A Matched-pair Analysis on the Effect of Migration Background on Response Rates and Survival of Cancer Patients Treated at a Comprehensive Cancer Center in Germany

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Abstract

Background: There are several studies that investigate health inequalities in Germany due to its being a destination for immigrants since the 1960s. In this study, we pay specific attention to differences in cancer survival between German patients with and without a migration background being treated at a comprehensive cancer center. This becomes of particular interest since previous studies suggested that immigrant patients have a worse response to treatment and lower survival rates in their new host country.

Methods: We considered 8162 cancer patients being treated at the CIO Bonn of the University Hospital of Bonn between April 2002 and December 2015 for our matched-pair analysis. Patients with migrant background were identified using a manual name-based algorithm with high specificity and then matched with patients without migrant background adjusting demographic characteristics, tumor features, defined staging criteria and primary therapy. Finally, 211 patients with a migrant background were matched to 211 patients without a migrant background and then compared with regard to response to treatment and survival rates (i.e. Overall survival, Progression-free survival and Time to progression).

Results: Compared to the cohort with migration background, the cohort without migration background is slightly older (57.9 vs. 54.9 years) with equal gender distribution (55.0% vs. 54.5% female) and had a longer follow-up time (42.6 vs. 36.9 months). We did not find significant differences in cancer survival (overall survival; P=0.802) and response rates (ORR; McNemar's test, P=0.3458) between both collectives.

Conclusion: In contrast to previous studies, we found no evidence that migration background of cancer patients being significantly affects response rates and survival. A worse outcome in populations of immigrant origin most likely has complex reasons, but highly standardized procedures in a comprehensive cancer center may contribute positively to reducing detrimental effects.

Background

On January 8th of 2020, the German Federal Ministry of the Interior presented the migration report 2018 of the Federal Agency of Migration and Refugees. This report showed that in the reporting period 2018 almost one quarter (20.8 million) of the 81.6 million people who live in Germany had a migration background, defined as a person who is a migrant or has at least one parent not born as a German citizen. Of those with a migration background, around 10.9 million (52.4%) have received German citizenship. Accordingly, the share of German citizens with a migrant background of the total population amounts to 13.3%. Overall, more than one third of the population with a migrant background came from an EU member state, while nearly another third came from non-EU nations. The remaining third is made up of people of different nationalities. Amongst these nations, Turkey presents itself as the country from which the largest population originates, amounting to about 2.8 million people. All in all, almost two thirds (64.7%) of the persons having a migration background migrated themselves (first generation), while more than one third (35.3%) was born in Germany (second, third generation) [1].
The aim of our study was to explore differences in cancer treatment response and survival in German citizens with a migrant background. Thus, we pay specific attention to these 52.4% of immigrants in Germany who have become naturalized. The new wave of immigrants and asylum seekers culminating in the refugee crisis in 2015 is not part of this investigation.

Immigration-related diversity can often result in disparities in essential areas of life. Different health needs and inequalities could be explained by divergent lifestyle factors, lower average socioeconomic status or the healthy-migrant effect assuming that especially young and healthy people immigrate as already described in previous studies [2]. The potential exposure of differences may help to create a fairer health care system that is more diligent in its taking into account of disadvantaged groups [3].

This study focuses on the differences in the outcome of cancer patients in regards to their immigrant or non-immigrant background. To investigate this issue, treatment responses and survival rates of 18 various tumor entities were explored matching patients of different origin by using a list of matching criteria.

