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Alcohol-related mortality by ethnic origin: Findings based on multigenerational population register data from Finland and Sweden

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Abstract

Background. Alcohol-related mortality is associated with culture. This study aims to assess diversity within ethnic groups, and in particular alcohol-related mortality risks of persons with mixed and uniform ethnic origin across two national contexts.

Methods. We studied men and women of ethnic Finnish and ethnic Swedish origin, born 1953-1999. Data were from the multigenerational population registers of Finland and Sweden. In Finland, ethnic origin was assessed through own, mother's, and father's Finnish or Swedish ethnolinguistic affiliation. The data on Sweden were restricted to index persons born in Sweden, whose mother and father were born in Sweden or in Finland. Cox regression was used to examine the associations between ethnic origin and alcohol-related mortality in 1971-2017.

Results. For men in Finland, the hazard rate of alcohol-related mortality of Swedish-speakers with uniform Swedish background was 0.44 (95% CI: 0.38-0.52) that of Swedish-speakers with uniform Finnish background. The corresponding number for women was 0.40 (95% CI: 0.28-0.55). In Sweden, the rate of men with both parents born in Sweden was 0.40 (95% CI: 0.32-0.49) that of men with both parents born in Finland. The corresponding number for women was 0.50 (95% CI: 0.31-0.79). In both countries, persons with mixed background had an alcohol-related mortality rate between that of persons with uniform Finnish background and that of persons with uniform Swedish background.

Conclusion. The consistent pattern across countries necessitates increased policy attention to offspring disadvantaged via parental ethnicity, in order to minimise harmful consequences of alcohol consumption across and within ethnic groups.

Keywords: Mortality, Sweden, Finland, Alcohol, Parental background

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1. Introduction

Alcohol-related deaths have been estimated to account for three million deaths, or more than five per cent of all deaths, worldwide every year. The harmful use of alcohol is a causal factor in more than 200 disease and injury conditions, and about five per cent of the global burden of disease and injury is attributable to alcohol (1). Alcohol use is ranked as the seventh leading risk factor for premature death and disability. For people aged 15-49 years, alcohol use is the leading cause of death (2).

The alcohol-attributable fractions of death vary globally, with many of the countries in Eastern Europe and the former Soviet Union ranked highest (3). Finland is well below their levels, but at a notably higher rate than that of the neighbouring Nordic country Sweden. In Finland, nine per cent of all deaths in men and 2.5 per cent of all deaths in women are attributed to alcohol, as compared to less than six per cent and 1.5 per cent, respectively, in Sweden.

A variety of factors that work at both the individual and societal levels affect the patterns of alcohol consumption, drinking behaviours, and the magnitude of alcohol-related problems (4-5). Individual vulnerability factors include age, gender, familial factors, and socio-economic status. Societal factors include the level of development, the drinking context, the production, distribution and regulation of alcohol, and culture (6).

Empirical evidence on how diversity within ethnic groups, and particularly how mixed ethnic origin, relate to alcohol-related mortality is sparse. The extent to which cultural norms affect alcohol use and, thus, alcohol-related mortality, may vary also by context and place (7). Cultural-related drinking behaviours in immigrant parents may assimilate toward the norms of a new context and seize to affect children's behaviours (8). If not, and the parents act as role models, certain behaviours such as alcohol use may be abiding and may even become more pronounced within another environment (9).

The multigenerational population registers of Finland and Sweden provide novel opportunities to study how alcohol-related mortality relates to ethnic background. Both countries have substantial populations of ethnic Swedish and ethnic Finnish origin, who differ notably in alcohol-related mortality. In ages 18-50 years, the ethnolinguistic group of Swedish-speakers in Finland have approximately three times higher rates of alcohol-related mortality than the native group of Swedish-speakers in the country (10-11). The Swedish-speakers report also more frequent drunkenness, suffer more frequent hangovers and have alcohol-induced pass-outs significantly more often than Swedish-speakers (12-13). Similar differences exist between ethnic Swedes and ethnic Finns in Sweden (14-16).

Swedish-speakers in Finland account for five per cent of the total population, while Finns constitute the fourth largest ethnic group in Sweden (17). Both these minority groups have managed to keep their cultural roots and identities in spite of a substantial degree of intermarriage (18-20). Swedish-speakers in Finland have a very long history, while most ethnic Finns in Sweden are more recent migrants, primarily arriving during the country's economic expansion in the 1960s and 1970s. In each national context, people in the minority group have formed a permanent and stable community.

