Trends in Breast Cancer Epidemiology in Chelyabinsk Region, 2006-2015

Irina A Aksenova1,2*, Malcolm A Moore3, Alla S Domozhirova1,2

Abstract

Breast cancer among women occupies a leading position in the profile of cancer incidence in most parts of the world. The present study of the incidence and prevalence of breast cancer was carried out using data from the Chelyabinsk population cancer registry for 2006-2015. A stable growth trend in the incidence over time was noted overall, as well as major differences in the figures for women of different ethnicities (Russian, Tatar, Bashkir), by far the highest incidences being observed for Russian women. Urban rates were generally higher than in rural sites and a shift towards older age at presentation was seen between 2006 and 2015. At the same time a slight decrease in mortality was noted, from 42.4% to 33.5% relative to incidence, with a decrease in the proportion of stage IV cancers. This might have been related to increasing use of mammography screening. The data have obvious connotations for primary prevention and particularly for measures adopted for secondary prevention in detection of the disease in its early stages, facilitating reduction in associated mortality. Improvement in screening rates is thus a high priority for more effective management of breast cancer in the region.

Keywords: Breast cancer - incidence - trends - age dependence - ethnic variation - Chelyabinsk

Introduction

Breast cancer is of great importance throughout Europe, generally being the most prevalent cancer in females, as evidenced by data from GLOBOCAN (Ferlay et al., 2015) and recent issues of Cancer Incidence in Five Continents (Parkin et al., 2002; Curado et al., 2007; Forman et al., 2014). Generally speaking, continuing increase in rates has been observed, although in the most developed countries of the world a recent slow down has been noted, from 42.4% to 33.5% relative to incidence, with a decrease in the proportion of stage IV cancers. This might have been related to increasing use of mammography screening. The data have obvious connotations for primary prevention and particularly for measures adopted for secondary prevention in detection of the disease in its early stages, facilitating reduction in associated mortality. Improvement in screening rates is thus a high priority for more effective management of breast cancer in the region.

Keywords: Breast cancer - incidence - trends - age dependence - ethnic variation - Chelyabinsk

Asian Pac J Cancer Prev, 18 (4), 1163-1168
The stage distribution of the breast cancers diagnosed.

The aim was to provide a first detailed appraisal of the situation with regard to breast cancer incidence and mortality in the Chelyabinsk region.

**Materials and Methods**

The subjects for this study were females diagnosed with a malignant neoplasm of the breast for the first time in their lives, residing in the territory of the Chelyabinsk region in the period from 2006 to 2015. All information about the female population morbidity and mortality from malignant neoplasms were verified and analyzed on the basis of the organizational-methodological department “Chelyabinsk Regional Clinical Oncology Center”. In addition to age and ethnicity, data on tumour stage, morphological confirmation, treatment and outcome in terms of one year mortality and five year survival were obtained by active follow-up. This information is routinely entered into the population register of cancer of the Chelyabinsk region. For the calculation of standardized indicators the basic standard age distribution of the population, adopted by the World Health Organization, was applied.

Since 2010, a set of measures for secondary prevention through breast examination of women over 20 years of age visiting clinics, as well as population-based mammography screening of the female population over 40 years for the purpose of early detection of breast cancer, have been introduced.

All information on the results of these activities were accumulated and analyzed in the Organizational and Methodical Department of Chelyabinsk Regional Clinical Oncology Center.

**Results**

Malignant cancer of the breast in females of the Chelyabinsk region occupied the leading position in 2015 accounting for 23.4% of the total neoplasms in women. Analysis of the incidence of cancer of breast in the Chelyabinsk region in the period from 2006 to 2015 showed a statistically significant increase in the standardized rate from 42.7 to 54.2 per 100,000 population (p <0.05) (see Table 1). During the same period a decrease in mortality was noted (18.1 to 16.0/100,000, relative to incidence this reduction from 42.4% to 29.5% was more marked).