As far as it is known to us, this investigation is the first that evaluates the prognostic value of migration background in such a wide range of different tumor entities in Germany. However, there are a few existing studies that have explored the relation between ethnic background and cancer in Western Europe, but most of them focused on incidence rates, specific cancer sites or certain ethnic groups. In Sweden, Hemminki and Mousavi et al. [4, 5] assessed incidence and mortality rates of a wide range of different tumor entities using the nationwide Swedish Family-Cancer Database for separate studies. Hemminki et al. found the most favorable survival in immigrant groups with the lowest prostate cancer risk. According to Mousavi et al., no large differences in the survival of breast cancer patients between the ethnic groups in spite of large differences in breast cancer incidence were found. However, a group of low risk non-Europeans showed poor survival for lobular breast cancer which could be explained by treatment differences. Siemerink et al. [6] compared survival rates of Western and Non-Western patients with stomach cancer being treated at the Comprehensive Cancer Centre North-East in the Netherlands. They observed a better outcome of first-generation non-Western immigrants compared with Western patients. Meanwhile, research in Germany has concentrated on specific ethnic groups: Jaehn et al. [7, 8] investigated etiologic differences and incidence rates among migrants from the former Soviet Union and the general population in Germany. Their conclusion is that cancer incidence among migrant populations shows a transition of incidence rates of their country of origin to incidence rates of their new host country. Similar results were obtained by Spallek et al. [9] among Turkish descents in Germany. Spix et al. [10] analyzed childhood cancer survival among children of Turkish descent in the German Cancer Childhood Registry. Apart from a small group of Turkish children with lymphoid leukemia who showed a significantly lower survival probability, they did not detect an effect of Turkish migrant status on the outcome of childhood cancer patients in Germany.

A matched-pair analysis of Budde et al. [3] compared the outcome of German and 'non-German' cancer patients in Germany. They found no major differences in treatment response and survival rates. Only a
small subgroup of patients with head and neck cancer showed a significantly longer progression-free survival for the German patients. To differentiate our study from those of Budde et al. whose matched-pair analysis seems to have a very similar approach, it must be emphasized that we, as a result of our name-based patient identification, assessed an entirely different cohort. Whereas German citizenship was a main requirement to be included in our study, Budde et al. compared German patients to patients without German citizenship. This means that our patient collective with a migrant background is likely to consist of naturalized immigrants or their descendants who have lived in Germany for a relatively long time, whilst the ‘foreign' patients Budde et al. have included in their study are likely to have resided in Germany for a comparatively short period of time.

Methods

Patients

Between April 2002 and December 2015, 8162 cancer patients from the cancer register of the CIO at the University Hospital of Bonn were considered for this study.

In order to determine patients with a migration background, defined as a person who is a migrant or has at least one ancestor who did not acquire the German citizenship at birth, a manual name-based procedure was utilized, following the automated algorithm of the University in Bielefeld which has been proven to have a high specificity (sensitivity and specificity ≥ 0.975) for the identification of patients of Turkish origin [11]. The majority of patients with migrant background was identified by their full name. That means that they were considered as Germans with migration background if their first name(s) and surname were definitely foreign, but they nevertheless had German citizenship according to their medical record. A smaller number of cases was taken into account as Germans with migrant background because one part of their name was certainly foreign and the other part was a doublet which means that it could be both German as well as foreign. At last, names which could not be assigned definitely but contained one name part or a combination of both that indicated a migrant background, led to further investigation, e.g. names of relatives, etc. and an allocation was made accordingly.

Finally, 211 out of 8162 cancer patients were considered patients with migration background and were included in this study together with 211 matched patients without a migration background.

Matched-pair analysis

Each patient with a migrant background was matched with a patient without a migrant background in a fashion blinded to patient outcomes by means of a manual assignment. Potential matches to the patients with immigrant background were found in the cancer database after executing the pairing criteria as filters. Amongst the remaining patients, those with a name that was not definitely German were excluded and then the final match was randomly selected. The pairing criteria were as follows: age difference ± 10 years, same sex, diagnosis according to ICD-10 and ICD-O-3 (or equivalent), disease status
(primary case vs. recurrence), tumor stage (UICC stage and grading for solid tumors, Durie and Salmon Staging System for multiple myeloma, Ann Arbor score for lymphomas, Binet status for CLL and WHO classification for tumors of the CNS). Furthermore, following morphological characteristics were added to improve the matching process: the Gleason score for prostate cancer patients, FAB classification for AML, Breslow's depth and Clark's level for malignant melanoma. For breast cancer patients the estrogen, progesterone and erbB-2 receptor status were additionally used to find a matching partner. Regarding primary therapy, matching partners with convergent treatment could be found for 211 of 226 patients (93.4%). The other 15 patients were therefore excluded from further analysis. In addition, slight differences in chemotherapeutic substances, in immune or hormone therapy regimes or in the use of supplementary therapies did occur. These distinctions were accepted since they affected only a small number of patients and the main treatment concept corresponded.