Socio-economic, demographic and area-level variables explain only a small part of the differentials in alcohol-related mortality between ethnic Finns and ethnic Swedes. One may therefore assume that they relate to group-specific cultural norms that affect alcohol use, and to variation in social networks and family bonds that protect from unhealthy drinking behaviours (21-22). Empirical support for such claims can be attained from analyses that

examine persons by ethnic background, that is, by using data that include information about parental ethnicity.

Not much is known about the interrelation between parental ethnicity and offspring's alcohol-related mortality, and in particular about the issue of how people with mixed heritage are positioned. We used population register data from two generations of the population in Finland and in Sweden to examine individuals who are the children of majority-culture parents, minority-culture parents, and those with mixed cultural origin. Based on these settings, the study sought to answer two major research questions:

i. Do persons with mixed ethnic background and those with varying uniform background differ with respect to alcohol-related mortality risks?

ii. Is any such variation consistent across national contexts?

2. Methods

2.1. Study populations

The study base includes the total population of Finland and Sweden observed in 1971-2017. In the population registers, persons born in each country can be linked to the mother and the father. We restricted the study to persons born 1953-1999. This was to ensure that both parents in the data from Finland could be identified (23), and that all persons were at least 17 years old when they entered the study window. All study persons in Finland, and their mother and father, were registered as a Swedish-speaker or as a Swedish-speaker. Foreign-born immigrants and their children were consequently excluded, because immigration and intermarriage across other ethnic lines in Finland has been rare until recently. The data on Sweden were restricted to index persons born in Sweden, whose mother and father were born in Sweden or in Finland. Index persons born abroad were consequently excluded.

2.2. Measures

2.2.1. Outcome

Alcohol-related mortality was assessed with the ICD-8 codes for deaths in 1971-1986, with the ICD-9 codes for deaths in 1987-1995, and with ICD-10 codes for deaths in 1996-2017 (see the notes of Table 1). For the entire period 1971-2017, we could separate alcohol as the main cause of death. For the period 1996-2017, we could observe if alcohol was the main or any contributing cause of death. For the sake of comparison and completeness, we performed parallel analyses for all-cause mortality.

2.2.2. Exposures

The exposures in the data from Finland were the index person´s, the mother's, and the father's ethnolinguistic registration (Finnish or Swedish), respectively. These were combined into one variable with the categories FFF, SSS, FFS, FSF, SFS, and SSF, where the first letter refers to the index person, the second to the mother, and the third to the father. FFF consequently consisted of persons with uniform Finnish background, and SSS of persons with uniform Swedish background. FFS and FSF contained Finnish-registered persons with mixed background, while SFS and SSF contained Swedish-registered persons with mixed background. With this setup we could determine how the ethnicity of the index person, the mother, and the father, separately or jointly, relate to the index person's mortality risk. People

categorised as FSS and SFF were included into analyses as well, but since they were rare and difficult to assess, the estimates are not reported (but available upon request).

The exposures in the data from Sweden were mother's country of birth and father's country of birth. Given our restrictions, we could combine these into one variable with the categories FF, SS, FS, and SF, where the first letter refers to whether the mother was born in Finland or Sweden, and the second to whether the father was born in Finland or Sweden. Since all study persons were native-born, FF consisted of those with uniform ethnic Finnish background, SS of those with uniform ethnic Swedish background, and FS and SF of those with ethnically mixed background. Like with the setup for the data on Finland, we can determine if mortality is differently associated with mother's and father's ethnicity.

2.2.3. Control variables

The control variables were year of birth, educational level, and region of birth, which all are important predictors of all-cause and alcohol-related mortality (24). Year of birth was used as a categorical variable. Educational level referred to the highest level ever attained and separated primary, secondary, and tertiary education. Region of birth was based on a regional division with 20 categories in Finland (landskap) and 25 categories in Sweden (län).

