

Incidence of ICD-Based Diagnoses of Alcohol-Related Disorders and Diseases from Swedish Nationwide Registers and Suggestions for Coding

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David Bergman,¹
Hannes Hagström,^{2–4}
Andrea Johansson Capusan,^{5,6}
Karl Mårild,^{7,8} Fredrik Nyberg,⁹
Kristina Sundquist,¹⁰
Jonas F Ludvigsson^{1,11–13}

¹Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden; ²Division of Hepatology, Department of Upper GI Diseases, Karolinska University Hospital, Stockholm, Sweden; ³Clinical Epidemiology Unit, Department of Medicine, Solna, Karolinska Institutet, Stockholm, Sweden; ⁴Department of Medicine, Huddinge, Karolinska Institutet, Stockholm, Sweden; ⁵Center for Social and Affective Neuroscience, Department of Biomedical and Clinical Sciences, Linköping University, Linköping, Sweden; ⁶Department of Psychiatry in Linköping, Department of Biomedical and Clinical Sciences, Linköping University, Linköping, Sweden; ⁷Department of Pediatrics, Institute of Clinical Sciences, Sahlgrenska Academy, Gothenburg, Sweden; ⁸Department of Pediatric Gastroenterology, Queen Silvia Children's Hospital, Gothenburg, Sweden; ⁹School of Public Health and Community Medicine, Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden; ¹⁰Center for Primary Health Care Research, Department of Clinical Sciences, Lund University, Malmö, Sweden; ¹¹Department of Pediatrics, Örebro University Hospital, Örebro, Sweden; ¹²Division of Epidemiology and Public Health, School of Medicine, University of Nottingham, Nottingham, UK; ¹³Department of Medicine, Columbia University College of Physicians and Surgeons, New York, NY, USA

Correspondence: Jonas F Ludvigsson
Department of Medical Epidemiology and Biostatistics, Karolinska Institutet,
Stockholm 17177, Sweden
Email jonasludvigsson@yahoo.com

Aim: To improve consistency between register studies in Sweden and ensure valid comparisons of possible changes in alcohol-related disorders and diseases (ARDDs) over time, we propose a definition of ARDDs. Based on this definition, we examined Sweden's incidence rates of ARDDs from 1970 to 2018 in non-primary healthcare settings (inpatient and outpatient).

Methods: Swedish Society of Epidemiology members were invited to give feedback on the International Classification of Disease (ICD) codes with a potential link to alcohol use. We then calculated age-standardised and age-specific incidence of ARDDs over time according to the National Patient Register, and the lifetime prevalence of ARDDs diagnosed in adults alive in Sweden on Dec 31, 2018.

Results: Sweden's estimated incidence of ARDDs increased substantially after introducing the new ICD-9 codes in 1987. In the past 10 years (2009–2018), the incidence of ARDDs has been stable (males: 110/100,000 person-years, females: 49/100,000 person-years). Requiring at least two ICD records for diagnosed ARDDs led to a somewhat lower incidence of ARDDs (males: 71 per 100,000 person-years, females: 29 per 100,000 person-years). In Sweden, the lifetime prevalence of diagnosed ARDDs in adults on Dec 31, 2018, was 1.9% (95% CI=1.9–1.9).

Conclusion: In this nationwide study, we found an incidence of ARDDs of 50–100/100,000 person-years. In 2018, 1 in 52 adults in Sweden had been diagnosed with ARDDs in the National Patient Register.

Keywords: alcohol, alcohol use disorder, alcohol-related disease, alcohol drinking, drug use, ethanol

Plain Language Summary

Excessive alcohol use has harmful health consequences including increased risks for injuries, violence, cardiovascular disease, and suicides. Considering the vast range of health effects of excessive alcohol use, it is important to consider alcohol-related disorders and diseases (ARDDs) in epidemiological research. Register-based research often uses diagnostic codes to identify individuals with ARDDs, but different researchers have used different codes. Besides, it is not well known how common these disorders and diseases are in Sweden. We carried out a web questionnaire survey among Swedish register researchers. Based on their responses, we defined a list of diagnostic codes that we believe can be used to identify ARDDs. We found that between 5–10 individuals receive a first-time diagnostic code for ARDDs for every 1000 people followed-up for ten years. In 2018, 1 in 52 adults in Sweden

had been diagnosed with alcohol-related disorder according to the nationwide National Patient Register that records all hospital-based diagnoses.

