Mortality and life expectancy of people with alcohol use disorder in Denmark, Finland and Sweden

Westman J, Wahlbeck K, Laursen TM, Gissler M, Nordentoft M, Häggren J, Arffman M, Ösby U. Mortality and life expectancy of people with alcohol use disorder in Denmark, Finland and Sweden.

Objective: To analyse mortality and life expectancy in people with alcohol use disorder in Denmark, Finland and Sweden.

Method: A population-based register study including all patients admitted to hospital diagnosed with alcohol use disorder (1 158 486 person-years) from 1987 to 2006 in Denmark, Finland and Sweden.

Results: Life expectancy was 24–28 years shorter in people with alcohol use disorder than in the general population. From 1987 to 2006, the difference in life expectancy between patients with alcohol use disorder and the general population increased in men (Denmark, 1.8 years; Finland, 2.6 years; Sweden, 1.0 years); in women, the difference in life expectancy increased in Denmark (0.3 years) but decreased in Finland (−0.8 years) and Sweden (−1.8 years). People with alcohol use disorder had higher mortality from all causes of death (mortality rate ratio, 3.0–5.2), all diseases and medical conditions (2.3–4.8), and suicide (9.3–35.9).

Conclusion: People hospitalized with alcohol use disorder have an average life expectancy of 47–53 years (men) and 50–58 years (women) and die 24–28 years earlier than people in the general population.

Significant outcomes

- People with alcohol use disorder have 24–28 years shorter life expectancy than the general population in the Nordic countries.
- Alcohol use disorder is a major public health problem that causes many years of lost life, even in countries with restrictive alcohol consumption policies.

Limitations

- A major limitation of the present study was the inclusion only of patients with alcohol use disorder from inpatient care, which may have caused selection bias of patients with the most severe health problems.
- The study was register-based and lacked clinical data about treatment and adherence.
- Alcohol consumption per capita was determined from aggregate data and not from alcohol exposure for individuals.
Introduction

Alcohol use disorder (AUD) is a major cause of morbidity and mortality (1). People with AUD have among the highest all-cause mortality of all people who receive treatment for mental disorders (2, 3). A meta-analysis that included 81 observational studies from many countries showed that people with AUD have three-fold higher mortality in men and four-fold higher mortality in women than the general population (4). In all people who have AUD, mortality is relatively higher in women, younger people and people in treatment for addiction (4). However, comprehensive mortality data over time of patients with AUD are not available from Nordic countries.

Increased alcohol consumption is associated with increased disease burden, accidents, and social problems (4, 5). In response to these effects, alcohol policies were created in Nordic countries (Sweden, Norway, Denmark, Finland and Iceland) to promote a decrease in alcohol consumption and restrict alcohol availability. The governments of all Nordic countries except Denmark have a monopoly of alcohol retail. However, after joining the European Union in 1995, Finland and Sweden shifted from a highly restrictive to a more liberal alcohol policy. The price of alcohol was reduced by tax reduction on alcoholic beverages in Denmark and Finland, abolition of quantitative quotas on alcoholic beverages in Sweden and Finland, and more generous opening hours of alcohol retailers in Sweden. These changes made alcohol more accessible to the public in these countries since 2003. The alcohol control policies of the countries were associated with total alcohol consumption (6, 7); Sweden has the most restrictive, and Denmark has the least restrictive alcohol policies. Frequency of heavy alcohol drinkers and alcohol-related problems are often assumed to depend on the level of alcohol consumption in the general population (7–9).

The reliable nationwide health care registers in Denmark, Finland and Sweden provide a unique opportunity to study mortality in people diagnosed with AUD.

Aims of the study

The purpose of this study was to evaluate mortality and life expectancy in people who had AUD in Denmark, Finland and Sweden between 1987 and 2006.