2.3. Statistical analyses

Cox regressions were used to estimate the association between ethnic background and mortality, adjusted for the control variables. For each country, we fitted two types of models. One was for persons born 1953-1999, observed in the period 1971-2017. All these persons entered at age 17, that is, in the calendar year when they become 18 years old. The highest age of observation, for persons born 1953, was consequently 64. The other was for persons born 1953-1974, observed in the period 1996-2017. All these persons entered at age 42 years, that is, in the calendar year when they become 43 years old, and the highest age of observation was 64.

With the first approach, we could observe the main cause of death. With the second approach, we could incorporate also any contributing cause of death. Right-censoring occured at death, first emigration, or end-2017. We analysed alcohol-related mortality as well as all-cause mortality. Separate models were fitted for men and women. The statistical analyses were performed using the softwares SPSS 26 and STATA 16.

3. Results

A total of 2,997,867 and 4,148,794 individuals were included in the final analyses of the Finnish and Swedish data, respectively (Tables 1 and 2). The total number of alcohol-related deaths by main cause was 13,204 in Finland and 3,336 in Sweden. In the data from Finland, Finnish-registered index persons with uniform Finnish background accounted for 92.7% of all study persons, Swedish-registered index persons with uniform Swedish background for 4.1%, Finnish-registered persons with mixed background for 1.7% , and Swedish-registered persons with mixed background for 1.5%. In the data from Sweden, persons with uniform Swedish background accounted for 95.0% of all study persons, those with uniform Finnish background for 1.5%, and those with mixed background for 3.6%. Death rates, and particularly those for alcohol-related mortality, were overall notably higher in Finland than in Sweden.

Table 1. Descriptive statistics of the data fom Finland by sex and own (first letter), mother's (second letter), and father's (third letter) ethnolinguistic affiliation, where F is for Finnish-registered and S is for Swedish-registered

	Born 1953-1999, period 1971-2017, observed from age 17						Born 1953-1974, period 1996-2017, observed from age 42							
	Number of individuals	Number of person-years	Number of alcohol-related deaths by main cause only	Number of all-cause deaths	Death rate per mille, alcohol-related by main cause only	Death rate per mille, all-cause	Number of individuals	Number of person-years	Number of alcohol-related deaths by main cause only	Number of alcohol-related deaths by main or contributing cause	Number of all-cause deaths	Death rate per mille, alcohol-related by main cause only	Death rate per mille, alcohol-related by main or contributing cause	Death rate per mille, all-cause
Men														
FFF	1419616	33244912	10608	68625	0.32	2.06	662904	7571206	7617	14293	35151	1.01	1.89	4.64
SSS	63894	1436213	181	1914	0.13	1.33	31067	359380	141	315	1086	0.39	0.88	3.02
FFS	16361	352144	92	615	0.26	1.75	6473	68981	63	109	296	0.91	1.58	4.29
FSF	10106	231357	56	424	0.24	1.83	4566	50787	35	66	229	0.69	1.30	4.51
SFS	10900	206390	33	252	0.16	1.22	3772	37808	26	44	119	0.69	1.16	3.15
SSF	11538	198086	29	262	0.15	1.32	3309	28975	20	35	110	0.69	1.21	3.80
Women														
FFF	1358794	31873160	2596	26519	0.08	0.83	639658	7430228	2033	3125	15466	0.27	0.42	2.08
SSS	59981	1311848	38	824	0.03	0.63	28704	334858	37	61	553	0.11	0.18	1.65
FFS	15835	335549	29	275	0.09	0.82	6183	65078	22	33	164	0.34	0.51	2.52
FSF	8927	202609	12	143	0.06	0.71	4032	45340	10	14	92	0.22	0.31	2.03
SFS	10105	185456	5	103	0.03	0.56	3450	35097	3	7	59	0.09	0.20	1.68
SSF	11810	204228	6	111	0.03	0.54	3530	32393	3	6	51	0.09	0.19	1.57

Alcohol-related mortality refers to the ICD-8 codes 291, 303, 571, 5728X, E849, E851, E860, E980, N979, and N980 for deaths in 1971-1986, to the ICD-9 codes 291, 303, 3050, 3317, 34570, 3457A, 3457X, 3575, 3594, 4255, 535, 571, 5771, 8609, 980, E849, and E851 for deaths in 1987-1995, and to the ICD-10 codes E244, F10, G312, G405, G621, G721, I426, K292, K70, K860, O354, P43, X45, T51, Y90, Y91, Z502, Z714, and Z721 for deaths in 1996-2017.

