Eur J Epidemiol (2012) 27:915–921
DOI 10.1007/s10654-012-9746-y

CANCER

Cancer mortality patterns among Turkish immigrants in four European countries and in Turkey

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Received: 12 July 2012 / Accepted: 5 November 2012 / Published online: 20 November 2012

Abstract The aim of this study on cancer mortality among Turkish immigrants, for the first time, traditional comparisons in migrant health research have been extended simultaneously in two ways. First, comparisons were made to cancer mortality from the immigrants' country of origin and second, cancer mortality among Turkish immigrants across four host countries (Belgium, Denmark, France and the Netherlands) was compared. Population-based cancer mortality data from these countries were included. Age-standardized mortality rates were computed for the local-born and Turkish population of each country. Relative differences in cancer mortality were examined by fitting country-specific Poisson regression models. Globocan data on cancer mortality in Turkey from 2008 were used in order to compare mortality rates of Turkish immigrants with those from their country of origin. Turkish immigrants had lower all-cancer mortality than the local-born populations of their host countries, and mortality levels comparable to all-cancer mortality rates in Turkey. In the Netherlands and France breast cancer mortality was consistently lower in Turkish immigrants women than among local-born women. Lung cancer mortality was slightly lower in Turkish immigrants in the Netherlands and France but varied considerably between migrants in these two host countries. Stomach cancer mortality was significantly higher in Turkish immigrants when compared to local-born French and Dutch. Our findings indicate that exposures both in the country of origin and in the host country can have an effect on the cancer mortality of immigrants. Despite limitations affecting any cross-country comparison of mortality, the innovative multi-comparison approach is a promising way to gain further insights into determinants of trends in cancer mortality of immigrants.

Keywords Cancer mortality · Immigrants · Europe · Cross country analyses

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Introduction

Many studies have been conducted exploring cancer incidence and mortality in immigrant populations from low and middle-income countries in comparison to the local-born population of their host country. A recent literature overview on this topic revealed largely consistent patterns

between studies, confirming lower all-cancer risks but substantial variation and heterogeneity by cancer site, country of residence and the origin of immigrants [1]. Whereas breast cancer risk was found to be low in immigrants from low-incidence countries compared to the native population of their host country, lung cancer risk strongly depended on the country of origin and the prevalence of driving risk factors in the host country. Furthermore, a transition of risks among immigrants from low-income countries has been observed over time and with subsequent generations, approaching risks of high-income countries [2]. Immigrants thus retain parts of their risk profile typical for their region of origin, while changing physical and socio-cultural environments in the host countries entail the gradual change in disease patterns [3]. However, cancer incidence and mortality often show contrasting patterns, precipitated by additional underlying factors. Mortality has often been reported to be higher in immigrant populations when compared to the local-born population of their host country, presumably due to access barriers to health services and thus to adequate treatment [4]. On the other hand, improvements in structural conditions and health care services that are associated with migration to high-income countries can also have a positive influence on cancer mortality [5].

Yet, the magnitude of changes in cancer risks and mortality—and thus the influence of environmental and other extrinsic risk factors—can only be assessed fully by comparing corresponding measures (such as standardized cancer incidence and mortality rates) in immigrant populations with those of the population of their country of origin and with the same immigrant group residing in other host countries, respectively [6]. Such three-way comparisons can help determining the impact of national contexts on disparities in cancer risk and mortality in immigrant groups [7]. Thus, if living conditions in the host countries would exert strong effects, cancer rates of immigrants from one origin would be expected (a) to be "caught in the middle", i.e. between home and host country; and (b) to differ across host countries. Information on changes in cancer risks among immigrants is important firstly for cancer research, as it helps to understand the influence of exogenous factors in the aetiology of cancer; and secondly for cancer care, as it helps to anticipate the occurrence and patterns of cancer among immigrant groups, benefiting clinical cancer care, cancer prevention and health system planning in the countries involved.

To date, comparisons involving more than one host country, and in particular comparisons with low- and middle-income host country, are scant. In this study, we extend traditional comparisons in two ways, using Turkey and Turkish immigrants as an example: first, we include data on cancer mortality from the country of origin. Second, we compare cancer mortality in Turkish immigrants across four European countries (Belgium, Denmark, France and the Netherlands). Our broader aim is to introduce the idea of cross-country comparisons of cancer mortality among immigrants and to discuss strengths, potentials and methodological limitations of this approach.

