark. All the above registries were linked by a personal identification number: a unique identifier assigned to all Danish residents since 1968.

General population data for comparison

We used publicly available data aggregated by sex, age-group, and calendar year for cause-specific hospital admission and mortality for the general Danish population (25,26). Mortality rates by cause, sex, age-group, and calendar year for the Danish population were derived from the mortality database held by the World Health Organization (27).

Follow-up for subsequent hospital admissions and cause of death

Individuals with a hospital contact with alcohol problems were followed for all subsequent hospital admissions (inpatient admissions) and death. The cohort was followed from the date of termination of first-time hospital contact with alcohol problems, until death (n = 13 088), reaching age 85 years (n = 628), or end of follow-up (31.12.2012), whichever occurred first. To ensure comparability with data derived from the general Danish population we used the primary diagnosis listed as the cause of hospital admission, and the underlying cause for cause of death. ICD-10 codes for cause-specific hospital admissions and causes of death used in this paper are listed in Appendix A.

Statistical analyses

Indirect standardization was used to compare observed numbers of subsequent hospital admissions and deaths with those expected based on age, sex, and calendar year-specific rates in the total general population. The ratio of observed to expected events (O/E) provides an estimate of the relative risk for hospital admissions and mortality in individuals with a hospital contact with alcohol problems compared to the general population. By definition the general population used includes those included in our cohort. Observation time was from date of termination of first-time hospital contact with an alcohol problem to death, reaching age 85 years, or end of follow-up, whichever was the soonest. Days spent in hospital did not contribute to the observation time. Poisson regression was used to model standardized incidence ratios (SIR) or standardized mortality ratios (SMR) ratios for hospital admissions and mortality, in men and women with a hospital contact with alcohol problems relative to the general population.

People who drink heavily also tend to smoke, which increases their morbidity and mortality (1,28). Based on a prior suggested definition, we calculated causes of death mostly attributed to tobacco (ref: Oza). We also measured the "excess" of subsequent hospital admissions related to alcohol in individuals hospitalized with alcohol problems compared to the general population. These non-smoking causes of hospital admission were mental, gastroenterological, and external causes of disease (injuries, fractures, and poisonings) (9). We calculated the proportion that these non-smoking causes (NS causes) contributed to the excess of the total number (TN) of hospital admissions to somatic departments in men and women with a hospital contact with alcohol problems compared to the general population:

[Observed (NS) – Expected (NS)] / [Observed (TN) – Expected (TN)] * 100%

Analyses were carried out using Stata (version 15; Stata-Corp LP, College Station, TX).

Ethics

All data were delivered anonymized. The Danish Data Protection Agency approved the study (j.nr. 2014-41-3516).

Results

Between 1998 and 2002, 26 716 men and 12 169 women in Denmark had a first-time hospital contact where they were given an alcohol problem diagnosis (Table 1). Alcohol problem diagnoses for intoxication and dependence were equally common (38%-42%), while 21%-22% had a diagnosis for harmful alcohol use. The majority had their hospital contact at a somatic department. Median age (interquartile range; IQR) was 44 years (33-55) in men and 45 years (34-56) in women. About half the patients had nine or less years of education, and the majority were unmarried. At the time of the hospital contact, the majority of individuals had no somatic or psychiatric comorbidity. Seven out of ten had a Charlson comorbidity index score of zero and the vast majority had not been registered with a psychiatric diagnosis.

(Table 1 here)

Overall rate of subsequent hospital admission

During the follow-up 391 003 person-years (mean follow-up 10 years) were accumulated, during which we observed 50 179 hospital admissions to psychiatric departments and 226 885 to somatic departments among individuals with a first-time hospital contact with alcohol

problems (Table 2). Compared to the general population, men and women hospitalized with alcohol problems had more than ten times higher rate of subsequent hospital admission in psychiatric departments [SIR in men, 12 (95% confidence interval 11 to 12), SIR in women, 16 (16 to 17)], and about three times higher rate of hospital admission in somatic departments [SIR in men, 3.0 (3.0 to 3.0), SIR in women 2.8 (2.8 to 2.9)].

