Chapter 32

An overview of cancer survival in Africa, Asia, the Caribbean and Central America: the case for investment in cancer health services

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Abstract

Population-based cancer survival data, a key indicator for monitoring progress against cancer, are reported from 27 population-based cancer registries in 14 countries in Africa, Asia, the Caribbean and Central America. In China, Singapore, the Republic of Korea, and Turkey, the 5-year age-standardized relative survival ranged from 76–82% for breast, 63–79% for cervical, 71–78% for bladder, and 44–60% for large-bowel cancer. Survival did not exceed 22% for any cancer site in The Gambia, or 13% for any cancer site except breast (46%) in Uganda. For localized cancers of the breast, large bowel, larynx, ovary, urinary bladder and for regional diseases at all sites, higher survival rates were observed in countries with more rather than less developed health services. Inter- and intra-country variations in survival imply that the levels of development of health services and their efficiency to provide early diagnosis, treatment and clinical follow-up care have a profound impact on survival from cancer. These are reliable baseline summary estimates to evaluate improvements in cancer control and emphasise the need for urgent investment to improve awareness, population-based cancer registration, early detection programmes, health-services infrastructure, and human resources in these countries in the future.

Introduction

Population-based cancer survival data from 27 population-based cancer registries in 14 countries in Africa, Asia, the Caribbean and Central America are briefly described and discussed in this publication (Table 1). Survival data for 40 cancer sites are described in this chapter, although the number of registries reporting for each cancer site varied from 2 to 26 (Table 2). The countries contributing data in our study have variable levels of economic development, as indicated by the varying gross national income (GNI) per capita, and development of health services. The levels of development of health services and their efficiency in providing early diagnosis, treatments and clinical follow-up care have a profound impact on survival from cancer. Poorly developed and inaccessible health services obviously result in great disparity in early diagnosis, adequate treatment and follow-up care. We discuss the observed survival patterns and inter- as well as intra-country variations in this chapter, in the background of basic and effective early detection, diagnosis and treatment requirements for selected cancer sites, taking into account data quality issues, the wide differences in awareness, socio-economic development, human resources, health services investment, development and accessibility in the countries included in this study.

Case-finding and follow-up

The methods used by each cancer registry to identify and register all diagnosed cases from the various data sources in their geographical regions have been described in the individual chapters. In brief, the registries used a mix of both passive notification of cases and active registration by visiting and abstracting data on cases from different data sources to register all incident cancer cases in the populations they covered. They used quality assurance procedures as advocated by the International Agency for Research on Cancer (IARC) to validate the quality and completion of cancer registration in their target populations [1]. Uniform criteria [2] described in detail in Chapter 4 were adopted for inclusion of

cases for survival analysis and the disease codes of the International Classification of Diseases and Related Health Problems, tenth revision (ICD-10) [3] were used for coding the collected data.

A mix of active and passive follow-up methods were employed by participating registries in eliciting the vital status of patients at or within five years from the incidence date. Twelve registries used active follow-up methods only, two registries used passive methods only, and the remaining 13 used a mix of both methods (Table 1). Active follow-up methods included repeated visits to data sources including hospitals to scrutinise clinical follow-up notes and death registry offices, churches and mosques to collect death information by scrutinising their death registers; telephone or reply-paid postal enquiries; investigations in workplaces or the neighbourhood and house visits for personal enquiries. Passive follow-up relied on matching cancer cases with all-cause death information collected from death registration systems and hospital records by using unique person numbers or by using a combination of personal identifiers from the national population registers, such as the first and last name, address and date of birth, etc., for record linkage.

Outcome measures and 5-year survival

Death, irrespective of the cause, was the end-point studied. Survival experiences for each cancer site and participating registries are described in terms of 5-year age-standardized relative survival (ASRS). Comparison of 5-year ASRS by countries (Figures 1a–1w) and registries (Table 3; Figures 2a–2s) are provided for all cancers. Observed survival by clinical extent of disease categories at five years from diagnosis is described for eight cancer sites using information from eight to 16 registries in four to nine countries for different sites (Tables 4a–4h). The different categories of clinical extent of disease are defined as follows:

- Localized: cancer was confined to the organ of origin without invasion into the surrounding tissue/organ and without involvement of any regional or distant lymph nodes or organs;
- Regional: cancer had invaded into the surrounding tissue/organ, with or without the involvement of the regional lymph nodes but not involving or spread to the non-regional lymph nodes or organs;
- Distant metastasis: cancer that had spread to the non-regional lymph nodes or distant organs;
- Unknown: when clinical extent of disease could not be categorised.

It is important to consider data quality issues when interpreting the results. Mortality ascertainment in a passive follow-up environment may be sub-optimal if the data linkage is not based on a unique personal identification number backed by a good death registration system. Hence, an unknown degree of under-ascertainment of deaths cannot be ruled out in some of the populations included in our study, despite of our best and active efforts to ascertain such events.

An earlier study addressing the impact of the lack of active follow-up in Chennai registry in India had shown an upward bias in population-based survival ranging between three and 13 percent units in the presence of 5-21% of random losses to follow-up for different cancers [4]. This bias was estimated by assuming that the lost to follow-up cases were alive at the closing date of follow-up. Using the same analogy for registries that used predominantly passive follow-up, when such misclassification of cases as alive at closing date does not exceed one in five cases, the over-estimation of five-year age standardized relative survival is unlikely to exceed 13 percent units. On the other hand, studies employing loss-adjusted survival methods with such data have clearly shown that over-estimation of population-based survival was minimal [5,6].

We have made considerable efforts to improve data quality for each registry; hence the survival estimates from our study are reliable and are more likely to reflect the impact of varying levels of awareness, early diagnosis and treatment and development of cancer health care services in the different countries and populations included in our study. Thus, they are reliable baseline summary estimates for any comparison and for future improvements in survival outcome. The observed differences in survival between the countries and populations in our study seem to be largely caused by the wide differences in awareness, socio-economic development, human resources, availability of and accessibility to early diagnosis and treatment due to the different levels of development of health services, on-going health service investments and, to a lesser extent, to data quality and reliability issues.

Variation in survival and levels of development of health services

We have classified the health services of countries included in the study into three groups, namely well-, moderately- and least-developed based on

selected indicators as shown in Table 5. We have also attempted to classify the countries included in our study into three tiers, based on the variations in survival rates: the countries or regions showing the highest survival in our study include Hong Kong Special Administrative Region (SAR) and metropolitan areas of China, Republic of Korea, Singapore and Turkey, which have well-developed health services as indicated by large numbers of well-developed diagnostic and treatment centres across the countries and high per-capita gross national income (GNI) values (http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20535285~menuPK:1192694~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html) (Table 5). Those with intermediate survival experience include rural areas in mainland China, Costa Rica, Cuba, India, Pakistan, the Philippines and Thailand, which have moderately-developed cancer health services as indicated by diagnostic and treatment facilities centred in and around metropolitan or urban cities and medium per-capita GNI values; the lowest survival rates were observed in the Gambia, Uganda and Zimbabwe, which have poorly-developed health services as indicated by very limited availability of cancer diagnostic and treatment facilities and low per capita GNI values (Table 5).

The classification of three tiers of survival was used to obtain further insight by comparing five-year observed survival and the proportion of cases presenting in different categories of clinical extent of disease for six cancer sites (Figures 3a–8b). Data on clinical extent of disease were not available from any country in Africa. Among the countries having the highest survival, data on clinical extent of disease was available from Singapore for all sites, Turkey for most sites and Hong Kong (SAR) for breast only; the available data on clinical extent of disease from these countries were pooled together for each site and classified as "More-developed health services". Similarly, data on respective categories of extent of disease from countries having intermediate survival were pooled together as "Less-developed health services". A decreasing survival with advancing stages of disease was observed for all cancers in both groups. For localized cancers of the breast, large bowel, larynx, ovary and urinary bladder and for all regional diseases at all sites, higher survival rates were observed in countries with more-developed than in less-developed health services. This seems to be clearly related to the capability of health services to provide early diagnosis and adequate treatment for treatable forms of cancers.

Inter- and intra-country comparison of survival rates for individual cancer sites

Head and neck cancers (Tables 3, 4a–4c; Figures 1a–1e, 2a–2d, 2i, 3a–3b)

Five-year survival rates for oral cavity and pharyngeal tumours varied markedly by anatomical site, countries and populations. The 5-year survival for tongue cancer varied from 12% in Barshi in India to more than 60% in China. Survival rates were lower than 30% in India and most of Thailand. The survival rates for advanced disease (regional and distant metastasis) were less than 20%, and that for localized cancers exceeded 45% in most countries. The survival rates for oral cavity cancers were generally higher than that of tongue and varied from 22% in Chiang Mai, Thailand to 71% in Shanghai, China. Survival for localized oral cavity cancer exceeded 50% in most countries, whereas it was less than 25% for regional and distant metastatic disease in most countries. Early cancers (stages I and II) of the tongue and oral cavity are curable by surgery or by radiation therapy, and the choice of treatment is dictated by the anticipated functional and cosmetic results of treatment as well as by the availability of specific facilities. Patients with stage III or IV tongue and oral cancers are candidates for treatment by a combination of surgery and radiation therapy and local and regional recurrences are common in this group of patients. It is well established that tongue cancers carry much poorer prognosis than oral cavity cancers and, once the disease involves regional lymph nodes, survival prospects are very poor for head and neck cancers [7].

The survival for oropharyngeal cancers, including tonsil, ranged 16–20% in Chennai and Mumbai in India to 68% in Tianjin, China. Survival for hypopharyngeal cancers was less than 25% in most populations studied. Oropharyngeal and hypopharyngeal cancers often present in advanced stages and treatment outcomes for advanced disease are poor for these cancer sites [8]. The survival for nasopharyngeal cancer exceeded 59% in Singapore and Hong Kong. Survival rates for laryngeal cancer exceeded 60% in China, Singapore, Republic of Korea and Turkey, while survival rates did not exceed 40% in India, Harare in Zimbabwe, rural Qidong district in China and some regions of Thailand, indicating an advanced clinical presentation.

Prognosis for small laryngeal cancers with no lymph node spread is very good, with cure rates ranging from 75 to 95% depending on the site, tumour bulk and degree of infiltration. The 5-year survival for both localized and regionally spread laryngeal cancer was 16 to 19 percentage points higher in countries

with well-developed health services, such as Singapore and Turkey, than in other countries, underlining the importance of both early diagnosis and appropriate treatment (Figure 3a). Survival rates for the above cancer sites were lower in rural compared to urban areas of India and China, whereas the survival differences were minimal across Republic of Korea and Thailand.

The poor survival outcomes for most patients with head and neck cancer in our study and elsewhere [2,9] underscore the importance of primary prevention and early detection of these cancers. Most head and neck cancers are caused by tobacco use in any form [10,11] and alcohol drinking [12], and avoiding these risk factors has a substantial impact on preventing these cancers. A 35% reduction in oral cancer mortality following three rounds of oral visual screening among tobacco and/or alcohol users was documented in a randomized trial in Southern India [13]. Routine visual screening of such high-risk populations will improve survival and reduce oral cancer mortality.

Digestive tract cancers (Tables 3, 4d, 4e; Figures 1f–1j, 2e–2h and 4a–4b)

Five-year survival prospects of patients with liver, pancreas, gall bladder, oesophagus and stomach cancers were generally poor, not exceeding 15% in most populations studied, indicating the poor prognosis of cancers in these organs and the importance of primary prevention in controlling these tumours. Most of the cancers arising in these sites are rarely curable. The overall 5-year survival rate in patients amenable for radical definitive treatment by surgery or radiotherapy for oesophageal cancer ranges from 5% to 30%. Cytological and endoscopic screening have been evaluated in countries with a high incidence of oesophageal cancer. Although these efforts have shown that it is possible to detect cancers in an early asymptomatic stage, and those with very early disease have a better chance of survival, screening is unlikely to reduce mortality from oesophageal cancer and may result in some serious side-effects associated with endoscopy such as aspiration, perforation, bleeding and cardiopulmonary events. Improving general nutrition and controlling tobacco and alcohol consumption are important in the context of preventing oesophageal cancer. Symptomatic gastroesophageal reflux disease (GERD) has been identified as a risk factor of oesophageal adenocarcinoma.

The survival outcome of patients with stomach cancer is related to tumour extension beyond the gastric wall, regional lymph node involvement, and to a lesser extent on tumour grade [14,15]. Screening is unlikely to reduce mortality from stomach cancer. Overall stomach cancer incidence and mortality are declining across the world due to better food preservation using refrigerators, reduced consumption of salted, smoked and pickled food products, and wide availability of fruits and vegetables the year round. Risk factors for gastric cancer include the presence of precursor conditions such as chronic atrophic gastritis, intestinal metaplasia and pernicious anaemia. There is increasing evidence that Helicobacter pylori infection of the stomach is associated with both the initiation and promotion of gastric carcinoma.

