European Journal of Population **18:** 307–323, 2002.
© 2002 *Kluwer Academic Publishers. Printed in the Netherlands.*

Alcohol-Related Mortality in 15 European Countries in the Postwar Period

MATS RAMSTEDT
Centre for Social Research on Alcohol and Drugs, Stockholm University, Sveaplan, Stockholm, Sweden (e-mail: mats.ramstedt@sorad.su.se)

Received 15 May 2001; accepted in final form 28 September 2001

Ramstedt, M., 2002. Alcohol-Related Mortality in 15 European Countries in the Postwar Period, European Journal of Population, **18**: 307–323.

Abstract. The aim of this paper is to assess postwar differences and trends in alcohol-related mortality in the current European Union (minus Luxembourg plus Norway) on the basis of liver cirrhosis mortality and deaths with explicit mention of alcohol, primarily alcohol dependence, alcohol psychosis and alcohol poisoning (AAA). The question of the extent to which these indicators are comparable across Western European countries is also addressed. A marked north-south gradient was found for cirrhosis mortality, with the highest rates revealed in Southern Europe and the lowest in Northern Europe. However, this gradient weakened with the passage of time and the initially quite substantial regional differences declined during the latter part of the study period. Explicitly alcohol-related mortality (AAA), on the other hand, showed a reverse cross-national pattern with the highest rates in the north and the lowest in the south. A positive cross-national relationship was observed between cirrhosis and per capita consumption but this match was not improved by combining cirrhosis with explicitly alcohol-related causes. Nevertheless, within Southern, Central and Northern European countries the relationship between per capita consumption and AAA-mortality was positive. It is concluded that cirrhosis mortality is useful for making rough national comparisons in a Western European context whereas the validity of explicitly alcohol-related mortality is questionable. Cultural differences in recording practices and drinking patterns are discussed as possible determinants of geographical differences in AAA-mortality.

Key words: alcohol-related mortality, European comparisons, comparability of causes of death data, per capita alcohol consumption, drinking patterns

Ramstedt, M., 2002. La mortalité due à l'alcool dans 15 pays européens depuis la deuxième guerre mondiale, Revue Européenne de Démographie, **18**: 307–323.

Résumé. Cet article compare les niveaux et tendances de la mortalité due à l'alcool dans les pays de l'Union européenne (sans le Luxembourg mais avec la Norvège) depuis la deuxième guerre mondiale, en étudiant la mortalité par cirrhose du foie et par cause spécifiée comme alcoolique, principalement la dépendance, la psychose et l'empoisonnement alcooliques (AAA). Il traite également de la comparabilité de ces indicateurs dans les pays d'Europe occidentale. Pour la mortalité par cirrhose, il existe un axe nord-sud nettement marqué, avec les taux les plus élevés en Europe méridionale et les plus bas en Europe du nord. Cependant, les écarts se réduisent au fil du temps et les différences régionales, au départ assez prononcées, sont beaucoup moins fortes

dans la période la plus récente. Par ailleurs, la mortalité par cause spécifiée comme alcoolique a une configuration géographique inverse avec des taux plus élevés au nord qu'au sud. Il existe une corrélation entre la mortalité par cirrhose et la consommation d'alcool par tête, mais celle-ci n'est pas renforcée lorsque l'on considère l'ensemble de la mortalité due à l'alcool (cirrhose et causes spécifiées comme alcooliques). Néanmoins, si l'on distingue trois groupes de pays (Europe du sud, Europe centrale, Europe du nord), on retrouve au sein de chaque groupe une corrélation entre la consommation par tête et la mortalité par cause spécifiée comme alcoolique. En conclusion, la mortalité par cirrhose permet de donner une approximation utile des différences nationales en Europe occidentale, tandis que la validité de la mortalité par cause spécifiée comme alcoolique est incertaine. Pour cette dernière, les différences culturelles dans les pratiques d'enregistrement des causes de décès et dans les modes de consommation peuvent expliquer une partie des différences géographiques observées.

Mots clés: mortalité due à l'alcool, comparaisons européennes, comparabilité des causes de décès, consommation d'alcool par tête, habitudes de consommation

1. Introduction

Liver cirrhosis mortality is a classical indicator of harmful drinking in a population, and this measure is still the main marker in comparative studies (see, e.g., Munoz-Perez and Nizard 1999, Ramstedt 1999, Edwards et al. 1994, Davies and Walsh 1983, Bruun et al. 1975). It is yet surprising that no comparative study has considered deaths explicitly caused by alcohol, e.g., alcoholism, alcohol psychosis and alcohol poisoning. Besides the fact that it may seem to be a matter of course to include such causes of death in analyses of alcohol-related mortality, a broader indicator is generally regarded as more reliable than a narrower one. If national differences in cirrhosis mortality are partly explained by a preference for competing codes (e.g., alcoholism) in some countries, the comparability would be improved if these competing codes were included. Liver cirrhosis and alcoholism are indeed diagnoses that may be confused since a sign of alcohol-induced liver disease is one criterion for using the diagnosis alcoholism (Romelsjö et al. 1993). Similarly, practical difficulties have been noticed in the choice among alcoholism, alcohol poisoning, alcohol psychoses and alcoholic cardiomyopathy (see, e.g., Poikolainen 1977, Sundby 1967).

On the other hand, it is well known that diagnoses with a mention of alcohol are strongly underreported in many countries (Savolainen et al. 1992, Haberman et al. 1990, Blake et al. 1988, Ågren and Jakobsson 1987, Maxwell and Knappman 1985). Little is known about national differences in this respect, but it may be noted that substantial variation in certification and coding practices across European countries has been found for other less controversial causes of death, such as diabetes (Jougla et al. 1992). It can thus not be taken for granted that adding explicitly alcohol-related deaths to cirrhosis mortality improves the international comparability. The results below will shed some light on this issue.