The rate of outpatient visits to somatic departments (calculated for 2006-2013) was slightly higher for men with a hospital contact with alcohol problems compared to men in the general population (SIR, 1.2 (95% confidence interval 1.2 to 1.2), but this difference was not found among women [SIR, 1.0 (1.0 to 1.0)].

Cause-specific subsequent hospital admission

Men and women with a hospital contact with alcohol problems had higher rates of subsequent hospital admissions for all diagnoses compared to the general population (Table 2). The diagnosis-specific SIRs were mostly similar in men and women, though it were higher in women than men for the alcohol-related mental and behavioral disorders, liver and pancreatic disease, and for poisoning by alcohol or other substances. In both sexes, it was among these alcohol-related diseases the highest SIRs were found. For example, the SIR for hospital admission due to liver and pancreatic disease was 11 (95% confidence interval 11 to 12) in men and 17 (15 to 18) in women with alcohol problems compared to the general population.

SIRs ranged from three to five for admission for stroke, respiratory disease, nervous system disease, gastroenterological disease overall, infectious disease, ill-specified disease, admission for observation, and for admission with fractures and injuries. SIRs ranged from one and a half to two for hospitalization due to cancer, cardiovascular disease, ischemic heart disease, and musculoskeletal disease.

Non-smoking causes of hospital admission (mental, gastroenterological, and external causes of disease – that is injuries, fractures, and poisonings) accounted for 46% (men) and 45% (women) of all the "excess" observed admissions in the alcohol problem cohort compared to the general population (which also included those hospitalized with alcohol problems).

(Table 2 here)

All-cause mortality

During follow-up of the cohort 9451 men and 3637 women died. The cumulative all-cause mortality in men and women was 5.2% (95%CI, 4.0-5.8) and 3.8% (95%CI, 3.0-4.5) after one year, 16% (95%CI, 15-17) and 14% (95%CI, 13-15) after five years, and 29% (95%CI, 28-30) and 26% (95%CI, 24-27) after ten years (Figure 1). The SMR for all-cause mortality was 4.0 (95%CI, 3.8-4.1) in men and 4.3 (95%CI, 4.0- 4.7) in women with a hospital contact with alcohol problems compared to the general population (Table 3). SMRs were highest in those who were young and middle-aged (20-49 years) at the time of the hospital contact with alcohol problems. For example, in men with alcohol problems, the SMR was 7.2 (95%CI, 6.7-7.7) for 30-39 years and 2.1 (95%CI, 1.9- 2.2) for 70-84 years compared to the general population.

(Table 3 here)

Cause-specific mortality

Overall, 2703 (29%) of all deaths in men and 915 (25%) of all deaths in women in the cohort were fully attributed to alcohol (caused by alcoholic liver disease, alcohol poisoning, etc.) (Table 4). Comparing rates of causes of deaths to the general population, SMRs for the cohort were higher for nearly all causes of death investigated for men and women.

SMRs for death due to mental disease caused by alcohol or substance abuse, liver disease, and the aggregate of all causes fully attributable to alcohol were higher in women than men. For example, the SMR for all causes fully attributable to alcohol was 16 (95%CI, 15-17) in men but 33 (95%CI, 29-38) in women. For all other causes the SMRs were relatively similar between the sexes. In both men and women, it was among these alcohol-related causes that the highest SMRs were found (ranging from 10 to 34).

SMRs were three to six times greater in the majority of causes of death examined, including the aggregate of all causes mostly attributable to tobacco, cancers of the upper aerodigestive tract (mouth, throat, upper esophagus, etc.), liver cancer, cardiovascular disease overall, cardiomyopathy, stroke, respiratory disease, infectious disease, musculoskeletal disease in women, ill-specified diseases, external causes overall (see appendix A for definitions), suicide, and accidents in men. For example, the aggregate of

causes mostly attributable to tobacco showed SMRs of 3.5 (95%CI, 3.1-4.0) in men and 3.5 (95%CI, 2.9-4.2) in women.