Introduction

In vulnerable individuals, alcohol consumption may have a negative impact on health. Harmful consequences¹ range from increased risk for injuries, violence, negative psychosocial outcomes to premature death due to increased risks for cardiovascular disease, and suicides,² but also for cancer, ranging from a 5% increased risk of breast cancer, an 11% increased risk for colorectal cancer to a 48% increased risk of liver cirrhosis.² The WHO estimates that more than 3 million people worldwide died of excessive use of alcohol in 2016².

Given the vast array of health effects of excessive alcohol use, it is important to consider alcohol-related disorders and diseases (ARDDs) in epidemiological research. ARDDs may serve as exposure, covariate or outcome for different research questions. A PubMed search on July 27, 2020, yielded more than 1100 scientific publications on alcohol use in register-based research in Sweden. These publications do not include research when alcohol was not the main focus of the research, or when the topic was strongly linked to alcohol, but alcohol was not mentioned (eg, liver cirrhosis). Register-based research often uses the International Classification of Disease (ICD) codes to identify individuals with ARDDs,^{1,3–7} but definitions of ARDDs have differed substantially between studies. Establishing a proper definition of ARDDs is vital to understanding the condition and the need for treatment.

The ICD coding system and the Swedish National Patient Register (NPR)⁸ have changed over time, with the 8th edition (ICD-8) introduced in Sweden in 1969, 9th (ICD-9) in 1987 (when the NPR became nationwide) and 10th (ICD-10) in 1997. In 2001, data on hospital-based outpatient care were added to the NPR.⁸ These administrative reforms need to be considered when examining the incidence and lifetime prevalence of ARDDs in Sweden.

This study aimed to suggest a definition of ARDDs to improve consistency between register-based studies. A second aim was to examine incidence rates of the global health concern related to alcohol use (as captured by diagnoses) in non-primary healthcare contexts (inpatient and outpatient) in Sweden over time.

Methods

Development of a Definition of ARDDs

Co-author JFL, together with HH, KS, KM and the steering group of the Swedish Society of Epidemiology, created a list of medical conditions that could potentially be included in a definition of ARDDs. Our definition of ARDDs included both alcohol use disorders (eg misuse) and alcohol-related diseases (eg liver disease and other somatic diseases).

The initial list also considered data from the US Centers for Disease Control and Prevention (CDC) on diseases that were deemed to be 100% attributable to alcohol.⁹ For sensitivity analyses, we also developed a secondary definition requiring two ICD codes representing ARDD.

In this study, we considered ARDD-specific ICD codes. Therefore, we did not include conditions that, although strongly linked to alcohol, may also have other causes, such as acute pancreatitis, psoriasis, epilepsy, stroke, spontaneous abortion, cholelithiasis or liver cancer. For instance, the ICD-10-code G40.5 represents seizures that may be due to alcohol, but G40.5 also covers seizures due to sleep deprivation, hormonal changes, medication and stress and was therefore not considered. When a specific alcohol use code (eg, gastritis caused by alcohol, ICD-10: K29.2) was available, the corresponding non-specific code (chronic gastritis unspecified, K29.5) was not included in our list. Nor did we include trauma conditions that may, but not necessarily, be coupled to excessive alcohol use, such as aspiration, drowning, fall injuries and traffic accidents. Foetal conditions that may have been due to maternal alcohol consumption (eg, foetal alcohol syndrome, Q86.0, or foetus affected by alcohol, P04.3) were not included either.

Through a web survey, twenty members of the Swedish Society of Epidemiology then voted on conditions that would form a register-based definition of ARDDs and were asked for input on the suggested ICD codes.

After their input, we decided to examine diagnoses of acute alcohol intoxication (ICD-9: 305A and ICD-10: F10.0) separately from the other conditions because they were not judged to necessarily reflect ARDDs and because they have a very different age distribution than ARDDs (acute alcohol intoxication is more common in teenagers, whereas ARDDs mainly affect adults).

