# Supplemental Digital Content 1

# A detailed description of patients and methods

Our study was a historical cohort study of patients with ALD who participated in one of three Danish National Health Surveys conducted in 2010, 2013, and 2017.1 We used the unique identification number assigned to all individuals living in Denmark and linked information from DNHS with the national registries to obtain data on ALD, hospital care, alcohol misuse treatment, socioeconomic status, and vital statistics.2

##### THE STUDY POPULATION

### Data sources

We used data from the three nationally representative Danish National Health Surveys (DNHS).1 Each survey included a random stratified sample of individuals aged 16 years or older with residence in Denmark. The questionnaires contained approximately 50 key questions and, within these, 11 questions regarding alcohol intake. In total, 911,349 persons received the questionnaire from 2010-2017. The participation rates for 2010, 2013, and 2017 ranged from 54% to 60%. In total, 523,294 questionnaires were answered.1 In our study, we used the answers to questions regarding alcohol habits, CAGE-questionnaire3, health-related quality of life (12-item Short Form questionnaire)4, and motivation to reduce alcohol consumption.

The *National Patient Registry* was established in 1977 and contains data on all hospital inpatient admissions with emergency and outpatient hospital contacts added since 1995. Diagnoses were recorded according to the tenth edition of the International Classification of Diseases (ICD-10) since 1994.

### The sample of patients with alcohol-related liver disease

A strength of the our study was the large pooled sample with complete and valid registry information on hospital contacts, diagnoses, and socioeconomic status.2,5,6 We used the *National Patient Registry* to identify patients diagnosed with ALD before they participated in DNHS in 2010, 2013, or 2017.2 All diagnoses were hospital diagnoses, and we had no data on diagnoses given in primary care. We excluded patients who had their first diagnosis more than ten years before participating in DNHS (n=323). In Denmark, few patients survive more than ten years with ALD7, and we were concerned that many of the long-term survivors did not truly have ALD. By excluding them we included a more homogenous study population. See Supplemental Digital Content 5 that illustrates the creation of the cohort. If patients participated in more than one of the health surveys (n=45), we used information from the earliest survey after their ALD diagnosis.

ALD was defined in our study either as a diagnostic code specifying ALD or as the combination of a diagnostic code for a liver disease of unspecified etiology and a diagnostic code indicating alcohol use disorder. The diagnostic codes for a liver disease of unspecified etiology and alcohol use disorder had to be recorded within one year. The date of the latest of these codes defined the time of ALD diagnosis. For all applied diagnostic codes, see Supplemental Digital Content 4.

Compared to medical chart reviews, the positive predictive value of the diagnostic codes obtained from the hospital registry are 85 %8, 100%9, and 71 %10 for respectively liver cirrhosis, mild and moderate/severe liver disease, and ALD.”

**National comparison cohort**

We investigated whether the included ALD patients from DHNS and all ALD patients in Denmark were comparable with respect to sociodemographic factors and liver disease severity. We identified all patients in Denmark who were alive and had a diagnosis of ALD in February 2017. At this time point, we assessed their sociodemographic factors and liver disease severity. We excluded patients who had been diagnosed with ALD before February 2007 (corresponding to the exclusion criterion of patients with ALD diagnosis more than ten years before DHNS). The included ALD patients were representative according to sociodemographic characteristics and liver disease severity(see Supplemental Digital Content 3).

##### THE MEASUREMENTS

### The self-reported alcohol consumption

The participants in DNHS were asked if they had been drinking alcohol in the past twelve months (yes/no). ﻿If yes, they were asked about the number of standard units of alcohol consumed per day of specific types of alcohol (beer/alcohol cider, wine, liquor/alcohol soda) during an average week. The total amount was converted into standard units per day (containing 12 g of ethanol).11 In this study, we categorized alcohol consumption into abstaining (<1 unit per week), 1-13, 14-27, 28-41, and ≥42 units per week. Alcohol use disorder was assessed with the CAGE questionnaire validated for detecting alcohol misuse and dependence disorders.3

### The motivation to reduce alcohol consumption

Only in patients reporting active alcohol consumption, the motivation to reduce alcohol consumption was assessed by the question: “*Do you want to reduce your alcohol consumption?*” with the response categories “*yes*”, “*no*” and “*don’t know*”. This question has not been validated in isolation, but it is included in several validated questionnaires to assess motivation to change drinking behavior.12–16 Two circumstances in our study indicated that the question was reliable to assess ALD patients’ motivation to reduce alcohol consumption. First, we found similar associations between the motivation to reduce alcohol consumption and severity of alcohol consumption, dependence symptoms, and hospital admission, as reported in prior studies.17–20 Second, reporting motivation to reduce alcohol consumption in the DNHS was associated with the highest level of motivation to change drinking behavior (action)13, assessed by the higher engagement in alcohol misuse treatment after participating in the DNHS.