More specifically, the aim of this paper is to describe variations in alcohol-related mortality in postwar Western Europe and to assess how these match variations in overall consumption of alcohol. It should be stated from the outset that the purpose is not to estimate the total load of mortality caused by alcohol (for an example of such efforts, see, e.g., Single et al. 1999), but only to describe and analyse mortality where alcohol is the major risk factor.

2. Data and methods

Annual population and mortality data (gender specific in 5–year age groups) were compiled for all current EU countries (except Luxembourg) and Norway. Data on liver cirrhosis mortality were obtained from the World Health Organisation (WHO, Geneva office), whereas data for explicitly alcohol-related deaths were gathered from national statistical agencies. Liver cirrhosis also includes other chronic liver diseases but is designated as only liver cirrhosis. Moreover, data for cirrhosis with mention of alcohol were separately compiled from WHO (Geneva office) for 1987–1995. This group is denoted alcoholic cirrhosis.

The category referred to as "explicitly alcohol-related deaths" comprises deaths from alcoholism, alcohol psychosis and alcohol poisoning up to the ninth revision of the International Classification of Diseases (ICD–9), which mostly came into practice around 1979–1980, except for the Nordic countries where it was first applied in 1986–1987. The introduction of ICD–9 included the following alterations: the previous category of "alcoholism" was now renamed "alcohol dependence", and four new mortality categories explicitly attributable to alcohol were introduced: alcohol abuse (non-dependent abuse of alcohol), alcoholic gastritis, alcoholic cardiomyopathy and alcoholic polyneuropathy (World Health Organisation 1975). Throughout the analyses, all causes of death with explicit mention of alcohol, except alcoholic cirrhosis, were merged into one mortality-category, abbreviated AAA. Besides the fact that these deaths are explicitly attributed to alcohol, it is well established that distinguishing among many of these diagnoses is fairly difficult in practice (Poikolainen 1977). Table I lists all causes of death (and ICD-codes) included in the study.

The approximate study period is 1950–1995, but for many countries some years are missing. For instance, data on explicitly alcohol-related mortality in Portugal and Greece were not available before 1980 (see Table II).

Country-specific information on per capita alcohol consumption (in litres of 100% alcohol per inhabitant 15+) was derived from the Brewers Association of Canada (1997). This consumption indicator is based on sales figures as well as statistics on production and trade with alcohol. Thus, non-taxed home production is not included and traveller's imports or consumption abroad may be recorded in one country but consumed in another. Although unrecorded consumption is most prevalent in the high price countries of Northern Europe, recent studies

Table I. ICD-codes for alcohol-related causes of death

Causes of death	ICD 6–7	ICD–8	ICD–9
Liver cirrhosis*	581	571	571
Alcoholic diseases of the liver	–	–	571.0–571.3
Alcoholism/Alcohol dependence syndrome	307	303	303
Alcoholic Psychosis	322	291	291
Alcohol Poisoning	E880	E860	E860
Alcohol Abuse	–	–	305.0
Alcoholic Cardiomyopathy	–	–	425.5
Alcoholic Gastritis	–	–	535.3
Alcoholic Polyneuropathy	–	–	357.5

*Chronic liver diseases since ICD–9.

show that no major changes in rank-order of the EU-countries occur if unrecorded consumption (as estimated) is taken into account (Leifman 2001a, Trolldal 2001).

In estimations of the relationship between alcohol and mortality, the variables are transformed to satisfy the assumption that the death risk is an exponential function of accumulated alcohol intake. The mortality measure is thus logged, and the consumption measure is weighted to take present and past consumption into consideration. The following lag-scheme (suggested by Norström 1987 and Skog 1984) was applied: $w_i = p\lambda_1^{\,i} + (1 - p)\lambda_2^{\,i}$, where w_i is the weight of consumption year t_i, λ_1 is the lag parameter for the short time effect and λ_2 is the lag parameter for the long-term effect. The parameter p determines their relative importance and the following fixed lag weights are used: $\lambda_1 = 0.5$, $\lambda_2 = 0.93$, and $p = 0.8$ (In all analyses, the weighted alcohol measure showed a somewhat better fit with mortality than did the unweighted).

To facilitate geographical comparisons in mortality, the countries are grouped as follows: Northern Europe (Finland, Norway and Sweden), Central Europe and the British Isles (Austria, Belgium, Denmark, Ireland, the Netherlands, the UK and West Germany (whole Germany after 1990)), and Southern Europe (France, Greece, Italy, Portugal and Spain). (For short, the mid-group will be referred to as "Central Europe" in the text). This division of countries is not the only conceivable one, and attention should always be paid to variations within country groups. However, the countries within these groups are fairly similar in the following important respects: postwar consumption levels (Norström 2001), beverage preferences (Karlsson and Simpura 2001, Leifman 2001b), alcohol policy regimes (Karlsson and Österberg 2001), and alcohol prices (Trolldal 2000). Moreover, although comprehensive comparisons regarding drinking patterns are scarce, available data suggest similarities in binge drinking within these groups of countries (Rossow 2001).

Table II. Observation period and years for missing data

Country	Observation period	Notes
Austria	1955–1995	AAA missing 1969
Belgium	1954–1994	
Denmark	1951–1995	
Finland	1952–1995	
France	1950–1995	
Greece	1961–1995	AAA missing prior to 1980
The Netherlands	1950–1995	
Norway	1951–1995	
Ireland	1950–1995	Alcohol poisoning missing prior to 1979
Italy	1951–1993	
Portugal	1955–1995	AAA missing prior to 1980
Spain	1951–1995	Alcohol poisoning missing[-1pt] prior to 1981
Sweden	1951–1995	
United Kingdom	1950–1995	
West Germany	1952–1995	Alcohol psychosis missing prior to 1968

3. Results

3.1. LIVER CIRRHOSIS MORTALITY

Table III presents cirrhosis mortality rates in the study countries during 4 time periods.

