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Mortality from circulatory diseases by specific country of birth across six European countries: test of concept

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Background: Important differences in cardiovascular disease (CVD) mortality by country of birth have been shown within European countries. We now focus on CVD mortality by specific country of birth across European countries. **Methods:** For Denmark, England and Wales, France, The Netherlands, Scotland and Sweden mortality information on circulatory disease, and the subcategories of ischaemic heart disease, and cerebrovascular disease, was analysed by country of birth. Information on population was obtained from census data or population registers. Directly age-standardized rates per 100 000 were estimated by sex for each country of birth group using the WHO World Standard population 2000–25 structure. For differences in the results, at least one of the two 95% confidence intervals did not overlap. **Results:** Circulatory mortality was similar across countries for men born in India (355.7 in England and Wales, 372.8 in Scotland and 244.5 in Sweden). For other country of birth groups—China, Pakistan, Poland, Turkey and Yugoslavia—there were substantial between-country differences. For example, men born in Poland had a rate of 630.0 in Denmark and 499.3 in England and Wales and 153.5 in France; and men born in Turkey had a rate of 439.4 in Denmark and 231.4 in The Netherlands. A similar pattern was seen in

women, e.g. Poland born women had a rate of 264.9 in Denmark, 126.4 in England and Wales and 54.4 in France. The patterns were similar for ischaemic heart disease mortality and cerebrovascular disease mortality. **Conclusion:** Cross-country comparisons are feasible and the resulting findings are interesting. They merit public health consideration.

Introduction

As a result of post-World War II inward migration Europe has become a multi-ethnic continent that has substantial populations born outside its boundaries. This has accelerated legal and policy requirements to reduce discrimination and promote equity including in its migrant and ethnic minority populations.[1] Planning to achieve this goal, and demonstrating success, requires information on the health status of immigrants and their descendants. However, health data by immigration status and/or ethnic group are sparse across Europe.[2] Country of birth, a direct indicator of migration status, is also the most commonly available proxy measure for ethnicity in Europe,[3] and currently the only one that can be used to produce epidemiological data for several European countries simultaneously.[2]

The MEHO (Migrant and Ethnic Health Observatory, http://www.meho.eu.com/) demonstration project mapped the availability and quality of data across the EU in a range of subject areas including cardiovascular disease (CVD) (work package 6, reported here), cancer and infection, and developed methods for standardized analyses. The mapping phase in relation to CVD, which had the express aim of examining ethnicity related data, showed that relevant data were sparse, heterogeneous in their quality and methods, but sufficient to allow limited standardized analyses in a number of EU States.[2] Country of birth was available in 15 of 24 national data sets, while self-reported ethnic group was only available in five, so we focused our project on the former. The strengths and weaknesses of these and other indicators in relation to ethnicity are considered in our earlier article,[2] and by Stronks *et al.*[3]

Differences in circulatory diseases, including ischaemic heart disease (IHD) and stroke (cerebrovascular disease) were demonstrated within MEHO by country of birth standardized analyses within six European countries (submitted to DG Sanco). In these analyses, which followed the approach established in a few European countries,[4,5] each country of birth group has been compared with the population born within the country. Such analyses have proven to be powerful and have led to new understanding of public health priorities and avenues for explanatory research. For example, such work in England and Wales[4,6] has established that for mortality, comparative to England and Wales born groups, populations born in South Asia (India, Pakistan and Bangladesh) have high rates of IHD and stroke; those born in Africa and the Caribbean have high rates of stroke; for IHD, the rates have risen fast and exceeded the England and Wales born groups;[6] and those born in China have low rates of IHD.[4] Classical migration studies, comparing health in the country of origin and in the country of residence, provide another valuable perspective.[7–9]

