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# Investigating cervical, oesophageal and colon cancer risk and survival among migrants in The Netherlands

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**Background:** Studies on cancer in migrants can shed light on grey areas in cancer aetiology and can help assessing the effectiveness of prevention measures. In this study, we aimed to determine the impact of migration and different ethnic backgrounds on cervical, colon and oesophageal cancer risk and survival. **Methods:** Cancers diagnosed in 1996–2009 were selected from The Netherlands Cancer Registry. Besides standardized incidence ratios, differences in survival were explored using Cox regression and relative survival analysis. **Results:** All migrant women had increased risks for cervical cancer when compared with Dutch native women, ranging from standardized incidence ratio = 1.8 (95% confidence interval 1.6–2.2) in Surinamese women to 1.2 (0.9–1.5) in Turkish women. Relative survival was better among Moroccan, Surinamese and Antillean migrants [5-year relative survival rates (RSR) range: 71–73%] compared with that of native Dutch (66%); however, it was poorer in Indonesians (51%). Although oesophageal cancer risk was lower in all migrants with Standardized incidence ratios ranging from 0.1 to 0.6, survival was slightly lower relative to Dutch natives (1-year RSR: 21–32% compared with 37%; Turkish: 42%). Colon cancer was less common among migrants, particularly among Moroccans and Turkish. Five-year RSR from colon cancer was equal or better in all migrants (range: 48% in Indonesians to 62% in Turkish) compared with Dutch natives (48%). **Conclusion:** Risk of cervical, oesophageal and colon cancer in migrants mainly reflects the risks in their countries of origin. Almost similar cancer survival rates in migrants and native Dutch individuals points towards successful and comprehensive health care in The Netherlands. Primary cancer prevention should target high-risk groups and involve migration-sensitive approaches.

## Introduction

Studies on cancer in migrant populations may provide valuable insight into carcinogenesis and be helpful in exploring the contributions of environmental and genetically determined risk factors as well as their interaction.[1]

Cervical cancer is the second most common female cancer worldwide, and it varies greatly on a global scale, being most prevalent in developing countries. Studies from Sweden reported increased risks of cervical cancer in immigrant women,[2,3] especially among those who originate from Central America and Middle Africa.[2,3] The opposite was true for women from Eastern Africa and Asia, who had lower risks than Swedish-born women.[2] The heterogeneous geographical and ethnic distribution of cervical cancer has been found to be strongly linked to human papillomavirus (HPV) infection.

Oesophageal cancer was reported to be less common in various migrant groups[4]; however, it was particularly high in African

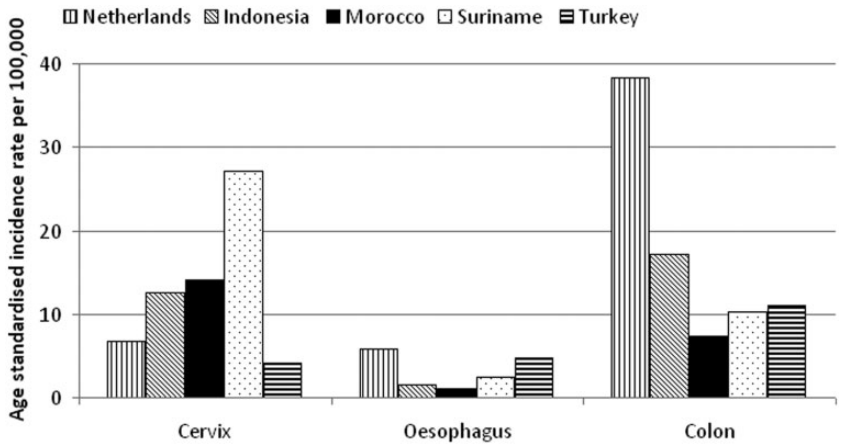


**Figure 1** Age-standardized incidence rates per 100 000 of cervical, oesophageal and colon cancer in The Netherlands, Indonesia, Morocco, Suriname and Turkey
*Source*: GLOBOCAN (2008).[5]