Most patients with stomach cancer present with metastatic disease, either regional or in distant sites such as the liver. The curative treatment option for stomach cancer is radical surgery; however, the frequency of local failure in the tumour bed and regional lymph nodes and distant failures via haematogenous or peritoneal routes remains high. Although 30–50% of patients with localized distal stomach cancer can be cured, such disease accounts for less than 10% of cases. On the other hand, the 5-year survival rate of patients with localized proximal stomach cancer is less than 15%. None with disseminated disease survive at 5 years.

Survival for colorectal (large bowel) cancer varied from 4% in The Gambia to 64% in Seoul, Republic of Korea. The survival figures were less than 8% in the sub-Saharan African countries of The Gambia and Uganda and less than 30% in Harare, Zimbabwe, all of which have poorly-developed cancer health care infrastructure and limited availability of and accessibility to curative treatments for most patients. The survival prospects of patients with large bowel cancer is clearly related to the degree of penetration of the tumour through the intestinal wall, the presence or absence of regional lymph nodal involvement, and the presence or absence of distant metastases; these three characteristics form the basis for staging and treatment options for this cancer [16].

It is well established that screening with faecal occult blood testing reduces colorectal cancer mortality, and flexible sigmoidoscopy and colonoscopy leads to earlier detection of polyps and colorectal cancer. The standard treatment for patients with colon cancer has been open surgical resection of the primary and regional lymph nodes for localized disease. Patients with advanced disease may require combined modality therapy with chemotherapy with or without radiation therapy. The survival outcomes for colorectal cancer depend on the clinical stage at presentation and the ability of the health services to provide prompt standard care with radical surgery and other adjuvant therapies as indicated. Survival

rates exceeding 50% reported from Hong Kong, Republic of Korea, Singapore, regions in Thailand and mainland China seem to reflect the wide availability of screening, endoscopy and treatment in their well- or moderately-developed health services. The flexible sigmoidoscope permits a more complete examination of the distal colon with more acceptable patient tolerance than the rigid sigmoidoscope. Virtually all the screening studies using these types of sigmoidoscopes have demonstrated an increase in the proportion of early cases and survival compared with cases diagnosed in a routine environment. It is quite likely that the early recognition of the clinical importance of flat lesions detected in colonoscopy by the endoscopy practices in east Asian countries has also led to earlier detection of colorectal cancers there [17]. The survival experience of large bowel cancer patients in Hong Kong and the Republic of Korea are similar to that reported for white patients in the United States Surveillance Epidemiology and End Results (US-SEER) [9].

The 5-year survival rates of localized and regional large bowel cancer were 64% and 46%, respectively in Singapore and Izmir, Turkey, as compared to 50% and 32%, respectively in countries with less-developed health services such as Thailand, India and the Philippines (Figure 4a). It is interesting to note that the survival experience of localized colorectal cancer patients in countries with less-developed health services and that of patients with regional disease in countries such as Singapore and Turkey with well-developed health services were almost similar (Figure 4b). The higher survival in Singapore and Turkey seems to be a reflection of both earlier stages of clinical presentation and the capability of the health services to promptly respond with early diagnosis and comprehensive management. On the other hand, the wide difference in the outcome between localized and regional cancers (18 percentage points) indicates the potential for early detection to prevent more deaths from colorectal cancer (Figure 4a).

The vast majority of patients with liver cancer die within a year, although a small fraction of those with localized cancers can be potentially cured by surgical resection. However, screening for liver cancer with ultrasonography and/or alpha fetoprotein (AFP) estimation does not reduce liver cancer mortality [18,19]. A vast majority of liver cancers are caused by chronic infection with Hepatitis B (HBV) or C (HCV) viruses, ingestion of foods contaminated with aflatoxins and alcohol consumption. Controlling these risk factors has a major impact on liver cancer prevention. A 69% reduction in the incidence of liver cancer among the vaccinated cohort has been recently demonstrated after the introduction of HBV vaccination in the national immunization programme of Taiwan [20].

Cancer of the pancreas is rarely curable, although complete surgical excision in patients with localized disease and small cancers (<2 cm) with no lymph node metastases and no extension beyond the capsule of the pancreas can result in 5-year survival rates around 20%. It is quite likely that survival rates exceeding 15–20% for these poor-prognosis cancers in our series suffer from over-estimation due to under-ascertainment of death events in many patients who might have been misclassified as alive at the closing date.

Lung cancer (Table 3; Figures 1l and 2j)

The 5-year survival from lung cancer was less than 15% in most countries and populations in our study (Table 3). Surgery is the most potentially curative therapeutic option for most localized non-small cell lung cancers (NSCLC). Radiation therapy, combined with chemotherapy, can produce a cure in a small number of patients and can provide palliation in most patients. Regardless of clinical stage and improvements in diagnosis and therapy made during the past 25 years, treatment outcomes are not satisfactory for most patients with lung cancer. Although a small proportion of NSCLC patients with surgically resectable disease may be cured, the majority of patients with lung cancer die of their tumour even with the best available therapy.

Small-cell lung cancer (SCLC) accounts for approximately 15–20% of lung cancers; without treatment, SCLC has the most aggressive clinical course of any type of lung cancer, with median survival less than 4 months. Although SCLC is more responsive to chemotherapy and radiotherapy, long-term survival and cure are difficult to achieve due to its tendency to disseminate early and widely. However, for patients with limited stage SCLC (confined to the hemithorax of origin), a median survival up to 24 months and 5-year survivals around 15–20% can be achieved [21]. Comparatively, a higher 5-year survival rates around 20% observed in Hong Kong and Republic of Korea may be a reflection of the wider accessibility to curative treatments in their health services, although some over-estimation cannot be ruled out.

The single most important risk factor for the development of lung cancer is tobacco smoking, as reflected by the fact that the risk for lung cancer is on an average tenfold higher than in lifetime non-smokers (defined as a person who has smoked <100 cigarettes in their lifetime). The risk increases with the quantity of cigarettes or smoking products (such

as bidis or cigars), duration of smoking, and starting age. Smoking cessation results in a decrease in precancerous lesions and a reduction in the risk of developing lung cancer. However, former smokers continue to have an elevated risk for lung cancer for years after quitting.

Screening does not reduce mortality from lung cancer and would lead to false-positive tests and unnecessary invasive diagnostic procedures and treatments. Given the poor prospects for screening, early diagnosis and treatment to cure lung cancers, tobacco control offers the most cost-effective way of controlling it. Significant reductions in lung cancer mortality in developed countries such as the US, UK and Nordic countries have been due to their success in reducing consumption of tobacco by a variety of tobacco control measures including education, ban on tobacco advertisements, legislation, taxation and pricing. The incidence of and mortality from lung cancer is showing an increasing trend in many low- and medium-resourced countries due to failure to control tobacco use, and this trend should be reversed. Every effort should be taken to keep lung cancer incidence rates as low as possible in developing countries.

Breast cancer (Tables 3, 4f; Figures 1n, 2k, 5a–5b)

Five year survival rates exceeded 75% in Hong Kong SAR, Shanghai and Tianjin in mainland China, Singapore, the Republic of Korea, and Izmir in Turkey, indicating better care in terms of early diagnosis as well as availability and accessibility to surgery, radiotherapy and systemic hormone and chemotherapeutic treatments (Table 3). The survival experience in Hong Kong was similar to that reported for US-SEER White patients [9] and that of Singapore and the Republic of Korea are similar to figures reported from Europe [2]. There is considerable diagnostic mammography and ultrasonography activity in the health services in the Republic of Korea, Hong Kong, Singapore and Turkey, which would have led to much earlier detection of breast cancers in these health services. Screening mammography in women aged 40 to 70 years decreases breast cancer mortality, although to a higher extent in women aged 50–70 years [22]. The value of mass screening programmes using clinical and breast self-examination remain unclear.

Survival ranged between 65% and 70% in Costa Rica, Cuba, Saudi Arabia and in some regions of Thailand. The lowest survival, around 13%, was reported from The Gambia, which has no cancer-directed treatment available in the health services. The five-year survival observed in the capital cities of Uganda (46%) and Zimbabwe (58%), even with the limited cancer surgery, radiotherapy and chemotherapy available there, indicates the good prognosis from breast cancer that can be achieved with basic local (primary tumour directed) and systemic treatment. Survival rates ranged between 31% and 54% in different regions of India and 57% and 65% in Thailand (Table 3).

The 5-year survival for localized breast cancer was 90% in the more-developed health services of Singapore and Turkey, whereas it was 76% in the less-developed health services in Thailand, India and Costa Rica, among other countries (Figure 5a). However there was a wide difference (29 percentage points) between the survival outcomes for regional disease (indicating larger tumours or local spread to skin or chest wall or lymph nodes) between the two health care settings. In fact, the survival experience of patients with regional disease in Singapore and Turkey are similar to that of localized breast cancer patients in India and Thailand among other countries, and the two survival curves superimpose on each other (Figure 5b). Although some misclassification between localized and regional disease cannot be ruled out, inter-country differences in the availability and accessibility to early detection and appropriate treatment are predominantly responsible for this observation.

Breast cancer incidence rates are increasing steadily in all low- and medium-resource countries, and it is the most common cancer among women in many countries. The cause of breast cancer is not known, although risk factors such as family history of breast or ovarian cancer (particularly first-degree relatives on either the mother's or father's side); early age at menarche and late age at first childbirth, menopausal hormone use, obesity, and alcohol intake have been identified to increase the risk. Early detection and appropriate treatment are the currently available methods of preventing breast cancer deaths. The prognostic factors affecting survival outcome include the clinical stage of disease, menopausal status of the patient, histology and grade of the tumour, oestrogen (ER) and progesterone receptor (PR) status, and human epidermal growth factor receptor (HER2/neu) gene amplification status, all of which influence the choice of treatments.

Patients with breast cancer require a multimodal approach to curative treatment. Surgery is central to its management, and surgical options for breast cancer include breast-conserving surgery plus radiation therapy or mastectomy plus reconstruction or mastectomy alone. The axillary lymph nodes should be explored and histologically studied to aid in determining treatment and prognosis. Axillary node dissection, in the presence of clinically negative nodes, is a necessary staging procedure; controversy

exists as to the extent of the procedure because of long-term morbidity (e.g., arm discomfort and swelling) associated with it. Lymphatic mapping and sentinel lymph node biopsy may be used in women with invasive breast cancer to decrease the morbidity of axillary lymphadenectomy while maintaining accurate staging. Radiation therapy is regularly employed after breast-conservation surgery. Adjuvant radiotherapy for post-mastectomy patients may be used to eradicate residual disease, thus reducing local recurrence. Approximately 5 years of adjuvant hormone therapy with tamoxifen is indicated in patients with ER positive cancers, and reduces the annual breast cancer death rate by 31%, irrespective of the use of chemotherapy and of age, progesterone receptor status, or other characteristics [23]. Ovarian ablation is another useful and feasible adjuvant systemic treatment option in premenopausal women. Adjuvant combination chemotherapy reduces annual risk of relapse and death by 37% and 30%, respectively, which translates into a 10% absolute improvement in 15-year survival (hazard ratio = 42% vs. 32%) in women under 50 years; for women over of 50 years, these values were 19%, 12% and 3%, respectively [23]. The 15-year cumulative reduction in mortality from 6 months of an anthracycline-based regimen (e.g. fluorouracil, doxorubicin, cyclophosphamide [FAC] or fluorouracil, epirubicin, cyclophosphamide [FEC]) was 38% in women younger than 50 years, and 20% in those aged 50 to 60 years.

The wide variation in breast cancer survival (from 13% to 90%) in our study indicates the vast potential for improving survival outcomes by ensuring early detection, resulting in the diagnosis of very small tumours (<2 cms) without axillary node metastasis, adequate staging and combined modality treatment and follow-up care. We believe that the higher survival rates in countries with well-developed health services are direct consequences of the above factors. Investing in improving breast awareness as well as the infrastructure and efficiency of health services is vital to achieve such cure rates as high as 90% 5-year survival.

Genital tract cancers in women (Tables 3, 4g-4h; Figures 1o-1p, 2l, 2m and 6a–7b)

Five-year survival rates exceeded 75% for cervical cancer in Hong Kong and the Republic of Korea, and 65% in Singapore. On the other hand, survival was less than 25% in The Gambia and Uganda (Table 3). The prognosis for patients with cervical cancer depends on the clinical extent of disease at the time of diagnosis. Early stage (stage I) cervical cancers may be treated by radical surgery or radical radiotherapy combining external beam therapy and intracavitary radiation. Surgery and radiation therapy are equally effective for early-stage small-volume disease, whereas locally advanced disease (stages II and III) are treated by a concurrent combination of radiotherapy and chemotherapy with cisplatinum containing combinations. Although clinical trials demonstrate significant survival benefit and reduced risk of death from cervical cancer for the concurrent chemoradiation therapy in regional disease, radiotherapy alone is still used for treating locally advanced regional disease due to the cost and limited availability of chemotherapeutic agents in many low-resource countries.