An alternative approach is to compare one country of birth group across countries to investigate whether outcomes differ by country of destination. If populations emigrating to different countries are similar prior to emigration this tackles the question of whether the migrant population's disease patterns are affected by local context. Environmental, demographic and social factors influencing disease occurrence that are not similarly distributed across countries are likely to produce such differences. If the disease patterns in such populations are similar across recipient countries, it suggests the patterns are intrinsic to the social, cultural and genetic composition of the migrant populations and their offspring. If, however, a migrant population from one country (say Turkey) differs by recipient country, we would expect disease patterns to be different, e.g. if highly qualified migrants were admitted to one country and unqualified workers were admitted to another. We explore and focus on this alternative analytical approach, to help assess whether routine population and mortality data systems should be developed to facilitate this type of analysis. We offer this article as a 'test of concept', fully aware that the empirical data are limited.

Methods

Data

Based on our analysis of the potential availability of suitable data on both CVD mortality and morbidity across European countries,[2] we chose to study the following EU countries that provided data by country of birth: Denmark, England and Wales, France, The Netherlands, Scotland and Sweden. Analyses were in those aged 35–74 years following the recommendations of the EUROCISS Project.[10] This restriction was owing to: (i) few deaths from circulatory disease in people under 35 years of age; (ii) potentially more inaccuracies in death certification in those over 75 years of age; (iv) more potential inaccuracies due to return migration to home countries at older ages; (v) for some ethnic minority groups, younger age groups may have significant proportions of ethnic minorities born in the recipient country; and (vi) older populations may have significant numbers of European groups (born in what were then colonies).

Data on deaths by age (in 5-year age groups), sex, country of birth and underlying cause of death were acquired. The mortality data were provided for variable time periods, in some countries being centred on the 3- to 5-year period around the last Census year (table 1). Data were extracted using ICD-9 and/or ICD-10 codes as follows: total circulatory disease ICD9 390–459, ICD10 I00–I99; IHD ICD9 410–414, ICD10 I20–I25; cerebrovascular disease ICD9 430–438, ICD10 I60–I69.

The Danish and Dutch data sets were longitudinal i.e. people enumerated at the population register were followed for mortality through individual linkage to the national death registry (people could enter or exit the study during follow-up in case of new immigration or emigration, so this is an open cohort). For these data, the number of person-years at risk (PYR) in each stratum was computed using the time of birth, entry onto the population register, and of death or migration, of each resident.

In Sweden, deaths during the period 2000–06 were obtained annually from the National Cause of Death Register and PYR from a national population register. For England and Wales, Scotland and France, population data by age (5-year age groups), sex and country of birth were obtained from the most relevant census in each country. For these countries, PYR was computed multiplying the number of persons in each stratum at the census by the number of years of observation for deaths. This approach assumes the denominator size and composition is closed over the study period.

The following criteria were used to select country of birth groups: (i) the focus of the MEHO project, which is on predominantly socioeconomically deprived migrant and ethnic minority populations originating outside Western Europe and the OECD countries; (ii) sufficient size of population for meaningful analysis (see below); and (iii) the particular country of birth group had to be available in at least two study countries. As a consequence of differences in migration history and patterns across study countries, the individual country of birth groups that were analysed differed across countries. We included only country of birth groups with PYR equal to or greater than 30 000 for men and women combined as the number of expected events in smaller populations would mostly be too small for meaningful comparison.

Ethics

As our data were completely anonymized ethical approval was deemed unnecessary.

Statistical analysis

Directly age-standardized rates (ASR) per 100 000 population for total circulatory disease, IHD and cerebrovascular disease mortality were computed for each country of birth group and sex. The WHO

projected World Standard population 2000–25 was used as the standard. Precision was estimated using 95% confidence intervals (95% CIs), which were calculated using a normal approximation and standard errors.[11]

For findings described as similar there is overlap in the associated 95% CIs, while in findings described as different the 95% CI do not overlap for one or more of the comparisons. The CIs are given in the tables in Supplementary Appendix 1, and for total circulatory disease mortality also in figures 1 and 2.