Incidence of ARDDs

Incidence Was Calculated as the Number of First ARDD Records Divided by Years of Follow-Up. Annualised data on ARDD ICD codes recorded in the nationwide NPR (includes inpatient and non-primary care outpatient data) were obtained from the Swedish National Board of Health and Welfare. The NPR represents the complete Swedish population. We calculated age-standardised incidence rates of ARDDs over time. Data were retrieved from 1964 to 2018, but because there were almost no records of ARDDs during ICD-7 (years 1964–1968) when the NPR had inadequate coverage, we chose to present incidence data from 1969 and onwards (ICD-8, –9, –10).

We also examined whether the estimated incidence differed when requiring at least 2 ICD records for ARDDs, as well as the incidence of acute alcohol intoxication.

Lifetime Prevalence of ARDDs

Finally, we calculated the lifetime prevalence of ARDDs in adults alive in Sweden on Dec 31, 2018, by dividing the number of adults with any of the ICD codes listed in Table 1 in the NPR until that time with the registered Swedish population in 2018. For this analysis, all ARDDs records since 1964 were considered.

We also present data for children and adolescents (0–17 years).

Statistics

To control for changing demographics we age-standardised our incidence rates to the 2018 Swedish population. Stratifying on sex, we calculated incidence as age-standardised rates per 100,000 person-years. We also calculated the age-specific incidence rates stratified by sex. We used two-sided exact confidence intervals (CIs) based on a Poisson distribution.

Data on prevalence are presented as percentage of living individuals having met our definition for ARDDs before or on December 31, 2018.

In sensitivity analyses, we used a reduced number of ICD codes for ARDDs (Table 1) to determine how that would impact incidence and prevalence data.

A p-value of <0.05 (two-sided) was considered significant. Statistics were performed using Stata version 14.2 (StataCorp, College Station, TX, USA) or R version 3.4.0 (R Core Team (2015)).

Ethics

Because this study was based on aggregated, anonymous data that were not possible to link to any individual, ethical approval or informed consent was not required.¹⁰

Results

Definition of ARDDs

After discussing the results of the web survey, the co-authors agreed on a list of 29 conditions (Table 1). For sensitivity analyses, we used 23 of these conditions (Table 1).

Incidence of ARDDs

The estimated incidence of ARDDs increased markedly with the introduction of ICD-9 in 1987 (Figure 1).

During the past 10 years (2009–18), the incidence of ARDDs was stable (males: 110/100,000 person-years, females: 49/100,000 person-years) (Figure 1). Restricting our definition of ARDDs in a sensitivity analysis had a marginal impact on incidence figures (107/100,000 person-years in males and 46/100,000 person-years in females) (Figure 2).

Requiring ≥ 2 ICD records for an ARDD diagnosis resulted in a lower incidence during the past decade (male: 71/100,000 person-years, female: 29/100,000 person-years).

Examining age-specific rates, we found increasing rates for males up to age 65–69 years, after which the incidence declined. For females, a first peak was observed for patients aged 15–19 years and a second peak in the late 40s (Figure 3). Analysing incidence rates based on at least 2 ICD records to define ARDDs, the same pattern was observed, albeit with a smaller peak for females aged 15–19 years (results not shown).

Acute Alcohol Intoxication

We defined acute alcohol intoxication as having a record of ICD-9: 305A or ICD-10: F10.0. The first diagnosis coincided with the introduction of ICD-9 in Sweden. Thereafter, incidence was relatively low until 1997 when it again increased with the introduction of ICD-10, reaching the highest rates in 2012 (68/100,000 person-years for males and 43/100,000 person-years for females), after which it declined somewhat (Figure 4).