Material and methods

Study populations

National health registers from Denmark, Finland and Sweden were used to follow the entire population, approximately 20 million people, aged 15 years or above, in these three countries and identify all people who were admitted to hospital because of AUD as the primary or secondary diagnosis during 20 years (January 1, 1987 to December 31, 2006). Data about patients were retrieved from the national hospital discharge registers in each country. In Denmark, the data about patients were retrieved from the Psychiatric Care Register and the Hospital Discharge Register for medical care. In Finland and Sweden, the Hospital Discharge Registers, which contained information about medical and psychiatric care, were used. The hospital register information was linked to the national registers about causes of death in each country to retrieve data about date and cause of death. Data about alcohol consumption per capita were collected from an international database (6). Follow-up started on the day of first hospital admission for AUD. Each person was followed from the day of first hospital admission until death or the end of a 5-year period to estimate time trends with a sufficient number of deaths; therefore, a person could be counted in more than one time period if readmitted during a different period. For analysis of time trends, the 20-year observation period was divided into 5-year periods: 1987–1991, 1992–1996, 1997–2001 and 2002–2006. Ethical approval was obtained from the regional ethics committee in Gothenburg. The data-keeping authorities from each country gave permission to use health register data in this study.

Definitions

The diagnosis of AUD (mental and behavioural disorders due to alcohol use) was defined according to the World Health Organization classification system (International Classification of Diseases [ICD]): ICD-8, codes 291, 303; ICD-9, codes 291, 303, 305A; ICD-10, codes F10.0 to F10.9 (10–12). Causes of death were defined according to the classification as (1) all-cause mortality (ICD-8, codes 001 to E999; ICD-9, codes 001 to E999; ICD-10, codes A00 to Y98); (2) death from diseases and medical conditions (ICD-8, codes 001 to 796; ICD-9, codes 001 to 799; ICD-
10, codes A00 to R99); (3) suicide (ICD-8, codes E950 to E959; ICD-9, codes E950 to E959; ICD-10, codes X60 to 84); and (4) external causes of death other than suicide (ICD-8, codes E800 to E999, excluding codes E950 to E959; ICD-9, codes E800 to E999, excluding codes E950 to E959; ICD-10, codes V01 to Y98, excluding codes X60 to 84) (10–12).

Alcohol consumption was defined as the national average of registered amount of alcohol consumed (litres of pure alcohol) per capita aged ≥15 years during a calendar year. The aggregate indicator from taxation data included consumption for the entire population based on production, import, export and sales (6).

Statistical analysis

The study population for each country was stratified into 5 age groups (15–29 years; 30–44 years; 45–59 years; 60–74 years; ≥75 years), and frequency of mortality was calculated for each group. Person-years and number of deaths were determined for each age group and 5-year period. Standardized mortality per 100 000 person-years was calculated for each country and standardized using Nordic population data for the year 2000 (13). Mortality rate ratios were calculated by taking standardized mortality rate in people with AUD divided by standardized mortality rate in general population. We calculated life expectancy for people with AUD aged ≥15 years, stratified by sex, using Wiesler method with 1-year age stratification (14). Life expectancy for each of the 5-year periods was determined. Population life expectancy data for each country, calculated and published by the World Health Organization (6), were used for population comparisons. The difference in life expectancy between people with AUD and the general population increased for men but decreased for women during the entire study (Table 2).

Age

In all three countries, mortality rate ratios in people with AUD were higher in young age groups. In Denmark, mortality rate ratios increased during the entire study in men and women for most age groups, especially ages 30–59 years (Table 3). In Finland, mortality rate ratios increased during the entire study period in men and women aged 30–44 years. In Sweden, mortality rate ratios increased during the entire study period in men aged 30–74 years and women aged 45–74 years (Table 3).