The 5-year survival for localized cervix cancer patients in our study was 70% in countries with well-developed health services and 73% in those less-developed services (Figure 6a). The lack of variation in the survival outcome of localized cervix cancer patients and the minimal difference in the outcome for locally advanced regional disease in these two groups of countries is interesting (Figure 6b). This probably indicates that facilities for cervical cancer treatment were not found wanting in these countries. Cervical cancer screening with Pap smear is widespread in Hong Kong, Singapore, the Republic of Korea and Costa Rica. Cervical cancer cases in these countries are more likely to be diagnosed in those who did not participate in screening and such cases may have a poor prognosis.

Cervical cancers are caused by persistent infection with one of the oncogenic human papilloma virus (HPV) types, and HPV vaccination is an emerging prevention option. While Pap smear screening has already reduced cervical cancer mortality in developed countries, new screening approaches such as HPV testing seem to be a more effective way of preventing cervical cancer [24,25] particularly in low-resource settings, with the eventual availability of affordable and rapid HPV tests [26] and when HPV vaccination becoming widespread, thereby reducing the prevalence of cervical precancerous lesions. In countries where HPV testing is not feasible due to costs and infrastructure, visual screening may provide an alternative screening option [27], but the subjective nature of the test, variations in test positivity and sensitivity, quality assurance and low specificity may pose challenges to obtaining optimum cost-effectiveness in routine health care settings. The commercial availability of affordable HPV tests such as the careHPV test [26] may make HPV testing feasible as a primary screening approach for cervical cancer in low- and medium-resource settings.

Five-year survival of ovarian cancer patients was less than 30% in India and Uganda and was above 60% in Hong Kong, Singapore and the Republic of Korea with well-developed health services (Table 3). The case

mix between epithelial, germ cell and borderline ovarian malignancies, as well as the diagnostic practices, should be taken into account when interpreting overall survival from ovarian cancer. There was 20 percentage points difference in the 5-year survival outcome for localized ovarian cancer between countries with well developed health services and others with less developed services (Figure 7a). On the other hand, there were no major survival differences between these countries for locally advanced regional disease (Figure 7b).

Most patients with ovarian cancer have widespread disease at presentation due to early spread of tumour and symptoms such as abdominal pain and swelling, gastrointestinal symptoms, and pelvic pain often going unrecognized, leading to diagnostic delays. The most favourable prognostic factors for epithelial ovarian cancer include early stage (stage I), young age, cell types other than mucinous and clear cell, well-differentiated tumour, smaller disease volume prior to surgical debulking, absence of ascites and smaller disease volume following cytoreductive surgery.

Stages IA and IB ovarian cancer patients are treated with total abdominal hysterectomy and bilateral salpingo-oophorectomy with omentectomy. However, those with high-grade or adherent stage I or IC tumours will require systemic chemotherapy based on platinum compounds or in combination with alkylating agents. Patients with locally advanced ovarian cancer are treated with debulking cytoreductive surgery and platinum containing chemotherapy regimes. Surgery should include total abdominal hysterectomy and bilateral salpingo-oophorectomy with omentectomy and debulking of as much gross tumour as can be safely performed.

Germ cell tumours of the ovary are diagnosed most often in young women or adolescent girls. They are mostly unilateral and are highly curable if found and treated early. Use of combination chemotherapy after initial surgery has dramatically improved the prognosis for most ovarian germ cell tumours.

Urinary tract cancers (Table 3, Figures 1r, 2o and 8a–8b)

The 5-year survival exceeded 55% for kidney cancer in Hong Kong, Singapore, the Republic of Korea, and urban mainland China while it was less than 40% in India, Thailand and rural China (Qidong) which might be related to the ability of the health services to provide prompt diagnostic and surgical services (Table 3). This is again reflected by survival rates exceeding 70% observed for bladder cancer in Hong Kong, Singapore, the Republic of Korea, and urban mainland China as compared to less than 50% survival in other countries (Table 3). There was a 17 percentage point difference in the 5-year survival rate of localized bladder cancer and a 10 percentage point difference for regional disease between countries with highly developed and less developed health services (Figure 8a). Radical surgery is the mainstay of curative treatment for both kidney and bladder cancers. Five-year survival exceeded 85% for testicular cancer in Hong Kong, Singapore and the Republic of Korea (Table 3). Testicular cancers are treated by both surgery and chemotherapy, and the sustained availability of such services ensure high cure rates. The survival outcome for testicular cancer in countries such as India, Thailand and mainland China are highly encouraging and reflect the good prognosis for testicular cancer using currently available treatment options.

Lymphomas (Table 3; Figures 1t, 1u, 2p-2q and 9a–10b)

The 5-year survival rate exceeded 75% for Hodgkin lymphoma (HL) in Hong Kong, urban mainland China, Singapore and Republic of Korea, whereas it ranged between 37% and 58% in Cuba, India and half of the regions in Thailand (Table 3). HL is predominantly treated with radiotherapy (in early stages: non-bulky IA or IIA disease) and/or combination chemotherapy (in advanced stages: stages III and IV, bulky disease, presence of B-symptoms). These high survival figures reinforce the fact that more than 75% of all newly diagnosed patients with adult HL can be cured with combination chemotherapy and/or radiation therapy. The prognosis depends upon the stage of disease, presence or absence of symptoms, presence or absence of large masses, absolute sites of nodal involvement, extent of abdominal involvement and the quality of treatment.

There are 27-29 percentage points difference in the 5-year survival of HL between countries categorized as "High" with well-developed and as "Low" with less-developed health services (Figure 9a). On the other hand, the survival difference between countries classified as "Intermediate" with moderately-developed health services in India, mainland China, Thailand, and Cuba and less-developed services in sub-Saharan Africa are minimal, possibly indicating that sub-optimal treatments may have similar outcomes given the generally good prognosis for HL (Figure 9b).

The non-Hodgkin lymphomas (NHL) are characterized by a heterogeneous group of lymphoproliferative malignancies with variable clinical behaviour and responses to treatment. The clinical course of NHL is much less predictable than HL, and has high tendency

to disseminate to extra nodal sites. The prognosis depends on the histologic type, stage, and treatment. The 5-year survival for NHL is much lower than for HL. The overall survival from NHL depends upon the case mix between indolent and aggressive NHL. Indolent NHL types have a relatively good prognosis, with a median survival as long as 10 years. Early-stage (stages I and II) indolent NHL can be effectively treated with radiation therapy alone, but NHL is usually not curable in advanced clinical stages. The aggressive type of NHL has a shorter natural history, but a significant number of these patients can be cured with intensive combination chemotherapy regimens. Aggressive lymphomas are common in HIV-positive patients, and treatment of these patients requires special consideration. Thus NHL assumes a special significance in regions with high prevalence of HIV infection such as sub-Saharan Africa. In general, with modern treatment of patients with NHL, overall survival at 5-years is approximately 50% to 60%. The survival for NHL ranges between 49% to 65% in Hong Kong, Singapore and the Republic of Korea, is lower than 50% in other Asian countries and less than 25% in the Gambia, Uganda and Zimbabwe (Table 3). The differences in outcome for NHL between these countries are striking (Figures 10a-b), and are possibly explained by the capacity of the health services to provide diagnosis, histological typing, accurate staging and appropriate treatment.

Conclusion

In summary, our results imply that the levels of development of health services and their efficiency in providing early diagnosis, treatment and clinical follow-up care have a profound impact on survival from cancer. Survival outcomes were higher in countries with highly-developed health services than in countries with less-developed services. The critical concentration of trained human resources for cancer control is definitely higher in developed health care services.

The large variation in survival observed within populations in different regions of China, India and Thailand reflects the varying levels of development of cancer health services and the availability of trained personnel within these countries, particularly in urban vs. rural areas. All three regions in the Republic of Korea showed no major differences in survival for any cancer, possibly reflecting equitably developed and accessible health care services across the country. The poor survival rates observed in The Gambia, Uganda and Zimbabwe emphasize the importance and urgent need for direct vertical investments to improve health services and to generate sufficient trained human resources by national governments of sub-Saharan African and other developing countries. It is quite likely that the survival rates in many low- and medium-resourced countries that were not included in this study, particularly those from sub-Saharan Africa, would be lower than those reported in our study.

This study would not have been possible without the availability of reliable population-based cancer registries. It is important to organize such information systems in the regions/countries that lack them. However, the registries must collect more reliable information on clinical stages, particularly in terms of composite clinical stages and Tumour, Node, Metastasis (TNM) categories according to internationally-accepted stage classifications and summary treatment data to explain the observed survival patterns and differences between different populations in a convincing manner. The staging information in terms of composite stages and/or TNM categories should be collected at least for treatable forms of cancers such as oral cavity, larynx, breast, cervix, ovary, lymphomas and childhood cancers. Treatment information in terms of proportions of patients completing prescribed treatment will be an important measure of health service efficiency and will be useful to describe observed survival variations.

Striking differences in cancer survival between countries reflect the large inequality in accessible and available cancer health services for populations across the world, and such inequality is clearly unacceptable. Health services need to be upgraded for cancers where there exist marked differences in survival for localized cancer between well-developed and less-developed countries. Urgent and adequate investment by countries in comprehensive cancer control, including improving public and professional awareness, early detection, prompt treatment using locally feasible yet effective regimens, health services infrastructure, human resources development and referral pathways, will reduce such inequality and ensure improved and equitable accessibility to health services. The current data can serve as a baseline to evaluate improvements in cancer control and cancer health services in the future.

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Table 1. An overview of follow-up methods practised by the registries and countries

Follow-up of incident cancer cases carried out by			
Active method only	**Predominantly active method**	**Predominantly passive method**	**Passive method only**
The Gambia	**China**	**China**	**China**
India	Qidong	Shanghai	Hong Kong SAR
Barshi	**Philippines**	Tianjin	**Singapore**
Bhopal	Manila	**Costa Rica**	
Chennai	Rizal	**Cuba**	
Karunagappally	**Thailand**	**Saudi Arabia**	
Mumbai	Khon Kaen	Riyadh	
Pakistan		**Republic of Korea**	
South Karachi		Busan	
Thailand		Incheon	
Chiang Mai		Seoul	
Songkhla		**Thailand**	
Turkey		Lampang	
Izmir			
Uganda			
Kampala			
Zimbabwe			
Harare			

Table 2. Major cancer sites/types by number of registries and countries reported

Major cancer site/type	ICD-10 code	Number of registries	Number of countries
Tongue	C01-02	18	7
Oral cavity	C03-06	19	7
Tonsil	C09-10	14	7
Nasopharynx	C11	14	6
Hypopharynx	C12-13	15	5
Oesophagus	C15	18	7
Stomach	C16	19	8
Colon	C18	19	10
Rectum	C19-20	22	11
Liver	C22	15	7
Gall bladder	C23-24	11	4
Pancreas	C25	14	5
Nose/Sinuses	C30-31	11	4
Larynx	C32	20	8
Lung	C33-34	19	8
Bone	C40-41	11	4
Skin melanoma	C43	12	5
Skin others	C44	13	5
Mesothelioma	C45	5	3
Kaposi sarcoma	C46	2	2
Connective tissue	C47; C49	11	4
Breast	C50	26	13
Cervix uteri	C51	24	12
Corpus uteri	C54	11	4
Ovary	C56	19	8
Penis	C60	11	5
Prostate	C61	14	6
Testis	C62	9	5
Kidney/Renal pelvis	C64-66	12	5
Bladder	C67	19	8
Eye	C69	7	4
Brain & nervous	C70-72	12	5
Thyroid	C73	13	6
Adrenal/Other endocrine	C74	7	3
Hodgkin lymphoma	C81	16	8
Non-Hodgkin lymphoma	C82-85; C96	22	10
Multiple myeloma	C90	11	6
Lymphoid leukaemia	C91	16	6
Myeloid leukaemia	C92-94	17	6

Table 3. Comparison of 5-year age-standardized relative survival of major cancer sites/types between all registries

Cancer site/type	5-year age-standardized relative survival (0-74 years), %						
	China				Costa Rica	Cuba	The Gambia
	Hong Kong SAR	Qidong	Shanghai	Tianjin			
	1996–2001	1992–2000	1992–1995	1991–1999	1995–2000	1994–1995	1993–1997
Tongue	64.0		66.9	68.2		38.9	
Oral cavity	64.5	43.8	70.9	69.2		43.7	
Tonsil	47.8[$]		62.1	68.3		51.2	
Oropharynx						55.8	
Nasopharynx	74.0	36.4	57.6	57.6			
Hypopharynx	24.1		31.0	82.3			
Oesophagus	26.4	6.1	20.6	40.3			
Stomach	41.5	20.1	36.0	44.2			2.8
Colon	63.2	42.1	54.0	61.9		46.4	
Rectum	63.4[#]	34.5	51.0	58.1		50.7	
Liver	24.6	5.4	9.8	25.8			3.2
Gall bladder	29.7	17.5	21.0	50.3			
Pancreas	19.9	6.7	9.5	31.0			
Nose/Sinuses	70.2	22.3	52.4	61.6			
Larynx	73.4	48.7	67.2	69.7		58.1	
Lung	25.1	6.4	18.0	32.3			19.7
Bone	70.1	15.2	34.0	29.8			
Skin melanoma	61.7	26.6	61.7	62.8			
Skin others	100.1	37.3	85.9	86.7			
Mesothelioma	38.1			58.1			
Kaposi sarcoma							
Connective tissue	66.5	36.2	62.9	78.7			
Breast	89.6	58.3	79.4	85.6	69.6	70.4	12.5
Cervix uteri	79.5	47.9	63.5	70.5	53.5	56.3	21.8
Corpus uteri	85.1	62.2	86.9	91.3			
Ovary	67.3	35.1	47.9	64.4			
Penis	86.8		90.7	79.0			
Prostate	78.2	36.3	54.2	68.4			
Testis	92.1		81.7	76.4			
Kidney	70.5[@]	26.7	60.3	65.7			
Renal pelvis			71.2	93.9			
Ureter			73.0	77.9			
Bladder	81.2	47.3	74.5	81.1		68.8	
Eye	51.9		79.1	100.3			
Brain & nervous	48.7	11.1	51.1	49.5			
Thyroid	95.1	76.8	91.2	89.1			
Adrenal gland	71.2[+]		69.5	69.2			
Hodgkin lymphoma	87.4		77.6	81.9		57.5	
Non-Hodgkin lymphoma	64.7	13.4	45.6	53.2		50.3	25.5
Multiple myeloma	37.8	10.9	28.1	46.1			
Lymphoid leukaemia	59.1	5.4	30.4	64.9			
Myeloid leukaemia	42.3	6.0	30.0	68.0			
Unspecified leukaemia	36.8	7.1	14.6	22.0			

[$] includes oropharynx; [#] includes anus; [@] includes renal pelvis; [+] includes other endocrine

Table 3 (Continued).