### Clinical and sociodemographic characteristics

*The severity of liver disease*

The severity of ALD at the time of participation in DNHS was categorized as either *cirrhosis* or *non-cirrhotic liver disease*. The categorization as *cirrhosis* occurred if the patients had a diagnostic code for cirrhosis or had a diagnostic or procedure code indicating variceal bleed or ascites before participating in DNHS. All applied diagnostic codes are provided in Supplemental Digital Content 4, and a flowchart of the cohort selection is presented in Supplemental Digital Content 5.

*Hospital care*

Recent hospital care (outpatient clinics and hospital admissions) prior to DNHS participation was obtained from the *National Patient Registry.*2 Emergency room visits and inpatient admissions counted as hospital admissions.

*Quality of life*

Information on health-related quality of life was measured with the 12-item Short Form questionnaire (SF-12), which evaluates mental and physical health within eight dimensions.4,21,22 In our study, we used the summary score for both physical and mental health. The score ranges from 0 to 100, with higher scores indicating better health. A poor physical and mental health score was below 35.37 and 35.76, respectively, based on the total survey sample's 10% lowest summary score.23 Complete answers to SF-12 questions were available for 537 (80%) of 674 ALD patients; why we only included 547 patients in the health-related quality of life measurements.

*Sociodemographic characteristics*

Information on the highest attained education was obtained from the *Education Registry* 5. Occupational status was obtained from the *Labor Market Statistics* 6*.* The term ‘permanently outside labor market’ used in our study included pension and disability retirement. Data on vital status and migration was obtained from the *Danish Civil Registration System* 24. Data on cohabitation status was self-reported for ALD patients participating in the DNHS. For the national comparison cohort, information on cohabitation status was obtained from the *Family Registry.*25

**Engagement in alcohol misuse treatment**

Patients who reported active alcohol consumption were followed for two years for engagement in alcohol misuse treatment after DNHS participation*.* The alcohol misuse treatment was defined as either attending a specialized alcohol misuse treatment center or redeeming a drug prescription to treat alcohol use disorder. Any doctor in Denmark, including general practitioners, hospital physicians, psychiatrists, and doctors from the specialized alcohol misuse treatment centers, could prescribe the appropriate drug.24 Information on attainment in specialized alcohol misuse treatment centers was obtained from the *National Registry of Alcohol Treatment.*26 Information on redeemed prescriptions for acamprosate, naltrexone, nalmefene, or disulfiram was obtained from the *National Prescription Registry.*27Some patients might have received alcohol misuse treatment before participating in the DNHS. When we assessed the incidence of alcohol misuse treatment, we only considered alcohol misuse treatment after DNHS participation.

Both private and public institutions for alcohol misuse treatment are obligated to report alcohol misuse treatments to the *National Registry of Alcohol Treatment*. The registry contains all alcohol misuse treatments in Denmark since 2006. About 10% of individuals attending alcohol misuse treatment choose to be anonymous and are not recorded in the *National Registry of Alcohol Treatment*. However, in our study, individuals chosen to be anonymous that redeemed prescriptions on drugs to treat alcohol use disorders would still be included in the group of patients receiving alcohol misuse treatment. Our data did not include treatment in self-help groups or management of alcohol problems at the general practitioner, except when drugs were prescribed. We find it unlikely that this lack of data could be of such magnitude that it would affect the association between motivation to reduce alcohol consumption and subsequent engagement in alcohol misuse treatment.

##### STATISTICAL ANALYSES

Associations between clinical characteristics and the motivation

The following analyses were restricted to ALD patients reporting active alcohol consumption (n=436). We used a generalized linear model to calculate prevalence ratios (PR) for being motivated to reduce alcohol consumption according to a range of clinical characteristics including sociodemographic characteristics, severity of liver disease, health-related quality of life, recent hospital admissions, current alcohol consumption and severity of alcohol use disorder. PR is a measure of the relative risk, which avoids overestimations observed in calculations of odds ratios when the outcome is prevalent.28 The generalized linear model was from the Poisson family using a logarithmic link function.29 We treated motivation to reduce alcohol consumption as a binary variable: “yes” in one category and “don’t know” or “no” in the other. We performed a univariable analysis for all the assessed characteristics and a multivariable analysis in which all variables were included simultaneously.

### Engagement in alcohol misuse treatment

The following analyses were restricted to ALD patients reporting active alcohol consumption (n=436). We used the cumulative incidence function to obtain the 2-year probability of engaging in alcohol misuse treatment after participation in DHNS. This analysis takes account of the competing risk of death before engaging in alcohol misuse treatment.

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