Regarding the three major ethnic groups, incidence rates were highest in the Russians, followed by the Tatars and Bashkirs, only the former demonstrating a clear increase over time (see Table 2 and Figure 1). Similarly, only the Russian group exhibited consistent differences between urban and rural populations, except in the year...
Trends in Breast Cancer Epidemiology in Chelyabinsk Region 2006-2015

During the period from 2006 to 2015, Chelyabinsk region among the female population has seen an increase share of I-II breast cancer stages from 60.7% to 67%, while stage IV decreased by 4.5% from 11.1 to 6.6%, stage III not appreciably changing (see Table 3). There has been a slight increase in surgery only treatment. In line with these data, although mortality within the first year has decreased, there has been no significant improvement in 5 year survival. During the period from 2010 to 2015, the coverage of mammography screening of women increased from 19.5% to 47.7% of the subject population (see Table 4). Detection of breast cancer in stage I-II reached 73.7% by 2015, but this was only slightly greater than the figure for those diagnosed in general. However, the percentage of screened cancers at stage IV has become very low. The level of histological confirmation of diagnosis reached 97.1% at the end of 2015 (Table 3), with difficulties mainly related to the lack of morphological verification capabilities in some areas of the Chelyabinsk region, as well as the refusal of older women to accept further examination and treatment.

**Discussion**

The present results demonstrated a clear increase in the overall incidence rate of breast cancer in Chelyabinsk Oblast over the time period from 2006-2015 with only limited change in mortality. Much lower rates were evident in Tatar and especially Bashkir populations than in Russians and there was a general tendency for lower rural than urban rates, at least until the most recent data.

The 17.1 % increase in 10 years observed here, from 42.7 to 54.2 per 100,000, giving an annual increment of approximately 1.7%, is in line with results found elsewhere, for example in the former states of the USSR, with the notable exception of the St Petersburg Russian Federation registry, and also neighbouring Eastern European countries (see Table 5). Similarly, in Kazakhstan as a whole the increase in incidence was 1.9% a year from 1999-2014 (Beysebayev et al., 2015a) and in the Aral sea area a rise from 13.4-26.1/100,000 was noted from 1999-2010 (Igissinov et al., 2011a). In the Kemerova region also gradual increase was observed from 1999-2009 (Kutikhin et al., 2012), although there was no discernible trend in

Table 4. Dynamics of Screening Coverage for the Chelyabinsk Female Population over 40 Years Old

| Year | Population >40 years | No. of women subjects | % Implementation | No. of mammogram machines | Load | No. of cancers confirmed | Stage I | Stage II | Stage III | Stage IV | Unknown |
|------|----------------------|-----------------------|-----------------|--------------------------|------|-------------------------|--------|---------|----------|----------|---------|
| 2010 | 810,004              | 277,124               | 28.6%           | 55                       | 1439.4 | 265 (100)               | 29 (9.5) | 141 (53.2) | 67 (25.3) | 14 (5.3) | 14 (5.3) |
| 2011 | 843,492              | 110765                | 67.5%           | 55                       | 2013.9 | 740 (100)               | 138 (18.6) | 360 (48.6) | 189 (25.5) | 53 (7.2) | 0 (0)   |
| 2012 | 843,504              | 119747                | 73.0%           | 55                       | 2177.2 | 603 (100)               | 98 (16.3) | 297 (49.3) | 166 (27.5) | 42 (7.0) | 0 (0)   |
| 2013 | 804,874              | 158479                | 91.6%           | 58                       | 2732.4 | 520 (100)               | 118 (12.3) | 239 (46.0) | 144 (27.7) | 19 (3.6) | 0 (0)   |
| 2014 | 827,399              | 168996                | 97.7%           | 58                       | 2913.7 | 390 (100)               | 116 (23.7) | 179 (45.9) | 79 (20.3) | 16 (4.1) | 0 (0)   |
| 2015 | 948,011              | 225994                | 50.8%           | 64                       | 3531.2 | 471 (100)               | 137 (29.1) | 210 (44.6) | 112 (23.8) | 12 (2.5) | 0 (0)   |

*Mammography work in 2 shifts at 12 women a day, 250 days = 6000 women studied
Irina A Aksenova et al
Asian Pacific Journal of Cancer Prevention, Vol 18

St Petersburg apparent anomaly, a high level in Belgium points to other factors. Clearly quality of registration but continued rapid increase from very low levels as in Israeli variation in overall exposure to risk factors. Explanation and almost 90 in Israeli Jews (Table 5), must reflect for example from 30 in India Mumbai to 70 in Austria decade. Why relatively stable rates may greatly vary, where rates have not appreciably changed over the last recent Russian overview document (Merabishvili, 2015).