American male migrants and immigrants from East/Central Asia and East Africa.[5,6] Heavy alcohol use, tobacco smoking as well as low consumption of fruits and vegetables, obesity and gastro-oesophageal reflux is related to oesophageal cancer.[7]

The incidence of colon cancer has also been reported to vary substantially among ethnic groups. Globally, the highest rates have been observed among African Americans and Japanese Americans.[8] Low physical activity, a positive family history, high meat and alcohol intake as well as smoking are considered the most important risk factors, whereas high consumption of vegetables and dairy foods (calcium) as well as a low body mass index are known to be protective.[9]

Ethnic background was found not only to influence cancer risk but also to stage of disease at diagnosis and prognosis.[10] However, to date, studies on cancer survival among migrants remain scarce, and especially the link between cancer incidence and survival in migrant populations has so far been paid little attention. The Netherlands represent a unique setting for such studies, given its obligatory health insurance for all inhabitants and its nationwide cancer registry.

The aim of this study was to investigate the impact of migration on the incidence and survival of cervical, oesophageal and colon cancer in different migrant groups in The Netherlands. These cancers were selected because of their relevance to the migrant groups under study (particularly low or high risk; figure 1). We hypothesized that because of manifold environmental influences before, during and after migration, the various groups differ with regards to their risk factor patterns and their cancer risk.

## Methods

### Cancer cohort

We obtained invasive cancers of the oesophagus (C15), colon (C18) and cervix uteri (C53), diagnosed between 1996 and 2009, from the population-based Netherlands Cancer Registry (NCR). For oesophageal and cervical cancer, we only included squamous cell carcinomas (SCC) and adenocarcinomas (AC).

Stage at diagnosis was taken into account using the tumour-node-metastasis (TNM) classification at the year of diagnosis.[11–13] Hereby, pathological and clinical TNM were combined into one variable, primarily referring to the pathological stage unless missing for colon and oesophagus. FIGO (International Federation of Gynaecology and Obstetrics) stage for cervical cancer was derived from clinical TNM stage[11–13] using pTNM in case of an unknown cTNM. Vital status was established either directly from the patient's medical record or through linkage of cancer registry data with the (automated) municipal population registries that record information on their inhabitant's vital status (follow-up until 31 December 2009).

We identified migrants based on their country of birth (COB), which is collected in the NCR and is supplemented with data from the nationwide database of all municipal population registries in case of death or emigration. Besides native Dutch cancer patients, the largest migrant groups, originating from Turkey, Morocco, Suriname, The Netherlands Antilles/Aruba as well as Indonesia, were included and analysed separately. Patients with another ($n = 3092$) or unknown COB ($n = 31\,714$) were excluded. Not all regional cancer registries (which together form the NCR) have complete registration of COB. In case of cancers with low lethality, patients being alive at the end of the follow-up may have missing COB. For colon and cervical cancer (both of which have low lethality), we, therefore, only included data of cancer registries with complete registration of COB for the analyses on survival and stage distribution. These data were gathered from the former areas (both rural and urban) of the comprehensive cancer centres Amsterdam, West and Stedendriehoek Twente, which cover ~40% of the Dutch population.

We applied an ecological proxy for socio-economic status (SES) by using four-digit postal code at the time of diagnosis, provided by The Netherlands Institute for Social Research. SES was based on mean income per household, the percentage of households with a low income, low education and unemployed inhabitants. The variable SES was analysed in tertiles, resulting in three SES levels: high, intermediate and low. A more detailed explanation is described elsewhere.[14]

### Statistical analysis

Oesophageal, colon and cervical cancer were analysed separately. Incidence rates were calculated per age group (0–14, 15–29, 30–44, 45–64 and ≥65 years), sex and year of diagnosis, with cancer incidence rates of the entire Dutch population as reference, acquired from Statistics Netherlands.[15] Population data of all legal residents of The Netherlands contained country of birth as a proxy for migration background and were available for the period 1996–2009. Expected numbers of cancer cases in each migrant group were derived from annual population data as well as age- and sex-specific cancer incidence and were compared with the observed numbers of cases in our data. Standardized incidence ratios (SIRs) were computed as the ratio between observed and expected numbers of cases between 1996 and 2009, with their 95% confidence intervals (CIs), calculated after log transformation.[16]