Cancer site/type	5-year age-standardized relative survival (0-74 years), %									
	India					Pakistan	Philippines		Saudi Arabia	Singapore
	Barshi	Bhopal	Chennai	Karuna-gappally	Mumbai	South Karachi	Manila	Rizal	Riyadh	
	1993-00	1991-95	1990-99	1991-97	1992-99	1995-99	1994-95	1996-97	1994-96	1993-97
Tongue	11.8	13.1	23.4	29.6	29.7	39.3				44.3
Oral cavity	26.1	37.5	36.7	45.3	36.0	40.9				49.2
Tonsil			15.6		16.6	32.3				44.7
Oropharynx			20.7		20.4					
Nasopharynx					24.7					59.2
Hypopharynx	10.0	2.0	15.0	15.5	23.1					11.9
Oesophagus	5.3	3.6	8.6	18.5	16.2					12.1
Stomach	6.0	3.8	10.3	4.1	15.2					27.4
Colon		5.2			30.3		43.5			52.5
Rectum	14.7	6.5		32.6	31.1		30.6			52.1
Liver	0.0			4.5						6.5
Gall bladder										18.3
Pancreas			8.7	4.3	15.2					4.8
Nose/Sinuses										50.4
Larynx	15.7	15.7		28.3	36.0					65.7
Lung	5.3	1.0		7.8	13.4					9.3
Bone										38.5
Skin melanoma			38.0							44.5
Skin others	75.3		7.1	83.7						95.2
Mesothelioma										11.4
Kaposi sarcoma										
Soft tissue sarcoma										57.1
Breast	52.7	30.6	47.7	54.4	51.6		55.0	39.7	64.5	76.4
Cervix uteri	35.7	34.5	59.6	57.8	46.4		37.4			65.7
Corpus uteri										79.6
Ovary		18.9	28.5	27.8	22.9					62.4
Penis	64.1				53.3					74.8
Prostate				32.6	42.3					64.3
Testis					56.2					88.2
Kidney					35.2					55.0
Renal pelvis										43.9
Ureter										
Bladder		9.7	32.0	48.4	45.6					71.9
Eye										
Brain & nervous				16.2						29.6
Thyroid				90.0						91.2
Adrenal gland										32.1
Hodgkin lymphoma			37.8		52.2					75.4
Non-Hodgkin lymphoma	25.9	9.9	23.2	39.8	37.1					52.0
Multiple myeloma				13.4						26.0
Lymphoid leukaemia		12.6	16.4	45.6	15.5					42.9
Myeloid leukaemia	19.5	14.2	14.9	8.2	15.2					22.6
Unspecified leukaemia			11.2		7.1					12.9

Table 3 (Continued).

Cancer site/type	5-year age-standardized relative survival (0-74 years), %									
	Republic of Korea			Thailand				Turkey	Uganda	Zimbabwe
	Busan	Incheon	Seoul	Chiang Mai	Khon Kaen	Lampang	Songkhla	Izmir	Kampala	Harare[$]
	1996-01	1997-01	1993-97	1993-97	1993-97	1990-00	1990-99	1995-97	1993-97	1993-97
Tongue	52.8	52.0	59.6	24.3	32.4	33.2	31.4			
Oral cavity	48.4	54.4	51.6	22.0	41.9	37.2	35.3			
Tonsil	57.9	48.4	58.3	30.6		43.4	13.5			
Oropharynx	20.9		42.8							
Nasopharynx	53.2	53.6	47.1	41.5	34.6	39.9	47.4		0.0	
Hypopharynx	23.5	38.3	31.3	30.0		32.8	24.0			
Oesophagus	20.5	25.9	22.8	6.4		26.8	9.9		3.0	12.3
Stomach	46.5	50.0	49.2	12.1		20.4	8.8		0.0	22.8
Colon	57.0	57.4	65.7	32.5	44.3	39.4	52.8	52.2	8.2	28.6
Rectum	57.3	57.6	61.5	30.4	42.8	36.8	31.9	52.0	10.1	30.3
Liver	10.0	16.8	20.3	3.3		11.9	2.5		1.4	3.7
Gall bladder	21.8	25.3	30.3	6.4		18.5	14.4			
Pancreas	7.4	14.2	17.1	10.6		15.0	15.9			
Nose/Sinuses	39.3	63.4	50.9	30.8		50.7	25.9			
Larynx	58.9	61.6	75.6	28.0	26.5	49.1	44.6	71.4		29.7
Lung	13.7	20.6	19.7	4.8		12.1	8.6		0.0	11.4
Bone	39.7	46.9	39.8	8.5		19.9	27.5			
Skin melanoma	48.1	71.5	49.5	23.3		46.2	53.8			77.4
Skin others	89.4	85.4	92.6	59.2		85.4	76.6			
Mesothelioma	17.0		40.8							
Kaposi sarcoma									35.6	4.4
Connective tissue	40.8	55.6	55.7	44.6		52.6	32.0			
Breast	80.6	78.5	78.6	57.3	65.6	63.3	62.4	77.2	45.8	57.8
Cervix uteri	75.8	79.5	79.2	60.0	53.9	63.3	61.3	63.5	13.1	39.1
Corpus uteri	74.3	72.3	81.7	64.4		74.4	72.5			
Ovary	54.5	58.7	62.2	44.7	58.1	46.3	48.7	59.7	8.6	34.0
Penis	73.0		77.5	36.7		73.1	64.6			
Prostate	59.5	69.4	70.2	35.0		58.3	32.7		47.2	
Testis	72.2	98.3	93.9			61.1				
Kidney	64.1	67.9	70.3	23.1		29.0	37.0			
Renal pelvis	54.6	72.3	71.1			28.0				
Ureter	68.1	91.0	57.5							
Bladder	72.8	76.1	79.5	33.2	59.7	49.5	45.9	70.7		37.2
Eye	59.3		58.1						35.7	69.9
Brain & nervous	37.5	41.0	38.9	16.4		43.4	31.1			
Thyroid	93.0	92.6	94.4	65.4		73.1	86.9		10.8	
Adrenal gland	32.3[+]	78.4	31.6							
Hodgkin lymphoma	76.9	82.8	76.3	73.1	67.7	56.4	55.9	65.8		46.5
Non-Hodgkin lymphoma	49.0	57.4	58.0	28.1	39.3	44.3	47.7	50.6	25.1	26.0
Multiple myeloma	14.5	29.0	32.0				32.3	31.1		
Lymphoid leukaemia	32.7	40.3	38.5	15.4		44.1	36.5	50.1		
Myeloid leukaemia	27.5	36.0	26.3	10.9		35.0	15.4	34.2		
Unspecified leukaemia	6.1		16.8	11.0		12.9	17.0			

[$] *all races together; + includes other endocrine glands*

Table 4a. Frequency and 5-year absolute survival by clinical extent of disease for all registries: cancer of the tongue

Country/ registry	Period of registration	Frequency (%)				5-year absolute survival (%)			
		L	R	D	U	L	R	D	U
Cuba	1994–1995	35.5	39.8	2.2	22.5	46.7	27.3	20.0	16.8
India									
Bhopal	1991–1995	39.4	55.9	0.0	4.7	16.0	5.6	-	0.0
Chennai	1990–1999	4.4	86.8	2.6	6.2	59.2	17.3	15.4	14.7
Karunagappally	1991–1997	30.2	47.7	10.5	11.6	48.7	15.4	0.0	47.4
Mumbai	1992–1999	30.5	58.4	7.1	4.1	58.4	12.0	0.0	29.1
Pakistan									
South Karachi	1995–1999	37.8	50.6	0.6	11.0	57.4	11.7	0.0	47.6
Singapore	1993–1997	25.8	25.0	4.2	45.0	48.4	23.3	20.0	33.1
Thailand									
Lampang	1990–2000	23.6	68.4	4.0	4.0	32.6	36.2	0.0	33.3
Songkhla	1990–1999	19.9	30.6	7.1	42.3	40.0	27.9	26.0	26.0

L: localized; R: regional; D: distant metastasis; U: unknown

Table 4b. Frequency and 5-year absolute survival by clinical extent of disease for all registries: cancer of the oral cavity

Country/ registry	Period of registration	Frequency (%)				5-year absolute survival (%)			
		L	R	D	U	L	R	D	U
Cuba	1994–1995	44.2	34.6	0.4	20.8	52.6	22.2	0.0	24.4
India									
Bhopal	1991–1995	40.7	55.8	0.6	2.9	45.7	17.7	0.0	20.0
Chennai	1990–1999	3.5	88.7	2.7	5.0	54.9	30.0	10.0	30.9
Karunagappally	1991–1997	14.6	65.9	12.2	7.3	83.0	28.5	0.0	38.2
Mumbai	1992–1999	32.6	55.8	6.9	4.6	62.5	18.0	1.1	35.5
Pakistan									
South Karachi	1995–1999	36.3	53.0	0.5	10.2	58.3	18.6	-	18.3
Singapore	1993–1997	28.1	22.2	1.5	48.1	52.2	26.3	0.0	28.9
Thailand									
Lampang	1990–2000	21.2	66.1	4.2	8.5	35.6	30.7	0.0	40.0

L: localized; R: regional; D: distant metastasis; U: unknown

Table 4c. Frequency and 5-year absolute survival by clinical extent of disease for all registries: cancer of the larynx

Country/ registry	Period of registration	Frequency (%)				5-year absolute survival (%)			
		L	R	D	U	L	R	D	U
Cuba	1994–1995	51.3	23.0	1.3	24.5	65.5	34.5	10.0	22.2
India									
Chennai	1990–1999	6.6	85.5	3.6	4.3	44.3	30.3	-	34.1
Karunagappally	1991–1997	30.4	45.7	13.0	10.9	55.6	19.0	0.0	-
Mumbai	1992–1999	33.2	51.1	9.7	6.1	57.1	16.5	0.5	23.2
Singapore	1993–1997	35.7	12.2	2.3	49.8	63.6	28.6	14.3	41.8
Thailand									
Chiang Mai	1993–1997	11.8	82.4	3.8	2.0	52.4	21.4	16.7	0.0
Lampang	1990–2000	17.3	61.7	7.4	13.6	53.4	31.6	25.0	45.5
Songkhla	1990–1999	21.0	39.9	8.7	30.4	59.5	31.9	42.4	21.9
Turkey									
Izmir	1995–1997	32.1	23.0	7.5	37.4	74.8	45.1	47.6	65.8

L: localized; R: regional; D: distant metastasis; U: unknown

Table 4d. Frequency and 5-year absolute survival by clinical extent of disease for all registries: cancer of the colon

Country/ registry	Period of registration	Frequency (%)				5-year absolute survival (%)			
		L	R	D	U	L	R	D	U
Cuba	1994–1995	28.0	20.3	9.6	42.1	64.7	45.0	20.5	14.6
India									
Bhopal	1991–1995	37.5	27.1	18.8	16.7	11.1	7.7	0.0	0.0
Mumbai	1992–1999	38.7	26.7	25.9	8.7	51.8	19.1	1.6	27.5
Philippines									
Manila	1994–1995	33.8	33.1	17.9	15.2	68.9	34.3	0.0	29.2
Singapore	1993–1997	27.0	22.4	18.8	31.9	66.5	43.2	6.6	40.6
Thailand									
Chiang Mai	1993–1997	1.3	65.8	31.6	1.3	66.7	40.8	6.0	0.0
Lampang	1990–2000	8.4	44.2	33.7	13.7	60.0	56.8	2.1	37.5
Turkey									
Izmir	1995–1997	8.9	43.7	19.9	27.5	59.8	54.1	20.8	43.0