We must wait for CIV 11 to appear since increase from an 2015b). Regarding the CIV10 in No. Change

| Region/Country | Incidence | Change | % |
|----------------|-----------|--------|---|
| Austria (Tyrol) | 68.9 | 72.3 | 70.7 | 1.8 | 2.6 |
| Belgium (Flanders) | 88.1 | 101.3 | 110.8 | 22.7 | 25.7 |
| Germany (Saar) | 71.4 | 76.6 | 81.9 | 10.5 | 14.7 |
| Ireland | 69.6 | 78.1 | 83.1 | 13.5 | 19.4 |
| Netherlands | 85.6 | 90.3 | 93.4 | 7.8 | 9.1 |
| UK (England) | 79.4 | 80.4 | 82.6 | 3.2 | 4.0 |
| (N. Ireland) | 73.5 | 76.5 | 80.2 | 6.7 | 9.1 |
| (Scotland) | 75.6 | 79.2 | 82.8 | 7.0 | 9.3 |
| Denmark | 81.3 | 83.7 | 86.1 | 4.8 | 5.9 |
| Finland | 72.4 | 80.6 | 83.2 | 10.8 | 14.9 |
| Iceland | 76.1 | 84.6 | 86.7 | 10.6 | 13.9 |
| Norway | 63.2 | 71.0 | 75.9 | 12.7 | 20.1 |
| Sweden | 76.5 | 78.9 | 81.1 | 4.6 | 6.0 |
| Belarus | 33.0 | 35.6 | 41.0 | 7.0 | 21.2 |
| Estonia | 41.5 | 47.2 | 48.9 | 7.4 | 17.8 |
| Latvia | 39.4 | 44.1 | 49.0 | 9.0 | 22.8 |
| Lithuania | 37.7 | 43.7 | 46.4 | 8.7 | 23.1 |
| Russia | 46.1 | 47.1 | 47.7 | 1.4 | 2.8 |
| Croatia | 47.3 | 57.4 | 59.4 | 12.1 | 25.6 |
| Czech | 52.9 | 59.9 | 64.6 | 11.7 | 22.1 |
| Slovakia | 42.4 | 46.9 | 51.7 | 9.3 | 21.9 |
| Slovenia | 51.3 | 58.3 | 63.6 | 12.3 | 24.0 |
| Israel Jew | 89.5 | 96.8 | 89.4 | -0.1 | -0.1 |
| Arab | 27.7 | 38.5 | 56.1 | 28.4 | 102.5 |
| India Mumbai | 28.9 | 26.9 | 30.4 | 1.5 | 5.2 |
| Karunagapally | 15.0 | 16.0 | 16.6 | 1.6 | 10.7 |
| Thailand Bangkok | 25.5 | 34.3 | 8.8 | 34.5 |
| Chiang Mai | 16.1 | 21.6 | 25.6 | 9.5 | 59.0 |
| Songkhlaa | 11.7 | 18.2 | 21.6 | 9.9 | 84.6 |
| Philippines | 54.2 | 55.2 | 60.1 | 5.9 | 10.9 |
| Singapore C | 44.7 | 56.4 | 59.2 | 15.5 | 34.7 |
| I | 36.7 | 45.0 | 49.0 | 12.3 | 33.5 |
| M | 37.1 | 43.5 | 53.6 | 16.5 | 44.5 |
| China Hong Kong | 36.2 | 41.3 | 45.2 | 9.0 | 24.9 |
| Jiashan | 9.1 | 14.7 | 22.4 | 13.3 | 146.2 |
| Korea Seoul | 20.8 | 28.8 | 37.3 | 16.5 | 79.3 |
| Japan Miyagi | 33.1 | 42.5 | 54.0 | 20.9 | 63.1 |
| Osaka | 27.9 | 32.0 | 37.3 | 9.4 | 33.7 |