Results

Overview of population and death registry data

Table 1 summarizes the features of the available data: two data sets were longitudinal; most data sets except Denmark (1992–2001) and Sweden (1990–2006) were over relatively limited time spans around the year 2001; the PYR of the foreign born population varied greatly but was large in all countries and often greatly exceeded our cut-off of 30 000.

Total circulatory disease mortality

Men

Figure 1 shows marked variations in male mortality rates in the local-born populations with the highest in Scotland (372.4) and the lowest in France (137.2). China born men in France (46.9) had much lower rates than Scotland and Sweden (145.4 and 154.4, respectively). India born men in Sweden (244.5) had similar rates to those in England (355.7) or in Scotland (CIs overlap). Pakistani born men had similar rates in Denmark, England and Wales and Scotland (518.9, 422.2 and 353.1 with overlapping CIs). Poland born men had extremely high rates in Denmark (630.0), and England and Wales (499.3), intermediate in Sweden (287.9) and much lower in France (170.5). Turkey born men had lower rates in France (153.5) than The Netherlands (231.4), Denmark (439.4) and Sweden (265.7). Yugoslavia born men had comparatively low rates in France (183.9) and similar rates in Denmark (313.2) and Sweden (275.1).

Women

The number of deaths and death rates in women were much smaller than for men with less precision in estimates. Figure 2 shows that, as for men, the highest rate in the local born was in Scotland (175.2) and the lowest in France (46.3). China born women in France (29.6) had much lower rates than Scotland (140.6) and Sweden (94.4). India born women in England and Wales, Scotland and Sweden had similar rates (185.5, 161.8 and 152.2). Pakistani born women in Denmark (100.4) had lower rates than those in England and Wales (238.7) and Scotland (260.0 with 95% CIs overlapping with Denmark). Poland born women had highly varying rates in Denmark (264.9), England and Wales (126.4), France (54.4) and Sweden (123.8); and the same applied to Turkey born women in Denmark (246.3), compared to France (69.1), The Netherlands (107.6) and Sweden (129.2), with some overlap in the CI in the latter. Yugoslavia born women had much higher rates in both Denmark (206.1) and Sweden (136.4) than in France (74.9).

IHD and cerebrovascular disease mortality

As IHD deaths comprise a high portion of all circulatory deaths, the patterns were very similar to those described above but with less precision because of smaller numbers, as can be seen in the Supplementary appendix tables A2 and A3. Cerebrovascular deaths comprise a small proportion of all circulatory deaths and have slightly different risk factors and pathophysiology. The numbers of outcomes was too small for easy interpretation but one clear observation from Supplementary appendix table A3 is that France born populations had comparatively low rates in all country of birth groups.

Discussion

Principal findings and key questions arising

Within the MEHO project major inequalities in circulatory diseases, including IHD and stroke, have been demonstrated by country of birth analyses within six European countries using data prepared and analysed in a standardized fashion (Report to DG Sanco 2010). The alternative

Table 1 Overview of study design, time period, number of PYR and number of deaths from circulatory disease by study country