Table 2. Descriptive statistics of the data fom Sweden by sex and mother's (first letter) and father's (second letter) country of birth, where F is for Finland and is for Sweden

	Born 1953-1999, period 1971-2017, observed from age 17						Born 1953-1974, period 1996-2017, observed from age 42							
	Number of individuals	Number of person-years	Number of alcohol-related deaths by main cause only	Number of all-cause deaths	Death rate per mille, alcohol-related by main cause only	Death rate per mille, all-cause	Number of individuals	Number of person-years	Number of alcohol-related deaths by main cause only	Number of alcohol-related deaths by main or contributing cause	Number of all-cause deaths	Death rate per mille, alcohol-related by main cause only	Death rate per mille, alcohol-related by main or contributing cause	Death rate per mille, all-cause
Men														
FF	30921	744428	84	1395	0.11	1.87	16199	146203	50	115	553	0.34	0.79	3.78
SS	2022947	46761800	2385	56976	0.05	1.22	962191	10754768	1757	3975	30009	0.16	0.37	2.79
FS	47505	1129150	102	1815	0.09	1.61	23443	257812	65	157	901	0.25	0.61	3.49
SF	28476	561815	35	731	0.06	1.30	10490	93815	20	50	263	0.21	0.53	2.80
Women														
FF	29373	711045	19	598	0.03	0.84	15571	143425	11	30	309	0.08	0.21	2.15
SS	1917461	44321881	677	31518	0.02	0.71	914443	10345432	517	1165	19682	0.05	0.11	1.90
FS	44800	1062951	24	870	0.02	0.82	22113	245013	20	43	513	0.08	0.18	2.09
SF	27311	535898	10	363	0.02	0.68	10015	90426	8	21	164	0.09	0.23	1.81

See the notes of Table 1 for ICD codes.

In Finland, significant differences were observed in alcohol-related mortality between Swedish-speakers with uniform Finnish background and Swedish-speakers with uniform Swedish background in Finland (Table 3). For men, the hazard ratio of mortality when alcohol was the main cause of death was 0.44 (95% CI: 0.38-0.52) for Swedish-speakers with a uniform background compared to Finnish-speakers with a uniform background over the entire observation period, and almost the same if observing men from age 42. In women, the corresponding hazard ratios were similar to those for men, in spite that the number of alcohol-related deaths was smaller.

Table 3. Mortality hazard ratios in Finland by own (first letter), mother's (second letter) and father's (third letter) ethnolinguistic affiliation, where F is for Finnish-registered and S is for Swedish-registered

	Born 1953-1999, period 1971-2017, observed from age 17		Born 1953-1974, period 1996-2017, observed from age 42	
	Men	Women	Men	Women
Alcohol, main cause				
FFF	1	1	1	1
SSS	0.44 (0.38-0.52)	0.40 (0.28-0.55)	0.43 (0.35-0.51)	0.44 (0.31-0.62)
FFS	0.89 (0.72-1.09)	1.06 (0.73-1.53)	0.86 (0.67-1.11)	1.05 (0.69-1.61)
FSF	0.77 (0.59-1.00)	0.67 (0.38-1.19)	0.66 (0.47-0.92)	0.71 (0.38-1.33)
SFS	0.72 (0.51-1.02)	0.45 (0.19-1.09)	0.78 (0.53-1.14)	0.34 (0.11-1.05)
SSF	0.74 (0.51-1.07)	0.52 (0.23-1.16)	0.78 (0.50-1.21)	0.35 (0.11-1.10)
Alcohol, main or contributing cause				
FFF			1	1
SSS			0.56 (0.50-0.64)	0.48 (0.36-0.63)
FFS			0.87 (0.72-1.05)	1.06 (0.75-1.51)
FSF			0.73 (0.57-0.93)	0.67 (0.40-1.14)
SFS			0.77 (0.57-1.04)	0.52 (0.25-1.09)
SSF			0.80 (0.58-1.12)	0.47 (0.21-1.06)
All-cause				
FFF	1	1	1	1
SSS	0.72 (0.68-0.75)	0.77 (0.71-0.84)	0.72 (0.67-0.77)	0.83 (0.75-0.92)
FFS	0.92 (0.85-0.99)	1.01 (0.90-1.15)	0.94 (0.83-1.05)	1.16 (0.99-1.36)
FSF	0.93 (0.84-1.02)	0.83 (0.70-0.98)	1.00 (0.87-1.14)	0.95 (0.77-1.17)
SFS	0.78 (0.69-0.89)	0.82 (0.67-1.00)	0.79 (0.66-0.94)	0.88 (0.68-1.13)
SSF	0.89 (0.78-1.00)	0.85 (0.70-1.02)	0.98 (0.81-1.18)	0.84 (0.64-1.11)

Each model includes year of birth, educational level, and region of birth as categorical variables.