The regional differences follow a north-south gradient, with the lowest rates in Northern and the highest in Southern Europe. The differences are most marked during the first two time periods, with men in Southern Europe having about 6 times higher rates than men in Northern Europe, and 2–3 times the rates of Central Europe. The same regional pattern is disclosed for women, although the differences are somewhat smaller. The male/female ratio in mortality is typically in the range between 2 and 3, reflecting men's higher consumption.

However, the regional differences have decreased since the middle of the observation period (1966–1980), and the north-south gradient in 1995 has become considerably weaker for both men and women. Striking reductions in liver cirrhosis mortality in Southern Europe in combination with increasing mortality rates in Finland, Denmark and the UK are conductive to this development. Thus, in 1995, Southern European men and women have cirrhosis rates barely 3 times higher than those observed in Northern Europe and only about 1.5 times the cirrhosis rates found in Central Europe. This development is also echoed in the measures of dispersion (range and standard deviation) presented in Table III.

Yet, the experience for individual countries indicates a fairly stable rank-order throughout the postwar period, although some countries have changed positions

Table III. Age-adjusted liver cirrhosis mortality per 100,000 inhabitants aged 15+

Country	1950–1965		1966–1980		1981–1995		1995	
	Men	Women	Men	Women	Men	Women	Men	Women
Northern Europe	7.3	4.2	11.9	4.9	12.7	5.0	12.2	4.8
Finland	8.4	4.5	11.1	3.9	16.9	5.8	19.7	5.8
Norway	5.9	4.1	7.6	3.9	9.5	4.2	7.6	3.6
Sweden	7.7	4.1	17.1	6.8	11.7	4.9	9.3	4.9
Central Europe and the British Isles	16.8	7.6	24.9	12.5	19.1	7.5	21.9	9.6
Austria	44.1	12.2	65.8	17.0	54.3	16.2	47.1	15.1
Belgium	15.9	7.4	21.7	10.4	19.6	9.9	18.6	9.5
Denmark	9.8	11.0	15.3	9.3	22.2	9.7	27.7	13.3
Ireland	4.7	2.5	6.8	4.1	5.8	3.7	4.3	4.0
Netherlands	7.3	4.8	9.0	4.7	8.9	4.4	7.7	4.4
UK	4.4	2.8	5.6	3.8	8.2	5.4	11.1	6.4
West Germany	31.6	12.8	49.8	17.1	38.7	14.6	36.8	14.5
Southern Europe	47.4	20.4	68.1	23.6	46.7	16.0	33.7	12.1
France	57.4	23.5	69.7	24.7	38.8	14.3	28.0	11.0
Italy	40.8	13.5	67.2	21.1	49.4	18.6	35.0	15.8
Spain	34.9	17.1	53.3	19.4	40.2	12.8	29.3	9.4
Portugal	67.1	27.6	82.2	29.2	58.5	18.2	42.5	12.1
Greece	36.7	13.3	31.0	11.0	16.6	5.5	9.5	3.3
All countries	25.1	10.7	34.2	13.9	25.0	9.1	22.3	8.9
Regional dispersion								
Range	40.1	16.2	56.2	18.7	34.0	11.0	21.5	7.3
Standard deviation	21.0	8.5	29.4	9.4	18.1	5.8	10.1	3.7

quite markedly. A previously high rate country like Greece is among the lowest in the most recent observation (1995), whereas the reverse trajectory applies to Denmark.

3.2. ALCOHOLIC CIRRHOSIS

Although not all cirrhosis deaths are alcohol-related, it is generally agreed that cirrhosis deaths classified as "alcoholic cirrhosis" (571.0–571.3 in ICD–9) are less reliable for cross-cultural comparisons (e.g., Hyman 1981). However, variations in the use of this code across countries may shed some light on cultural differences in diagnostic practises concerning alcohol-related deaths.

Table IV shows the rates of alcoholic cirrhosis as well as the fraction of the total of deaths from liver cirrhosis that is diagnosed as alcoholic during the period 1987–1995. The comparison reveals another geographical pattern than that disclosed

Table IV. Age-adjusted mortality from alcoholic liver disease per 100,000 inhabitants aged 15+ (571.0–571.3 as in ICD–9) and its share in the total number of deaths from liver cirrhosis (571). 1987–1995

Country	Men		Women	
	Alcoholic cirrhosis	Share in all liver cirrhosis (%)	Alcoholic cirrhosis	Share in all liver cirrhosis (%)
Northern Europe	9.9	70	2.7	44
Finland	16.9	90	4.2	56
Norway	7.9	79	2.5	50
Sweden	4.9	42	1.5	25
Central Europe and the British Isles	7.0	40	2.9	31
Austria	4.9	10	1.7	6
Belgium	6.8	32	3.6	31
Denmark	15.2	65	5.8	55
Ireland	1.7	33	0.6	20
Netherlands	4.5	61	1.9	40
UK	4.2	45	2.4	38
West Germany	11.6	31	4.4	28
Southern Europe	8.4	21	2.7	18
France	19.2	56	7.3	54
Greece	1.3	9	0.2	3
Italy	3.5	8	0.9	4
Portugal	13.9	22	4.2	23
Spain	4.2	10	0.9	5

above: the highest male mortality rate is found in Northern Europe, whereas Southern Europe scores only somewhat higher than Central Europe. Regarding females, the average rates are about the same in the different regions. However, a generally higher consumption among men is reflected in a male/female ratio that approximates that for total cirrhosis.

Turning to the relative prevalence of alcoholic liver cirrhosis (as a proportion of all cirrhosis deaths), we note marked geographical differences. The fraction among men is highest in Northern Europe (70%), lower in Central Europe (40%) and lowest in Southern Europe (21%). The corresponding figures for women are 44%, 31%, and 18%.