L: localized; R: regional; D: distant metastasis; U: unknown

Table 4e. Frequency and 5-year absolute survival by clinical extent of disease for all registries: cancer of the rectum

Country/ registry	Period of registration	Frequency (%)				5-year absolute survival (%)			
		L	R	D	U	L	R	D	U
Cuba	1994–1995	38.8	25.4	7.2	28.6	58.5	38.0	25.0	27.7
India									
Bhopal	1991–1995	41.0	33.3	15.4	10.3	12.5	7.7	0.0	0.0
Mumbai	1992–1999	46.2	26.0	20.3	7.5	46.5	19.8	1.6	32.4
Philippines									
Manila	1994–1995	34.0	27.2	15.5	23.3	56.0	26.4	-	23.1
Singapore	1993–1997	30.2	27.0	16.8	25.9	61.6	44.9	6.6	41.9
Thailand									
Chiang Mai	1993–1997	3.7	74.2	20.0	2.1	71.4	31.2	5.9	..
Lampang	1990–2000	9.2	59.8	17.7	13.3	42.3	41.8	4.5	48.5
Turkey									
Izmir	1995–1997	14.2	40.8	21.2	23.8	51.8	50.3	20.4	49.2

L: localized; R: regional; D: distant metastasis; U: unknown

Table 4f. Frequency and 5-year absolute survival by clinical extent of disease for all registries: cancer of the breast

Country/ registry	Period of registration	Frequency (%)				5-year absolute survival (%)			
		L	R	D	U	L	R	D	U
China									
Hong Kong SAR	1996–2001	12.2	34.6	1.5	51.7	94.9	79.1	31.8	82.7
Costa Rica	1995–2000	31.2	34.0	20.3	14.5	89.9	77.1	31.0	29.9
Cuba	1994–1995	43.5	33.3	4.9	18.3	81.6	58.9	30.2	43.3
India									
Bhopal	1991–1995	42.9	44.1	5.7	7.3	41.1	22.6	0.0	42.1
Chennai	1990–1999	1.7	67.9	13.0	17.5	70.8	48.9	12.3	46.6
Karunagappally	1991–1997	18.4	53.2	12.1	16.3	78.6	43.1	7.8	53.4
Mumbai	1992–1999	39.6	41.5	12.8	6.2	74.2	32.8	3.8	48.1
Philippines									
Manila	1994–1995	31.6	46.5	12.8	9.2	73.5	42.0	3.2	42.2
Rizal	1996–1997	17.5	43.7	9.9	28.9	65.3	35.0	11.9	34.8
Saudi Arabia									
Riyadh	1994–1996	30.9	32.6	20.8	15.7	70.4	55.7	56.7	62.3
Singapore	1993–1997	30.6	22.5	4.8	42.1	85.9	66.3	18.8	71.2
Thailand									
Chiang Mai	1993–1997	14.3	70.0	11.9	3.8	79.3	63.7	24.8	49.4
Khon Kaen	1993–1997	5.3	41.6	21.1	32.0	82.3	66.9	32.8	67.9
Lampang	1990–2000	22.5	52.9	14.2	10.4	84.1	65.2	8.2	82.5
Songkhla	1990–1999	17.1	34.7	14.4	33.8	82.8	66.2	27.0	59.6
Turkey									
Izmir	1995–1997	20.5	34.3	4.7	40.5	85.5	65.4	35.1	72.3

L: localized; R: regional; D: distant metastasis; U: unknown

Table 4g. Frequency and 5-year absolute survival by clinical extent of disease for all registries: cancer of the cervix

Country/ registry	Period of registration	Frequency (%)				5-year absolute survival (%)			
		L	R	D	U	L	R	D	U
Costa Rica	1995–2000	22.4	40.5	4.0	33.1	89.5	43.1	11.3	43.2
Cuba	1994–1995	41.3	34.3	1.7	22.7	73.9	41.5	33.3	45.0
India									
Bhopal	1991–1995	28.3	70.5	0.3	0.9	60.6	22.7	0.0	0.0
Chennai	1990–1999	6.4	86.0	3.7	3.9	69.1	55.3	12.4	43.4
Karunagappally	1991–1997	15.3	60.6	8.8	15.3	72.1	43.5	23.1	44.3
Mumbai	1992–1999	27.9	56.8	8.6	6.7	68.3	35.7	3.4	40.7
Philippines									
Manila	1994–1995	21.5	30.5	10.3	37.7	63.1	29.9	7.1	28.2
Singapore	1993–1997	45.5	5.7	5.0	43.8	69.7	48.0	20.4	55.7
Thailand									
Chiang Mai	1993–1997	26.1	69.7	3.7	0.5	81.2	52.7	12.2	75.0
Khon Kaen	1993–1997	17.3	53.8	6.3	22.6	65.1	48.7	30.6	57.0
Lampang	1990–2000	31.2	53.9	5.8	9.2	78.7	57.9	6.5	70.6
Songkhla	1990–1999	22.3	54.6	5.8	17.3	81.2	56.3	15.4	61.3
Turkey									
Izmir	1995–1997	41.8	41.8	6.1	23.2	67.7	54.6	9.3	69.1

L: localized; R: regional; D: distant metastasis; U: unknown

Table 4h. Frequency and 5-year absolute survival by clinical extent of disease for all registries: cancer of the ovary

Country/ registry	Period of registration	Frequency (%)				5-year absolute survival (%)			
		L	R	D	U	L	R	D	U
India									
Bhopal	1991–1995	66.7	8.7	13.0	11.6	21.7	33.3	0.0	12.5
Chennai	1990–1999	1.5	62.5	19.4	16.6	73.4	30.8	6.0	38.1
Karunagappally	1991–1997	17.1	11.4	54.3	17.1	100.0	0.0	8.8	44.4
Mumbai	1992–1999	28.6	11.4	49.9	10.1	59.7	27.5	3.0	26.4
Singapore	1993–1997	45.7	3.9	19.8	30.6	83.3	35.4	24.5	55.2
Thailand									
Chiang Mai	1993–1997	24.1	43.8	30.2	1.9	88.2	48.3	16.9	0.0
Khon Kaen	1993–1997	29.6	21.4	29.6	19.4	88.8	60.6	17.5	66.6
Lampang	1990–2000	22.8	34.7	30.1	12.4	86.2	56.6	0.0	75.0
Songkhla	1990–1999	24.3	28.9	12.7	34.1	92.1	30.0	19.8	43.0
Turkey									
Izmir	1995–1997	22.6	5.2	47.4	24.8	89.4	51.1	33.6	62.3

L: localized; R: regional; D: distant metastasis; U: unknown

Table 5. Classification of health services development based on a few indicators

Overall grading of health services development - Countries/ regions	GNI* (in USD)	Population* (millions)	Adult literacy[$] (%)	Diagnostic services		Treatment services			Population-based screening services	Palliative services
				Imaging	Pathology	Radiation (MeV)[a-c]	Surgery	Chemo		
A. Well developed	*9220-34 760*		*87-99*	*Extensively available and widely distributed*		*Extensively or adequately available and widely distributed*			*Routinely available*	*Adequate*
Hong Kong SAR	31 420	7.0	95	Extensively available; widely distributed		Adequately available; widely distributed *MeV: 9*	Extensively available; widely distributed	Adequately available; widely distributed	Exist	Adequate
Saudi Arabia	15 500	24.6	78	Adequate and widely distributed		Adequate and widely distributed *MeV: 27*			No	Adequate
Singapore	34 760	4.8	94	Extensively available; widely distributed *MeV: 10*					Exist	Adequate
Republic of Korea	21 530	48.6	99	Extensively available; widely distributed *MeV: 69*					Exist	Adequate
Turkey	9340	73.9	87	Extensively available; widely distributed		Adequately available; widely distributed	Extensively available; widely distributed	Adequately available; widely distributed	Exist	Adequate

** GNI: Gross National Income per capita 2008, Atlas method. World Development Indicators Database, World Bank, 7, 2009. http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20535285~menuPK:1192694~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html*

[$] World Health Statistics 2008 (WHO); UNDP Report 2009, Pg 171; MeV: Megavolt machines total

Source:

a Tatsuzaki and Levin (2001). Radiotherapy and Oncology; 60: 81–89

b Zubizarreta, Poitevin and Levin (2004). Radiotherapy and Oncology; 73: 97–100

c Levin, Gueddari and Meghzifene (1999). Radiotherapy and Oncology; 52: 79–84.

Table 5. Classification of health services development based on a few indicators (continued)

Overall grading of health services development - Countries/ regions	GNI* (in USD)	Population* (millions)	Adult literacy[$] (%)	Diagnostic services		Treatment services			Population-based screening services	Palliative services
				Imaging	Pathology	Radiation (MeV)[a-c]	Surgery	Chemo		
B. Moderately developed	*980-6060*		*50-99*	*Adequate in urban; inadequate in rural*		*Variably developed even between urban areas; inadequate in rural*			*Not routinely available*	*Variably developed*
China (Mainland)	2940	1325.6	91	Adequate in urban; inadequate in rural		Adequate in urban; inadequate in rural *MeV: 667*	Adequate	Adequate in urban; inadequate in rural	Available in selected metropolitan areas	Adequate in urban; inadequate in rural
Costa Rica	6060	4.5	95	Adequately available; widely distributed		Adequately available; *MeV: 6*	Adequately available;	Adequately available;		
Cuba	>3856	11.2	99	Adequate	Adequate	Adequate *MeV: 12*	Extensive	Adequate	Available	Adequate
India	1070	1140.0	61	Adequate in urban; inadequate in rural	Adequate in metropolitan areas; not in others	Adequate in metropolitan areas; not in others *MeV: 291*	Adequate in urban; inadequate in rural	Adequate in metropolitan areas; not in others	No	Adequate in urban; inadequate in rural
Pakistan	980	166.0	50	Adequate in urban; inadequate in rural *MeV: 34*					No	Adequate in urban; inadequate in rural
Philippines	1890	90.3	93	Adequate in urban; inadequate in rural *MeV: 17*					No	Adequate
Thailand	2840	67.4	93	Adequate in urban; inadequate in rural *MeV: 50*					Available	Adequate

** GNI: Gross National Income per capita 2008, Atlas method. World Development Indicators Database, World Bank, 7, 2009. http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20535285~menuPK:1192694~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html*

[$] World Health Statistics 2008 (WHO); UNDP Report 2009, Pg 171; MeV: Megavolt machines total

a Tatsuzaki and Levin (2001). Radiotherapy and Oncology; 60: 81–89; b Zubizarreta, Poitevin and Levin (2004). Radiotherapy and Oncology; 73: 97–100
c Levin, Gueddari and Meghzifene (1999). Radiotherapy and Oncology; 52: 79–84.

Table 5. Classification of health services development based on a few indicators

Overall grading of health services development - Countries/ regions	GNI* (in USD)	Population* (millions)	Adult literacy[$] (%)	Diagnostic services		Treatment services			Screening services	Palliative services
				Imaging	Pathology	Radiation (MeV)[a-c]	Surgery	Chemo		
C. Least developed	*390-975*		*69-89*	*Inadequately developed*		*Inadequately developed and not widely distributed*			*No*	*Inadequate*
The Gambia	390	1.7	n.a.	Inadequate and not widely distributed	Not available	Not available	Available in capital city	Not widely distributed	No	Inadequate
Uganda	420	31.7	67	Inadequate	Available in capital city	Available in capital city *MeV: 2*	Adequate in capital city	Inadequate	No	Inadequate
Zimbabwe	<975	12.5	89	Adequate in capital; inadequate in others	Adequate in capital; inadequate in others	Adequate in capital; inade-quate in others MeV: 5	Adequate in capital; inadequate in others	Adequate in capital; inadequate in others	No	Inadequate

** GNI: Gross National Income per capita 2008, Atlas method. World Development Indicators Database, World Bank, 7, 2009. http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20535285~menuPK:1192694~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html*

[$] World Health Statistics 2008 (WHO); UNDP Report 2009, Pg 171; MeV: Megavolt machines total

Source:

a Tatsuzaki and Levin (2001). Radiotherapy and Oncology; 60: 81–89

b Zubizarreta, Poitevin and Levin (2004). Radiotherapy and Oncology; 73: 97–100

c Levin, Gueddari and Meghzifene (1999). Radiotherapy and Oncology; 52: 79–84.