Estimates for men in Sweden were almost the same as for men in Finland. The mortality hazard ratio between men with uniform Swedish background and men with uniform Finnish background was 0.40 (95% CI: 0.32-0.49) over the entire observation period, and 0.45 (95% CI: 0.34-0.60) if the persons were observed from age 42. Differences in women were less pronounced, with corresponding hazard ratios of 0.50 (95% CI: 0.31-0.79) and 0.62 (95% CI: 0.34-1.13), respectively.

Table 4. Mortality hazard ratios in Sweden by mother's (first letter) and father's (second letter) country of birth, where F is for Finland and S is for Sweden

	Born 1953-1999, period 1971-2017, from age 17		Born 1953-1974, period 1996-2017, from age 42	
	Men	Women	Men	Women
Alcohol, main cause				
FF	1	1	1	1
SS	0.40 (0.32-0.49)	0.50 (0.31-0.79)	0.45 (0.34-0.60)	0.62 (0.34-1.13)
FS	0.68 (0.51-0.91)	0.72 (0.39-1.31)	0.67 (0.46-0.97)	0.99 (0.47-2.07)
SF	0.69 (0.46-1.02)	0.91 (0.42-1.95)	0.67 (0.40-1.13)	1.28 (0.51-3.18)
Alcohol, main or contributing cause				
FF			1	1
SS			0.44 (0.37-0.53)	0.52 (0.36-0.74)
FS			0.72 (0.57-0.92)	0.81 (0.50-1.29)
SF			0.72 (0.52-1.01)	1.20 (0.69-2.10)
All-cause				
FF	1	1	1	1
SS	0.66 (0.63-0.70)	0.81 (0.75-0.88)	0.67 (0.61-0.72)	0.80 (0.71-0.90)
FS	0.85 (0.79-0.91)	0.93 (0.83-1.03)	0.84 (0.75-0.93)	0.90 (0.78-1.03)
SF	0.79 (0.72-0.86)	0.95 (0.83-1.08)	0.78 (0.67-0.90)	0.90 (0.74-1.08)

Each model includes year of birth, educational level, and region of birth as categorical variables.

When alcohol-related mortality was analysed as the main or any contributing cause, the difference between the two groups with uniform background diminished somewhat for Finland, while they slightly increased for Sweden. For persons observed from age 42 in Finland, the hazard ratio was 0.56 (95% CI: 0.50-0.64) for men and 0.48 (95% CI: 0.36-0.63) for women. Corresponding numbers for Sweden were 0.44 (95% CI: 0.37-0.53) and 0.51 (95% CI: 0.36-0.74).

Mortality differentials between the two groups with ethnically uniform background were in both countries less pronounced for all-cause mortality than for alcohol-related mortality.

In both Finland and Sweden, persons with mixed background had an alcohol-related mortality risk below that of persons with uniform Finnish background and above that of persons with uniform Swedish background. These estimates were in the range 0.66-0.89 for men in Finland, 0.34-1.06 for women in Finland, 0.67-0.72 for men in Sweden, and 0.72-1.28 for women in Sweden, and many were statistically not significant. When collapsing the mixed categories that separated each parent by ethnicity, it was more evident that persons with mixed ethnic background were generally positioned between those with uniform ethnic background (see the

online supplementary). For women in Finland with mixed background, own ethnic affiliation mattered. Swedish-registered women had a similar risk of alcohol-related mortality as those with uniform Swedish background, whereas Finnish-registered women were at a similar level as those with uniform Finnish background.