Country and study period	PYR for local-born population		PYR for foreign-born populations	
	(35–74 years)	Deaths	(35–74 years)	Deaths
Longitudinal data				
The Netherlands, 1996–2006	71 766 025	93 839 m, 45 031 f	Turkey, 1 022 646	869 m, 301 f
Denmark, 1992–2001	24 888 235	43 467 m, 22 260 f	Pakistan, 37 598	72 m, 9 f
			Poland, 52 425	80 m, 81 f
			Turkey, 72 853	97 m, 37 f
			Yugoslavia[a], 45 631	44 m, 23 f
Non-longitudianal data—variable denominator				
Sweden, 1990–2006	57 908 351	103 723 m, 44 920 f	China, 57 545	36m, 24 f
			India, 44 968	45 m, 22 f
			Poland, 404 326	359 m, 307 f
			Turkey, 247 191	247 m, 123 f
			Yugoslavia[a], 1 013 075	1216 m, 623 f
Non-longitudinal data—fixed denominator				
Scotland, 1999–2003	10 650 675	22 355 m, 12 752 f	China, 31 810	19 m 16 f
			India, 34 630	92 m, 36 f
			Pakistan, 39 320	59 m, 31 f
England and Wales, 1999–2003	106 617 055	172 851 m, 87 736 f	India, 1 588 410	3435 m, 1810 f
			Pakistan, 842 080	1703 m, 794 f
			Poland, 128 780	528 m, 219 f
France, 2005–07	74 653 899	56 228 m, 22 782 f	China, 82 477	15 m, 9 f
			Poland, 132 115	91 m, 60 f
			Turkey, 356 000	207 m, 67 f
			Yugoslavia[a], 183 497	225 m, 81 f

a: Refers to total former Yugoslavia (i.e. Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia, Serbia and Montenegro or Slovenia) in Danish and Swedish data but former Yugoslavia (i.e. same as before apart from Bosnia and Herzegovina) in French data.
m = male, f = female

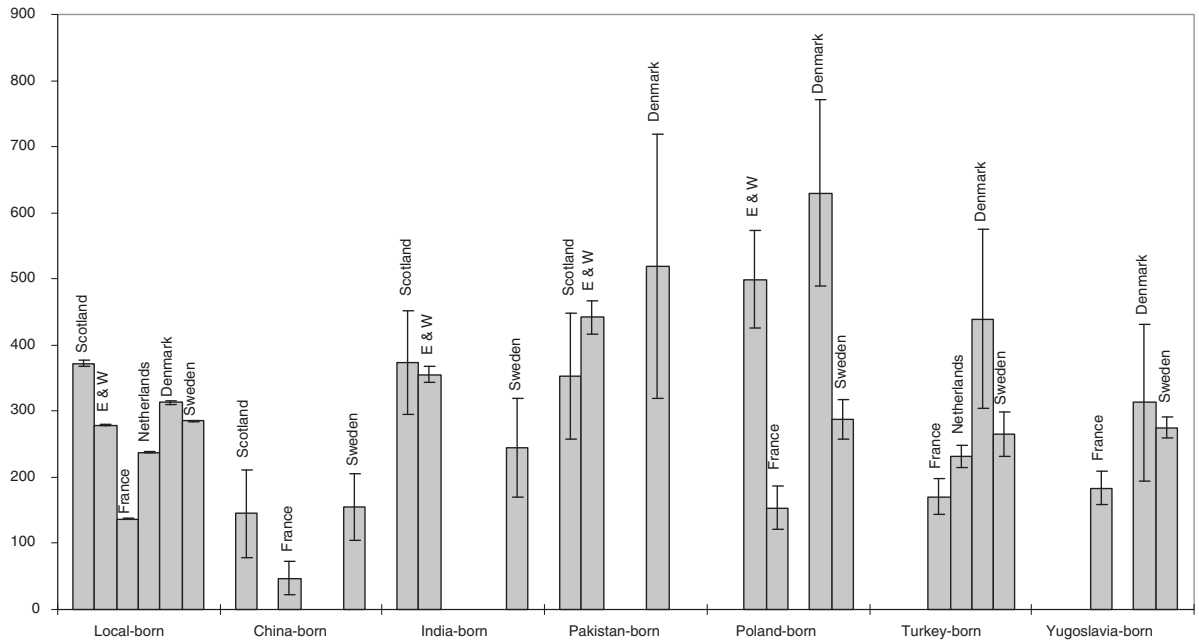

Figure 1 Total circulatory disease mortality by country of birth (*x*-axis) and country of residence (marked on bars) in six European countries. Figures are directly age-standardized mortality rates (*y*-axis) per 100 000 PYR in 35–74 year old men, and 95% CIs (lines on bars)