For survival analysis, first, hazard ratios (HRs) were computed using Cox regression, adjusting for sex, age, morphology, SES, COB and stage of disease at diagnosis. Second, cohort-based

relative survival was calculated. To account for the fact that migrants may experience different competing risks and comorbidities, we incorporated country of birth-specific death rates in the background mortality. This approach had been used earlier to correctly measure socio-economic differences in cancer survival.[17,18] To correct for low numbers of deaths in some groups, we used log-linear regression with interaction terms for period, age and sex to smooth the mortality rates. In all analyses, all-cause mortality was used as the outcome measure. All analyses were performed with SAS 9.1.

## Results

In total, 5546 patients with invasive cervical cancer, 16 217 patients with oesophageal cancer and 67 479 patients with colon cancer were included in the study. Cancer patients with a foreign background were on average younger at diagnosis than cancer patients from The Netherlands, with the exception of migrants originating from Indonesia (table 1). There were statistical significant differences ($P < 0.05$) in SES between the groups for all three cancer types and for cervical and colon cancer in stage at diagnosis.

**Table 1** Description of cohort of newly diagnosed patients with cervical, colon and oesophageal cancer in The Netherlands according to COB (1996–2009)

| | Country of birth | | | | | |
|---|---|---|---|---|---|---|
| | Native Dutch | Antilles/ Aruba | Indonesia | Morocco | Suriname | Turkey |
| **Cervix uteri (C53)** | | | | | | |
| Total (*n*) | 5072 | 39 | 129 | 81 | 151 | 74 |
| Mean age (year) | 55 | 48 | 62 | 48 | 54 | 47 |
| AC (%) | 22 | 15 | 17 | 24 | 13 | 15 |
| SCC (%) | 78 | 85 | 83 | 77 | 87 | 85 |
| SES high (%) | 27 | 18 | 36 | 11 | 19 | 4 |
| SES mid (%) | 30 | 15 | 18 | 14 | 15 | 11 |
| SES low (%) | 43 | 67 | 46 | 75 | 66 | 85 |
| SES unknown (%) | 0 | 0 | 1 | 0 | 1 | 0 |
| *P*-value ($\chi^2$) | | | | <0.0001 | | |
| Stage[a] (*n* included) | 2406 | 22 | 83 | 49 | 103 | 41 |
| Stage 1 (%) | 55 | 73 | 37 | 57 | 66 | 59 |
| Stage 2 (%) | 24 | 9 | 28 | 33 | 11 | 29 |
| Stage 3 (%) | 15 | 18 | 23 | 10 | 20 | 5 |
| Stage 4 (%) | 5 | 0 | 12 | 0 | 2 | 7 |
| Stage unknown (%) | 2 | 0 | 0 | 0 | 1 | 0 |
| *P*-value ($\chi^2$) | | | | 0.0028 | | |
| **Oesophagus (C15)** | | | | | | |
| Total (*n*) | 15 865 | 32 | 232 | 20 | 43 | 25 |
| Female migrants (%) | 28 | 22 | 29 | 10 | 19 | 44 |
| Mean age (year) | 68 | 64 | 70 | 64 | 64 | 60 |
| AC (%) | 62 | 31 | 56 | 70 | 21 | 24 |
| SCC (%) | 38 | 69 | 44 | 30 | 79 | 76 |
| SES high (%) | 26 | 22 | 35 | 5 | 14 | 12 |
| SES mid (%) | 35 | 16 | 26 | 20 | 19 | 16 |
| SES low (%) | 40 | 63 | 39 | 75 | 67 | 72 |
| SES unknown (%) | 0 | 0 | 0 | 0 | 0 | 0 |
| *P*-value ($\chi^2$) | | | | <0.0001 | | |
| Stage (*n* included) | 15 865 | 32 | 232 | 20 | 43 | 25 |
| Stage 1 (%) | 5 | 6 | 4 | 5 | 0 | 4 |
| Stage 2 (%) | 14 | 16 | 14 | 15 | 12 | 8 |
| Stage 3 (%) | 21 | 19 | 19 | 25 | 26 | 48 |
| Stage 4 (%) | 35 | 44 | 37 | 30 | 42 | 28 |
| Stage unknown (%) | 25 | 16 | 26 | 25 | 21 | 12 |
| *P*-value ($\chi^2$) | | | | 0.564 | | |
| **Colon (C18)** | | | | | | |
| Total (*n*) | 65 011 | 153 | 1548 | 135 | 461 | 171 |
| Female migrants (%) | 51 | 54 | 52 | 26 | 54 | 36 |
| Mean age (year) | 72 | 61 | 73 | 59 | 62 | 59 |
| SES high (%) | 27 | 28 | 38 | 13 | 20 | 8 |
| SES mid (%) | 34 | 16 | 26 | 13 | 20 | 13 |
| SES low (%) | 39 | 56 | 36 | 75 | 60 | 80 |
| SES unknown (%) | 0 | 1 | 0 | 0 | 1 | 0 |
| *P*-value ($\chi^2$) | | | | <0.0001 | | |
| Stage[a] (*n* included) | 27 528 | 83 | 902 | 75 | 321 | 77 |
| Stage 1 (%) | 13 | 12 | 15 | 11 | 12 | 6 |
| Stage 2 (%) | 32 | 25 | 31 | 31 | 29 | 42 |
| Stage 3 (%) | 24 | 24 | 25 | 24 | 31 | 26 |
| Stage 4 (%) | 23 | 35 | 23 | 29 | 23 | 25 |
| Stage unknown (%) | 7 | 4 | 7 | 5 | 5 | 1 |
| *P*-value ($\chi^2$) | | | | 0.0358 | | |