Some exceptions to this general pattern are worth noting. Sweden has substantially lower rates and shares than do Finland and Norway; Austria belongs rather to the typical Southern European pattern and France deviates clearly from the other Southern European countries, having substantially higher death rates and shares than Greece, Italy and Spain in particular. In fact, France is more similar to Central

Table V. Fractions (%) of the following AAA-mortality categories: Alcoholism (303), Alcohol psychosis (291), Alcohol poisoning (E860) and Other (alcohol abuse (305.0), alcoholic cardiomyopathy (425.5), alcoholic gastritis (535.3) and alcoholic polyneuropathy (357.5)). Average for the period 1987–1995

Country	Men				Women			
	303	291	E860	Other	303	291	E860	Other
Northern Europe	50	4	36	10	44	3	46	7
Finland	13	6	61	20	12	4	70	14
Norway	72	3	21	4	63	2	32	3
Sweden	64	3	27	6	58	2	35	5
Central Europe and the British Isles	66	5	9	20	66	3	13	20
Austria	85	2	0	13	87	1	0	12
Belgium	80	8	2	10	78	6	2	14
Denmark	84	1	14	1	74	1	24	1
Ireland	68	4	28	0	62	1	37	10
Netherlands	51	9	3	37	54	11	2	33
UK	37	3	17	43	40	1	20	39
West Germany	60	5	1	34	66	3	1	30
Southern Europe	78	13	3	7	76	12	3	9
France	82	9	0	9	87	6	1	6
Greece	87	8	1	4	63	20	0	17
Italy	83	8	2	7	81	8	3	8
Portugal	66	24	9	1	82	15	3	0
Spain	72	15	1	12	68	12	7	13
All countries	67	7	12	13	65	6	16	14

and Northern Europe in this respect. However, the overall tendency to use the explicitly alcohol-related cirrhosis diagnoses seems to be subject to substantial cultural variations, which roughly follow a north-south gradient opposite to that observed for the total number of cirrhosis deaths.

3.3. AAA-MORTALITY

We now turn to the explicitly alcohol-related causes of death (AAA). This measure includes all causes of death listed in Table I, except liver cirrhosis. The relative proportion of the various causes of death that are part of the AAA measure is presented for each country in Table V (the new codes introduced in ICD–9 are collapsed).

Table VI. Age-adjusted mortality from explicitly alcohol-related causes (AAA) per 100,000 inhabitants aged 15+

	1950–1965		1966–1980		1981–1995		1995	
Country	Men	Women	Men	Women	Men	Women	Men	Women
Northern Europe	4.6	0.3	12.5	1.4	17.7	2.9	17.7	3.1
Finland	9.5	0.4	18.3	1.4	23.6	3.2	28.6	4.0
Norway	1.7	0.2	7.6	1.0	14.3	2.7	14.0	3.3
Sweden	2.6	0.2	11.7	1.8	15.1	2.8	10.6	2.1
Central Europe and the British Isles	2.1	0.4	4.0	1.0	5.6	1.5	6.9	2.1
Austria	6.8	1.1	5.9	1.3	5.7	1.2	7.6	1.5
Belgium	3.4	0.8	5.2	1.5	4.8	1.5	5.6	2.1
Denmark	0.8	0.1	2.6	0.6	8.5	2.5	9.6	3.0
Ireland	0.4	0.1	0.9	0.3	2.0	0.8	2.8	2.0
Netherlands	1.4	0.1	1.9	0.3	2.8	0.6	3.1	0.8
UK	0.3	0.1	1.2	0.5	2.2	0.8	2.8	1.1
West Germany	1.5	0.3	7.5	1.8	13.3	3.2	16.8	4.0
Southern Europe	9.2	2.0	6.3	1.1	4.0	0.7	3.0	0.5
France	20.8	4.9	18.8	4.1	12.7	2.6	9.2	2.0
Italy	3.4	0.4	2.0	0.2	1.4	0.2	1.3	0.2
Spain	3.1	0.7	3.2	0.4	2.3	0.4	1.9	0.3
Portugal	9.6	1.8	5.5	0.7	2.9	0.2	1.4	0.2
Greece	N.A	N.A	2.1	0.1	0.9	0.0	1.1	0.0
All countries	4.7	0.8	6.5	1.1	7.5	1.5	7.8	1.8

The results are based on data for 1987–1995 where data for all countries are complete, and the same ICD-version is applied. In most countries alcoholism mortality typically dominates, and other categories are of minor importance. One exception is Finland where alcohol poisoning is the most frequently used diagnosis. This cause of death also plays a larger than average role in Norway, Sweden and Ireland. It can also be noted that the new ICD–9 codes play a larger than average role in the mortality pattern in the Netherlands, UK and West Germany. The most common cause of death within this category is alcoholic cardiomyopathy.

Table VI shows the rates in AAA-mortality during 4 time periods. The gender-ratio is typically in the range 5–6, which is much larger than for cirrhosis mortality.

The stable north-south gradient revealed for cirrhosis mortality is not found for explicitly alcohol-related mortality even though most AAA-deaths are found in Southern Europe during 1950–1965 (due to high rates in France). However,

Northern Europe has the highest rates already during the next period (1966–1980), and this position is maintained throughout the study period. From the 1980s onwards, the lowest rates are instead found in Southern Europe.

The cross-national pattern observed for AAA-mortality during 1980–1995 is similar to what was revealed for alcoholic cirrhosis during 1987–1995. Several matching results are also observed for AAA and alcoholic cirrhosis in individual countries. For instance, the rank order within Northern Europe is identical, with Finland on top and Sweden with the lowest rate. Further, Denmark and Germany have the highest rates in Central Europe and the highest rates in Southern Europe are found in France.