Eventually, each cancer patient with a migrant background (n = 211) could be matched with a cancer patient without a migrant background (n = 211).

Significant differences between the two patient collectives could be excluded for all matching variables except patients’ age as we accepted an age difference of 10 years. The cohort with migrant background was a few years younger on average (54.9 vs. 57.9 years). The most important patient characteristics are shown in Table 1. The frequencies of the tumor-specific matching criteria are reflected in Table 2. Statistical analysis could only be performed for those variables, which possessed an adequate number of not completely identical cases.
## Table 1
Patient characteristics

| Patients | Without migrant background | With migrant background | p-value |
|----------|---------------------------|-------------------------|---------|
|          | n  | %   | n  | %   |         |
| Total    | 211| 211 |    |     |         |
| Gender   |    |     |    |     |         |
| Female   | 116| 55.0| 115| 54.5| 0.796<sup>a</sup> |
| Male     | 95 | 45.0| 96 | 45.5|         |
| Age      |    |     |    |     |         |
| <31      | 9  | 4.3 | 17 | 8.1 | 0.174<sup>b</sup> |
| 31–60    | 107| 50.7| 116| 55  |         |
| 61–80    | 90 | 42.7| 72 | 34.1|         |
| >80      | 5  | 2.4 | 6  | 2.8 |         |
| Tumor entities |    |     |    |     |         |
| Head and neck cancer | 15 | 7.1 | 15 | 7.1 | N.d.<sup>c</sup> |
| Gastrointestinal cancer | 20 | 9.5 | 20 | 9.5 |         |
| Lung cancer | 5  | 2.4 | 5  | 2.4 |         |
| Skin cancer | 19 | 9.0 | 19 | 9.0 |         |
| Gynecologic cancer | 64 | 30.3| 64 | 30.3|         |
| Urological cancer | 35 | 16.6| 35 | 16.6|         |
| CNS cancer | 19 | 9.0 | 19 | 9.0 |         |
| Thyroid cancer | 12 | 5.7 | 12 | 5.7 |         |
| Tumors of the hematopoietic and lymphoid tissues | 22 | 10.4| 22 | 10.4|         |
| Treatment |    |     |    |     |         |
| None     | 3  | 1.4 | 3  | 1.4 | N.d.    |
| Chemotherapy | 20 | 9.5 | 20 | 9.5 |         |
| Radiotherapy | 2  | 0.9 | 2  | 0.9 |         |
| Resection | 70 | 33.2| 70 | 33.2|         |
| Radiotherapy + resection | 32 | 15.2| 32 | 15.2|         |

<sup>a</sup> McNemar's test
<sup>b</sup> Bowker's test
<sup>c</sup> Not done
| Patients                     | 1   | 2   | 3   | 4   |
|-----------------------------|-----|-----|-----|-----|
| Chemoradiotherapy           | 10  | 4.7 | 10  | 4.7 |
| Chemotherapy + stem cell therapy | 6   | 2.8 | 6   | 2.8 |
| Chemotherapy + resection    | 27  | 12.8| 27  | 12.8|
| Chemoradiotherapy + resection | 41  | 19.4| 41  | 19.4|

a McNemar's test  
b Bowker's test  
c Not done
## Table 2
Frequencies of tumor-specific characteristics