1Parkin et al., 2002; 2Curado et al., 2007; 3Forman et al., 2014

Table 5. Change in Breast Cancer Incidence in Five Continents Data Over Time

the Aktobe region, 2004-2008 (incidence range 6.0-10.1), mortality (5.9-8.8) (Bekmukhambetov et al., 2015a; 2015b). Regarding the St Petersburg apparent anomaly, we must wait for CIV 11 to appear since increase from an incidence of 19 in 1970 to 75 in 2010 was reported in a recent Russian overview document (Merabishvili, 2015). Presumably within each population there is a stable level which is achieved, at least looking at data from a number of registries in Europe, Australia and Northern America where rates have not appreciably changed over the last decade. Why relatively stable rates may greatly vary, for example from 30 in India Mumbai to 70 in Austria and almost 90 in Israeli Jews (Table 5), must reflect variation in overall exposure to risk factors. Explanation of explosive increase from very low levels as in Israeli Arabs and rural China might depend at least partly on quality of registration but continued rapid increase from a high level in Belgium points to other factors. Clearly more emphasis needs to be placed on impact at the country or local regional level on risk factors like those from the Korean breast cancer risk assessment tool: family history of breast cancer, age at menarche, menopausal status, age at menopause, experience of pregnancy, age at first full-term pregnancy, number of pregnancies, duration of breastfeeding, oral contraceptive usage, hormone replacement therapy, exercise, body mass index (BMI), smoking, alcohol drinking, and number of screening breast examinations (Park et al., 2013).

Reported risk factors in nearby Kazakhstan include unfavorable living conditions, chronic stress, unilateral breastfeeding, breastfeeding less than 3 months and over 2 years, abortions, and hereditary predisposition (Toleutay et al., 2013). In addition, a direct strong correlation between the degree of contamination with high pollution emissions in the atmosphere from stationary sources and the incidence of breast cancer has been described (Bilyalova et al., 2012). Whether these are also influences in Chelyabinsk remains to be determined.

Our findings for ethnicity are in line with earlier reports for Kyrgyzstan (Igisinov, 2004; Igisinov et al., 2005) with standardized rates in 1995-2002 of 39.1 for Russian but only 10.6 for Kyrgyz. Particularly low rates have also been described for Mongolians (Sandagdorj et al., 2010; Troisi et al. 2012). Ethnic differences have also in been documented in Israel, rates for Israelis being much higher than for Arabs (Salim et al., 2010), and in Pakistan, where Baluchis from the rural north have much lower incidences than in Punjabis and immigrants from India (Bhurgri et al., 2007). Also in Guam (Haddock et al., 2009) and in Australia where Aborigines are less affected than whites (Roder, 2005), while the opposite is true in New Zealand, Maoris having higher rates than Caucasians (Forman et al., 2014). There is evidence for environment not genotype as the predominating influence. For example in Singapore, Indians had higher rates than Malays and Chinese in the 1960s but more recently Chinese have higher incidences, looking at CIV data (Moore et al., 2010e). In our specific Tatar and Baskiri populations the lower incidences, looking at CIV data (Moore et al., 2010e). In our specific Tatar and Baskiri populations the lower rates than in Russians might be linked to religious and cultural differences in terms of reproductive factors like age at marriage and parity, and exposure to environmental lifestyle factors like alcohol (Brooks and Zakhari., 2013).

Regarding age dependence, our findings indicate increase to a plateau at ages 55 and now 65, compared with the 50 and above reported for the Aral sea area (Igisinov et al., 2011b). Age effects were earlier found to level off after 40s in Japan (Ito et al., 2011). Whether the shift in age that we noted reflects a cohort influence requires further investigation.