a: Data on stage distribution of cervix and colon cancer are based on the former regions of Comprehensive Centres Amsterdam, West and Stedendriehoek Twente.

### Cervical cancer

The risk of cervical cancer was increased in all migrant women when compared with Dutch native women, and it ranged from SIR = 1.8 (95% CI 1.6–2.2) in Surinamese women to 1.2 (0.9–1.5) in Turkish women (figure 2). This pattern was more pronounced for SCCs where migrant women from all origins exhibited significantly increased risks, being highest in Surinamese women (2.1; 1.7–2.4) (data not shown). Significantly increased risks for ACs of the cervix were only found in Moroccan women (1.7; 1.1–2.6).

The risk of dying after cervical cancer was increased, however, non-significantly, for patients from Antilles/Aruba (HR = 2.0, 95% CI 1.0–4.0) and Turkey (1.2; 0.7–2.0). Risks for Indonesians, Moroccans and Surinamese women were similar to those of native Dutch. The 1 - and 5-year relative survival rate (RSR) was better in migrants not only from The Antilles/Aruba and Turkey but also from Morocco and Suriname (ranging from 91 to 96% for 1-year RSR and from 66 to 73% for 5-year RSR) compared with that of native Dutch cancer patients (1-year RSR: 84%; 5-year RSR: 66%); however, statistically significant only for 1-year RSR in Moroccan and Surinamese women (table 2).

### Oesophageal cancer

All migrant groups exhibited lower risks for oesophageal cancer as compared with Dutch natives (figure 2); risks were significantly lower for male migrants from Indonesia (SIR = 0.6; 95% CI 0.4–0.7), Morocco (0.1; 0.0–0.4), Suriname (0.2; 0.1–0.4) and Turkey (0.4; 0.3–0.8). Similarly, risks were also significantly reduced in female migrants from Indonesia (0.6; 0.4–0.7), Morocco (0.1; 0.0–0.4), Suriname (0.2; 0.1–0.4) and Turkey (0.4; 0.3–0.8). Those patterns also held after stratification for SCC and AC; however, they were more pronounced in the latter (data not shown).