Figure 1. 5-year age-standardized relative survival (ASRS%; 0-74 years) by country and cancer site/type
(median {minimum-maximum} of values if more than one registry is contributing)

Figure 1a. Tongue

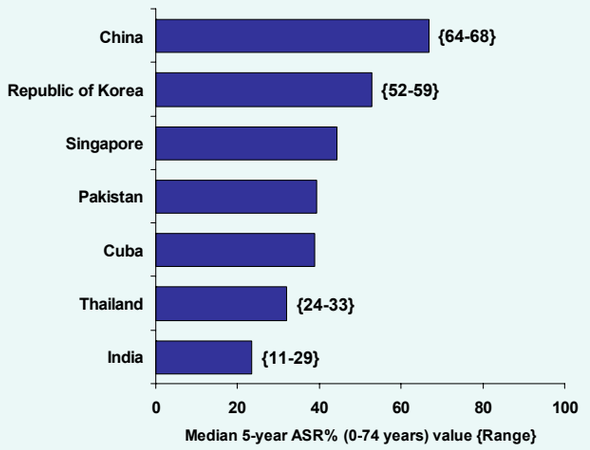


Figure 1b. Oral cavity

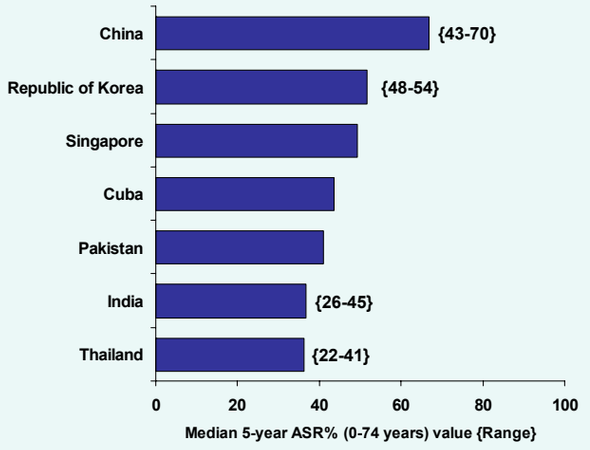


Figure 1c. Tonsil

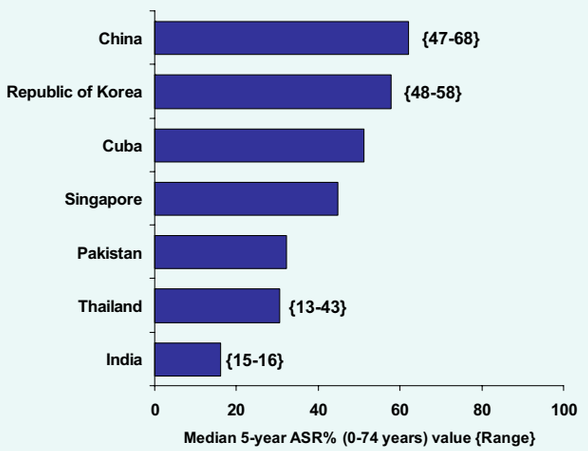


Figure 1d. Nasopharynx

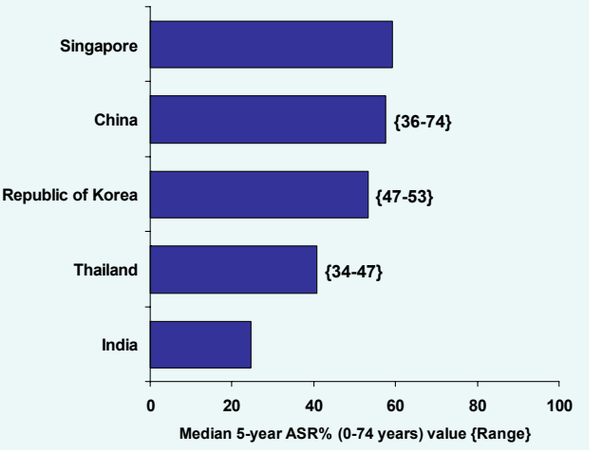


Figure 1e. Hypopharynx

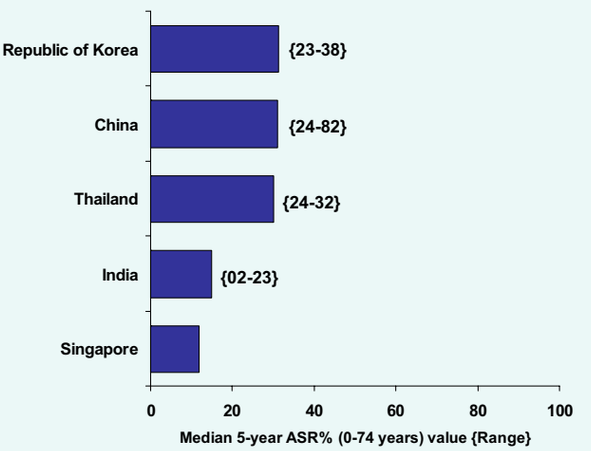


Figure 1f. Oesophagus

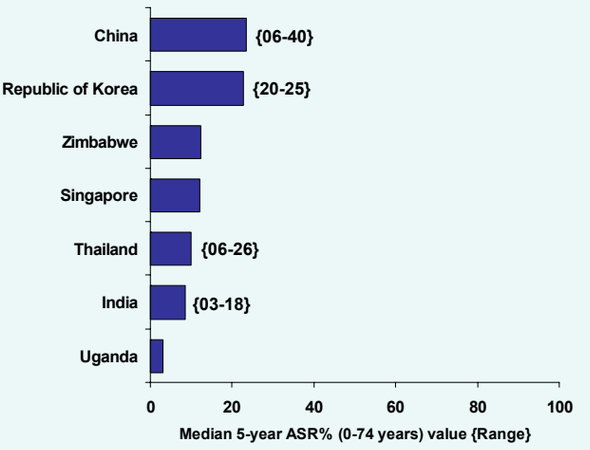


Figure 1 (Continued).

Figure 1g. Stomach

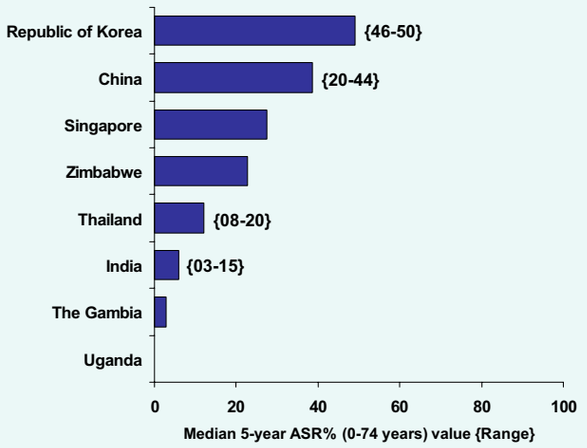


Figure 1j. Liver

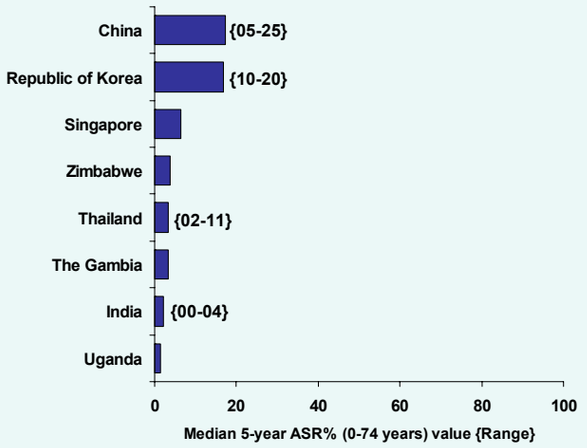


Figure 1h. Colon

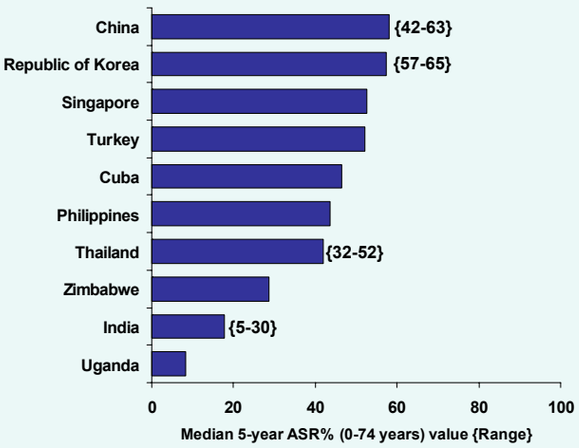


Figure 1k. Larynx

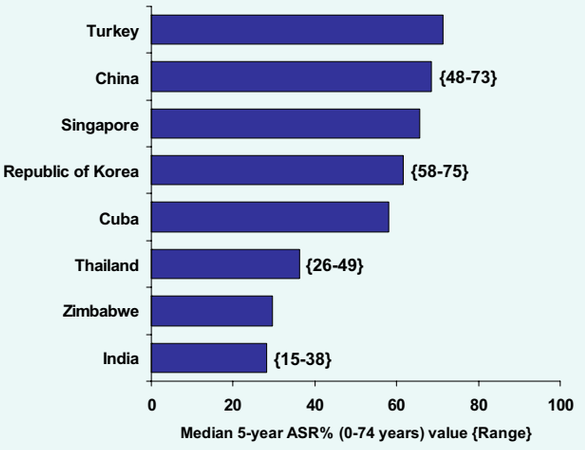


Figure 1i. Rectum

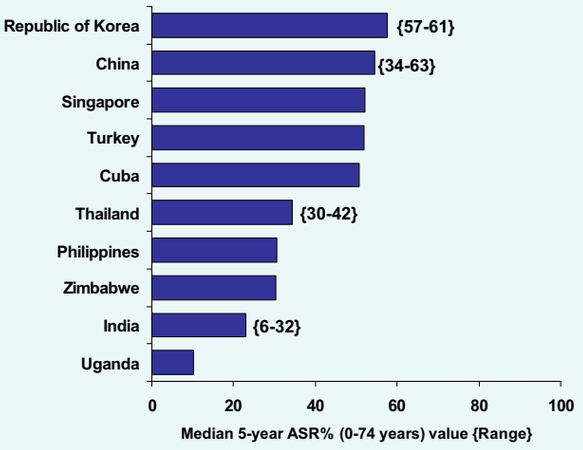


Figure 1l. Lung

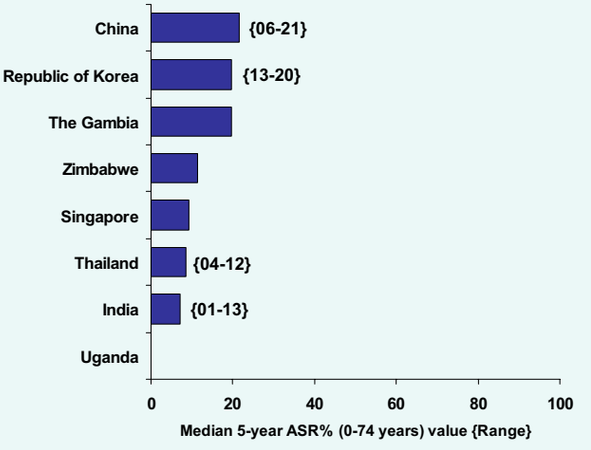


Figure 1 (Continued).