Our findings for influence of mammography do not point to a major role in increasing the incidence, in contrast to earlier reports for the Western world (Duffy and Parmar, 2013; Beckmann et al., 2014) although minor effects on numbers of stage I and II cancers can not be ruled out. Detection of breast cancer in stage I-II reached 73.7% by 2015, but this was only slightly greater than the figure for those diagnosed in general. However, the percentage of screened cancers at stage IV has become very low. In general, there has been a significant increase in the active
detection of breast cancer among the female population of the Chelyabinsk region is almost 2 times the 10-year period from 2006 to 2015. from 27.5% to 55.8%, while the nationwide rate in 2015 was 37.2%.

While only very slight decrease in overall mortality was evident, contrasting to the 0.8% decrease per year reported by Beysebayev et al. (2015a) the present study indicated an improvement of the mortality to incidence ratio from 42.4% to 29.5%. While much higher than the 15-20% evident in most Western European countries, this compares well with data for Eastern Europe and country members of the ex-Soviet Union (Ferlay et al., 2015).

While short term survival for one year appears to have considerably improved the same is not the case for five year data and compared to other regions of the world the observed 57% is very low.

In conclusion, at the population level, increase in breast cancer incidence in the Chelyabinsk region was identified, primarily affecting Russians. The lower levels in other ethnic groups presumably reflect lifestyle and religious influences. From the literature, the relatively poor survival might be linked to the distribution of molecular subtypes (Jia et al., 2014; Kongsiang et al., 2014), which were not determined in the present study. This should be a focus of attention in the future, along with any age dependence of subtypes, as described earlier (Thapa et al., 2013; Tichy et al., 2013; Elkablawy et al., 2015). Use an arsenal of measures to optimise secondary prevention (Cherenkov et al 2013.; Beysebayev et al 2015b) and provision of the most effective clinical therapies clearly need emphasis, with an ongoing focus on accurate accounting of cases of morbidity and mortality, within the context of development of a network of specialized oncology institutions in the Russian Federation.

References

Beckmann KR, Roder DM, Hiller JE, Farshid G, Lynch JW (2014). Influence of mammographic screening on breast cancer incidence trends in South Australia. Asian Pac J Cancer Prev, 15, 3105-12.

Bekmukhambetov Y, Imangazina Z, Jarkenov T, et al (2015a). Cancer incidence and mortality data in Aktobe, West Kazakhstan, 2000-2010. Asian Pac J Cancer Prev, 16, 2379-83.

Bekmukhambetov Y, Mamyrbayev A, Jarkenov T, Makenova A, Imangazina Z, (2015b). Malignant neoplasm prevalence in the Aktobe region of Kazakhstan. Asian Pac J Cancer Prev, 16, 8149-53.

Beysebayev E, Tulebayev K, Meymanaliev T (2015a). Breast cancer diagnosis by mammography in Kazakhstan - staging results of breast cancer with double reading. Asian Pac J Cancer Prev, 13, 2341-4.

Beysebayev E, Bilyalova Z, Kozhakeeva L, Baissalbayeva A, Abiltayeva A (2015b). Spatial and temporal epidemiological assessment of breast cancer incidence and mortality in Kazakhstan, 1999-2013. Asian Pac J Cancer Prev, 16, 6795-8.

Bilyalova Z, Igissinov N, Moore M, et al (2012). Epidemiological evaluation of breast cancer in ecological areas of Kazakhstan-association with pollution emissions. Asian Pac J Cancer Prev, 13, 2341-4.

Bhurgri Y, Kayani N, Faridi N, et al (2007). Patho-epidemiology of breast cancer in Karachi ’1995-1997’. Asian Pac J Cancer Prev, 8, 215-20.

Brooks PJ, Zakhari S (2013). Moderate alcohol consumption and breast cancer in women: from epidemiology to mechanisms and interventions. Alcohol Clin Exp Res, 37, 23-30.

Cherenkov VG, Petrov AB, Ivanchenko VV, Tverezovskii SA, Frunkin BB (2013). Diagnosis and morphologic verification of tumors detected by mammography screening. Vopr Onkol, 59, 118-22 (in Russian).