There was no consistent pattern related to the combination of parent's sex and parent's ethnicity. For women in Sweden, having a Finnish-born father and a Swedish-born mother was associated with higher alcohol-related mortality than if having a Swedish-born father and a Finnish-born mother, but the estimates came with wide confidence intervals. In Finland, Finnish-registered persons with a Finnish-registered mother and a Swedish-registered father had a higher alcohol-related mortality risk than Finnish-registered persons with Swedish-registered mother and Finnish-registered father, but these differences were statistically not significant. For Swedish-registered persons with mixed background, no level differences by parental ethnicity could be observed whatsoever.

Finally, it should be noted that the variation in all-cause mortality by ethnic background was overall less pronounced than the variation in alcohol-related mortality by ethnic background.

4. Discussion

4.1. Main findings

We investigated how alcohol-related mortality relates to ethnic origin in two national contexts, using population register data. In Finland, we analysed persons by own, mother's, and father's Swedish or Finnish ethnolinguistic affiliation. In Sweden, Swedish-born persons were separated according to whether the mother, the father, or both, were born in Sweden or in Finland. We found clear evidence that not only own ethnicity, but also parental ethnicity, is interrelated with alcohol-related mortality. Thus, parental ethnic affiliation is important for the alcohol-related mortality risk, net of own affiliation, but so is also own affiliation, net of the parental affiliation.

There was a substantial level difference between persons with uniform Finnish background and those with uniform Swedish background. In both countries, and for both sexes, the difference in risk was about 2 to 1, in spite that the overall rate of alcohol-related mortality is notably lower in Sweden than in Finland, and in women as compared to men. Another main finding consistent across the two countries was that persons with mixed background had an intermediate alcohol-related mortality risk. This pattern was more evident for men than for women. For Finland, we could observe that Swedish-registered women with mixed background had a mortality risk close to that of women with uniform Swedish background, while Finnish-registered women with mixed background were found close to those with uniform Finnish background. We could not see that either maternal or paternal parents in mixed unions had any consistent effect.

4.2. Interpretations

Cultural norms and beliefs that vary across ethnic and racial groups are known to be strong predictors of drinking behaviours (9, 25-26). Our findings are in line with this previous evidence. However, few studies have examined diversity within ethnic groups. We contributed to this specific area by evaluating how alcohol-related mortality depends on ethnicity across two generations and two national contexts, using high-quality population register data. Patterns specific to ethnic groups relate also to how alcohol use is correlated across generations (27-28). Although parental influence on the offspring diminishes after adolescence and young

adulthood (29-30), cultural-related alcohol behaviours can be expected to influence the risk of alcohol-related mortality over the life course. This fits well also with findings which say that family support, bonding, and parental monitoring are associated with lower levels of alcohol use, while higher levels of familism and the nuclear family serve as protective factors (31-33).

We found that taking account for the parental generation emphasises the interrelation between ethnicity and alcohol-related mortality as observed from one-generation studies only. In the Nordic context, alcohol-related mortality is notably lower among ethnic Swedes than among ethnic Finns, both in Sweden and in Finland. When additionally evaluated on basis of the parental generation, this presumed cultural influence is strengthened further. In support, persons with mixed background are at an intermediate risk of alcohol-related mortality. These findings are remarkable from the perspective that, apart from the variation in sociohistorical and economic position of the study populations across the two national settings, there is also a difference in terms of generation status (34). In Sweden, we studied the children of Finnish-born immigrants, while both Swedish-speakers and Swedish-speakers in Finland constitute the native population of the country. What we find can, thus, be interpreted as strongly reflecting retention of ethnic values and cultural norms across generations and national contexts. These may, in turn, be associated with a strong awareness of own ethnic identity (9). One support for this claim is that for women in Finland with mixed background, own ethnicity, which generally reflects the larger ethnic community in which a person has been raised (11), matters for the risk of alcohol-related mortality. Furthermore, we find an ethnic pattern that is similar in both countries, even though the group in majority in one country is in minority in the other. It is therefore not the minority status per se that affects drinking behaviour, but rather the cultural practices associated with ethnic origin.