Looking at age-specific rates, there was a peak for both sexes in the age group 15–20 years (Figure 5). Of note,

Table 1 International Classification of Disease (ICD) Codes Included in the Definition of Alcohol-Related Disorders and Diseases (ARDDs)

ICD-7	ICD-8	ICD-9	ICD-10	Sensitivity Analysis
280,00: vitamin B1 deficiency with alcoholism	261,00: B1 deficiency with alcoholism			X
281,00: vitamin B3 deficiency with alcoholism	262,00: B3 deficiency with alcoholism			X
307: alcoholic psychosis	291: alcoholic psychosis	291: alcoholic psychosis		X
			E24.4: alcohol-induced pseudo-Cushing syndrome	X
322: alcoholism	303: alcoholism	303: alcoholism	F10: psychiatric conditions and behavioural changes due to alcohol – minus F10.0 (acute alcohol intoxication)	X
		357F: alcoholic neuropathy	G62.1: alcoholic neuropathy	X
		425F: alcoholic cardiomyopathy	I42.6: alcoholic cardiomyopathy	X
		535D: gastritis due to alcohol	K29.2: gastritis due to alcohol	X
			G31.2: nervous system injury/disease due to alcohol	X
			G72.1: myopathy due to alcohol	X
		571B: alcoholic hepatitis	K70.1: alcoholic hepatitis	X
		571D: unspecified liver injury due to alcohol	K70.9: unspecified liver injury due to alcohol	X
581,10: liver cirrhosis with alcoholism	571,00: liver cirrhosis with alcoholism	571C: liver cirrhosis due to alcohol	K70.3: liver cirrhosis due to alcohol	X
583,10: fatty liver due to alcoholism	571,01: fatty liver due to alcoholism	571A: fatty liver due to alcohol	K70.0: fatty liver due to alcohol	X
			K70.2: liver fibrosis and liver sclerosis due to alcohol	X
			K70.4: liver failure due to alcohol	X
			K85.2: acute pancreatitis due to alcohol	X
			K86.0: chronic pancreatitis due to alcohol	X
			035.4: Care of pregnant mother with alcohol abuse in which the foetus may be affected	X
960,20: Toxic effect of ethanol	980,00; 980,01: Toxic effect of ethanol and ethanol surrogates	980A: toxic effect of ethanol	T51.0: toxic effect of ethanol	

(Continued)

Table 1 (Continued).

ICD-7	ICD-8	ICD-9	ICD-10	Sensitivity Analysis
960,29: toxic effect of alcohol, unspecified	980,99: toxic effect of alcohol, unspecified	980X: toxic effect of alcohol, unspecified	T51.9: toxic effect of alcohol, unspecified	
		790D: high blood levels of alcohol	R78.0: high blood levels of alcohol	
		977D: intoxication with medicine against alcohol abuse	Y57.3: intoxication with medicine against alcohol abuse	X
			X65: Self-destructiveness with alcohol use	
			Y90: signs of alcohol intoxication confirmed by blood measurement	
			Y91: signs of alcohol intoxication, clinically confirmed	
			Z50.2: rehabilitation due to alcohol abuse	X
		V79B: health check-up for psychiatric problems and alcoholism	Z71.4: advice and check-up for alcohol abuse	X
			Z72.1: lifestyle problems due to use of alcohol	X

Note: Diagnoses used in our sensitivity analyses are marked with "X".

when requiring ≥ 2 ICD records to indicate acute alcohol intoxication, the age-specific rates were much more stable across all ages, indicating that the healthcare contact requiring intoxications in the younger age group may have been relatively isolated occurrences for many individuals (Figure 6).

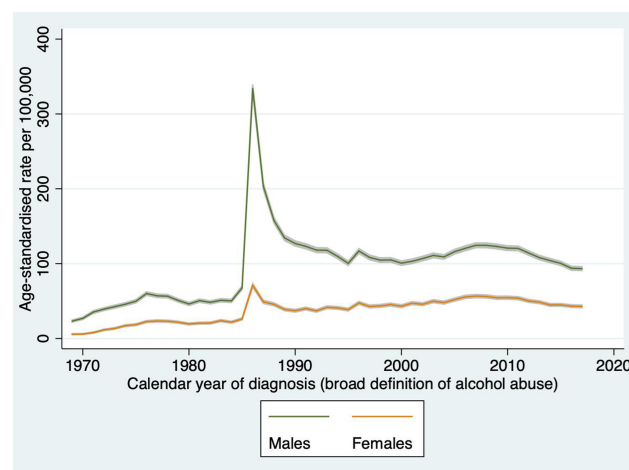


Figure 1 Incidence of alcohol-related disorders and diseases in Sweden (all ages).
Note: Figure shows incidence rate as per 100,000 person-years.