Chukmaitov A, Wan TT, Menachemi N, Cashin C (2008). Breast cancer knowledge and attitudes toward mammography as predictors of breast cancer preventive behavior in Kazakh, Korean, and Russian women in Kazakhstan. Int J Public Health, 53, 123-30.

Curado MP, Edwards B, Shin HR, et al (2007). Cancer Incidence in Five Continents Volume IX (IARC Scientific Publications No. 160). IARC: Lyon.

Dudarev A, Chupakhin V, Odland J. (2013). Cancer incidence and mortality in Chukotka, 1999-2010. Int J Circumpolar Health, 72, 20470

Duffy SW, Parmar D (2013). Overdiagnosis in breast cancer screening: the importance of length of observation period and lead time. Breast Cancer Res, 15, 41.

Elkablawy MA, Albasri AM, Hussainy AS, Nooh MM, Alhujailly A (2015). Molecular profiling of breast carcinoma in Almadinah, KSA: immunohistochemistry and clinicopathological correlation. Asian Pac J Cancer Prev, 16, 7819-24.

Ferlay J, Soerjomataram I, Dikshit R, et al (2014). Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer, 136, 359-86.

Forman D, Bray F, Brewster DH, et al (2014). Cancer Incidence in Five Continents Volume X (IARC Scientific Publications No. 164). IARC: Lyon.

Haddock RL, Whippy HJ, Talon RJ, Montano MV (2009). Ethnic disparities in cancer incidence among residents of Guam. Asian Pac J Cancer Prev, 10, 571-62.

Igisinov N (2004). Ethnic and age variation of cancer of the reproductive system in women of Kyrgyzstan. Asian Pac J Cancer Prev, 5, 217-22.

Igisinov N, Kokteubaev N, Kudaibergenova I (2005). Epidemiology of breast cancer in females of reproductive age in Kyrgyzstan. Asian Pac J Cancer Prev, 6, 37-40.

Igisinov N, Igissinov S, Moore MA, et al (2011a). Trends of prevalent cancer incidences in the Aral Sea area of Kazakhstan. Asian Pac J Cancer Prev, 12, 2299-303.

Igisinov N, Tereshkevich D, Moore MA, et al (2011b). Age characteristics of incidences of prevalent cancers in the Aral Sea area of Kazakhstan. Asian Pac J Cancer Prev, 12, 2295-7.

Igisinov NS, Bilyalova ZA, Turemuratova MA (2010). Breast cancer in Kazakhstan: age and ethnic factors. Clin Med Kazakhst, 3, 105-11.

Igisinov S, Igissinov N, Moore MA, et al (2011). Trends of prevalent cancer incidences in the Aral-Syr Darya ecological area of Kazakhstan. Asian Pac J Cancer Prev, 6, 37-40.

Ito Y, Ioka A, Nakayama T, Tsukuma H, Nakamura T (2011). Comparison of trends in cancer incidence and mortality in Osaka, Japan, using an age-period-cohort model. Asian Pac J Cancer Prev, 12, 879-88.

Jia WJ, Jia HX, Feng HY, et al (2014). Her-2 enriched tumors of breast cancer in Karachi ’1995-1997’. Asian Pac J Cancer Prev, 8, 215-20.

Kongsiang et al., 2014; Kongsiang et al., 2014.

In conclusion, at the population level, increase in breast cancer incidence in the Chelyabinsk region was identified, primarily affecting Russians. The lower levels in other ethnic groups presumably reflect lifestyle and religious influences. From the literature, the relatively poor survival might be linked to the distribution of molecular subtypes (Jia et al., 2014; Kongsiang et al., 2014), which were not determined in the present study. This should be a focus of attention in the future, along with any age dependence of subtypes, as described earlier (Thapa et al., 2013; Tichy et al., 2013; Elkablawy et al., 2015). Use an arsenal of measures to optimise secondary prevention (Cherenkov et al 2013.; Beysebayev et al 2015b) and provision of the most effective clinical therapies clearly need emphasis, with an ongoing focus on accurate accounting of cases of morbidity and mortality, within the context of development of a network of specialized oncology institutions in the Russian Federation.
Irina A Aksenova et al

(2014). Survival time and molecular subtypes of breast cancer after radiotherapy in Thailand. *Asian Pac J Cancer Prev*, 15, 10505-8.