Materials and methods

Target populations

Immigrants of Turkish origin form a considerable ethnic group in many Western European countries, mostly attributable to large labour migration waves during the 1960s and 1970s. After settling permanently, many were followed by their families [8]. Today, this group has reached retirement age and their health situation has become a focus of public health.

Data sources

Nationwide data on cancer mortality in Turkish immigrants were available for Belgium (1991–1995), Denmark (1992–2001), France (2005–2007) and The Netherlands (1996–2006). This study is based on the same data set as Vandenheede et al. [9] and Bhopal et al. [10], who described differences in mortality from diabetes and circulatory diseases among immigrants. These data refer to the complete national population and cover the entire territory of the participating EU countries (in France, excluding the overseas departments Guadeloupe, Martinique, Guyane, and La Réunion). Data from longitudinal, record linkage studies were used in Belgium, Denmark, and The Netherlands. Here, people enumerated at the population census were followed through a linkage between the census and the mortality register. In Denmark and the Netherlands an open cohort design was used. Participants could enter or exit the study at any point in time during the follow-up period; late entry was not possible in Belgium. For France, cross-sectional data were used. The number of deaths according to country of birth provided by this study was derived from the national mortality registers, whereas the person-years at risk (PY) were based on population census information. Mortality data were centred around the latest population censuses.

Variables

Having been born in Turkey was used to determine immigrant status. Non-residents of Turkish origin, such as asylum seekers, were excluded from the analyses.

Depending on the country and years of the studies, either the 8th, 9th or 10th revision of the International classification of disease (ICD) was used in order to determine mortality from cancer. The relevant codes for ICD-9 were 161-163 and 165 for lung cancer, 174–175 for breast cancer and 151 for stomach cancer. In ICD-10, C30-34 and C39 were used for lung, C50 for breast, and C16 for stomach cancer. In the Danish dataset ICD-8 codes were applied until 1993.

Age was stratified in 5-year age bands. The recorded age corresponded to age at time of the population census in linked studies and to age at death in the unlinked study. Consequently, persons from the census linked studies were slightly older than persons from the unlinked study (and whom we allocated to the same age group).

Statistical analysis

Age group-specific mortality rates were computed for the local-born and Turkish population of each country, using person-years at risk (PY) as the denominator. Next, age-standardised mortality rates (ASMRs) were calculated based on the direct method of age standardization, using the WHO World Standard Population [11]. To examine relative differences in cancer mortality, country-specific Poisson regression models were fitted using number of deaths as the dependent variable, person-years at risk as the offset variable, and country of birth as the independent variable. Due to low numbers of cases, site-specific comparisons were carried out with the Dutch and French datasets only. All analyses were performed stratified by sex and adjusted for age. Poisson models for breast cancer among women were also stratified for 'younger than 50 years' and '50 years and older' to account for possible differences in breast cancer mortality among younger and older immigrants.

Data on cancer mortality from Turkey was obtained from the Globocan database. Although data from a previous Globocan version from the year 2000 [12], are temporally closer to the period covered by the data sets included here, estimates from 2008 [13] were judged to be more reliable. This is mainly due to different approaches that were used in the estimation of incidence and mortality rates for Turkey as a whole. While Globocan 2000 data are based on data only from the Izmir cancer registry, Globocan 2008 data additionally incorporate estimates from the Antalya Cancer Registry and the Ardabil province in Iran, which are used to approximate cancer mortality in Eastern Turkey. This approach led to a better estimation of cancer rates in rural and Eastern Turkey, from where a considerable number of Turkish immigrants in Western Europe originates [14]. Cancer mortality estimates from Globocan are directly age-standardized to the WHO world population [11]. Ratios of the age-standardized mortality rates comparing Turkey to the corresponding host country were calculated as an indicator for the difference in cancer mortality between the country of birth and the host countries. All regression analyses were performed using SAS 9.2.