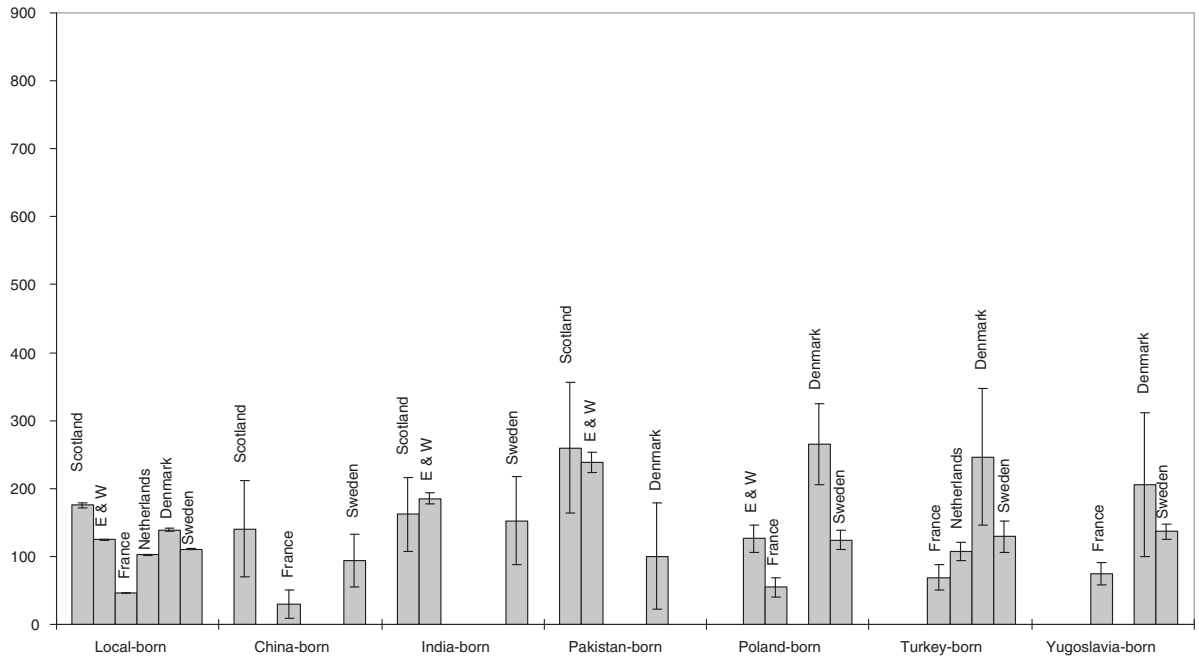

Figure 2 Total circulatory disease mortality by country of birth (*x*-axis) and country of residence (marked on bars) in six European countries. Figures are directly age-standardized mortality rates (*y*-axis) per 100 000 PYR in 35–74 year old women, and 95% CIs (lines on bars)

approach here, comparing the mortality of country of birth groups across a number of European countries is, to our knowledge, new in Europe.

Our findings warrant further work not only on circulatory diseases, but also on all-cause mortality and other outcomes, and using other kinds of data, e.g. prevalence and incidence of morbidity. Conceptually similar work is underway on cardiovascular risk factor data, in the first instance trying to harmonize and compare, retrospectively, surveys in The Netherlands and England.[12] That study has examined blood pressure,[12] cigarette smoking,[13] obesity,[14] diabetes (in press), metabolic syndrome and exercise patterns (manuscripts in preparation) and shown how, in some respects, similar ethnic minority groups living in different European countries differ, possibly reflecting local context.