(Table 4 here)

Discussion

This study defined the cohort of all Danish men and women who had a first-time hospital contact with alcohol problems between 1998 and 2002 and has examined their subsequent rate of hospital admissions and mortality through to 2012. We found that such patients had much higher rates of hospital admission than the Danish population as a whole: ten times higher to psychiatric departments and three times higher to somatic departments. Cumulative mortality risks approximated one-third after 10 years. Hospital admission and mortality rates were higher for a range of medical conditions. In particular those associated with heavy drinking including mental, gastroenterological, and external causes of disease.

Their high mortality and morbidity in the subsequent 15 years after a hospital contact with alcohol problems indicate ongoing health problems most likely due to alcohol among these patients.

Strengths of our study include its nationwide setting with complete data on hospital care and causes of death (20,21,23). The validity of hospital discharge diagnoses is high: the positive predictive value of the primary hospital discharge diagnosis in the registry was 81% when compared with medical chart review of a random sample of 1000 admissions (21). Thus, our findings are likely to represent valid populations-based estimates on morbidity and mortality of patients hospitalized with alcohol problems in Denmark.

Limitations of our study include the inability to separate the effects of heavy drinking from other factors such as smoking and socioeconomic position on the risk of admissions and mortality. However, non-smoking causes (mental, gastroenterological, and external) of hospital admissions accounted for almost half of all the "excess" hospital admissions observed compared to the general population. For mortality, SMRs were much greater for causes fully attributable to alcohol than causes mostly attributable to tobacco. Therefore, although smoking may explain some of the excess morbidity and mortality, it is unlikely to alter our conclusion that ongoing alcohol use in these individuals with a hospital contact with alcohol problems causes a high burden of hospital admissions and mortality.

To the best of our knowledge, no prior studies have assessed the frequency of hospital admissions due to a range of causes in individuals hospitalized with alcohol problems compared to the general population. Two prior studies of patients hospitalized with alcohol problems found higher incidences of later readmission for liver cirrhosis, pancreatitis, cancer, and accidents compared to controls (29,30).

Our reported SMRs for all-cause and cause-specific mortality for men and women hospitalized with alcohol problems compared to the general population are in line with previous meta-analyses of alcohol treatment cohorts (5,31). Half the patients in our study had a diagnosis of less severe alcohol problems (alcohol intoxication and harmful alcohol use) and only 40% were diagnosed with alcohol dependence. Nevertheless, we found a high rate of alcohol-related hospital admission and deaths. These observations are consistent with a study that followed more than 2000 individuals after an index alcohol-related healthcare contact and found a high number of individuals with recurrent alcohol-related contacts even among those individuals diagnosed with alcohol intoxication at their index alcohol contact (20% had at least one contact per year in the following 10 years) and harmful alcohol use (40% had at least one contact per year in the following 10 years) (8).

More than 25% of the observed deaths in our study were directly attributable to alcohol and this proportion is most likely conservative (32,33). In a validation study of 403 deaths, the proportion of deaths where the cause was attributable to alcohol rose from 25% to 36% when information from medical records and autopsies were added to registry data (33). Further, the high SMRs of death due to unspecified causes and ischemic heart disease (other than myocardial infarction) may reflect mortality due to alcohol, which was observed to fluctuate with alcohol-induced death in Russia (34).

Those most at risk of subsequent hospital admission are also likely to be those most at risk of dying. To this extent, hospital admission rates in the cohort might have been even higher if mortality had been postponed. However, as the focus of this paper considers both outcomes as indicators of disease burden in the cohort, our analyses in this respect are not biased, being based on complete follow-up of the whole population.

