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ORIGINAL PAPER

Cancer profile of migrants from the Former Soviet Union in Germany: incidence and mortality

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Abstract This study compares cancer mortality and incidence of ethnic German migrants from the Former Soviet Union (FSU) in Germany. Data were obtained from two migrant cohorts residing in the federal state of North Rhine-Westphalia (NRW) ($n = 34{,}393$) and Saarland ($n = 18{,}619$). Vital status of the NRW cohort was ascertained through local population registries. Causes of death were obtained from the NRW statistical office or from local health offices. Cancer incidence of the Saarland cohort was derived from the Saarland cancer registry using record linkage. From 1990 to 2005, we observed 708 cancer deaths and 586 incident cancer cases. In males, both cancer incidence and cancer mortality were similar to the German population. Female cancer incidence and mortality were lower, the latter significantly. Site-specific standardized mortality and incidence ratios showed great variation in comparison to Germans and were remarkably similar to each other for most sites. Lung cancer was elevated among males, but lower among females. Stomach cancer was higher contrasting with lower ratios for prostate cancer, male colorectal cancer, and female breast cancer. Results confirm that FSU-migrants suffer from cancers, which may be prevented by prevention programs. Furthermore, we cannot conclude a different health-seeking behavior compared to Germans.

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Introduction

Several epidemiological studies have demonstrated that cancer incidence and cancer mortality of migrants clearly differ from cancer patterns of the respective national populations [1–5]. Such studies led to new findings on the etiology of diseases [6, 7], but they are also important to develop targeted cancer prevention strategies [8, 9].

Since the beginning of the 1990s more than 2 million ethnic German migrants from the Former Soviet Union (FSU) migrated to Germany. Previous studies revealed unanticipated mortality patterns of these migrants: They had a lower mortality from all causes of death, mainly determined by a low mortality from cardiovascular disease [10, 11]. In contrast, males had a higher risk to die from external causes and deaths associated with these causes such as mental and behavioral disorders due to substance use [12]. In addition, this migrant population had a significantly elevated mortality from viral hepatitis and from some cancers associated with infectious agents such as stomach and liver cancer when compared to their host population [13, 14].

Only few migrant studies assess cancer incidence, and even less research is carried out comparing cancer incidence and mortality. Most investigations using both, cancer incidence and mortality, were occupational cancer studies, which describe health risks associated with workplace exposures [15–17].

Zeeb et al. [5] found evidence for a transition of cancer incidence and mortality patterns toward the host population among Turkish migrants in Germany. Swerdlow observed

very low colorectal and breast cancer mortality for Vietnamese refugees in England and Wales, which contrasted with elevated mortality from stomach cancer in both sexes, cancers of the nasopharynx and liver in males [1]. Another study analyzed differences in cancer rates between first and second generation migrants relative to the host country and stratified by country of origin showing cancer site-specific patterns for succeeding generations [18]. Results from a study by Warshauer et al. [19] indicated increasing rates of colorectal and stomach cancer incidence and mortality of Puerto Rican-born residents after migration to New York City.

All previous investigations on FSU-migrants in Germany consider mortality as the endpoint. However, from this perspective the effects of risk factors and of later diagnosis or less optimal treatment cannot be disentangled. It is therefore crucial to investigate the cancer incidence pattern in this population.

This study is among the few migrant studies examining the extent to which cancer mortality is in line with cancer incidence. Two cohorts of FSU-migrants in Germany were compared to assess differences between these indicators and between migrants and the host population.

Materials and methods

This study used data of two migrant cohorts from the FSU that reside in two different federal states of Germany. One cohort has settled in the federal state of North Rhine-Westphalia (NRW) and the other one in the federal state of Saarland.

Mortality of the cohort in NRW from an earlier follow-up period was presented by Becher et al. [10] and Ott et al. [12]. The current study uses data of an extended follow-up period until 2005.

NRW cohort (cancer mortality)

The study population of the NRW cohort comprises FSU-migrants aged 15 years and above, who settled in NRW between 1990 and 2001. Methodological details on selection and follow-up procedures have been described elsewhere [20, 21]). Briefly, a list of all 281,356 FSU-migrants in NRW containing names, sex, dates of birth and arrival in Germany, first city of residence, and country of origin was obtained from the NRW reception center. Out of them, a cohort of 34,393 (16,734 males and 17,659 females) was quasi-randomly selected.