Concerning the development over time, AAA-mortality and liver cirrhosis mortality show a similar development in several countries. For instance, during the latter part of the observation period, AAA-mortality increases in Finland, Denmark and the UK and decreases in southern European countries. This correspondence suggests that changes in these indicators reflect real changes in alcohol-related mortality. However, in some countries there is a mismatch between these mortality indicators to the extent that cirrhosis rates decline while AAA-mortality rates increase, e.g., in Austria, Belgium, Ireland the Netherlands and Germany. This pattern might be explained by changing diagnostic practises or by the fact that different forms of mortality are reflected in these indicators.

So far, we must conclude that variations in alcohol-related mortality across Western Europe clearly depend on which mortality category one focuses on. In fact, the patterns for total liver cirrhosis and AAA-mortality are reversed, while the pattern for alcoholic cirrhosis is similar to that of AAA. The analyses below will shed more light on this paradox.

3.4. THE GEOGRAPHICAL ASSOCIATION BETWEEN PER CAPITA CONSUMPTION AND MORTALITY

Both theoretical considerations and empirical findings suggest that the higher the per capita alcohol consumption in a population, the higher the rate of alcohol-related mortality (Edwards et al. 1994). This expectation is borne out in the data shown in Figure 1; countries with high consumption level tend to have more deaths from cirrhosis than countries with low consumption. However, there are certainly countries that deviate from the expected rate. For instance, Ireland, the Netherlands and France score lower than expected, whereas Austria and Italy score higher.

Could it be the case that a country scoring below the expected rate in cirrhosis compensates this by scoring higher than expected in other alcohol-related diagnoses? If this were so, the inclusion of AAA mortality would provide a composite measure displaying a better match with per capita consumption than does cirrhosis.

To illuminate this question, we look at the corresponding figure where explicitly alcohol-related deaths (AAA-mortality) have been added to cirrhosis mortality.

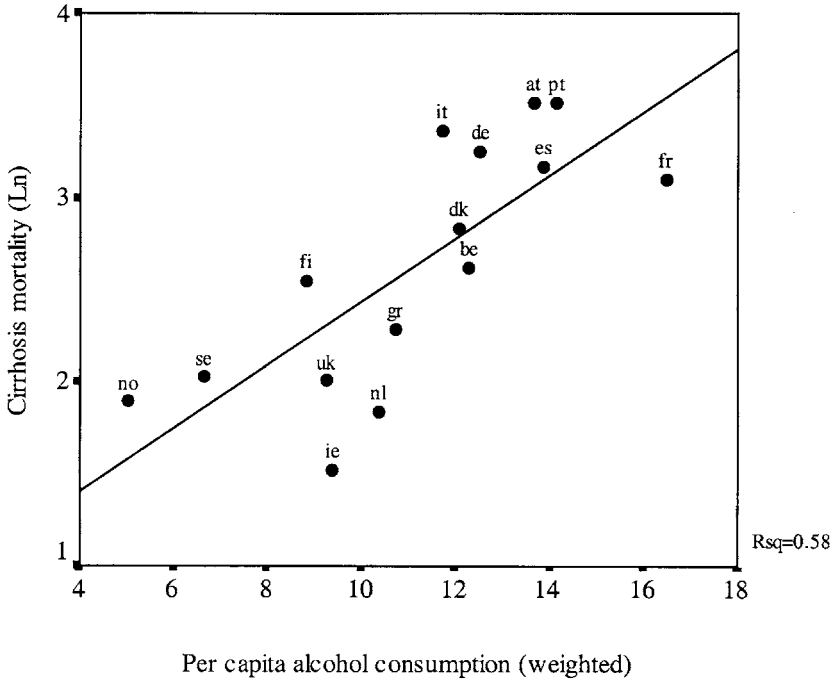

Figure 1. Relationship between alcohol consumption (litres 100% per capita 15+) and liver cirrhosis mortality (men and women). Average figures for each country for 1987–1995. (at = Austria, be = Belgium, de = Germany, dk = Denmark, es = Spain, fi = Finland, fr = France, gr = Greece, ie = Ireland, it = Italy, nl = The Netherlands, no = Norway, pt = Portugal, se = Sweden, uk = United Kingdom).

However, the result does not support our conjecture; as a matter of fact, the fit is worsened (as indicated by a reduction in R^2 from 0.58 to 0.28), and the deviating countries remain the same (Figure 2).

The explanation for the weakened relationship becomes obvious when only AAA-mortality is used as the outcome (Figure 3). In fact, the geographical correlation between consumption and AAA-mortality is negative.

However, within each of the three groups of countries that represent different drinking cultures, the relationship is positive (Figure 4). This suggests two things: either that cultural factors affect the recording of explicitly alcohol-related deaths, or that differences in drinking patterns generate cross-country mortality differences not reflected in the overall level of drinking. Before this question is settled, the results call for caution in making cross-national comparisons of these causes of death.

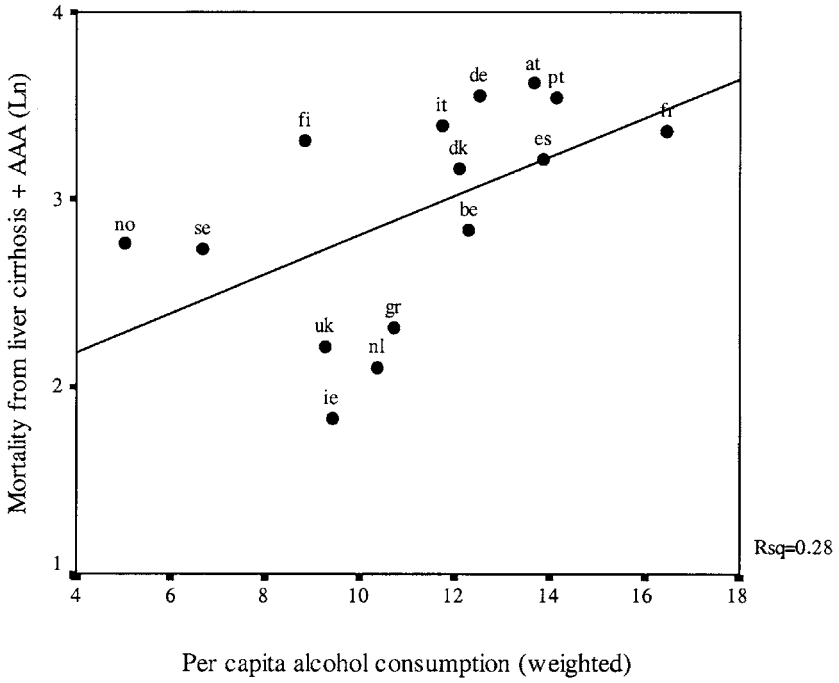

Figure 2. Relationship between alcohol consumption (litres 100% per capita 15+) and liver cirrhosis mortality + AAA-mortality (men and women). Average figures for each country for 1987–1995.