Heavy drinking is associated with psychiatric disease (35,36) and increases the risk of more than 200 diseases including cancers, heart disease, neurologic disease, infectious

disease, and gastrointestinal diseases, in particular cirrhosis and pancreatitis (37). With respect to cancer, the risk was fivefold increased for mouth, throat, and esophagus cancer, but only slightly increased for colon cancer and breast cancer in women. This observation is in accordance with the fact that alcohol explains about 40% of mouth, throat, and esophagus cancer cases (the attributable fraction), but only 10-15% of colon cancer cases and 7% of breast cancer cases (38).

Around 620 000 individuals (14%) in Denmark have a harmful alcohol use and 150 000 individuals (3%) are alcohol dependent. With only 20 000 individuals receiving specialized alcohol treatment, there is substantial undertreatment of alcohol problems in Denmark, in line with the situation in other countries (4,39).

This study points to a potential substantial reduction in healthcare costs, morbidity, and premature mortality if interventions to reduce harmful alcohol consumption were prioritized among patients hospitalized for alcohol problems. The challenge to be addressed however is to develop optimal approaches to identify which hospitalized patients who would benefit most from interventions to reduce their alcohol intake. Hospital contacts with alcohol problems represents an opportunity to raise these patients awareness of the threat alcohol intake poses to their health (40–42). Observational data suggests that brief interventions and implementation of alcohol care teams in the hospital setting reduce 1-year mortality, alcohol-related hospital admissions, and healthcare cost (43,44). Although ideally, such interventions should be studied in randomized controlled trials.

In conclusion, men and women hospitalized with alcohol problems have much higher rates of subsequent alcohol-related hospital admission and mortality than the general population. Thus, disease and premature mortality may be reduced by increased focus on preventing continued alcohol consumption in these individuals.

submitted work; no financial relationships with any organizations might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Ethical approval: Not required.

Appendix A - Diagnostic codes

Hospitalization/cause of death	ICD-10 diagnostic code
Mental and behavioral disease	F00-99
- Mental disease due to alcohol or substance abuse	F1
Cancer	C00-96
- Upper aerodigestive tract cancer (mouth, throat, upper esophagus, etc.)	C00-15, C32
- Lung cancer	C33-34
- Breast cancer	C50
- Stomach, colon and rectal cancer	C16-21
- Pancreatic cancer	C25
- Liver cancer	C22
Cardiovascular disease	I10-25, I30-69
- Acute myocardial infarction	I21
- Ischemic heart disease other than acute myocardial infarction	I20, I22-25
- Cardiomyopathy	I42-43
- Stroke	I60-69
Respiratory disease	J20-22, J30-34, J36-99
- Chronic obstructive pulmonary disease and asthma	J40-46
Nervous system disease	G00-99
Gastroenterological disease	K00-79, K85-93
- Liver and pancreatic disease	K70-77, K85-87
Infectious disease including pneumonia	A00-B99, J00-18, L00-L08, H65-70, N10N12, N30, M00-03
Musculoskeletal disease	M04-99
Ill specified disease	R00-99, N994
Admission for observation	Z00-13
External causes of disease	S00-T98
- Fractures	S02, S12, S22, S32, S42, S52, S62, S72,S82, S92
- Injuries	S00-11, S13-21, S23-31, S33-41, S43-51, S53-61, S63-71, S73-81, S83-91, S93-99, T00-35, T66-98
- Poisoning by alcohol or other substances	T36-65
External causes of death	S00-T98, V01-99, X60-84, Y00-98
- Suicide	X60-84
- Accidents	V01-99
All causes fully attributed to alcohol (37): Alcohol-induced Cushing's syndrome, mental disease due to alcohol, degeneration of nervous system due to alcohol, alcoholic polyneuropathy, alcoholic myopathy,	E24.4, F10, G31.2, G62.1, G72.1, I42.6, K29.2, K85.2, K86.0, O35.4, K70, P04.3, Q86.0, R78.0, T51, X45, X65, Y15, Y90, Y91

alcoholic cardiomyopathy, alcoholic gastritis, alcoholic liver disease, alcoholic pancreatitis, fetus and newborn affected by alcohol, fetal alcohol syndrome, finding of alcohol in the blood, toxic effect of alcohol, accidental self-poisoning by alcohol, intentional self-poisoning by alcohol, poisoning by alcohol, evidence of alcohol involvement

All causes mostly (≥ 74%) attributed to tobacco (45): Lung cancer, upper aerodigestive tract cancer, and chronic obstructive pulmonary disease	C00-15, C32-34, J40-44

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Tables

Table 1. Characteristics in men and women with a hospital contact with alcohol problems between 1998 and 2002, n = 38 885. Values are numbers (percentages) unless stated otherwise.