Vital status was ascertained through local population registries. Participants who changed residence were censored at last known date of moving, deceased participants at date of death, and remaining participants at 31 December 2005. For deceased participants, causes of death were obtained either from the NRW statistical office ($n = 2{,}294$) through a record linkage system using sex, dates of birth and death, and last residence for identification [22] (ICD-9 codes for deaths before 1998, thereafter ICD-10) or from anonymized death certificates. These death certificates were available from local health offices and were coded according to ICD-10 by the official coding office in the state of Saarland ($n = 152$). Cause of death was not available for 134 cases (5.2% of all death).

Person-years (PY) were calculated for each sex, 5-year age group, and calendar year. Official WHO cause of death statistics were used to calculate standardized mortality ratios (SMR) [23].

Saarland cohort (cancer incidence)

The second study population of FSU-migrants in the Saarland provided information on cancer incidence. This cohort was not restricted to a particular age and consists of FSU-migrants who arrived in the Saarland between 1990 and 2005. Information on 26,384 FSU-migrants in the Saarland (more than 90% of all FSU-migrants who first settled in the Saarland) was directly obtained from all seven existing local reception centers containing names, sex, date of birth, German passport issue date, first city of residence, and country of birth. A sample of 18,619 (8,975 males and 9,644 females) individuals without missing data was drawn. More details are given by Winkler [24].

Passport issue date minus 6 month was used as an approximation for date of arrival in Germany up to 1993, taking this as mean processing time in local refugee offices into account. After 1993, a new German law shortened the processing period and thus, the arrival date was set 3 months earlier than issue date of the passport.

Record linkage based on the phonetic code of first and last name, sex, and date of birth was applied to assign cancer cases of the Saarland Cancer Registry to the cohort of migrants. For some individuals, city of residence was used as an additional variable to ensure correct identification. Therefore, most recent information on city of residence was collected through local registry offices. Twenty-one cases were not considered in the analysis because they were diagnosed in the country of origin.

As a result of strict data protection regulations, mortality follow-up was only available for 12.4% of the cohort up to now and PY of observation had to be approximated. The method of PY estimation was applied as described in detail by Winkler [24]: sex, age, and calendar year-specific PY were estimated by a two-step procedure. First, it was assumed that each cohort member who has not experienced

a cancer diagnosis contributed PY until 31.12.2005. In a second step, PY were adjusted by sex- and age-adjusted German mortality rates and by a factor, which takes possible loss to follow-up into account.

German mortality rates for all causes except cancer were used since participants were censored at the date of cancer diagnosis, and thus all others could not have died from cancer. The factor of loss to follow-up was estimated from those 12.4% that had a complete mortality follow-up. Most loss to follow-up resulted from moves into other regions of Germany not covered by the Saarland cancer registry. Separate analysis of these 12.4% showed an age and calendar year-specific pattern of changing residence, which was taken into account. The yearly migration, however, was rather low with less than 2%. Additionally, a sensitivity analysis was performed (data not shown) to ensure the robustness of the estimated number of PY.

Cancer incidence data was provided by the cancer registry of the Saarland [25] and used to calculate the expected number of cases for standardized incidence ratio (SIR).

SMR and SIR were calculated for all cancers combined except nonmelanoma skin cancer (ICD-10: C44) and for specific cancer sites as shown in Table 1. All 95% confidence intervals (95% CI) were calculated using the exact method [26]. Analysis was performed using SAS version 9.1 [27].

Results

Table 2 presents descriptive results of both cohorts. The size of the Saarland cohort was about half the size of the cohort in NRW. Females were slightly overrepresented in both cohorts. The arrival period for entering the cohort was 4 years longer in the Saarland cohort. The NRW study population was restricted by age at migration of 15 years or older; the Saarland cohort had no age restriction. Thus, the Saarland cohort was on average younger. The NRW cohort accumulated 344,486.1 PY, whereas for the Saarland cohort 176,587.7 PY were estimated.

Follow-up of the NRW cohort was completed for 96.7% of the cohort members with a mean follow-up time of 10.1 years. Overall, 2,580 (7.5%) cohort members died. Causes of death were known for 94.8% of deceased persons, and 1,138 (3.3%) persons were lost to follow-up within the observation period, either because they moved abroad or to an unknown destination. During the observation period, 586 cohort members of the Saarland cohort were diagnosed as having cancer. Figure 1 shows the results of SIR and SMR analyses (observed and expected numbers of cases are shown in Table 1).