4. Discussion

The present study has focused on spatial and temporal variations in two main indicators of alcohol-related mortality in Western European countries: liver cirrhosis mortality, the classical marker of heavy drinking, and a composite measure of explicitly alcohol-related causes of death (AAA). In addition, the issue of cross-country comparability of these mortality indicators was addressed, in particular the question of whether combining these indicators would improve comparability.

To summarise the descriptive findings, a marked north-south gradient was found for cirrhosis mortality, with the highest rates in Southern Europe and the lowest in Northern Europe; this pattern prevailed throughout the study period for both men and women. However, this gradient weakened with the passage of time and the initially quite substantial regional differences declined during the latter part of the study period. A marked reduction was observed during the most recent decades in Southern Europe whereas a less favourable development was observed in the UK, Denmark and Finland. This development matched national trends in overall consumption fairly well (Leifman 2001b).

The decline in cirrhosis mortality in Southern Europe and the parallel increase in the UK, Denmark and Finland were confirmed by the temporal development

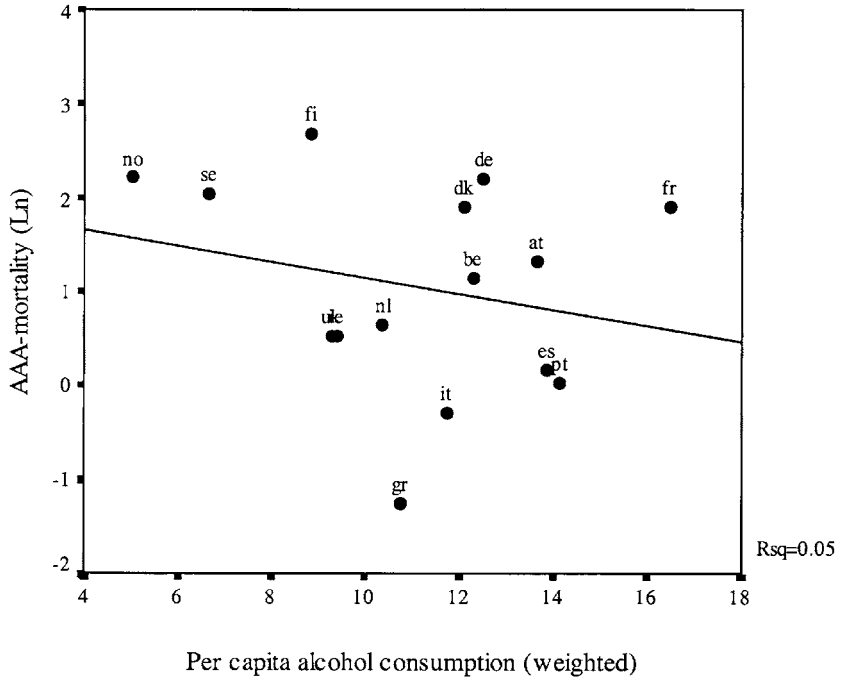

Figure 3. Relationship between alcohol consumption (litres 100% per capita 15+) and AAA-mortality (men and women). Average figures for each country for 1987–1995.

in AAA-mortality. However, we found a geographical pattern opposite that of cirrhosis, i.e., the highest rates were observed in the north and the lowest in the south. This result raised the question of whether one of these indicators was more reliable than the other as a measure of the total load of alcohol-related mortality, or whether they supplement each other by reflecting different forms of mortality. To shed some light on this issue we inspected the geographical relationship between per capita consumption and mortality. A fairly close positive relationship appeared for cirrhosis mortality, but the fit was not improved by combining cirrhosis and AAA-mortality into a single outcome measure. As a matter of fact, the geographical correlation between alcohol consumption and AAA-mortality was negative. However, within three groups of countries representing different drinking cultures, the relationship between per capita consumption and AAA-mortality turned out to be positive.

Concerning the cross-national comparability of these mortality indicators as markers of alcohol-related harm, the outcome suggests that cirrhosis mortality is the preferable indicator. It is not possible to explain the geographical mismatch between AAA-mortality and per capita consumption on the basis of the present data. However, two factors will be discussed here: recording practises and drinking patterns.