Lifetime Prevalence of ARDDs

The lifetime prevalence of ARDDs in Sweden on Dec 31, 2018, was 1.9% (95% CI=1.9–1.9). Additional data are given in Table 2.

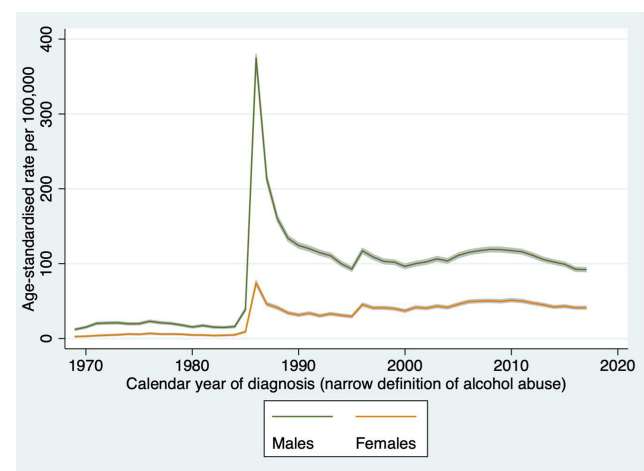


Figure 2 Incidence of alcohol-related disorders and diseases in Sweden (all ages) using a narrow definition (sensitivity analysis).

Notes: Figure shows incidence rate as per 100,000 person-years. The higher incidence in 1987 for the narrow definition is because this definition included fewer ICD-7 and ICD-8 codes and hence some individuals identified up until 1986 in our main analysis (Figure 1) were only identified in 1987 in our sensitivity analysis.

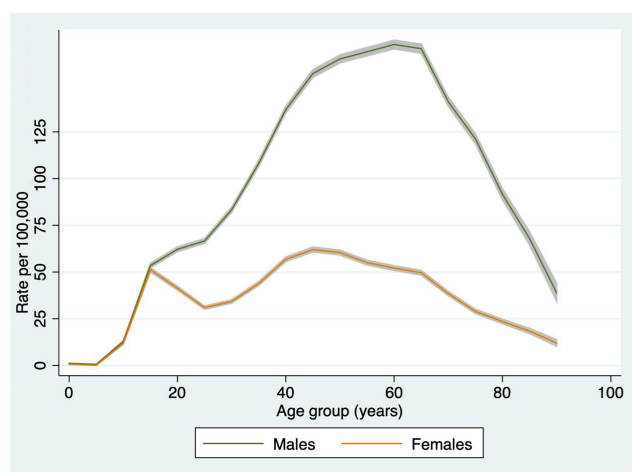


Figure 3 Age-specific incidence rates for alcohol-related disorders and diseases in Sweden, 1965–2018.

Note: Figure shows incidence rate as per 100,000 person-years.

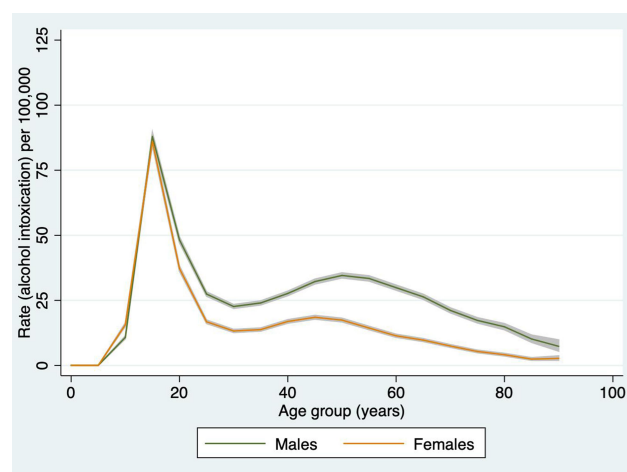


Figure 5 Age-specific incidence rates for acute alcohol intoxication (first diagnosis) in Sweden, 1965–2018.

Note: Figure shows incidence rate as per 100,000 person-years.