The risk of dying after oesophageal cancer among migrant patients was similar to that of native Dutch patients, regardless of the histological type (table 2). Low SES independently increased the risk of dying when compared with high SES (data not shown). One-year RSR was worse in most migrant groups (ranging from 21% in Surinamese and 32% in Indonesians; however, it was statistically significant only in Surinamese), with the exception of migrants from Turkey (42%) as compared with Dutch natives (37%) (table 2).

### Colon cancer

Colon cancer was less common among most migrant groups in comparison with Dutch natives. Particularly migrants from Suriname (SIR male migrants: 0.8; 95% CI 0.7–0.9; female migrants: 0.8; 0.7–0.9), Morocco (male migrants: 0.4; 0.4–0.5; female migrants: 0.3; 0.2–0.4) and Turkey (male migrants: 0.5; 0.4–0.6; female migrants: 0.4; 0.3–0.5) showed significantly lower risks, whereas migrants from The Antilles as well as Indonesia exhibited risks close to that of Dutch natives (figure 2).

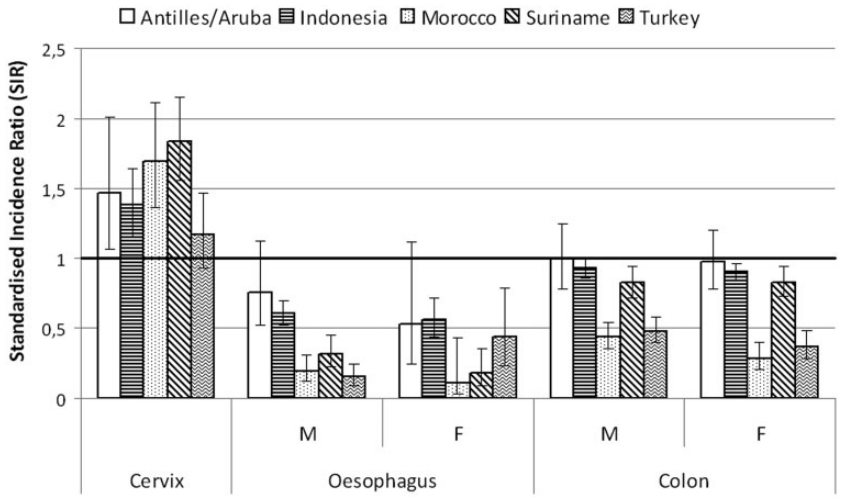


**Figure 2** SIRs with 95% Confidence Intervals for cervical, oesophageal and colon cancer for male (M) and female (F) migrants according to country of birth compared with the native Dutch population (reference; SIR = 1) 1996–2009

**Table 2** HRs[a] with 95% CI and RSRs[b] for cervical, oesophageal and colon cancer according to country of birth compared with the native Dutch population, 1996–2009

| | Country of birth | | | | | |
|---|---|---|---|---|---|---|
| | **Native Dutch** | **Antilles/Aruba** | **Indonesia** | **Morocco** | **Suriname** | **Turkey** |
| Cervix uteri (C53) | | | | | | |
| HR[c] (95% CI) | 1.0 | 2.0 (1.0–4.0) | 1.0 (0.7–1.3) | 0.9 (0.5–1.6) | 0.9 (0.7–1.3) | 1.2 (0.7–2.0) |
| 1-year RSR | 84 (82–86) | 91 (78–104) | 78 (69–87) | **96** (90–102) | **93** (88–98) | 93 (85–101) |
| 5-year RSR | 66 (64–68) | 70 (46–94) | **51** (39–63) | 73 (59–87) | 72 (62–82) | 66 (50–82) |
| Oesophagus (C15) | | | | | | |
| HR[c] (95% CI) | 1.0 | 0.9 (0.6–1.3) | 1.1 (0.9–1.2) | 0.8 (0.5–1.3) | 1.1 (0.8–1.5) | 0.9 (0.6–1.4) |
| 1-year RSR | 37 (36–38) | 29 (13–45) | 32 (26–38) | 27 (7–47) | **21** (8–34) | 42 (22–62) |
| Colon (C18) | | | | | | |
| HR[d] (95% CI) | 1.0 | 1.0 (0.8–1.4) | 1.0 (0.9–1.1) | 1.0 (0.7–1.4) | 0.9 (0.8–1.1) | 1.0 (0.7–1.4) |
| 5-year RSR | 48 (47–49) | 49 (36–62) | 49 (45–53) | 53 (39–67) | 56 (49–63) | 61 (47–75) |