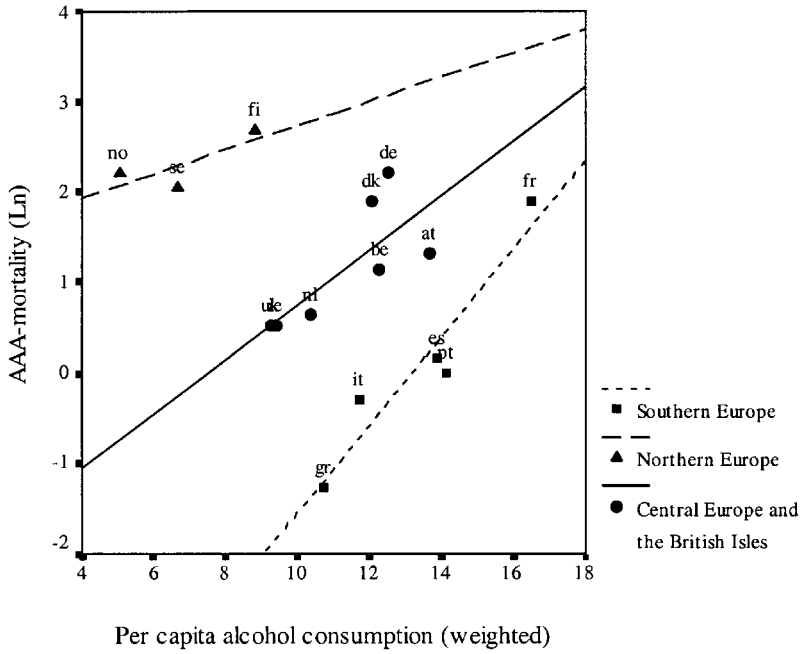

Figure 4. Relationship between alcohol consumption (litres 100% per capita 15+) and AAA-mortality (men and women) in Northern Europe, Central Europe and the British Isles and Southern Europe. Average figures for each country for 1987–1995.

As to recording practises, the observed pattern for explicitly alcohol-related mortality indicates that Northern European countries are much more prone to use these diagnoses than are other countries (the recording of alcoholic cirrhosis in Sweden was an exception). Some possible explanations of this are discussed below.

One common feature of Finland, Sweden and Norway is the long tradition of regarding alcohol as a serious social and health problem, which is reflected in their unique restrictive alcohol control policies (Holder et al. 1998, Sulkunen et al. 2000, Karlsson and Österberg 2001). At least during the first postwar decades, these countries qualify as "temperance cultures", with a preference for strong spirits, a Protestant history and large and enduring temperance movements (Levine 1992). It is possible that this general societal concern about alcohol also translates into a proneness to use alcohol-related mortality diagnoses. Another plausible explanation concerns whether death certificates are public and seen by the family, which may influence the likelihood that the physician uses a socially sensitive diagnosis. Although comprehensive data on this issue are not available, it is clear that in Finland, Norway and Sweden death certificates are strictly confidential (Johansson et al. 1999), which is not the case in, e.g., England and Wales, where a copy of the death certificate is publicly available. Carrying out an autopsy will increase the likelihood of detecting alcohol involvement in a death and national variations in

this respect should therefore influence recording practises. Available data, however, only partly suggest that this factor is relevant here. According to data for the 1990s, the proportion of deaths for which an autopsy was performed was highest in Sweden and Finland (35–36%) and lowest in the Netherlands and Germany (8%). However, it was much higher in Denmark (32%), Austria (31%) and the UK (24%) than in Norway (14%) (WHO 1994). Since no information was available for Southern European countries, it is difficult to assess the overall importance of differences in autopsy frequency.

With regards to the impact of differences in drinking patterns, it is not only a popular understanding that the Nordic drinking cultures contain a strong element of intoxication-oriented drinking practises, but empirical evidence also points in this direction (Rossow 2001). Previous mortality studies have particularly focused on variations in the death rate from alcohol poisoning as an indicator of differences in explosive drinking patterns. For instance, Poikolainen (1977) showed that the high Finnish alcohol poisoning mortality in the 1960–1970s compared to the other Nordic countries probably could be attributed to the Finnish intoxication-oriented drinking pattern. Mäkelä et al. (1981) draw similar conclusions for Finland and Poland in a another comparative study. The present findings can be interpreted similarly, since the fraction of alcohol poisoning mortality showed a north-south gradient with Finland on top.

What this study clearly shows, however, is that the selection of mortality indicators in cross-cultural studies must be carefully considered. In fact, the causes of death where the role of alcohol is most certain at the individual level cannot automatically be applied as markers of cross-national differences in the overall rate of alcohol-related mortality.

Acknowledgements

The article is written within the framework of the European Comparative Alcohol Study – ECAS, which is financially supported by the European Commission (DG V). An earlier version of the article was presented at the seminar, *Alcohol consumption, harm and policy in the European Union*, arranged by the European Comparative Alcohol Study (ECAS) and the Consortium of European Alcohol Research Centres (CEARC) Stockholm, 16–18 February, 2001. Thor Norström, Pia Mäkelä, Robin Room and two anonymous referees have given valuable comments on earlier versions.

References

Ågren, G. and Jakobsson S. W., 1987. 'Validation of diagnoses on death certificates for male alcoholics in Stockholm'. *Forensic Science* 33: 231–241.

Blake, J. E., Compton, K. V., Schmidt, W. and Orrego, H., 1988. 'Accuracy of death certificates in the diagnosis of alcoholic liver cirrhosis'. *Alcoholism: Clinical and Experimental Research* 12: 168–172.

Brewers Association of Canada, 1997. *Alcoholic Beverage Taxation and Control Policies*, 9th edn. Ottawa: Brewers Association of Canada.

Bruun, K., Edwards, G., Lumio, M., Mäkelä, K., Pan, L., Popham, R. E., Room, R., Schmidt, W., Skog, O.-J., Sulkunen, P. and Österberg, E., 1975. *Alcohol Control Policies in Public Health Perspective*. Helsinki: Finnish Foundation for Alcohol Studies.

Davies, P. and Walsh, D., 1983. *Alcohol Problems and Alcohol Control in Europe*. New York: Gardner Press.

Edwards, G., Anderson, P., Babor, T. F., Casswell, S., Ferrence, R., Giesbrecht, N., Godfrey, C., Holder, H. D., Lemmens, P., Mäkelä, K., Midanik, L. T., Norström, T., Österberg, E., Romelsjö, A., Room, R., Simpura, J. and Skog, O.-J., 1994. *Alcohol Policy and the Public Good*. Oxford: Oxford University Press.

Haberman, P. W. and Weinbaum, D. F., 1990. 'Liver cirrhosis with and without mention of alcohol as cause of death'. *British Journal of Addiction* 8: 217–222.