Cancer mortality in the NRW cohort

Cancer caused 708 (27.4%) of all deaths. Mortality for all cancer sites except nonmelanoma skin cancer in male FSU-migrants was comparable to the German population [SMR: 1.01 (95% CI: 0.92–1.11)]. Female cancer mortality was significantly lower with an SMR of 0.79 (95% CI: 0.71–0.89). The risk of dying from lung cancer was significantly elevated in males yielding an SMR of 1.28 (95% CI: 1.08–1.51) and lower among female migrants [0.52 (95% CI: 0.32–0.80)].

An elevated stomach cancer mortality [males: SMR: 1.44 (95% CI: 1.01–1.98); females: SMR: 1.40 (0.95–1.99)] was found for both, males and females. Liver cancer mortality was also higher among migrants (not significant). However, for colorectal cancer, the risk was lower among migrants compared to Germans [SMR: 0.67 (95% CI: 0.46–0.94)].

Breast cancer is the most common cancer site in females, and female FSU-migrants had a significantly lower mortality than German females yielding an SMR of 0.41 (95% CI: 0.27–0.59). Other cancers of the reproductive system except ovarian cancer showed a similar low risk without being significant. Among males, mortality from prostate cancer was significantly reduced at 0.64 (95% CI: 0.41–0.94). Deaths from leukemia yield an SMR of 0.65 in both sexes, but results are not significant.

Cancer incidence in the Saarland cohort

For male migrants, cancer incidence was similar to Germans [SIR: 0.97 (95% CI: 0.86–1.11)], whereas female migrants had an insignificant lower cancer incidence, [SIR: 0.91 (95% CI: 0.80–1.03)]. The SIR for stomach cancer was significantly elevated at 2.81 (95% CI: 1.85–4.11) for male and at 2.66 (95% CI: 1.65–4.07) for female migrants. Males had a high lung cancer SIR of 1.47 (95% CI: 1.14–1.88), but a reduced incidence of colorectal (cancer [SIR: 0.50 (95% CI: 0.30–0.79)]. Prostate cancer was also reduced, without being significant [SIR: 0.78 (95% CI: 0.55–1.09)]. Female SIR of lung cancer was significantly lower with 0.34 (95% CI: 0.13–0.75) as was breast cancer with 0.72 (0.55–0.93).

Comparison of both cohorts

SIR of the Saarland cohort is remarkably similar to the SMR of the NRW study population. This indicates that later diagnosis with poorer survival or treatment factors are unlikely. Statistically significant differences between SIR and SMR were observed for males for melanoma skin cancer with a higher and for leukemia with a lower SMR.

Table 1 Corresponding ICD-9, ICD-10 codes and observed number of cases of the two migrant cohorts, from North Rhine-Westphalia and Saarland, Germany

Cause of death group	ICD-9	ICD-10	Males				Females			
			Saarland cohort		NRW cohort		Saarland cohort		NRW cohort	
			Observed incident cases	Expected incident cases	Observed deaths	Expected deaths	Observed incident cases	Expected incident cases	Observed deaths	Expected deaths
Lip, oral cavity, and pharyngeal cancer	140–149	C00–C14	8	14.6	7	15.0	2	4.8	1	4.0
Stomach cancer	151	C16	27	9.6	37	25.7	21	7.9	31	22.2
Colorectal cancer	153–154	C18–C21	18	36.0	33	49.2	39	36.8	46	52.8
Liver cancer	155	C22	3	4.5	18	11.6	4	2.5	12	6.7
Pancreatic cancer	157	C25	4	5.3	21	21.5	6	6.5	21	22.9
Lung cancer	162	C33–C34	61	41.6	139	108.6	6	17.5	20	38.5
Melanoma skin cancer	172	C43	6	6.8	9	4.6	7	8.8	5	4.1
Breast cancer (female)	174	C50					57	79.3	29	70.8
Cervix uteri cancer	180	C53					9	10.9	7	8.6
Uterine cancer	179; 182	C54–C55					10	14.2	6	10.1
Ovarian cancer	183	C56					10	11.0	25	22.9
Prostate cancer	185	C61	35	44.7	24	37.6				
Bladder cancer	188	C67	9	9.0	9	13.3	3	4.1	4	6.9
Brain cancer	191	C71	6	5.1	14	11.1	4	4.9	5	9.9
Leukemia	204–208	C91–C95	9	6.6	8	13.0	7	5.8	8	12.2
All cancer sites[a]	140–208[a]	C00–C97[a]	235	241.6	399	395.2	235	259.5	294	370.1