This work shows that cross-country comparisons of circulatory disease mortality are potentially valuable for European public health. Many results accord with prior expectations helping in interpretation, e.g. the rates are generally much higher in men than women across the countries.[15] The rates are generally lowest in France in all groups, as previously observed.[15] There is no obvious difference in results from linked and unlinked data sets. The populations previously found to have high rates, e.g. Indian and Pakistani born, and Eastern European born,[4] have among the highest rates across countries, and those previously associated with low rates, e.g. the Chinese have among the lowest rates across countries. Some country of birth groups have similar ASRs in different countries, e.g. Pakistanis in Denmark, England and Wales and Scotland. In potentially important ways, however, the rates vary in some country of birth groups across countries, indicating that either (i) information systems differ, creating artefacts or (ii) country-specific context may be important to disease

outcome or (iii) that differences existed between the same country of birth groups in differing countries in social circumstances prior to migration. Notably, while people born outside France, except the Chinese immigrants, have higher circulatory disease mortality than the France born, their rates were lower than in their counterparts in other countries. This observation is considered in more detail below. These analyses by country of birth are the first to be reported on French data and will need corroboration.

Both the similarities and differences are of public health and epidemiological interest, pointing to issues around the challenges of disease surveillance, of migration history and local context. A key question is whether these exploratory analyses justify new efforts in Europe to create more complete and better validated data systems of this kind.

Strengths and limitations of the work

The strengths of the work include its novelty, topicality and methodological value in the context of a modern, diverse Europe seeking to tackle discrimination and inequality, and its development within the multidisciplinary framework of the MEHO project.[1,2] It is, however, an early (probably first) exploration of its kind. The results provide rationale and motivation for improvement of routine information systems to allow this kind of analysis in all European countries.[16] We used the indicator country of birth variable as the one best placed for pan-European work.[2,3]

The numbers of outcomes were small in some populations with imprecision reflected in wide CIs but as the immigrant populations age the number of outcomes will rise. The well-known limitations of this kind of analysis apply here, e.g. using, as here, country of birth as a proxy indicator for ethnicity.[3,17,18] This is mainly of value for diseases of older age, such as those studied here, as a high proportion of the young are born in the country of residence (The country of birth of the parents can identify these children.)

Mortality data are only one indicator of disease-specific outcomes, but the quality and quantity of CVD incidence and prevalence data by country of birth is extremely poor.[2] Incidence of acute myocardial infarction and/or survival after myocardial infarction in immigrants and ethnic groups has, nonetheless, shown results that are in line with those here within Sweden,[19,20] Scotland[21] and The Netherlands.[22]

Two of our data sets (Denmark, The Netherlands) are based on linked population and death registers, where the denominator is exact. For England and Wales, Scotland, Sweden and France this is not so. The bias arising from mis-measure of country of birth in these independent data sets is unknown but, as discussed elsewhere in detail, is likely to be modest because for some causes, e.g. CHD, rates tend to be high, and for others, e.g. cancers, they are low.[17] If the denominator for a country of birth was seriously underestimated, rates for all diseases would be high. Some immigrants may die while travelling to or living in their country of birth, the so-called salmon bias.[17] Such biases need to be considered in data interpretation, particularly across national boundaries but are less likely to apply to linked databases where there are procedures to capture movement of residents and their deaths.

Observing variations gives rise to questions, e.g. do variations relate to socio-economic position, cardiovascular risk factors etc. European data sets are not yet ready to answer such questions, particularly for lack of cardiovascular risk factor data by country of birth group. Socio-economic factors can sometimes be linked to mortality data sets. Scotland has extracted ethnicity, religion, social and economic indicators from census records to add to health records but these data were not available to MEHO because of disclosure controls.[23] Risk factor data were not available in Scotland. New research should seek to develop these areas.

Access to and utilization of medical care may differ around death by country of birth. There are no European studies, to our knowledge, of whether the quality of death certification and coding varies by country of birth.

Clearly estimates of absolute mortality levels in different countries, as here, need careful interpretation due to between-country differences in population coverage, study period and study design. The Swedish data span 18 years, e.g. while the French data are for 3-years. This matters for diseases, as here, where there are time trends.