4.3. Strengths and limitations

Apart from the obvious limitations of population register data, meaning that we cannot measure cultural norms or values in an explicit manner, nor drinking, alcohol-related behaviours of family relations directly, another issue needs to be stressed. Approximately 20 per cent of all Finnish-born immigrants in Sweden are Swedish-speaking Finns (35). If they have lower alcohol-related mortality than the Finnish-speaking immigrants in Sweden, which seems reasonable, we would expect that any variation as observed here is underestimated. In that case, the difference in alcohol-related mortality between persons who have two Finnish-speaking parents born in Finland and those with two parents born in Sweden would be even larger. Since population register data in Sweden do not separate people by ethnolinguistic affiliation we cannot address this issue, which is the same when studying mortality from other causes (36).

5. Conclusions

The parental influence on offspring's alcohol behaviours is often claimed to diminish over the life course. We have moved beyond most previous literature in examining not only how own ethnic identity and immigration history affect alcohol mortality, but incorporated the issue of how parental ethnicity relates to offspring alcohol-related mortality. We find strong such interrelations, and that mixed heritage generally implies an intermediate pattern of alcohol-related mortality. Hence, more effective policies and interventions specifically designed for offspring who may be disadvantaged via parental ethnicity are warranted, which may help to minimise the harmful consequences of alcohol consumption across and within ethnic groups.

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Online supplementary Table 1. Mortality hazard ratios in Finland, when collapsing the mixed categories that separate each parent by ethniciy, by own (first letter), mother's (second letter) and father's (third letter) ethnolinguistic affiliation, where F is for Finnish-registered and S is for Swedish-registered

	Born 1953-1999, period 1971-2017, observed from age 17		Born 1953-1974, period 1996-2017, observed from age 42	
	Men	Women	Men	Women
Alcohol, main cause				
FFF	1	1	1	1
SSS	0.44 (0.38-0.52)	0.40 (0.28-0.55)	0.43 (0.35-0.51)	0.44 (0.31-0.62)
FFS or FSF	0.84 (0.71-0.99)	0.91 (0.66-1.24)	0.78 (0.63-0.95)	0.91 (0.64-1.31)
SFS or SSF	0.73 (0.57-0.94)	0.49 (0.27-0.88)	0.78 (0.58-1.04)	0.34 (0.15-0.77)
Alcohol, main or contributing cause				
FFF			1	1
SSS			0.56 (0.50-0.64)	0.48 (0.36-0.63)
FFS or FSF			0.81 (0.70-0.94)	0.91 (0.68-1.21)
SFS or SSF			0.78 (0.63-0.98)	0.50 (0.29-0.86)
All-cause				
FFF	1	1	1	1
SSS	0.72 (0.68-0.75)	0.77 (0.71-0.84)	0.72 (0.67-0.77)	0.83 (0.75-0.92)
FFS or FSF	0.92 (0.87-0.98)	0.94 (0.86-1.04)	0.96 (0.88-1.05)	1.08 (0.95-1.22)
SFS or SSF	0.83 (0.76-0.91)	0.83 (0.73-0.95)	0.87 (0.76-0.99)	0.86 (0.71-1.04)

Each model includes year of birth, educational level, and region of birth as categorical variables.

Online supplementary Table 2. Mortality hazard ratios in Sweden, when collapsing the mixed categories that separate each parent by ethnicity, by mother's (first letter) and father's (second letter) country of birth, where F is for Finland and S is for Sweden

	Born 1953-1999, period 1971-2017, from age 17		Born 1953-1974, period 1996-2017, from age 42	
	Men	Women	Men	Women
Alcohol, main cause				
FF	1	1	1	1
SS	0.40 (0.32-0.49)	0.50 (0.31-0.79)	0.45 (0.34-0.60)	0.62 (0.34-1.13)
FS or SF	0.68 (0.52-0.89)	0.77 (0.44-1.34)	0.67 (0.47-0.95)	1.06 (0.53-2.13)
Alcohol, main or contributing cause				
FF			1	1
SS			0.44 (0.37-0.53)	0.52 (0.36-0.74)
FS or SF			0.72 (0.57-0.91)	0.91 (0.59-1.40)
All-cause				
FF	1	1	1	1
SS	0.66 (0.63-0.70)	0.81 (0.75-0.88)	0.67 (0.61-0.72)	0.80 (0.71-0.90)
FS or FS	0.83 (0.78-0.89)	0.93 (0.84-1.03)	0.82 (0.74-0.91)	0.90 (0.78-1.03)

Each model includes year of birth, educational level, and region of birth as categorical variables.

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