	Men	*Women*
	26 716 (69)	12 169 (31)
Characteristics of the initial hospital contact with alcohol problems		
Alcohol diagnosis		
Alcohol intoxication	10 300 (39)	4835 (40)
Harmful alcohol use	5485 (20)	2692 (22)
Alcohol dependence	10 931 (41)	4642 (38)
Department		
Somatic	20 680 (77)	8760 (72)
Psychiatric	6036 (23)	3409 (28)
Type of hospital care		
Admission	14 144 (53)	6280 (52)
Emergency	8477 (32)	4013 (33)
Outpatient	4095 (15)	1876 (15)
Demographic and medical characteristics		
Age, median (IQR)	44 (33-55)	45 (34-56)
Education, years		
≤9	13 007 (49)	6753 (55)
10-11	11 181 (42)	3234 (27)
≥ 12	2528 (9.4)	2182 (18)
Civil status		
Never married	12 840 (48)	4225 (35)
Married	7833 (29)	4217 (35)
Other	5478 (21)	3497 (29)
Missing	565 (2.1)	230 (1.8)
Charlson comorbidity index, score		
0	18 636 (70)	8501 (70)
1	3927 (15)	1805 (15)
≥ 2	4153 (16)	1803 (15)
Psychiatric comorbidity, number of diagnoses		
0	23 044 (86)	8911 (73)
1	2198 (8.2)	1772 (15)
≥ 2	1474 (5.5)	1486 (12)

Table 2. Observed numbers (O), expected numbers (E), and standardized incidence ratios (SIR) of subsequent hospital admission according to diagnosis in men and women with a hospital contact with alcohol problems in the years between 1998 and 2002, n = 38 885.

Diagnosis	Men			Women		
	O	E	SIR (95%)	O	E	SIR (95%)
Hospital admission to psychiatric departments						
Any diagnosis[1]	30 699	2488	12 (11-12)	19 480	1087	16 (16-17)
Mental disease due to alcohol or substance abuse[1]	10 614	563	15 (15-16)	5225	126	46 (43-48)
Outpatient visits to somatic departments						
Any diagnosis[2]	182 651	152,904	1.2 (1.2-1.2)	104 027	100,463	1.0 (1.0-1.0)
Hospital admission to somatic departments						
Any diagnosis	147 360	48 604	3.0 (3.0-3.0)	79 525	27,881	2.8 (2.8-2.9)
Mental and behavioral disease	17 764	1130	15 (15-16)	7720	294	26 (25-28)
Cancer	6356	4240	1.5 (1.4-1.5)	3600	2375	1.7 (1.6-1.8)
Cardiovascular disease	12 378	7207	1.7 (1.7-1.8)	3623	1902	2.0 (1.8-2.1)
Ischemic heart disease	4185	3055	1.4 (1.3-1.5)	923	639	1.7 (1.5-2.0)
Stroke	2813	1075	2.6 (2.4-2.8)	1264	388	3.0 (2.6-3.3)
Respiratory disease	6700	2107	3.3 (3.2-3.5)	3824	1018	3.5 (3.2-3.7)
Nervous system disease	4010	1423	2.8 (2.7-3.0)	1896	627	3.2 (2.9-3.5)
Gastroenterological disease	17 576	4209	4.1 (4.0-4.3)	7865	1631	5.0 (4.8-5.3)
Liver and pancreatic disease	7820	705	11 (11-12)	3242	207	17 (15-18)
Infectious disease	9827	3505	2.7 (2.6-2.8)	4606	1469	3.0 (2.8-3.2)
Musculoskeletal disease	5574	2928	1.7 (1.6-1.8)	3009	1614	1.7 (1.6-1.9)
Ill specified disease	11 323	3718	2.8 (2.7-3.0)	5942	1936	3.0 (2.8-3.2)
Admission for observation	11 157	3892	2.7 (2.5-2.8)	5743	1891	3.1 (2.9-3.3)
External causes	20 184	5073	3.8 (3.7-4.0)	11,917	2085	5.4 (5.2-5.7)
Fractures	5522	1506	3.7 (3.5-3.9)	3207	753	4.3 (4.0-4.6)
Injuries	10 484	3092	3.3 (3.2-3.4)	4218	1058	4.0 (3.8-4.3)
Poisoning by alcohol or other substances	4169	476	7.7 (7.2-8.3)	4476	273	15 (14-16)