Interpretation of the results in the light of the literature—the concept, findings and French (North–South/Mediterranean) Paradox

Sizeable variations in circulatory mortality by country of birth have been demonstrated in England and Wales for some decades[4,6,24] and more recently in The Netherlands,[5] and Scotland.[25] In Sweden, important differences have been seen for myocardial infarction incidence.[20] The finding here that rates of disease for one country of birth group appear to vary, sometimes quite substantially, across different countries in Europe suggests that disease outcomes may be influenced by the local context, whether this is health care, diagnostic methods and coding, availability of data in surveillance systems, social and economic standing, stress, lifestyle, migration history, social circumstances and health prior to migration or other environmental factors. These variations are extremely unlikely to be genetic. We consider such issues by focusing on France.

France has a reputation as a place where circulatory diseases are surprisingly uncommon, despite a high prevalence of traditional risk factors, e.g. cigarette smoking[26] and a high-fat diet,[27] and one that, similar to other countries, does not conform to current guidelines.[28,29] This has led to the phrase 'the French paradox'.[29] Other Southern European countries also have low rates,[15] giving rise to the terms North–South and Mediterranean Paradoxes. Miscoding and misclassification are considered likely, but even after corrections, the rates in France remain comparatively very low.[29,30] [All-cause mortality is not comparatively low in men in France compared to other European countries (and higher than in England and Wales), as might be expected given truly very low rates of circulatory disease.[15]] A global review pointed to two key hypotheses i.e. to high consumption of alcohol, particularly wine, and a time-lag effect, whereby the effects of high-fat diet are still to come.[31] In this study, compared with those who were born in France, people born outside France (from a wide range of countries) had high rates of circulatory diseases. Indeed, the differences by country of birth within France were similar to those seen within other European nations. We also saw that people born outside France have relatively low rates compared to their counterparts in other countries. (No other Southern European countries were compared here and that should be interesting.) Despite the substantial differences within France, the French paradox seemingly applies to people born outside France but living there.

It is unlikely that apparently protective aspects of French alcohol consumption patterns or diet have transferred to a wide-range of migrant groups—China, Poland, Turkey and Yugoslavia born. For example, the Turkish born are unlikely to have taken on red wine drinking in the French style. Turkey is a secular country where there is modest consumption of alcohol by a minority (especially low in women). Data from The Netherlands shows no evidence for major convergence to the alcohol use patterns of the majority Dutch population. In 2004, in Amsterdam, 74.8% of 189 Turkish men reported total abstinence compared with 9.5% of Dutch men.[32] While methods of data collection affect results, the prevalence of alcohol use was low by all methods, in the study by Dotinga *et al.*[33] We found no recent data from France but work in 1992 indicated 49% of Turkish men and 69% of women considered alcohol forbidden.[34]

These observations raise new questions about, and approaches to, study of the French Paradox. These questions will be both on the potential role of differences in death certification and, assuming these are not explanatory, the potential proactive factors, which may not be either alcohol or diet, given these findings.

Further work to explain the kind of patterns seen across the six countries will need to access information on populations' circumstances prior to migration and in the countries of residence, including data on social and economic circumstances, healthcare and risk factors. The approach here adds to classical migrant studies where, most usually, one migrant population is followed-up after migration in its new country of residence, or it is compared with populations continuing to

reside in the countries of origin.[7] One of the best known such studies is the NI-HON-SAN Study of Japanese in Japan, Honolulu and San Francisco.[8] It demonstrated convergence of cardiovascular risks and risk factors among migrants, and showed the protection against such diseases by maintenance of traditional behaviours rather than rapid acculturation. Recent work in this tradition includes Mbanya *et al.*'s study showing glucose intolerance and obesity levels in West African populations in Cameroon were lower than in corresponding populations in Jamaica and the UK, reflecting higher levels in the recipient population.[35] A recent review of cancer in non-western migrants to Europe judged that cancer risks were between those in the country of origin and recipient country.[36] Our data, from 6 countries of origin, showing both similarities and differences across countries, also point to such changes and call for studies to examine how immigrant populations are adapting the lifestyles associated with their countries of adoption.