a: Considered statistically significant if $P < 0.05$.
b: Considered statistically significant different from reference (native Dutch) if corresponding 95% CIs did not overlap (values given in bold).
c: Adjusted for age, sex (except cervix), stage, SES and SCC vs. AC.
d: Adjusted for age, sex, stage and SES.

Migrants exhibited death risks after colon cancer that were similar to those of native Dutch (table 2). Being of low or intermediate SES significantly increased the risk of dying when compared with the high SES group while adjusting for COB in the same model (data not shown). Five-year relative survival for patients with colon cancer was equal or better in all migrant groups, although not statistically significant (ranging from 48% in Indonesian to 62% in Turkish) in comparison with native Dutch (48%) (table 2).

## Discussion

The purpose of this study was to investigate the impact of migration on the risk and survival of oesophageal, colon and cervical cancer among migrants in The Netherlands. The findings suggest that migrants are on average at a higher risk of developing cervical cancer but are at a lower risk of developing oesophageal and colon cancer. Furthermore, we found that the risk of dying of cancer was similar to that of the native Dutch population, pointing towards a great success in health care in The Netherlands.

### *Cervical cancer*

The major cause of cervical cancer is HPV infection, showing a close association with the incidence of SCCs. Obesity and other lifestyle-related factors are more common in the development of ACs.[19] The high incidence of cervical cancer in (most, but not all) migrant women found in our study reflects the situation in their country of origin, with the highest SIR found among Surinamese women (figures 1 and 2). This might be because of a higher HPV prevalence in developing countries and/or the variation of different carcinogenic subtypes.[20,21] It should, however, be noted that not all countries have a cancer registry or have good quality data, making international comparisons difficult.

Our results are in line with other studies from Europe, confirming increased risks among migrant women who migrated at older age and who originated from Central America and Middle Africa.[2,3] In our study, risks were even more pronounced for SCCs, suggesting a predominant role for HPV-infection. A study on cervical cancer in Suriname found that besides high-incidence rates, also advanced stages at presentation and a strong correlation with socio-economic conditions (i.e. higher incidence among socially disadvantaged) were typical for the disease.[22] The correlation of lower SES with higher FIGO stage, fewer ACs and younger age at diagnosis has also been confirmed, in a study partly using the same database.[14]

Relative survival from cervical cancer was better among migrant women than in native Dutch women. Geographic and ethnic differences in cervical cancer survival can partly arise because of screening. Nationwide screening was established in 1996 in The Netherlands, contributing to an ongoing decrease in mortality from cervical cancer since a few decades.[23] Visser *et al.*[24] found that the participation of migrant women in cervical cancer screening was below target, especially in women originating from Morocco and The Antilles. Similarly, studies from the UK[25] and Sweden[26] reported lower uptakes for cervical cancer screening in various ethnic groups as compared with local-born women. Accordingly, we expected worse stage distribution and outcomes in migrant women with cervical cancer. However, screening for disease in pre-invasive stages not only leads to the removal of pre-malignant lesions and decreasing cancer incidence but may also leave more aggressive fast-growing tumours with worse survival. Unscreened populations may, therefore, have better survival as compared with screened populations,[27] possibly explaining the better survival among migrant women in our study.