[a] Except nonmelanoma skin cancer (ICD-9: 173, ICD-10: C44)

Table 2 Descriptive results of the two migrant cohorts, from North Rhine-Westphalia and Saarland, Germany

	Migrant cohort in the federal state of NRW[a]	Migrant cohort in the federal state of Saarland
Number of cohort members	34,393	18,619
Males (%)	16,734 (48.7%)	8,975 (48.2%)
Females (%)	17,659 (51.3%)	9,644 (51.8%)
Immigration period	1990–2001	1990–2005
1990–1993	14,728	6,933
1994–1997	11,441	6,536
1998–2001/5	8,224	5,150
Age restriction	15+	–
Mean age at migration (standard deviation; range)	40.0 (17.0; 15–97)	32.4 (19.8; 0–103)
Males	38.4 (16.0; 15–93)	30.9 (19.0; 0–95)
Females	41.5 (17.7; 15–97)	33.8 (20.4; 0–103)
Descriptive results of the follow-up procedure		
End of follow-up date	31-12-2005	31-12-2005
Mean time of follow-up	10.1 years	9.48 years[b]
Person-years	344,486.1	176,587.7[b]
Males	167,071.6	85,413.4[b]
Females	177,414.5	91,174.2[b]
Alive (%)	89.2	90.8[c]
Dead (%)	7.5	5.2[c]
Lost to follow-up (%)	3.3	4.0[c]
Cause of death unknown (%)	5.2	–

[a] North Rhine-Westphalia

[b] Estimated value based on Winkler [24]

[c] Based on subcohort with complete follow-up

Differences were also found for stomach cancer, female breast cancer, and for all cancer sites in females.

Discussion

Total cancer incidence and total cancer mortality of male FSU-migrants are comparable to the German population, but lower for female migrants. With regard to specific cancer sites, there are substantial differences.

Lung cancer is mainly caused by tobacco smoking and incidence as well as mortality has shown a great difference between the two sexes. Female migrants tend to smoke less than males and also less than German females. The average sex ratio (males to females) for lung cancer in the Russian Federation has consistently been 10:1 over the last 20 years [28]. In contrast, the sex ratio in the German population has fallen to 4:1 in 2003 and continues to decrease [28]. In our cohorts, the ratio found was 10:1 and 7:1 for mortality and incidence and is thus similar to that in the Russian Federation. This indicates a comparable smoking pattern as in the country of origin. The pattern was not repeated for other smoking related cancers such as laryngeal and bladder cancer, which may, however, be related to the small number of observed cases.

Elevated mortality from stomach and liver cancer of FSU-migrants has been shown previously [13], and the current study confirms a higher incidence for stomach cancer in migrants. Stomach cancer is a fatal malignancy with a low survival—the relative 5-year survival rate is 30–35% [29]—and thus the difference cannot be explained by differences in treatment and detection. *H. pylori* is one