Results

Turkish immigrants had a substantially lower all-cancer mortality than the local-born populations of the host countries included (Table 1), and than the population of Turkey. Mortality rate ratios (MRR) were significantly lower in Turkish immigrants when compared to the majority populations of all four host countries. Estimates from 2008 Globocan data show that all-cancer mortality in Turkey was higher, especially in males, (and MMRs thus closer to 1) than in Turkish immigrants in the four host countries.

The magnitude of the advantage in cancer mortality among the immigrants varied according to cancer site (Table 2). *Breast cancer* mortality in Turkish immigrant women was considerably lower than among local-born French and Dutch women, but higher than in Turkey. The younger immigrant women showed a breast cancer mortality more similar to the mortality experienced of locally born women.

Lung cancer mortality among Turkish immigrant women showed contrasting patterns in those residing in France (where rates converged to the mortality level of native French) and in the Netherlands (where mortality was even slightly lower than in Turkey). Lung cancer mortality among Turkish immigrant men in France and The Netherlands was lower than among local-born men. The lung cancer mortality in Turkey 2008 was higher than among the Turkish immigrant men and higher among the majority populations of the host countries.

Stomach cancer mortality was significantly higher in Turkish immigrants among males and females when compared to local-born French and Dutch. Comparisons with the 2008 data from Turkey suggest that stomach cancer mortality in Turkish immigrants is in-between that of their country of origin and their host country.

Discussion

Our findings show that Turkish immigrants tend to experience lower overall cancer mortality and lower cancer-specific mortality rates for breast and lung cancer when compared to local-born populations in the host countries, and—with the exception of lung cancer mortality among female Turkish immigrants in France—than the population

Table 1 Crude and age-standardized all-cancer mortality rates among Turkish immigrant and local-born populations in Belgium, Denmark, France and The Netherlands and age-adjusted all-cancer mortality rate ratios (MRR) among Turkish-born immigrants and in Turkey in comparison to the local-born populations

	Country[#]	Person-years at risk (PY)		Absolute cancer deaths (*n*)		Crude mortality rate		Age-standardized mortality rate (per 100,000 PY)		Age-adjusted mortality rate ratios (MRRs)*		
		Local-born population	Turkish population	Local-born population	Turkish population	Local-born population	Turkish population	Local-born population	Turkish population	MRR Turkish population vs. local-born population	95 % Confidence Interval	MRR Turkey** vs. country of residence
Males	Belgium	19,856,738	218,556	70,751	100	356.3	45.8	273.8	157.2	**0.65**	0.53–0.79	0.93
	Denmark	25,996,864	182,399	80,217	69	308.6	37.8	139.2	96.6	0.85	0.67–1.08	0.91
	France	78,719,481	381,402	240,949	492	306.1	129.0	219.3	166.0	**0.69**	0.63–0.75	0.98
	Netherlands	71,247,835	1,859,854	213,579	916	299.8	49.3	201.3	126.8	**0.71**	0.67–0.76	0.98
Females	Belgium	20,982,893	202,450	51,790	43	246.8	21.2	140.0	60.7	**0.51**	0.38–0.68	0.80
	Denmark	26,655,302	162,014	78,447	37	294.3	22.8	113.0	56.2	**0.57**	0.41–0.78	0.59
	France	83,852,076	330,721	163,750	282	195.3	85.3	102.4	81.7	**0.83**	0.74–0.93	0.92
	Netherlands	72,988,509	1,704,834	176,380	431	241.7	25.3	127.1	63.8	**0.49**	0.45–0.54	0.67

Bold number are statistically significant at the $p < 0.05$ level

[#] Study periods varied by country: Belgium (1991–1995), Denmark (1992–2001), France (2005–2007), Netherlands (1996–2006)

* MRRs and 95 % CIs were derived from a Poisson regression model with local-born populations as reference category and adjusted for age

** Ratio of age-standardized mortality rates from Turkey versus the corresponding country of residence; estimates from Globocan 2008 [13]

in Turkey. The results on breast cancer mortality are in line with results from several national studies on cancer risks among Turkish immigrants in Europe [1, 15]. The findings on breast cancer mortality by age (<50 years/≥50 years) are in line with a study from Hamburg, Germany, which showed a convergence of breast cancer incidence among younger Turkish immigrant women towards the risks of women without immigrant background [16]. This convergence towards the mortality of the locally born women indicate a transition of the lifestyle of Turkish immigrant women towards that of Western-European women, including for example a later age at first childbirth. Rising age at first childbirth of mothers has been followed by increases in breast cancer incidence among women in several European countries in the last decades [17].