Holder, H. D., Kühlhorn, E., Nordlund, S., Österberg, E., Romelsjö, A. and Ugland, T., 1998. *European Integration and Nordic Alcohol Policies. Changes in Alcohol Controls and Consequences in Finland, Norway and Sweden, 1980–1997*. Aldershot: Ashgate Publishing Ltd.

Hyman, M. M., 1981. ' "Alcoholic", "unspecified" and "other specified" cirrhosis mortality: A study in validity'. *Journal of Studies on Alcohol* 42: 336–343.

Johansson, L. A., Bille, H., Ahonen, H., Helgadottir S., Gjertsen, F., Lönn, Y. and Nielsen. J., 1999. 'Causes of death statistics'. *Health Statistics in the Nordic Countries 1997* 56: 173–208 (NOMESKO).

Jougla, E., Balkau, B., Papoz, L. and the Eurodiab Subarea C study group, 1992. 'Death certificate coding practises related to diabetes in European countries – the Eurodiab study'. *International Journal of Epidemiology* 21: 343–351.

Karlsson, T. and Österberg, E., 2001. 'A scale of formal alcohol control policy in 15 European countries'. *Nordic Studies on Alcohol and Drugs* English Supplement 18: S117–S131.

Karlsson, T. and Simpura, J., 2001. 'Changes in living conditions and their links to alcohol consumption and drinking patterns in 16 European countries'. *Nordic Studies on Alcohol and Drugs* English Supplement 18: S82–S99.

Leifman, H., 2001a. 'Estimations of unrecorded alcohol consumption levels and trends in 14 European countries'. *Nordic Studies on Alcohol and Drugs* English Supplement 18: S54–S70.

Leifman, H., 2001b. 'Homogenisation in alcohol consumption in the European Union'. *Nordic Studies on Alcohol and Drugs* English Supplement 18: S15–S30.

Levine, H. G., 1992. 'Temperance cultures: Concern about alcohol in Nordic and English-speaking cultures', in M. Lader, G. Edwards and C. D. Drummond (eds), *The Nature of Alcohol and Drug Related Problems*. Society for the study of addiction, monograph no. 2. Oxford: Oxford University Press.

Mäkelä, K., Room, R., Single, E., Sulkunen, P. and Walsh, B., 1981. *Alcohol, Society and the State*, Vol. 1. Toronto: Addiction Research Foundation.

Maxwell J. D. and Knappman, P., 1985. 'Effects of coroners' rules on death certification for alcoholic liver disease'. *British Medical Journal* 291: 708.

Munoz-Perez, F. and Nizard, A., 1999. 'Alcohol consumption and cirrhosis mortality in the industrial countries since 1950'. *European Journal of Population* 14: 367–386.

Norström, T., 1987. 'The impact of per capita consumption on Swedish cirrhosis mortality'. *British Journal of Addiction* 82: 67–75.

Norström, T., 2001. 'Per capita alcohol consumption and all-cause mortality in 14 European countries'. *Addiction 96* Supplement 1: S113–S128.

Poikolainen, K., 1977. *Alcohol Poisoning Mortality in Four Nordic Countries*. Helsinki: Finnish Foundation for Alcohol Studies.

Ramstedt, M., 1999. 'Liver cirrhosis mortality in 15 European countries: Trends and differences during the post-war period'. *Nordic Studies on Alcohol and Drugs* English Supplement 16: S55–S73.

Romelsjö, A., Karlsson, G., Henningsohn, J. and Jakobsson, S. W., 1993. 'The prevalence of alcohol-involved mortality in both sexes: Variation between indicators, Stockholm, 1987'. *American Journal of Public Health* 83: 838–844.

Rossow, I., 2001. 'Drinking and violence: A cross cultural comparison of the relationship between alcohol consumption and homicide in 14 European countries'. *Addiction 96* Supplement 1: S77–S92.

Savolainen, V. T., Pentillä, A. and Karhunen P. J., 1992. 'Delayed increases in liver cirrhosis mortality and frequency of alcoholic liver cirrhosis following an increment and redistribution of alcohol consumption in Finland: Evidence from mortality statistics and autopsy survey covering 8533 cases in 1968–1988'. *Alcoholism: Clinical and Experimental Research* 16: 661–664.

Single, E., Robson, L., Rehm, J. and Xie, X., 1999. 'Morbidity and mortality attributable to alcohol, tobacco and illicit drug use in Canada'. *American Journal of Public Health* 89: 385–390.

Skog, O. -J., 1984. 'The risk function for liver cirrhosis from lifetime alcohol consumption'. *Journal of Studies on Alcohol* 45: 199–208.

Sulkunen, P., Sutton, C., Tigerstedt, C. and Warpenius, K. (eds), 2000. *Broken Spirits. Power and Ideas in Nordic Alcohol Control*. Helsinki: NAD Publication No. 39, Hakapaino Oy.

Sundby, P., 1967. *Alcohol and Mortality*. Oslo: Universitetsförlaget.

Trolldal, B., 2000. 'Cross-border shopping of alcoholic beverages in the Southern part of Sweden after the EU-membership in 1995 and the devaluation of the Swedish currency in 1992', in H. D. Holder (ed), *Sweden and the European Union: Changes in National Alcohol Policy and Their Consequences*. Stockholm: Almqvist and Wiksell International.

Trolldal, B., 2001. 'Sales of alcoholic beverages and the inhabitants' consumption in 15 European countries: A correction based on consumption during journeys abroad and tax-free purchases'. *Nordic Studies on Alcohol and Drugs* English Supplement 18: S71–S81.

World Health Organisation, 1975. *The International Classification of Diseases. 1975 Revision*, Vol 1. Geneva: World Health Organisation.

World Health Organisation, 1994. *World Health Statistics Annual*. Geneva: World Health Organisation.