Conclusion

Our work explores new territory in the field of inequalities in disease mortality within and between countries in Europe. Future work needs to extend the range of countries (particularly, more countries from Southern and Eastern Europe), the sample sizes and follow-up periods, improve the validity of population data outside census years, move to more emphasis on linked data sets and refine the methods to maximize comparability. Europe needs to consider whether, and if so how, to move from country of birth, a proxy that will not be valid for most descendants of migrants in European countries, to other measures of ethnic group, so that we can track change across several generations.[17] As we see from the example of the Roma (Gypsy Traveller) populations, migrants to Europe over the last 700–1000 years, there is no automatic convergence over time[37]—long-term public health surveillance is needed.

Studies of this kind can generate information to develop healthcare and public health interventions and services, and also generate hypotheses into the causes, consequences and control of diseases.[16] Insights from populations with very low rates of CVD morbidity and mortality, such as the Chinese born, will be of particular interest in informing public health initiatives designed to minimize death and disability from circulatory diseases in Europe. This article provides evidence in favour of a coordinated European effort that builds on and extends the national systems already in place to permit a better examination of country of birth and/or ethnic variations in disease and death. It is time to confront the challenge.[16]

Supplementary data

Supplementary data are available at *Eurpub* online.

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Key points

- Differences in mortality by country of birth have been demonstrated previously within several European countries.
- Whether the mortality of particular country of birth groups differs across European countries is unknown.
- We undertook new analyses as a test of concept in six EU nations.
- This exploratory study shows sufficient differences of interest across countries to warrant both further research, and refinement of surveillance systems, to permit such analyses across Europe.

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Measuring vaccination coverage in a hard to reach minority

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Background: Although childhood vaccination programmes have been very successful, there are some hard to reach minority groups that object to vaccination. The Netherlands has experienced several epidemics of vaccine-preventable diseases, confined to the orthodox Protestant minority. However, vaccination coverage in this minority is still unknown and this hampers prevention and control of epidemics. **Methods:** We estimated vaccination coverage among the orthodox Protestant minority and its various subgroups (denominations), using two sub-studies with different design and study population. For both sub-studies separately, we determined overall vaccination coverage and vaccination coverage per denomination. The results were compared and discussed. **Results:** An online survey was filled out by 1778 orthodox Protestant youngsters, invited via orthodox Protestant media using a snowball method. Next to that, results of a national sample study on vaccination were used, of which only orthodox Protestant respondents were included in our analyses (N = 2129). Overall vaccination coverage among orthodox Protestants in The Netherlands was estimated to be at minimum 60%. Moreover, in both sub-studies three clusters of denominations could be identified, with high (>85%), intermediate (50–75%) and low (<25%) vaccination coverage. **Conclusion:** The integration of both sub-studies, with their own specific strengths and weaknesses, added to our insight in the vaccination coverage in this minority. Based on these results, we recommend to focus prevention and control of vaccine-preventable diseases on the orthodox Protestant subgroups with intermediate and low vaccination coverage.

Introduction

Childhood vaccination programmes have been very successful in controlling infectious diseases. However, even in affluent societies like in Western Europe, there are minority groups with low vaccination coverage.[1] Some marginalized groups are not sufficiently reached by vaccination programmes[2–4] and an increasing number of parents refuse vaccination because of philosophical objections and safety concerns.[5] Social clustering of unvaccinated children may lead to outbreaks of vaccine-preventable diseases.[6] The last decades The Netherlands has experienced epidemics of poliomyelitis, measles, rubella and mumps, all largely confined to an orthodox Protestant minority with religious objections to vaccination.[7–10] These objections find their origin in the trust in Divine providence. God has predestined health and disease and