Mortality from lung cancer varied considerably between Turkish immigrants in The Netherlands and France, and also among women and men. Despite the high smoking prevalence in the general population, Turkish immigrants in the Netherlands had lower lung cancer mortality than the local born population, in particular among women, and compared to Turkey. In contrast, in particular Turkish immigrant women in France had nearly the same lung cancer mortality as the local-born women and considerable higher lung cancer mortality than women in Turkey. These variations might be related to different durations of stay or migration histories of the immigrants, acculturation mechanisms, selection effects or misclassification. Influencing factors could be differences in smoking prevalence and smoking policy, e.g. smoking laws and the availability of cigarettes, in these countries. In the Netherlands, prevalence of smoking in the general population is higher than in France [18], which is also reflected in a higher lung cancer mortality in the general population of the Netherlands as compared to France. These factors might interact with the beliefs and smoking behaviours that immigrants bring from their country of birth and retain in their ethnic communities over time [3]. Our results indicate that there are specific effects related to the situation in the host country which affect lung cancer mortality among Turkish immigrants.

Stomach cancer mortality in Turkish immigrants was higher than in local-born French and Dutch. The higher stomach cancer mortality among Turkish immigrants compared to the local-born population is in line with several national studies on cancer risks among Turkish immigrants in Europe [1, 15, 16]. In Turkey, stomach cancer represents one of the leading causes of death but mortality varies greatly according to geographical region [19]. This is mainly due to a higher prevalence of infection with *Helicobacter pylori* and differences in diet, e.g. in the consumption salty foods. Our results on stomach cancer mortality among Turkish immigrants therefore suggest the persistence of factors that are related to the situation in their country of origin. The

Table 2 Crude and age-standardized lung, breast and stomach cancer mortality rates among Turkish immigrant and local-born populations in France and the Netherlands and age-adjusted cancer mortality rate ratios (MRR) among Turkish-born immigrants and in Turkey in comparison to the local-born populations

	Country	Absolute cancer deaths (*n*)		Crude mortality rate		Age-standardized mortality rate (per 100,000 PY)		Age-adjusted mortality rate ratios (MRRs)*		
		Local-born population	Turkish population	Local-born population	Turkish population	Local-born population	Turkish population	MRR Turkish population vs. local-born population	95 % Confidence Interval	MRR Turkey** vs. country of residence
Lung cancer										
Males	France	57,985	156	73.7	40.9	54.5	52.8	**0.81**	0.69–0.95	1.17
	Netherlands	66,595	329	93.5	17.7	62.3	42.7	**0.83**	0.74–0.93	1.08
Females	France	12,426	29	14.8	8.8	9.0	9.5	0.98	0.68–1.41	0.44
	Netherlands	24,028	29	32.9	1.7	19.8	4.2	**0.19**	0.13–0.28	0.22
Breast cancer										
Females	France	30,019	50	35.8	15.1	21.4	11.8	**0.67**	0.51–0.89	0.70
	< 50 years							0.75	0.45–1.28	
	≥ 50 years							**0.64**	0.46–0.89	
	Netherlands	33,988	95	46.6	5.6	26.5	11.1	**0.45**	0.37–0.55	0.60
	< 50 years							**0.60**	0.44–0.80	
	≥ 50 years							**0.33**	0.24–0.46	
Stomach cancer										
Males	France	8,074	32	10.3	8.4	7.2	11.9	**1.44**	1.02–2.04	3.54
	Netherlands	9,949	76	14.0	4.1	9.3	11.1	**1.35**	1.07–1.69	2.98
Females	France	5,077	16	6.1	4.8	2.7	5.1	**1.69**	1.03–2.76	4.16
	Netherlands	6,389	37	8.8	2.2	4.1	6.3	**1.61**	1.17–2.23	2.72