| Patients | Without migrant background | With migrant background | p-value |
|----------|---------------------------|-------------------------|---------|
|          | n  | %   | n   | %   |         |
| **Solid tumors** |     |     |     |     |         |
| UICC classification |     |     |     |     |         |
| Total     | 168 | 167 | 0.993^a |
| Stage 0   | 1   | 0.6 | 1   | 0.6 |         |
| Stage 1   | 80  | 47.6| 78  | 46.7|         |
| Stage 2   | 35  | 20.8| 35  | 21  |         |
| Stage 3   | 24  | 14.3| 26  | 15.6|         |
| Stage 4   | 28  | 16.7| 27  | 16.2|         |
| **Histological grading** |     |     |     |     |         |
| Total     | 112 | 117 | 0.948^a |
| G1        | 12  | 10.7| 13  | 11.1|         |
| G2        | 57  | 50.9| 57  | 48.7|         |
| G3        | 43  | 38.4| 47  | 40.2|         |
| **Lymphomas** |     |     |     |     | N.d.^b |
| Ann Arbor score |     |     |     |     |         |
| Total     | 8   | 8   |      |     |         |
| Stage 1   | 1   | 12.5| 1   | 12.5|         |
| Stage 2   | 2   | 25.0| 2   | 25.0|         |
| Stage 3   | 1   | 12.5| 1   | 12.5|         |
| Stage 4   | 4   | 50.0| 4   | 50.0|         |
| **Haematologic malignancies** |     |     |     |     | N.d. |
| FAB classification |     |     |     |     |         |
| Total     | 19  | 19  |      |     |         |
| Grade I   | 1   | 5.3 | 1   | 5.3 |         |
| Grade II  | 2   | 10.5| 2   | 10.5|         |
Statistical analysis

SAS statistical analysis software (version 9.4 by SAS Institute Inc., Cary, NC, USA for Windows) was used for the statistical analyses. Nominal and ordinal variables were assessed using McNemar's test for 2 × 2 tables. Bowker's test was used for tables larger than 2 × 2. All tests were two-sided and p < 0.05 was preset as the cutoff for significance.

A conditional logistic regression model was used to analyze the primary outcomes of this study, overall deaths, progression-free survival and time to progression. Overall survival (OS) was defined as the time elapsing between the date of diagnosis and death from any cause. Time to progression (TTP) was defined as the time between the date of diagnosis and the date of disease progression or death related to cancer. Progression-free survival (PFS) was defined as the time starting with the date of diagnosis leading up to the date of disease progression or death from any cause.

Response rate was evaluated according to Response Evaluation Criteria in Solid Tumors (RECIST) and thus was classified in complete remission (CR), partial remission (PR), stable disease (SD) and progressive disease (PD).

Results

Patients' characteristics

| Patients | Grade III | 15.8 | 3 | 15.8 |
|----------|-----------|------|---|------|
| Grade IV            | 13       | 68.4 | 13 | 68.4 |
| Prostatic cancer     | Total     | 9    | 10 | N.d. |
| Gleason score        |          | 6    | 3  | 33.3 |
|                       |          | 7    | 5  | 55.6 |
|                       |          | 8    | 0  | 0    |
|                       |          | 9    | 1  | 11.1 |

a Bowker’s test
b Not done
**Patients without a migrant background**

The mean age of the cohort without a migration background (n=211) was 57.9 years old (range 22-88). One hundred fifty-seven patients (74.4%) were between 41-70 years old, whereas 18 (8.5%) were younger than 41 years and 36 patients (17.1%) were older than 70 years. Ninety-five patients (45%) were male and 116 (55%) were female. 183 patients (86.7%) of the cohort had an evaluable insurance status. One hundred and ten (60.1%) of those patients had a national health insurance, 45 (24.6%) had a private health insurance and 28 (15.3%) were self-payers. Follow-up data was available for the whole patient group. Mean follow-up time of the entire patient group was 42.6 months ranging between 0.7 and 156.3 months.