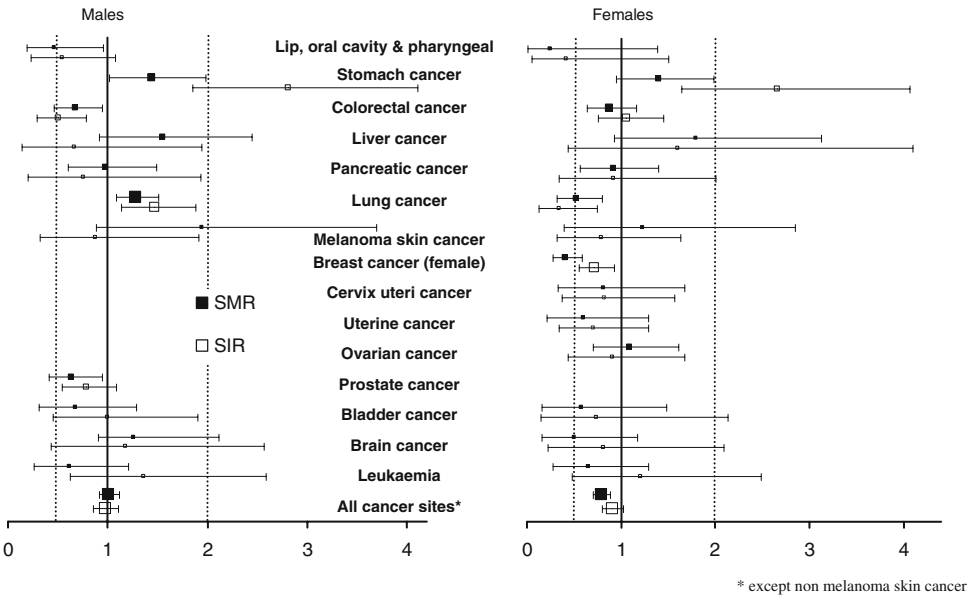

Fig. 1 SIR and SMR (with 95% confidence intervals) of FSU-migrants by cancer site, relatively to all Germans

of the risk factors for gastric cancer. Additionally, alcohol consumption and nutritional factors, such as low fruit and vegetable consumption and high intake of nitrite containing foods, play a role in the pathogenesis of gastric cancer [30–32]. High alcohol consumption, together with hepatitis virus infection, and aflatoxin produced by certain molds or fungi might also provide an explanation for the elevated SMR of liver cancer.

Colorectal and pancreatic cancer mortality and incidence was lower among FSU-migrants. Yet there is no agreement yet on most important causes for colorectal cancer, but this cancer site as well as pancreatic cancer, is influenced by a diet rich in meat and animal proteins and low intake of fruits and vegetables together with low physical activity [33–36].

Breast cancer was reduced among FSU-migrants. Lower rates may partly be explained by a combined effect of higher birth rates, as seen in rates of Kazakhstan and of the Russian Federation.

For prostate cancer, the picture is very similar. SIR was also reduced, but not significantly and confirms the low SMR observed for prostate cancer mortality. SIR may partly be associated with health-seeking behavior of male FSU-migrants. Since prostate-specific antigen (PSA) testing may not be as common among migrants in Germany.

Cancer incidence and mortality of FSU-migrants in the two different German federal states were very similar. This was expected because both cohorts have equal underlying conditions regarding the health care system and stresses of migration. Additionally, it confirms all striking differences in cancer mortality compared to the German population found in earlier studies [10, 14].

Most differences between SIR and SMR may be explained by chance and the slightly different populations, which were used for the standardization procedure. Statistically significant differences between SIR and SMR for stomach and female breast cancer might indicate that FSU-migrants in Germany do not underutilize preventive services, as previously shown [37, 38]. However, from our data, we cannot conclude what finally causes these differences.

Since the federal refugee office assigns the local office randomly, data can be considered as missing at random and representativeness for both cohorts is ensured. Additionally, it was shown by various descriptive aspects that both cohorts are comparable in terms of country of origin, sex, year of birth, and year of immigration (data not shown, see Winkler [24]). Follow-up procedures of the NRW cohort were successfully performed and reflected in a completeness of 96.7%.

The method of estimating PY of the Saarland cohort on basis of a partial follow-up is sufficient for a detailed analysis. Data were obtained from cities throughout the Saarland. Selection of individuals was not linked to cancer incidence or any other factor. The estimation procedure itself relies on different assumptions, which were mentioned in the methods section.

Incident cancer cases within the Saarland cohort were derived through record linkage, done directly by the Saarland cancer registry. Minor problems arose from the fact that FSU-migrants tend to adjust their Russian names and/or first names to common German spelling. However, the phonetic identification of names using information on sex and date of birth can be considered as a valid method of identification.

Mortality and incidence were compared to different populations by using German and Saarland rates for calculating the expected numbers. To analyze cancer incidence Saarland rates were used for comparison, due to two reasons: first, the Saarland marks the study area and the population-based Saarland Cancer Registry provides high-quality data on cancer incidence and mortality since 1970 and meets international standards in terms of quality and completeness of data [29, 39–41]. Second, incidence data for the whole of Germany do not yet exist and estimations rely on the Saarland data.

This study confirms that migrants from the FSU in Germany suffer from cancers which can, to some extent, be prevented by health promotion programs such as smoking cessation and dietary change. On the other hand, the low risk for cancers of the reproductive system has been verified by incidence analysis. To discover underlying reasons for this phenomenon, further studies are needed with different designs to assess individual risk profiles and genetic backgrounds. From the information available, so far we cannot conclude that FSU-migrants have a different health-seeking behavior than Germans but rather a different risk factor exposure.

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