SIRs are adjusted for calendar year of hospital contact with alcohol problems

[1]Psychiatric admissions were calculated for 2000-2013 due to limited data availability,

[2] Somatic outpatients visits were calculated for 2006-2013 due to limited data availability.

Table 3. Observed numbers (O), expected numbers (E), and standardized mortality ratios (SMRs) in men and women according to age at hospital contact with alcohol problems, in the years between 1998 and 2002, n = 38 885.

Age at hospital contact with alcohol problems	Men				Women			
	Person-years	O	E	SMR (95%CI)	Person-years	O	E	SMR (95%CI)
Overall, 20-84	265 451	9200	2206	4.0 (3.8-4.1)	125 551	3452	757	4.3 (4.0-4.7)
20-29	66 106	345	57	5.5 (5.0-6.2)	29 218	66	11	5.6 (4.4-7.2)
30-39	62 989	991	126	7.2 (6.7-7.7)	24 822	286	30	8.8 (7.8-10)
40-49	61 188	2051	320	5.9 (5.5-6.2)	32 824	750	109	6.4 (5.8-7.1)
50-59	46 330	2553	546	4.3 (4.0-4.5)	23 800	954	185	4.8 (4.4-5.2)
60-69	20 747	1962	595	3.0 (2.8-3.2)	10 138	785	198	3.7 (3.3-4.0)
70-84	8091	1298	562	2.1 (1.9-2.2)	4750	611	225	2.5 (2.3-2.8)