**Patients with a migrant background**

The mean age of the cohort with a migrant background (n=211) was 54.9 years old (range 21-92). One hundred thirty-four patients (63.5%) were between 41-70 years old, whereas 42 (19.9%) were younger than 41 years and 35 patients (16.6%) were older than 70 years. Ninety-six patients (45.5%) were male and 115 (54.5%) were female. One hundred seventy-two patients (81.5%) of the cohort had an evaluable insurance status. One hundred forty-one (82%) of those patients had a national health insurance, 13 (7.6%) had a private health insurance and 18 patients (10.5%) were self-payers. Follow-up data was available for all patients within the collective. Mean follow-up time was 36.9 months ranging between 0.2 and 151 months.

**Matched pair characteristics**

Two hundred and seven matches (98.1%) were cases with a primary tumor and eight matches (1.9%) with a diagnosed recurrence were included. One hundred eighty-nine cases (89.6%) of the matched pairs have been diagnosed with a solid tumor, only 22 of which (10.4%) had a hematological malignant disease.

In this study, breast cancer represented by far the largest tumor entity with 60 matched pairs (28.4%) followed by urological cancer (35 pairs, 16.6%), tumors of the hematopoietic and lymphoid tissues (22 pairs, 10.4%), cancer of the gastrointestinal tract (20 pairs, 9.5%), CNS tumors (19 pairs, 9%) and head and neck cancer (15 pairs, 7.1%).

**Response to treatment**

Only slight differences in response to treatment could be discerned when comparing the cohort with migrant background to the cohort without migrant background using RECIST criteria (Table 3).
Table 3
Response to treatment

| Patients | Without migrant background | With migrant background | p-value |
|----------|---------------------------|-------------------------|---------|
|          | n  | %   | n  | %   |         |
| RECIST   |    |     |    |     |         |
| CR       | 150| 71.8| 154| 73   | 0.487^a|
| PR       | 20 | 9.6 | 20 | 9.5  |         |
| SD       | 15 | 7.2 | 10 | 4.7  |         |
| PD       | 24 | 11.5| 27 | 12.8 |         |
| ORR      |    |     |    |     |         |
| CR+PR    | 170| 81.3| 174| 82.5 | 0.832^b|
| SD+PD    | 39 | 18.7| 37 | 17.5 |         |

^a Bowker’s test
^b McNemar’s test

Therapy data could be found for 209 patients without a migration background (99.1%) and 211 patients with a migration background (100%). Complete Remission (CR) was seen in 150 patients without a migrant background (71.8%) and 154 patients with a migrant background (73%). Twenty patients without a migration background (9.6%) as well as 20 patients with a migration background (9.5%) achieved a partial remission (PR). A stable disease (SD) was observed in 15 patients without a migration background (7.2%) and 10 patients with a migration background (4.7%) patients. Twenty-four patients without a migrant background (11.5%) and 27 patients with a migrant background (12.8%) had a progressive disease (PD) (Bowker’s test, P=0.4870).

If the Overall Remission Rate (ORR) which summarizes CR and PR as well as SD and PD was used differences between both groups remain minimal: One hundred seventy patients without a migrant background (81.3%) and 174 patients with a migrant background (82.5%) achieved a CR or PR. In contrast, only 39 patients without a migration background (18.7%) and 37 patients with a migration background (17.5%) had a SD or PD (McNemar’s test, P=0.3458).

Survival analysis

Kaplan-Meier analysis was used to compare the survival of patients with a migration background to patients without a migration background.

Overall survival
Mean OS of all patients without a migration background was 120 months (n=211) versus an OS of 111 months for the entire patients’ group with a migrant background (n=211) (P=0.802). Regarding the entire patients' group, 44 patients without a migrant background and 47 patients with a migrant background died during the time of the study.