Kutikhin A, Yuzhalin A, Brailovskiy V, et al (2012). Analysis of cancer incidence and mortality in the industrial region of South-East Siberia from 1991 through 2010. *Asian Pac J Cancer Prev*, 13, 5189-93.

Long N, Moore M, Chen W, et al (2010). Cancer epidemiology and control in North-East Asia - past, present and future. *Asian Pac J Cancer Prev*, 11 Suppl, 107-148.

Meraishvili VM (2015). Malignant tumors in saint petersburg (analysis of cancer registry database according to international standards: morbidity, mortality, survival). NN Petrov Research Institute of Oncology Ministry of Public Health of the Russian Federation, Saint Petersburg.

Moore MA, Eser S, Igisinov N, et al (2010). Cancer epidemiology and control in North-West Asia - past, present and future. *Asian Pac J Cancer Prev*, 11 Suppl, 17-32.

Park B, Ma SH, Shin A, et al (2013). Korean risk assessment model for breast cancer risk prediction. *PLoS One*, 8, e76736.

Parkin DM, Whelan SL, Ferlay J, Teppo L, Thomas DB (2002) Cancer Incidence in Five Continents, Volume VIII, (IARC Scientific Publications No. 155). IARC: Lyon.

Poddubnaya I, Axel E, Kipriyanova N, et al (2007). Component analysis of cancer incidence population (Yakutsk, 1990-2003). *Siberian J Oncol*, 2, 55-63.

Roder D, Webster F, Zorbas H, Sinclair S (2012). Breast screening and breast cancer survival in Aboriginal and Torres Strait Islander women of Australia. *Asian Pac J Cancer Prev*, 13, 147-55.

Sandagdorj T, Sanjaajamts E, Tudev U, et al (2010). Cancer incidence and mortality in Mongolia—national registry data. *Asia Pac J Cancer Prev*, 11, 1509-14.

Shi XJ, Au WW, Wu KS, Chen LX, Lin K (2014). Mortality characteristics and prediction of female breast cancer in China from 1991 to 2011. *Asian Pac J Cancer Prev*, 15, 2785-91.

Starinsky V, Poddubnaya I, Axel E, et al (2005). Component analysis of malignant tumors of the population of the republic of Sakha (Yakutia) in 1989-2001. *Russian J Oncol*, 1, 38-41.

Thapa B, Singh Y, Sayami P, et al (2013). Breast cancer in young women from a low risk population in Nepal. *Asian Pac J Cancer Prev*, 14, 5095-9.

Tichy JR, Lim E, Anders CK (2013). Breast cancer in adolescents and young adults: a review with a focus on biology. *J Natl Compr Canc Netw*, 11, 1060-9.

Toleutay U, Reznik V, Kalmatayeva Z, Smigelskas K (2013). Risk factors of breast cancer in Kyzylorda oblast of Kazakhstan: a case-control study. *Asian Pac J Cancer Prev*, 14, 5961-4.

Troisi R, Altantsetseg D, Davaasambuu G, et al (2012). Breast cancer incidence in Mongolia. *Cancer Causes Control*, 23, 1047-53.

Troisi R, Gannaa D, dos Santos Silva I, et al (2014). The role of hormones in the differences in the incidence of breast cancer between Mongolia and the United Kingdom. *PLoS One*, 9, e114455.

Wang FL, Chen F, Yin H, et al (2013). Effects of age, breast density and volume on breast cancer diagnosis: a retrospective comparison of sensitivity of mammography and ultrasonography in China’s rural areas. *Asian Pac J Cancer Prev*, 14, 2277-82.

Wu LZ, Han RQ, Zhou JY, et al (2014). Incidence and mortality of female breast cancer in Jiangsu, China. *Asian Pac J Cancer Prev*, 15, 2727-32.