SMRs are adjusted for calendar year of hospital contact with alcohol problems

Table 4. Observed numbers (O), expected numbers (E), and standardized cause-specific mortality ratios (SMRs) in men and women with a hospital contact with alcohol problems, in the years between 1998 and 2002, n = 38 885.
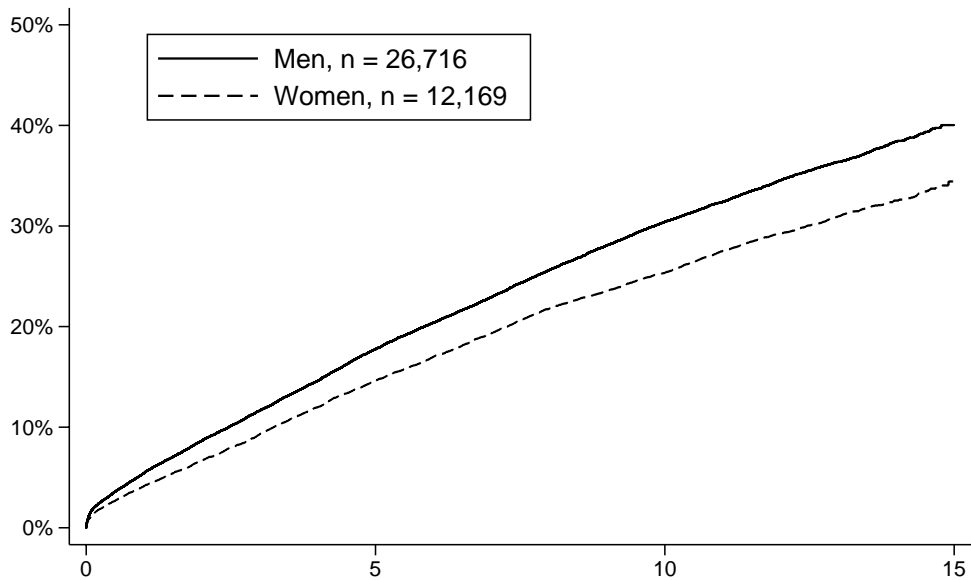
Cause of death	Men			Women		
	O	E	SMR (95%CI)	O	E	SMR (95%CI)
Mental disorders	1294	102	13 (11-14)	416	24	18 (15-22)
Mental disease caused by alcohol or substance abuse	1162	72	15 (14-17)	331	10	34 (28-43)
Cancer	1622	731	2.1 (1.8-2.3)	722	314	2.0 (1.7-2.3)
Upper aerodigestive tract cancer (mouth, throat, upper esophagus, etc.)	64	350	5.1 (4.1-6.5)	10	92	6.4 (3.9-11)
Lung cancer	454	190	2.2 (1.8-2.8)	231	77	2.5 (1.9-3.3)
Stomach, colon, and rectal cancer	193	113	1.4 (1.0-1.9)	61	41	1.5 (0.9-2.5)
Liver cancer	113	20	6.3 (4.3-9.2)	26	4	4.9 (2.1-12)
Pancreatic cancer	68	41	1.1 (0.6-2.1)	34	17	1.5 (0.7-3.3)
Breast cancer	<5	<5	N/A	92	56	1.4 (0.9-2.2)
Cardiovascular disease	1618	507	3.1 (2.8-3.4)	497	143	3.0 (2.5-3.7)
Acute myocardial infarction	306	133	2.0 (1.6-2.6)	88	30	2.7 (1.7-4.2)
Ischemic heart disease other than Acute myocardial infarction	345	119	3.4 (2.8-4.2)	80	25	3.0 (1.9-4.7)
Cardiomyopathy	67	11	6.1 (3.7-10)	8	2	6.0 (1.5-24)
Stroke	470	129	3.2 (2.6-3.9)	178	50	2.9 (2.1-4.1)
Respiratory disease	737	130	5.7 (4.9-6.6)	366	62	5.7 (4.6-7.1)
Chronic obstructive pulmonary disease and asthma	484	113	4.7 (3.9-5.7)	283	57	4.4 (3.4-5.7)
Nervous system disease	152	54	2.6 (1.8-3.8)	63	23	2.8 (1.6-4.7)
Gastroenterological disease	1806	135	12 (11-13)	729	41	16 (14-19)
Pancreatitis	123	10	9.9 (6.5-15)	29	2	10 (4.4-25)
Liver disease	1430	80	16 (14-18)	574	19	29 (25-35)
Infectious disease	353	66	4.7 (3.7-6.0)	124	23	7.2 (5.2-10)
Musculoskeletal disease	19	8	2.3 (0.9-6.1)	18	6	3.0 (1.1-7.9)
Ill specified disease	396	105	3.4 (2.7-4.2)	166	32	6.8 (5.1-9)
External causes of death	629	100	6.2 (5.3-7.3)	200	18	10 (7.6-14)
Suicide	381	58	6.4 (5.2-7.9)	138	10	12 (8.2-17)
Accidents	93	28	3.5 (2.3-5.3)	10	4	2.3 (1.2-4.3)
All causes fully attributable to alcohol (44)	2703	156	16 (15-17)	915	27	33 (29-38)
All causes mostly (≥ 74%) attributable to tobacco (51)	1268	363	3.5 (3.1-4.0)	592	142	3.5 (2.9-4.2)

SMRs are adjusted for calendar year of hospital contact with alcohol problems.

Figures

Figure 1. Cumulative all-cause mortality for men and women according to years since hospital contact with alcohol problems, in the years between 1998 and 2002, n = 38 885