Cause of death

In all three countries, people with AUD had higher mortality from all causes of death (Figs 5 and 6), all diseases and medical conditions, and suicide.
Table 1. Alcohol use disorder and associated mortality in Denmark, Finland and Sweden from 1987 to 2006

| Study period | Denmark | | | | Finland | | | | Sweden | | |
|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
|              | 1987–1991 | 1992–1996 | 1997–2001 | 2002–2006 | 1987–1991 | 1992–1996 | 1997–2001 | 2002–2006 | 1987–1991 | 1992–1996 | 1997–2001 | 2002–2006 |
| Men          |         |         |         |         |         |         |         |         |         |         |         |         |
| People with AUD |         |         |         |         |         |         |         |         |         |         |         |         |
| No. of people | 32 368  | 29 818  | 31 646  | 39 163  | 27 846  | 32 232  | 41 748  | 40 489  | 51 411  | 49 097  | 43 715  | 46 840  |
| No. of deaths | 4866    | 5042    | 5041    | 6997    | 3229    | 3465    | 5355    | 5458    | 7338    | 6705    | 5497    | 6313    |
| Person-years | 84 192  | 76 142  | 75 011  | 93 981  | 63 452  | 67 223  | 95 952  | 90 994  | 143 990 | 134 416 | 114 017 | 119 116 |
| Mortality per 100 000 person-years | 5780 | 6622 | 6720 | 7445 | 5092 | 5154 | 5811 | 5998 | 5096 | 4888 | 4821 | 5300 |
| Standardized mortality per 100 000 person-years | 7591 | 8142 | 7838 | 7720 | 6327 | 6476 | 6196 | 6067 | 5955 | 5459 | 5245 | 5119 |
| General population | | | | | | | | | | | | |
| Standardized mortality per 100 000 person-years | 1888 | 1867 | 1704 | 1576 | 1977 | 2011 | 2045 | 2009 | 1660 | 1524 | 1413 | 1294 |
| Women        |         |         |         |         |         |         |         |         |         |         |         |         |
| People with AUD |         |         |         |         |         |         |         |         |         |         |         |         |
| No. of people | 13 542  | 13 168  | 14 188  | 17 658  | 5428    | 7446    | 12 235  | 12 999  | 14 366  | 14 978  | 16 939  | 19 926  |
| No. of deaths | 1673    | 1827    | 1804    | 2579    | 435     | 523     | 976     | 1128    | 1305    | 1331    | 1327    | 1585    |
| Person-years | 36 070  | 33 484  | 35 090  | 43 735  | 12 086  | 14 844  | 28 136  | 29 502  | 39 488  | 39 879  | 43 150  | 49 649  |
| Mortality per 100 000 person-years | 4638 | 5460 | 5141 | 5897 | 3596 | 3523 | 3469 | 3824 | 3305 | 3338 | 3075 | 3192 |
| Standardized mortality per 100 000 person-years | 5379 | 5764 | 5249 | 5746 | 4614 | 4381 | 4152 | 4134 | 4352 | 4040 | 3788 | 3779 |
| General population | | | | | | | | | | | | |
| Standardized mortality per 100 000 person-years | 1223 | 1242 | 1164 | 1097 | 1162 | 1197 | 1190 | 1142 | 1046 | 979 | 934 | 891 |

AUD, alcohol use disorder.
than people in the general population (Table 3). In Denmark, mortality rate ratios in people with AUD increased from 1987 to 2006 from all diseases and medical conditions; mortality rate ratio from suicide was increased only in women during 2002 to 2006 (Table 3). In Finland, mortality rate ratios from all causes of death decreased during the entire study in both men and women; mortality rate ratios from all diseases and medical conditions were unchanged during the entire study for men and women, and mortality rate ratios from suicide increased in women but not men (Table 3). In Sweden, mortality rate ratios from all causes of death increased in men but was unchanged in women during the entire study; mortality rate ratio from suicide increased in both men and women (Table 3).