Figure 1m. Non-melanoma skin

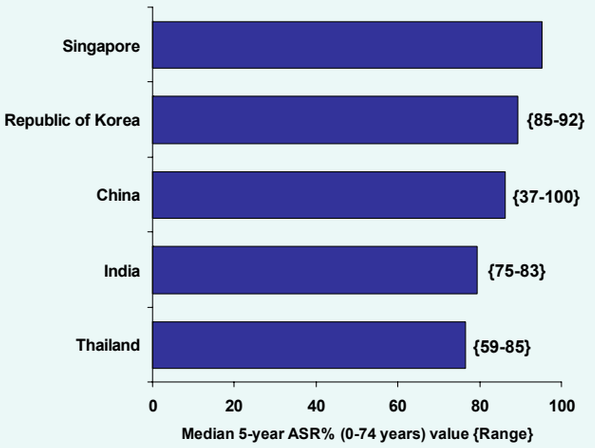


Figure 1p. Ovary

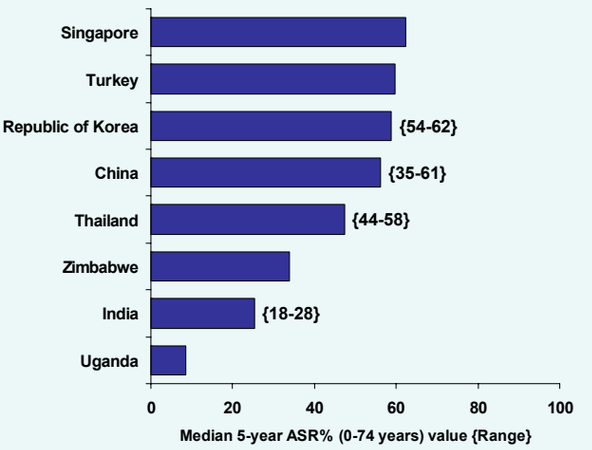


Figure 1n. Breast

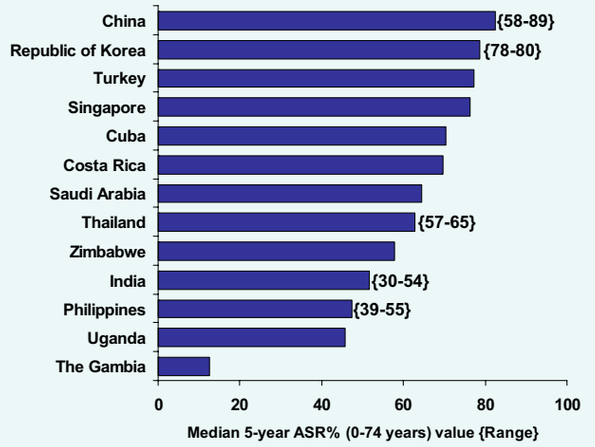


Figure 1q. Prostate

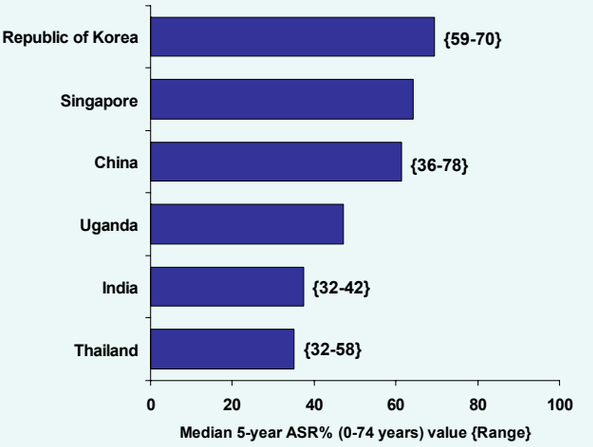


Figure 1o. Cervix

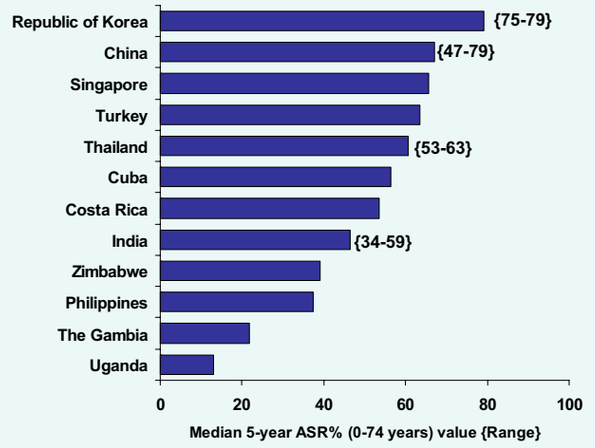


Figure 1r. Urinary bladder

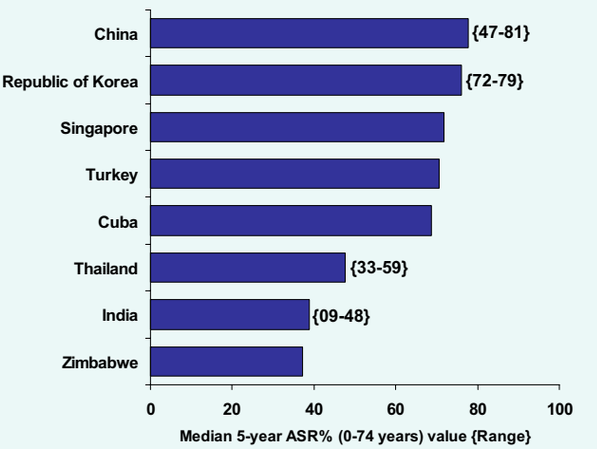


Figure 1 (Continued).

Figure 1s. Thyroid

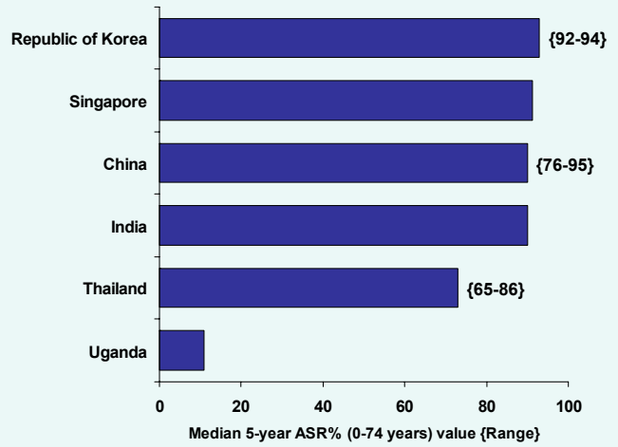


Figure 1v. Lymphoid leukaemia

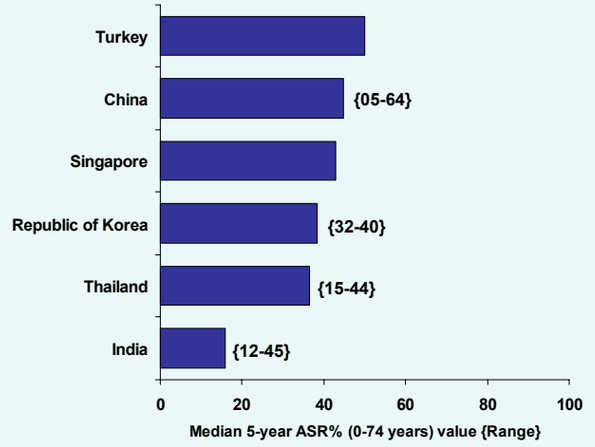


Figure 1t. Hodgkin lymphoma

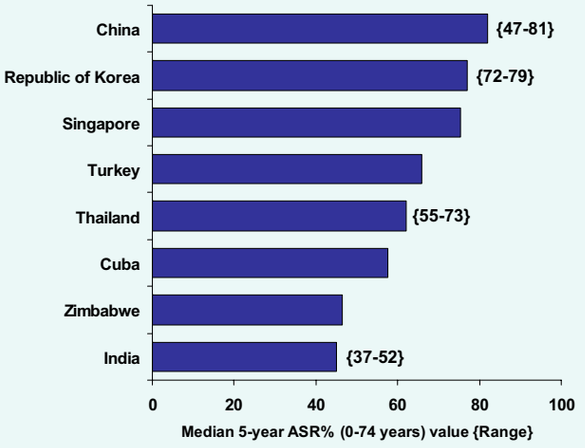


Figure 1w. Myeloid leukaemia

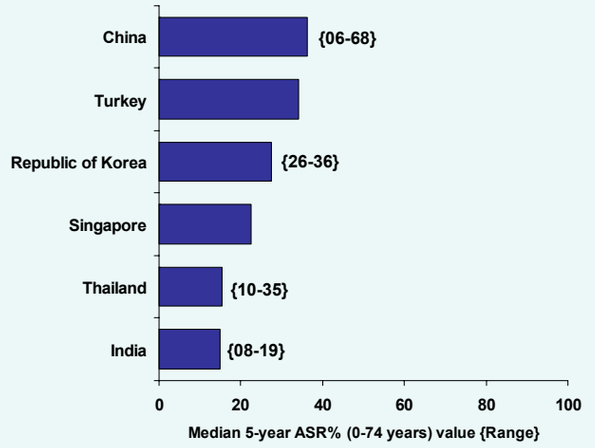


Figure 1u. Non-Hodgkin lymphoma

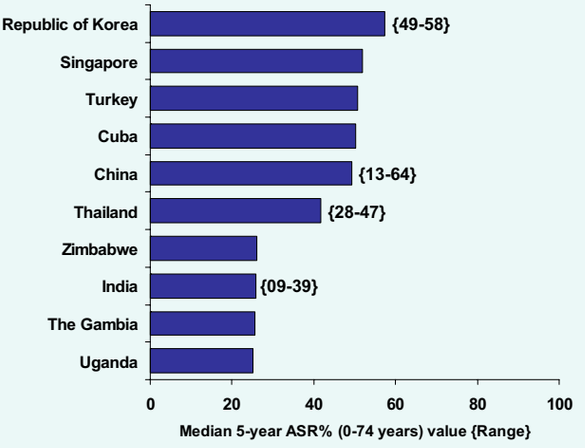


Figure 2. 5-year age-standardized relative survival (ASRS%; 0-74 years) of selected cancers by all registries (ranked on ASRS)

Figure 2a. Tongue (ICD-10: C01-C02)

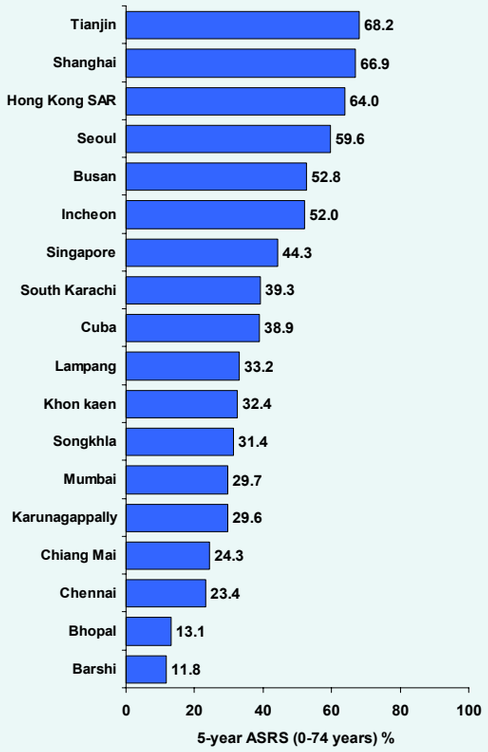


Figure 2b. Oral cavity (ICD-10: C03-06)

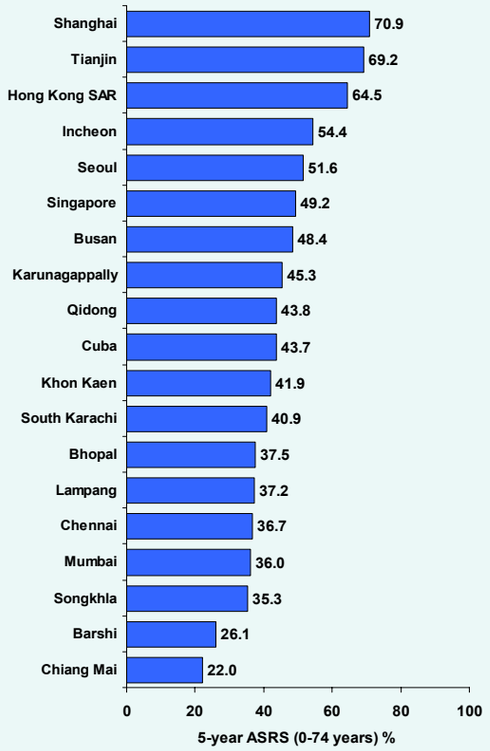


Figure 2c. Nasopharynx (ICD-10: C11)

Figure 2d. Hypopharynx (ICD-10: C12-13)

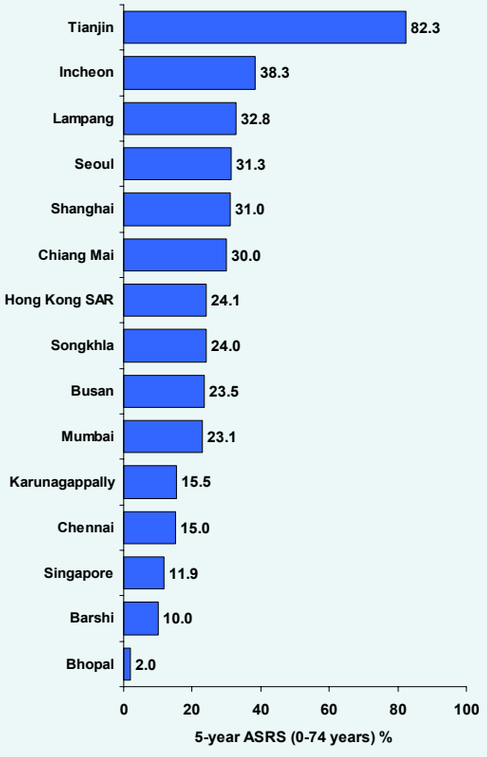


Figure 2 (Continued).