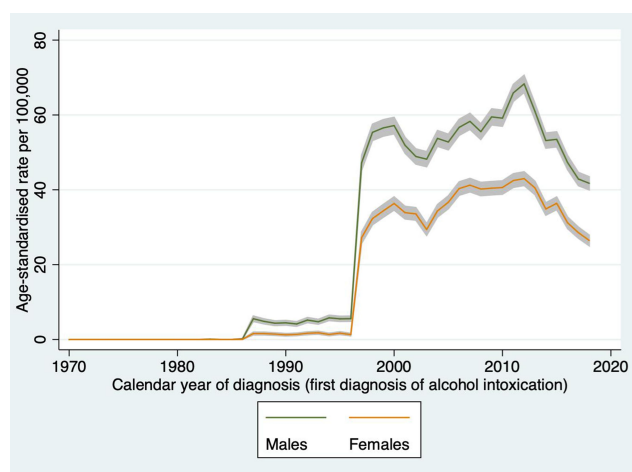


Figure 4 Incidence of acute alcohol intoxication (all ages).

Note: Figure shows incidence rate as per 100,000 person-years.

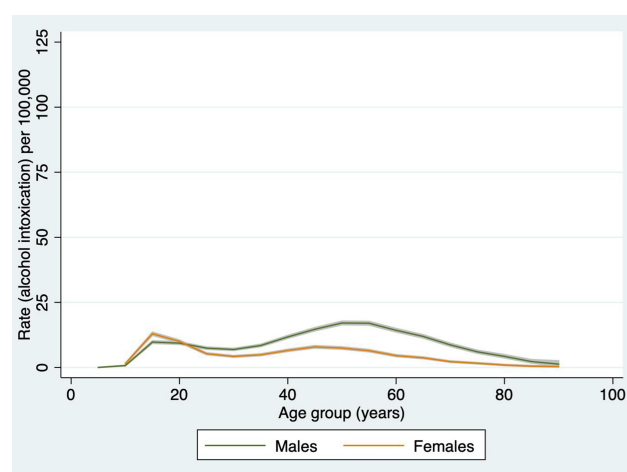


Figure 6 Incidence of acute alcohol intoxication (≥ 2 ICD diagnoses) in Sweden, 1965–2018.

Note: Figure shows incidence rate as per 100,000 person-years.

Very few children/adolescents (aged 0–17 years) fulfilled our criteria for ARDDs (1 in 13,556 individuals), with even fewer satisfying the definition of our sensitivity analysis. One in 1078 children/adolescents had a record of earlier alcohol intoxication and one in 3499 had ≥ 2 records of alcohol intoxication.

Discussion

We conducted a web questionnaire survey among Swedish epidemiologists. Based on their responses, we defined a list of codes that we believe can be used to ascertain ARDDs. Applying these codes to the NPR, covering the whole Swedish population, we noted that the incidence changed markedly after the introduction of ICD-9 in Sweden, most likely because of the development of the

ICD system in this version that allowed physicians to distinguish between alcohol and non-alcohol-related disorders and diseases. We found an incidence of ARDDs of 50–100/100,000 person-years. In 2018, 1 in 52 adults in Sweden had been diagnosed with ARDDs in the NPR.

The key message of this paper is the proposed definition for ARDDs. This definition may help researchers in their work and facilitate the inclusion of ARDD as a covariate in medical research. Unquestionably, our definition does not cover all diseases in which alcohol plays a role. For instance, the US Centers for Disease Control and Prevention (CDC) list a number of cancers, including gastrointestinal haemorrhage, low birth weight in offspring, psoriasis, stroke, hypothermia and heart

Table 2 Lifetime Prevalence of Alcohol-Related Disorders and Diseases and Alcohol Intoxication in Sweden, 2018

Definition	≥1 Record			≥2 Records		
	ARDDs – Main Analysis*	ARDDs – Sensitivity Analysis*	Acute Alcohol Intoxication#	ARDDs – Main Analysis*	ARDDs – Sensitivity Analysis*	Acute Alcohol Intoxication#
Number of individuals	156,015	128,200	141,716	78,381	73,600	42,820
Prevalence (%); 95% CI	1.9 (1.9–1.9)	1.6 (1.6–1.6)	1.8 (1.8–1.8)	1.0 (1.0–1.0)	0.9 (0.9–0.9)	0.5 (0.5–0.5)