Alcohol consumption

During the entire study, registered alcohol consumption per capita was highest in Denmark and lowest in Sweden (Fig. 7). In Denmark, registered alcohol consumption per capita decreased slightly

![Fig. 1. Alcohol Use Disorder (AUD) and associated mortality in Denmark, Finland and Sweden from 1987 to 2006. Standardized mortality per 100 000 person-years. Men.](image1)

![Fig. 2. Alcohol use disorder (AUD) and associated mortality in Denmark, Finland and Sweden from 1987 to 2006. Standardized mortality per 100 000 person-years. Women.](image2)

Table 2. Life expectancy of people with alcohol use disorder and people in the general population in Denmark, Finland and Sweden from 1987 to 2006

| Life expectancy (years) | Denmark | Finland | Sweden |
|------------------------|---------|---------|--------|
| 1987–1991 | 46.6 | 50.3 | 50.3 |
| 1992–1996 | 46.1 | 50.1 | 49.3 |
| 1997–2001 | 46.7 | 50.7 | 49.3 |
| 2002–2006 | 47.5 | 51.4 | 51.4 |

Men

| Life expectancy (years) | People with AUD | General population |
|------------------------|-----------------|--------------------|
| 1987–1991 | 46.6 | 72.3 |
| 1992–1996 | 46.1 | 72.3 |
| 1997–2001 | 46.7 | 72.3 |
| 2002–2006 | 47.5 | 72.3 |

Women

| Life expectancy (years) | People with AUD | General population |
|------------------------|-----------------|--------------------|
| 1987–1991 | 49.8 | 77.9 |
| 1992–1996 | 49.5 | 77.9 |
| 1997–2001 | 51.4 | 77.9 |
| 2002–2006 | 52.7 | 77.9 |

† Difference: life expectancy in general population minus life expectancy in people with AUD.
after the year 2002. In Finland, registered alcohol consumption per capita peaked in the time period 2002–2006 in connection with an alcohol tax reduction. In Sweden, registered alcohol consumption per capita decreased slightly in the 90s and increased thereafter.

Discussion

Main findings

In this study, our main finding was a 24- to 28-year shorter life expectancy in people with AUD compared with the general population. Mortality associated with AUD was sex-dependent; men with AUD in all three countries had over time an increased difference in life expectancy, but women with AUD in Finland and Sweden (not Denmark) had a decreased difference in life expectancy. The changes in mortality and life expectancy during the study were most negative in Denmark and least negative in Sweden.

Strengths and limitations

A major strength of this study was the comparison of life expectancy and mortality in all people who had AUD diagnosed in three Nordic countries with different alcohol policies and patterns of alcohol consumption. The availability of nationwide health registers enabled us to follow the entire study population. The large population size (all people treated for AUD from three countries) provided highly reliable data. Much time and effort was invested in quality assurance of statistical analytical techniques, which made the data comparable between the different countries.

A major limitation of this study was the inclusion of patients from inpatient care only, which may have caused selection bias towards AUD patients with the most severe health problems. Patients with AUD who had only outpatient care were not included. The study was register-based and lacked clinical data about the type of treatment and adherence. In addition to disease prevalence in the population, patterns of hospitalization data including clinical diagnoses may be affected by other factors that were not analysed, such as changes in the number of hospital beds available, changes in hospital remuneration policies, and differences in clinical indications for hospital treatment. A common shortcoming in register studies is that they rarely can provide satisfactory answers on why the mortality is high or whether its decrease is due to policy changes, improved care or merely administrative decisions (15), although they can hint at the answer and provide directions (15, 16).

Another study limitation was that alcohol consumption per capita was determined from aggregate data and not from alcohol exposure for individuals. However, the World Health Organization data used in this study were supported by similar results from population surveys in Denmark, Finland and Sweden (17–19). In the aggregate data, neither age- nor sex-specific alcohol consumption data were available. The results based on aggregated data were exploratory and may not be used to draw definitive causative conclusions. In addition, data about illegal alcohol production and individual cross-border import were not included in the national statistics (6) and could not be evaluated in this study.