### *Oesophageal cancer*

Oesophageal cancer is one of the most deadly malignancies. SCC is the dominant type; however, it is decreasing in many European countries and is mainly attributable to heavy alcohol use, tobacco smoking and low consumption of fruits and vegetables. In contrast, AC is strongly linked to obesity as well as severe gastro-oesophageal reflux and is increasing in Western countries.[7] In our study, we found proportionally more SCCs among migrants and more ACs among native Dutch cancer patients (table 1).

In accordance with our expectations, we found significantly lower risks for oesophageal cancer among all migrant groups. Risks were particularly low in migrants from Morocco and Turkey, reflecting lower incidences in their countries of origin (figure 1), most likely because of the retention of more favourable risk factor patterns, that is, higher prevalence of alcohol abstinence and lower prevalence of tobacco smoking.[28] Similarly, a study from Sweden[4] found decreased risks in migrant groups from low-incidence regions; however, socio-economic status was not taken into account. In our study, survival was equal or worse in all migrant groups compared with native Dutch, whereby there was no indication for these findings considering the stage distribution at diagnosis (table 1). A possible explanation is the strong inverse link with socio-economic determinants and poverty, potentially leading to worse access to and use of care.

At this stage, the most effective means to prevent oesophageal cancer is lifestyle change, that is, smoking cessation and moderation of alcohol intake.

### *Colon cancer*

Countries like Morocco, Turkey, Suriname and Indonesia are characterized by much lower rates of colon cancer than The Netherlands (figure 1).[5,29,30] The same pattern was reflected in our data where migrants from low-incidence countries apparently carried their risk patterns forward to their new host country. Mortality from colon cancer is decreasing in many developed countries because of screening, surveillance practices and more effective treatments both surgically and systemically. No significant differences in colon cancer survival were found in our data, even though relative survival was slightly better, although not significantly, in all migrant groups as compared with native Dutch. In another study from The Netherlands, slightly higher survival rates were found for the Dutch population as a whole.[31]

## Discussion of methods

There were three main methodological limitations related to our study. First, the validity of COB as indicator for ethnicity is impeachable. Yet, it is currently the most widely used proxy in health research, mainly because of the limited availability of migration-sensitive health/cancer data in many European countries.[32,33] In our study, there was missing COB information for many individuals still alive at the end of follow-up. To overcome this problem, survival analyses were limited to only three regional cancer registries, covering ~40% of the Dutch population. Only by doing this, we were able to calculate reliable estimates of survival rates according to COB. However, incidence rates were calculated with nationwide cancer registry data. This might have been affected by incomplete registration of COB. Because of generally low survival rates, this hardly affected oesophageal cancer incidence in our study. However, for cervical and colon cancer, with on average better survival, incidence rates might have been incorrectly estimated. We assumed that the completeness of registration of COB affects migrants and natives similarly, although registration clerks might have been more likely to register COB in case of a non-Dutch patient.

Second, we cannot entirely exclude selective remigration ('salmon bias') because of severe illness and death. However, because survival of colon and oesophageal cancer in migrants in our study came even below that of the Dutch population as a whole [compare colon 5-year-RSR: 59%; cervix 5-year-RSR: 66%; oesophagus 1-year-RSR: 42% (1999–2008)[34]], the impact is considered negligible.

Migrants are often referred to as a highly (self-)selected group, comprising on average healthier persons.[35] Yet, because of the population-based approach and the type of migrants we studied, the possible impact of the so called 'healthy migrant effect' is considered minor. Migrants from Indonesia took a distinct role relative to the other migrant groups, being older at diagnosis and having the highest SES. Moreover, their cancer incidence and survival rates were close to that of the native Dutch. As Indonesia was the first Dutch colony that claimed independence (in 1949), Indonesian migrants have the longest history in The Netherlands compared with other migrant groups. Length of stay is related to higher degrees of acculturation, which would explain the patterns we found.[36] Besides, the majority of migrants from Indonesia are ethnic Dutch. Unfortunately, (linked) data on age at immigration and duration of residence of immigrants are not available in Dutch cancer registry data.