Bold number are statistically significant at the $p < 0.05$ level

* MRRs and 95 % CIs were derived from a Poisson regression model with local-born populations as reference category and adjusted for age

** Ratio of age-standardized mortality rates from Turkey and the corresponding country of residence; estimates from Globocan 2008 [13]

prevalence of infections with *Helicobacter pylori* is especially high in rural Eastern Turkey where the majority of Turkish immigrants to Europe originates from. Compared to Globocan 2008 data, stomach cancer mortality risks of Turkish immigrants seem to lie between the risks of country of origin and country of residence, indicating a convergence over time. This convergence might occur due to changes in lifestyle, better health care in the host countries and a lower prevalence of infections with *H. pylori*.

Feasibility and potential of multinational studies on cancer mortality in immigrants

Our study demonstrates that immigrant-specific data on cancer mortality are available from several European countries and that cross-country comparisons of cancer mortality among immigrants are possible. However, such comparisons have to face important methodological challenges. Lag time, i.e. the time between the exposure to risk factors and cancer mortality, plays a major role in the interpretation of our results. Since the studies included cover dissimilar observation periods, time since migration is different in Turkish immigrants across the four host countries. This, together with different study designs, limits the comparability of mortality rates across countries and represents a weakness of our research design.

The large difference between the crude and the age-adjusted estimates in the immigrant group highlights substantial differences in age structure between Turkish immigrant populations and the local-born populations of the host countries and the need for age adjustments in studies on cancer risks among immigrants. The number of deaths among immigrants was rather small, in particular for stomach cancer and when stratified for age and sex. For this reason, to date only studies focussing on common cancers in sufficiently large population subgroups are possible. However, as the absolute number of immigrants and ethnic minorities in many European countries increases and many

immigrant populations are ageing, the number of cases will increase in the future.

The registration of deaths of immigrants is challenging for several reasons. Mortality among older immigrants is often underestimated due to unregistered remigration (and death outside the country of residence). For instance, of all immigrants of Turkish origin who permanently settle in the Netherlands, about 22 % die abroad, mostly in their country of birth [20]. While the death itself is in most cases registered with the Dutch authorities, the cause of death often remains unknown, leading to a considerable proportion of deaths that cannot be attributed. Future studies on cancer mortality of European populations, in particular on cancer mortality among specific sub-populations such as immigrants and ethnic minority groups, will benefit from improvements in the standardization of mortality registration across Europe.

Conclusions

Multinational comparisons of cancer mortality among immigrants yield promising results, both in terms of overcoming methodological challenges as well as gaining new insights related to the subject matter. Our approach, once refined and based on harmonized collection of mortality data throughout the EU, can be extended to other immigrants groups, host countries and cancer sites. It can then be used to study effects of national-level conditions on the health of population subgroups. In a similar manner, a recent study by Agyemang [21] analysed the association between metabolic syndrome and type II Diabetes in ethnic groups in The Netherlands and the UK.

Overall, Turkish immigrants had advantages in cancer mortality compared to the local-born populations of their host countries, and compared to the population of Turkey. These advantages are probably the expression of different factors acting together, e.g. transition of lifestyles (e.g. nutrition, smoking), better health care, cancer screening and treatment in their host countries, or possible selection effects in the process of migration. These advantages may however be only temporary. Changes in lifestyle associated with conditions in the host country may result in an increase in cancer mortality among immigrant populations. Thus, their mortality rates may converge towards, or even exceed, those of the local-born populations. More research is needed to monitor the change of cancer mortality (and risks) among Turkish (and other) immigrant populations, in order to identify specific cancer risks, and to keep the cancer mortality of immigrants as low as possible. Future studies based on multinational databases might be able to distinguish 'country of origin'-related factors in cancer genesis from 'country of residence'-related factors in more detail. The approach we tested in this study is a promising first step forward to such studies.

Acknowledgments This paper is a product of the EU-funded project Migrant and Ethnic Minority Health Observatory (MEHO) (http://www.meho.eu.com). We thank Statistics Netherlands for providing tabular data on cancer mortality by age, sex and country of origin in the Netherlands.

Conflict of interest The authors declare that there is no conflict of interest associated with this manuscript.

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