Life expectancy and mortality

The difference in life expectancy between people with AUD and the general population during the study increased in men in all three countries,
Table 3. Mortality rate ratio for people with alcohol use disorder compared with people in the general population in Denmark, Finland and Sweden from 1987 to 2006

| Mortality rate ratio* | Denmark | Finland | Sweden |
|----------------------|---------|---------|--------|
| Study period         | 1987–1991 | 1992–1996 | 1997–2001 | 2002–2006 | 1987–1991 | 1992–1996 | 1997–2001 | 2002–2006 | 1987–1991 | 1992–1996 | 1997–2001 | 2002–2006 |
|                      |         |         |         |         |         |         |         |         |         |         |         |         |
| **Men**              |         |         |         |         |         |         |         |         |         |         |         |         |
| Age (years)          |         |         |         |         |         |         |         |         |         |         |         |         |
| 15–29                | 9.5     | 9.1     | 8.7     | 7.5     | 15.1    | 21.7    | 18.8    | 16.8    | 9.6     | 11.5    | 9.2     | 10.3    |
| 30–44                | 14.2    | 16.4    | 19.6    | 19.3    | 12.7    | 13.5    | 17.6    | 20.7    | 14.7    | 15.5    | 18.5    | 18.7    |
| 45–59                | 8.8     | 11.1    | 11.6    | 13.1    | 6.9     | 7.0     | 6.6     | 6.7     | 8.4     | 9.4     | 10.3    | 11.4    |
| 60–74                | 5.0     | 5.3     | 5.8     | 6.3     | 3.1     | 3.3     | 3.3     | 3.6     | 4.2     | 4.3     | 4.6     | 5.3     |
| ≥75                  | 2.0     | 2.2     | 2.2     | 2.4     | 1.5     | 1.8     | 1.3     | 1.3     | 2.0     | 2.0     | 2.0     | 2.1     |
| Cause of death       |         |         |         |         |         |         |         |         |         |         |         |         |
| All causes           | 4.0     | 4.4     | 4.6     | 4.9     | 3.2     | 3.2     | 3.0     | 3.0     | 3.5     | 3.6     | 3.7     | 4.0     |
| All diseases and medical conditions† | 3.7 | 4.0 | 4.2 | 4.6 | 2.3 | 2.3 | 2.3 | 2.3 | 3.1 | 3.1 | 3.2 | 3.4 |
| Suicide              | 11.3    | 11.6    | 13.2    | 10.7    | 12.0    | 13.3    | 12.9    | 12.3    | 9.7     | 9.3     | 12.6    | 12.3    |
| Other external causes‡ | 8.6 | 9.3 | 9.5 | 11.5 | 12.3 | 13.5 | 10.0 | 11.0 | 10.2 | 11.4 | 11.0 | 12.0 |
| **Women**            |         |         |         |         |         |         |         |         |         |         |         |         |
| Age (years)          |         |         |         |         |         |         |         |         |         |         |         |         |
| 15–29                | 19.2    | 11.0    | 7.8     | 11.7    | 32.4    | 41.4    | 37.0    | 26.3    | 18.2    | 16.7    | 12.4    | 12.3    |
| 30–44                | 21.7    | 24.3    | 24.7    | 28.4    | 23.9    | 25.9    | 26.1    | 30.9    | 19.5    | 18.6    | 19.7    | 19.2    |
| 45–59                | 10.2    | 13.0    | 13.3    | 15.6    | 13.9    | 12.9    | 10.1    | 10.7    | 10.8    | 11.8    | 12.3    | 11.9    |
| 60–74                | 5.6     | 6.1     | 5.8     | 6.9     | 4.9     | 4.7     | 5.5     | 6.4     | 5.9     | 6.3     | 6.5     | 7.4     |
| ≥75                  | 2.0     | 1.9     | 1.9     | 2.4     | 1.5     | 1.5     | 1.5     | 1.4     | 2.2     | 2.1     | 2.0     | 2.1     |
| Cause of death       |         |         |         |         |         |         |         |         |         |         |         |         |
| All causes           | 4.4     | 4.6     | 4.5     | 5.2     | 4.0     | 3.7     | 3.5     | 3.6     | 4.2     | 4.1     | 4.1     | 4.2     |
| All diseases and medical conditions† | 3.7 | 4.1 | 4.0 | 4.8 | 3.0 | 2.6 | 2.6 | 2.8 | 3.6 | 3.6 | 3.5 | 3.6 |
| Suicide              | 21.4    | 22.4    | 20.4    | 24.9    | 22.0    | 35.5    | 35.9    | 27.3    | 15.9    | 23.5    | 26.8    | 28.5    |
| Other external causes‡ | 13.5 | 13.4 | 13.1 | 15.0 | 23.8 | 20.2 | 16.9 | 16.3 | 17.2 | 15.1 | 15.5 | 15.6 |