Third, the applied SES measure in this study is ecological and reflects the socio-economic background at the time of diagnosis (or preceding diagnosis). Thus, we cannot rule out that the effects for SES would be different if individual SES was used.

## Conclusion

We conclude that risks of cervical, oesophageal and colon cancer in migrants in large parts reflect the risks in their countries of origin. Early childhood experiences before migration (cervical cancer) and the retention of favourable health patterns with regard to smoking, alcohol consumption and diet (oesophageal and colon cancer) determine their cancer risks in the new host country. Especially in combination with corresponding cancer survival measures, the findings of this study can serve as important starting points for cancer prevention in disadvantaged groups.

## Acknowledgements

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*Conflicts of interest*: None declared.

## Key points

- Analysis of cancer patterns in high-risk migrants in low-risk host countries (and of low-risk migrants in high-risk host countries) may lead to important insight into carcinogenesis.
- To date, insight into the combined picture of cancer incidence and survival in migrant populations is much-needed but remains scarce.
- Ethnic differences in cervical, oesophageal and colon cancer incidence in large part reflect underlying risk factor patterns in the countries of origin; however, survival, in the presence of socio-economic disadvantages, seems to be similar to that of native Dutch.
- Equal cancer survival points towards equal access, quality and use of cancer care—a great success for the Dutch health care system.
- Prospectively, potential cancer inequalities should be measured and monitored by taking both incidence and survival (and mortality) into account.

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# Assessing Paediatric Asthma Occurrence through Dispensed Prescription Data and Questionnaires

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**Background:** The prevalence of asthma, a common disorder in childhood, is often estimated by cross-sectional studies based on questionnaires, with the drawback that estimates are limited to certain age groups and areas. The use of electronic health data is increasingly allowing researchers to overcome these limitations. This study is aimed at assessing asthma occurrence of a school-aged population in Northeast Italy using two different data sources. **Methods:** In 2004, a population-based survey using a standardized questionnaire was conducted to estimate asthma occurrence among a resident population of children aged 6–7 years and adolescents aged 13 years. A selection of dispensed asthma medications was extracted from electronic databases for a 4-year period prior to questionnaire completion (2000–03). Asthma prevalence was estimated by commonly used questionnaire classifications and compared with use of inhaled bronchodilators (alone or in combination) in various time periods. Correlations between the two approaches were calculated. **Results:** A total of 10 252 subjects were eligible for analysis (85% of the resident population). A total of 4747 subjects (38% of the resident population) were registered in the drug database during 2000–03. Asthma prevalence was higher in males and in children. Congruence between the two enquiry methods varied according to criteria applied and improved with the protraction of the observation period. **Conclusion:** A longer period for the capture of medication data yielded higher congruence. A degree of mismatch was observed between the two methods most likely related to factors of drug use and questionnaire reliability. Nonetheless, the benefits of using easily accessible population data prevail, and further studies are warranted.

## Introduction

Asthma is a common chronic condition in childhood and an enormous burden for families and society. Its assessment is complex due to several existing phenotypes and age-related disease manifestations.[1,2] Several studies aimed at estimating the prevalence and determinants of asthma have been undertaken.[3–5] In the absence of a gold standard for the assessment of asthma in epidemiological studies,[6] screening questionnaires are frequently used to measure asthma prevalence.[5] Even though these studies have used standardized enquiry procedures on representative population samples, they are primarily cross-sectional, covering determined areas and age groups, and are prone to selection and recall bias. On the other hand, the association of asthma with environmental risk factors, such as air pollution, has been mainly investigated by mortality and morbidity data (hospital admission, emergency room).[7,8]

Asthma medications are some of the most frequently prescribed drugs in childhood.[9] Given the availability of computerized databases, these now offer an inexpensive and easily accessible research tool. Electronic drug databases are increasingly suggested