**Progression-free survival**

Mean PFS was 102.1 months for the patients’ group without a migrant background (n=211) versus 97.7 months for the patients’ group with a migrant background (n=211) (P=0.768). Sixty-five patients without a migrant background (30.8%) and 63 patients with a migrant background (29.9%) died due to varying causes or experienced a disease progression.

**Time to progression**

Mean TTP was 104.6 months for the cohort without a migration background (n=211) and 99.3 months for the cohort with a migration background (n=211) (P=0.709). Sixty-three patients without a migration background (29.9%) and 60 patients with a migration background (28.4%) experienced a disease progression or died of cancer.

**Discussion**

Main objective of our study was to investigate the significance of migrant background for German citizens for the survival of cancer. In summary, it has to be stated that significant differences in treatment response as well as survival rates could neither be found for the overall collective of the study nor for smaller subgroups of various tumor entities being treated at the Centre of Integrated Oncology (CIO) in the University Hospital of Bonn.

It must nevertheless be said that the Kaplan-Meier curves for the overall survival of the whole collective of patients display a trend: up until 2500 days after cancer diagnosis immigrants show consistently lower survival rates than German patients. Both curves converge afterwards, but it has to be considered that only a few events occurred. Possibly, a more refined differentiation of patients with a migration background particularly regarding different migrant generations could further clarify the differences in overall survival probability of the whole study population seen in early phases, but such data are difficult to obtain in registry-based studies. According to Arnold et al., the name-based approach does not allow a distinction between generations, which can only be estimated vaguely based on age [12].

On top of that, it must be emphasized that our study fully focused on the mortality of cancer as we performed a matched-pair analysis by adjusting the various tumor-specific staging and grading categories as well as the primary therapy. It is therefore fundamentally different from studies which investigate the incidence of tumor diseases related to different risk patterns influencing carcinogenesis.
Moreover, while existing theories of health inequalities are based on disparities in terms of access, use and health literacy, our entire patient population has found access to a comprehensive cancer center which represents maximal medical care. Therefore, no differences due to access barriers are expected to be found.

Numerous different studies exist that have explored the effects of immigration on cancer. Many of them have shown that the incidence of cancer has moved to the level of the new host population in one or two generations [13, 14]. These findings suggest the significance of environmental factors such as socio-economic position [15–17], access to good healthcare and, moreover, question the role of genetics. Hemminki et al. have also shown that certain cancers e.g. liver, nasopharyngeal, esophageal, stomach and cervical cancers are related to microbial infections, nutritional imbalances and toxins [18] which is only relevant for those who have most recently immigrated as these risk factors are less likely to be seen in Germany. In regards to our immigrant patient group, it can be assumed that a majority immigrated many years ago or belongs at least to the second generation of migrants since immigration in Germany already started more than 50 years ago and as the process of becoming a German citizen takes time. Because our study did not detect any significant differences in cancer survival between patients of immigrant origin and patients of autochthonous origin it supports this thesis of adaptation to the country-specific cancer risk.

An assumption that could be derived from the absence of significant differences concerning survival rates is the effectiveness of highly standardized procedures in a comprehensive cancer center, in particular, given that all patient-related key features of relevance for the treatment response and survival were adjusted.

As already mentioned, many studies have shown that low socio-economic status is associated with poor survival rates in a variety of cancers [11–13]. Since socio-economic status itself was not available in the used cancer registry, the patient's insurance status could be an indicator for the socio-economic position of patients. It seems plausible to assume that a private health insurance is associated with higher socio-economic status. We found that patients of immigrant origin had a significantly lower rate of private health insurance (7.6%) than patients of German origin (24.6%) (Bowker's test, P < 0.05) which leads to the presumption that patients with a migrant background are more likely to have a lower socio-economic status. Finally, it has to be stated that these differences didn't have a significant effect on treatment response and survival rates.