Notes: Based on a total population of 10,230,185 individuals on Dec 31, 2018 and hospital-based diagnoses since 1964. *See Table 1 for definitions. #ICD-9: 305A or ICD-10: F10.0. ARDDs, alcohol-related disorders and diseases.

dysrhythmia as linked to alcohol use.⁹ Adding traffic accidents and psychiatric illness to the list, it becomes clear that our prevalence estimates do not represent the overall impact of alcohol on health. Still, our definition constitutes a set of core diagnoses in which the physician is confident that the condition can be attributed to alcohol. We also present data on a narrow definition in our sensitivity analyses. However, incidence rates using our narrow definition were remarkably similar to those of the main definition.

Although it was beyond the scope of this paper to examine individual patient charts of the more than 100,000 individuals with an ARDD diagnosis, we believe that such a diagnosis is likely to have a high positive predictive value (PPV) for ARDDs (similar to many other chronic disorders in the NPR, which have PPVs of 85–95%⁸), but with a lower negative predictive value as ARDDs can still occur without an individual being assigned any of our listed codes (Table 1). We recognise the need for future validations of our ARDD definition.

We used the NPR to ascertain ARDDs in that this register allows long-term incidence comparisons (the register started in 1964 and became nationwide in 1987). There are other sources of data for capturing some alcohol use, such as the Prescribed Drug Register,¹¹ where alcohol abuse treatments can be ascertained (disulfiram (ATC code, N07BB01), acamprosate (N07BB03) or naltrexone (N07BB04)). However, this register has only been available since mid-July 2005 and the listed drugs are only prescribed to individuals who acknowledge excessive alcohol use, have heavy abuse and most likely would be captured by some diagnostic code from the NPR.

Over the past 10 years, the incidence of ARDDs has been relatively stable (males: 110/100,000 person-years, females: 50/100,000 person-years). These incidence rates

should be considered reasonable minimum levels and the stability of the incidence is noteworthy.

We observed a possible drop in ARDDs in later years. A recent questionnaire study in Sweden found lower Alcohol Use Disorder Identification Test (AUDIT) scores in men in 2018 than in 2001.¹² Alcohol consumption in Sweden has been high from the 1970s to the early 2000s.¹³ During the past 10 years, however, alcohol consumption has decreased by 9%.¹⁴ Alcohol-related deaths have also decreased from 28 to 20/100,000 inhabitants in the past two decades.¹⁵

However, our study does not measure alcohol consumption or all alcohol-related problems but rather alcohol use disorder (harmful use and dependence) and alcohol-related diseases (captured by clinical diagnoses, ie, those most severe leading to medical care). The spectrum of ARDDs in Sweden may also have changed with the type of alcohol consumed. While Swedes were mainly drinking spirits in the 1950s (spirits made up 70% of the alcohol consumption back then), spirits only constituted 20% of the total alcohol consumption in 2018. Instead, wine had become the most consumed alcoholic drink.

The estimated lifetime prevalence of ARDDs was 1.9% among adults in this study. This percentage is low compared to 5.8% in those ≥12 years in the US¹⁶ and to Europe's 3.4% in people aged 18–64 years of age.¹⁷ A questionnaire study of 28,800 Swedish adults using DSM-IV criteria for alcohol dependence¹⁸ found that while 4% fulfilled 3–4 DSM-IV criteria, about 1% of the adults fulfilled 5–7 criteria, ie had severe alcohol dependence.¹⁸ The Swedish data suggest that our study based on register diagnoses apprehends the more severe end of the alcohol dependence spectrum.

We chose not to include alcohol intoxication in our definition of ARDDs. As assumed a priori and noted in Figure 5, the age pattern was distinctly different for alcohol intoxication than for the ARDDs included in our definition.