*Mortality rate ratio: Standardized mortality rate in people with AUD divided by standardized mortality rate in general population.
†Excludes suicides and other external causes.
‡Other external causes exclude suicides.
decreased in women in Finland and Sweden, and was unchanged in women in Denmark (Table 2). However, the number of women hospitalized because of AUD increased during the study in all three countries (Table 1), consistent with documented increase in alcohol consumption in women (13). In addition, there has been a decrease in the perceived stigma associated with seeking treatment for AUD (20, 21). Therefore, diagnosis and treatment of AUD may be more common in women currently than 20 years ago. Nevertheless, only 1 in 3 people with AUD seek treatment (21).

This study showed that people with AUD had a four-fold greater risk of premature death than people in the general population, and people with AUD died on average 24–28 years earlier than people in the general population. Previous studies showed the mortality risk to be two- to six-fold greater in people with AUD (4, 22). In this study, people with AUD had a greater risk of death from all diseases and medical conditions, suicide, and other external causes of death, than people in the general population, consistent with findings from previous studies (2–4, 22, 23).

In men, the difference in mortality between patients with AUD and the general population increased more in Denmark and Finland than Sweden. These differences may be associated with the overall level of alcohol consumption, which is highest in Denmark and lowest in Sweden. The difference in mortality between people with AUD and the general population was smaller for both men and women in all study periods in Sweden than Denmark or Finland (Table 2). The number of deaths among women increased in all three countries during the study period, due to increasing numbers of women diagnosed with AUD in all countries, although standard mortality ratios did not increase. The alcohol control policies of the countries are associated with total alcohol consumption; Sweden had the most restrictive, and Denmark had the least restrictive alcohol policies. Other studies have shown that the negative effects of the increased availability of alcohol in Finland mainly occurred in people with AUD (24–27). For example, in Finland, deaths from liver disease increased by 30% and alcohol-related sudden deaths increased by 17% after changes in alcohol regulations in 2004 (27–29).

Clinical implications

Findings from the present study show that AUD in the Nordic countries is associated with substantially increased mortality, even though alcohol control policies are restrictive compared with other countries. What might be important to add to the general restrictive alcohol policies would be
selective efforts aimed at high alcohol consumers, to achieve preventive effects in terms of reducing the rate of high consumers converting to AUD. In this field, a wider focus is necessary including testing new preventive efforts, with the aim of reducing alcohol-related harm in people with AUD. In addition the somatic care of people with AUD should be substantially improved.

In summary, the present study of the entire populations of Denmark, Finland and Sweden showed that people hospitalized with AUD had an average life expectancy of 47–53 years for men and 50–58 years for women. People hospitalized with AUD had a 24- to 28-year shorter life expectancy than the general population. During the study, the difference in life expectancy between people with AUD and the general population increased in men but not in women. Mortality and life expectancy were associated with total alcohol consumption in the three countries. Furthermore, the comprehensive population data confirmed that AUD is a major public health problem that causes many years of lost life, also in countries with restrictive alcohol consumption policies.

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Declarations of interest

Jeanette Westman, Kristian Wahbeck, Thomas Munk Laursen, Mika Gissler, Merete Nordentoft, Jonas Hällgren, Martti Arffman, and Urban Osby have no connections (direct or indirect) with the alcohol or pharmaceutical industries.

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