It has to be pointed out that the migration process is a highly complex subject. As Spallek et al. has shown, researchers studying migrant health should not only consider risks and exposures in the host country of migrants but also exposures during the migration process and in the country of origin [19]. This demonstrates the variety of different factors influencing the survival of immigrants in a new environment. Further studies should therefore pay closer attention to critical periods, promoting factors, the influence of genes and environment, and latency periods of the different processes [19] which could
enable investigators to differentiate between contrasting effects on survival of the second or third generation and the parental generation of migrants that could have cancelled each other out in our study.

Several limitations to our study have to be mentioned. First of all, a manual name-based acquisition of immigrant patients still has difficulties. In rare cases, a forename and a surname doublet can possibly lead to a false identification especially if further background information is not available. Another limitation of the name-based approach is that no reliable statement concerning the precise origin of the different immigrants can be made which does not allow a subgroup analysis based on the patients' ethnicities, as these are not recorded in the registries. However, an identification based on citizenship would have masked the large and increasing number of naturalized migrants [9]. We focused on differences between German citizens with or without migration background and did not study immigrants without German citizenship, because this group is much more heterogenous regarding social background, language, legal status and social security status. Second, some possible confounders were insufficiently taken into account: the patients’ comorbidity and the year of diagnosis were not a stable matching criterion because the main focus was on the other confounders mentioned above.

Third, we analyzed 17 different tumor entities, most of them with only a few matches. This great tumor heterogeneity and the low number of events limits the statistical power of our analysis.

Conclusions

Our study shows no significant differences in the survival of cancer patients depending on their migration background. It can thus be considered as a further indication that the medical treatment in a Comprehensive Cancer Center is provided regardless of the ethnic origin or migration background of cancer patients. Methodically comparable studies are rare but nevertheless our findings are reflected in several other studies.

Further studies could try to differentiate between various generations of immigrants in Germany. As already mentioned, a name-based approach does not allow this distinction. More detailed information on the patients’ origin could extend the cancer registry in the future for a more precise differentiation of patients with a migrant background.

Abbreviations

CIO: Center for Integrated Oncology; CR: Complete remission; ORR: Overall remission rate; OS: Overall survival; PD: Progressive disease; PFS: Progression-free survival; PR: Partial remission; RECIST criteria: Response evaluation criteria in solid tumors; SD: Stable disease; TTP: Time to progression

Declarations

Ethics approval and consent to participate
The need for an approval was waived by the ‘Ethnic committee of the University Hospital Bonn’ as the study was retrospective and individual patients were not identifiable.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

RR worked on conceptualization and methodology of the project as well as data curation, statistical analysis and investigation. He visualized the results and was the major contributor in writing the manuscript. MDKP, AF, MR, PB, UH, HV, FB, JL, JCK, DT, GK, TP, SA, FG, LR, FJK, CPS, MGC, DS, ME, MS, JN, NE and JL worked on review and editing the manuscript. BF participated in data curation and was responsible for the cancer register’s software where the data was firstly collected. JN supported the statistical analysis significantly. ISW had the project’s administration and was responsible for resources and funding acquisition as well as conceptualization, data curation and statistical analysis. He also supported writing and editing the manuscript in a fundamental way. All authors have read and approved the manuscript.

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Figures

Figure 1

Kaplan-Meier analysis including all entities. (A) Overall survival of all patients with and without a migration background (n=422). Mean OS of all patients without a migration background was 120 months (n=211) versus an OS of 111 months for all patients with a migration background (n=211) (P=0.802). (B)
Progression-free survival of all patients with and without a migration background (n=422). Mean PFS was 102.1 months for all patients without a migration background (n=211) versus 97.7 months all patients with a migration background (n=211) (P= 0.768). (C) Time to progression of all patients with and without a migration background (n=422). Mean TTP was 104.6 months for all patients without a migration background (n=211) and 99.3 months for all patients with a migration background (n=211) (P= 0.709).