Age seems to be a major factor influencing the incidence of ARDDs. The incidence increased throughout life in males but had a somewhat different pattern in females, where the incidence was bimodal with higher levels in teenage years and then again rising at the age of 35–40 years. We speculate that this pattern may be due to some females refraining from alcohol use during their fertile years out of concern for potential adverse effects on fertility and pregnancy outcome.

This study has both strengths and limitations. The Swedish healthcare system is tax-funded¹⁹ and offers universal access. Such a system should limit bias due to socioeconomic factors, which may be particularly relevant in ARDDs.^{20,21} The primary purpose of our paper was not only to suggest a definition of ARDDs for use in register-based research but also present incidence and prevalence data, partly to visualise how the coding of ARDDs has changed with the introduction of new ICD systems and changes to the NPR. Several important coding changes were noted, including the addition of outpatient data in 2001 that resulted in an increase in ARDDs, which likely reflects both incident cases and prevalent cases that had never received inpatient care and therefore not captured until 2001.⁸

The main limitation of our study is that our incidence and prevalence estimates probably represent conservative estimates of ARDDs in the populations that most likely capture the more severe end of the spectrum. We therefore urge caution when interpreting these data. Many people with ARDDs will never receive an ARDD diagnosis. Furthermore, our dataset did not include primary care data, where we expect to find a large proportion of mild to moderate alcohol-related cases.²² Data for this study were supplied by the National Board of Health and Welfare and did not allow for individual-based assessments (eg the presence of one intoxication plus one organ concern in a certain individual). Hence, we were unable to examine combinations of specific codes.

Neither were we able to examine specific ICD chapters since the data from the above government agency did not contain any ICD-specific information but only the number of individuals (according to age and sex) who had either 1 or 2 records of ARDD as per our stipulated definition. Since the National Patient Register does not contain diagnoses coded using the Diagnostic and Statistical Manual of Mental Disorders (DSM) system, we were unable to compare ICD-based and DSM-based definitions for alcohol-related disorders. However, an earlier Swedish population study²³ found

a substantial agreement between DSM-5 classifications of alcohol use disorders and those of ICD-10 as well as earlier DSM classifications. Since ICD diagnoses were clinically assigned in specialist care according to current medical practice, data does not include alcohol-related *symptoms*.

Finally, not all individuals with ARDDs will seek help, probably because of the stigma attached to ARDDs and the reluctance to seek help from healthcare services. A Swedish government national investigation estimated that only one in five of those with addiction would receive treatment,²⁴ these figures are similar to those found in European primary care settings.²²

The more severe cases will inevitably come in contact with the healthcare system because of alcohol-related medical or psychiatric complications. Thus, our algorithm may capture the more extreme end of the ARDD spectrum. Our suggested definition is therefore probably more reliable in including moderate to severe ARDDs but less likely to identify low alcohol users.

In conclusion, we propose a standardised list of ICD codes to identify ARDDs for use in register-based research. The incidence of ARDDs in Sweden, as measured in non-primary health care, seems to be higher in males than in females, which is consistent with the literature.^{16–18} This incidence rate has remained steady in the past 10 years. We hope that our proposal for an ARDD definition will improve consistency between register-based studies and support more valid comparisons of ARDD rates over time.

Key Notes

- Alcohol-related disorders and diseases (ARDDs) are common but epidemiological research on ARDDs is hampered by a lack of consensus on definitions.
- Through a web questionnaire, followed by group discussions, we systematically developed and agreed on a definition for epidemiological research on ARDDs using International Classification of Disease (ICD) codes in nationwide registers linked to high alcohol consumption.
- The incidence of ARDDs has been stable over the past 10 years. One in 52 adults in Sweden has been diagnosed with ARDDs in national registers.

Abbreviations

ARDDs, alcohol-related disorders and diseases; ICD, International Classification of Disease; NPR, National Patient Register.

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Disclosure

Andrea Johansson Capusan reports personal fees from Camurus, Indivior, and Lundbeck, outside the submitted work. Fredrik Nyberg reports being an employee of AstraZeneca until 30 September 2019, outside the submitted work. Jonas F Ludvigsson reports coordinating a study on behalf of the Swedish IBD quality register (SWIBREG); this study has received funding from Janssen corporation. The authors report no other potential conflicts of interest for this work.

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