Figure 2e. Oesophagus (ICD-10: C15)

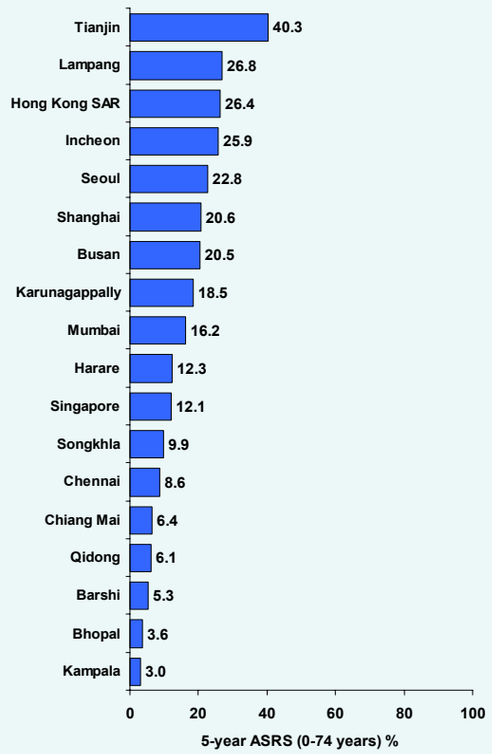


Figure 2g. Colon (ICD-10: C18)

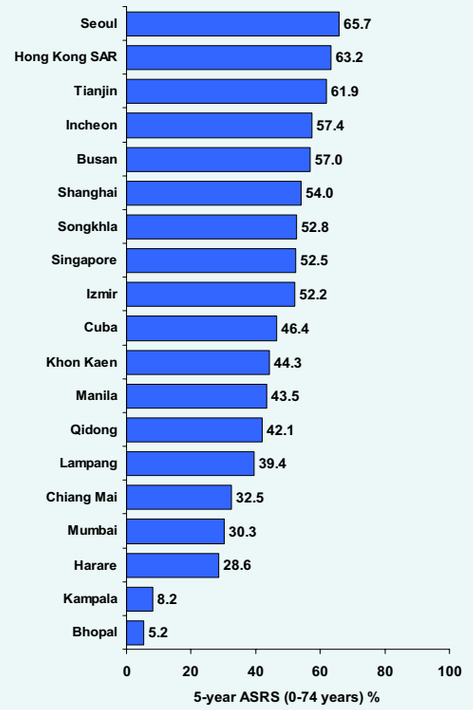


Figure 2f. Stomach (ICD-10: C16)

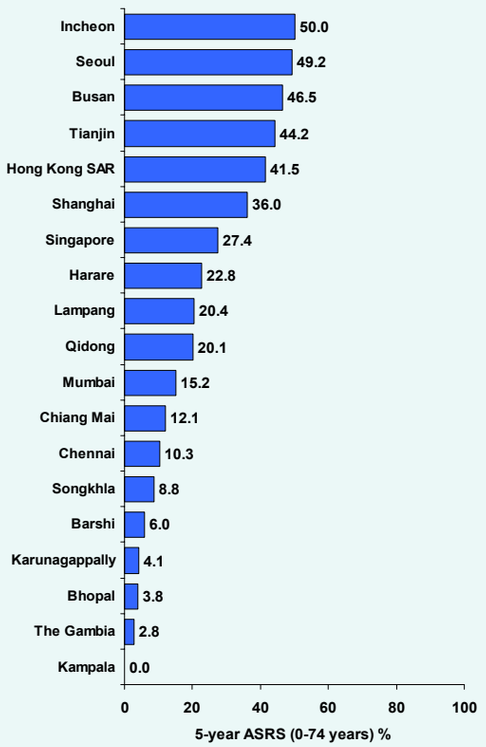


Figure 2h. Rectum (ICD-10: C19-20)

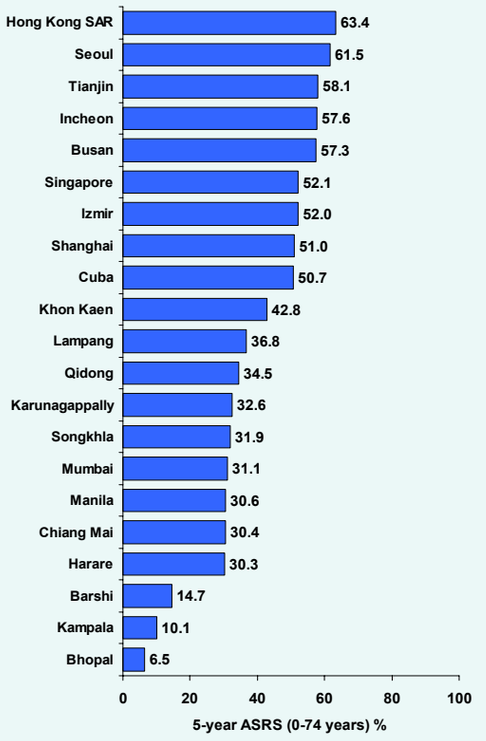


Figure 2 (Continued).

Figure 2i. Larynx (ICD-10: C32)

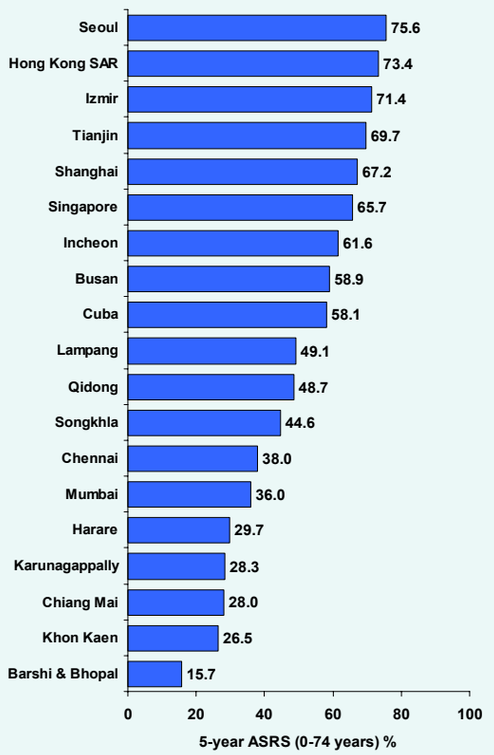


Figure 2k. Breast (ICD-10: C50)

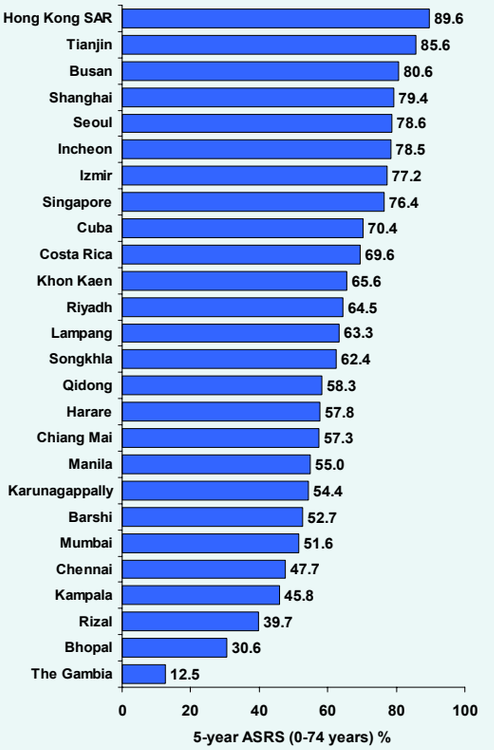


Figure 2j. Lung (ICD-10: C33-34)

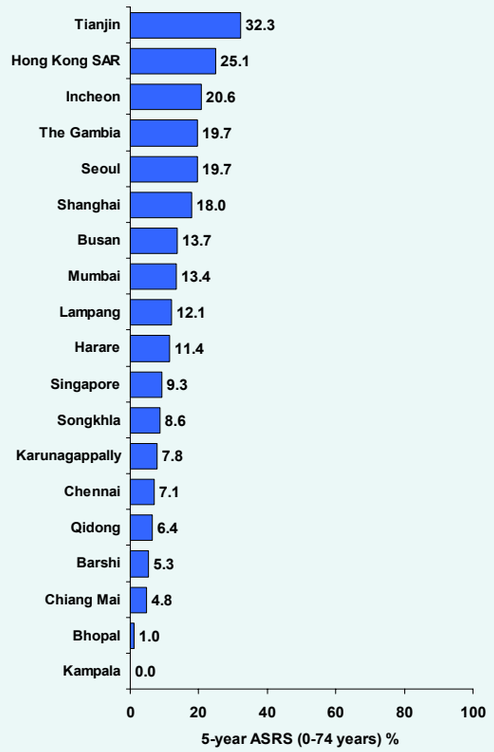


Figure 2l. Cervix uteri (ICD-10: C53)

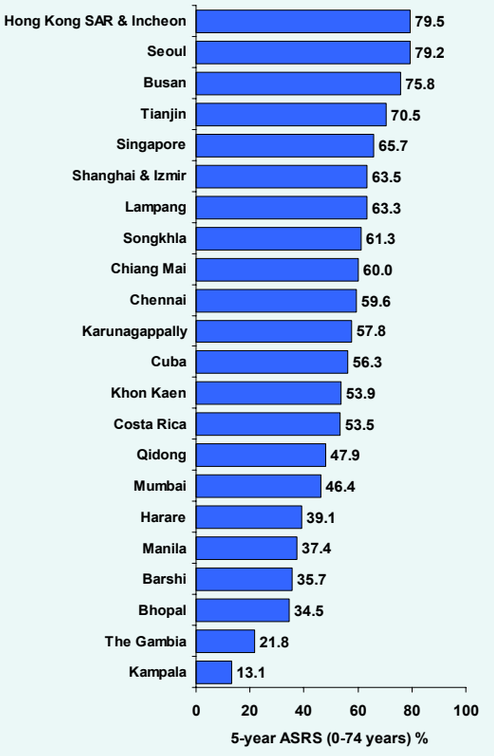


Figure 2 (Continued).

Figure 2m. Ovary (ICD-10: C56)

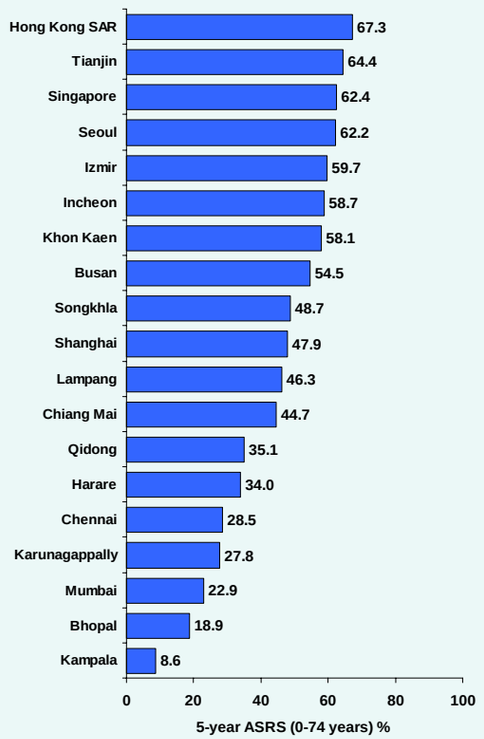


Figure 2o. Urinary bladder (ICD-10: C67)

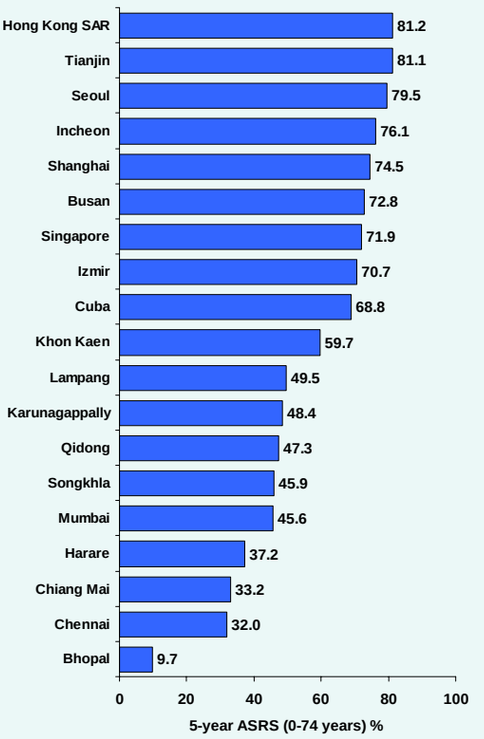


Figure 2n. Prostate (ICD-10: C61)

Figure 2p. Hodgkin lymphoma (ICD-10: C81)

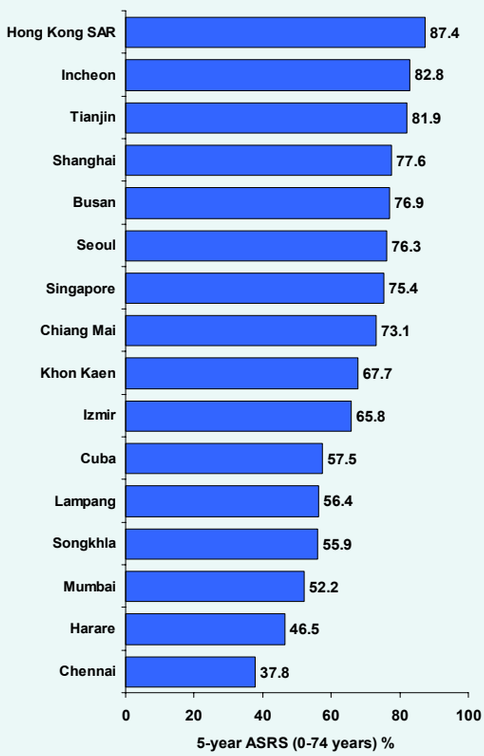


Figure 2 (Continued).

Figure 2q. Non-Hodgkin lymphoma (ICD-10: C82-85; C96)

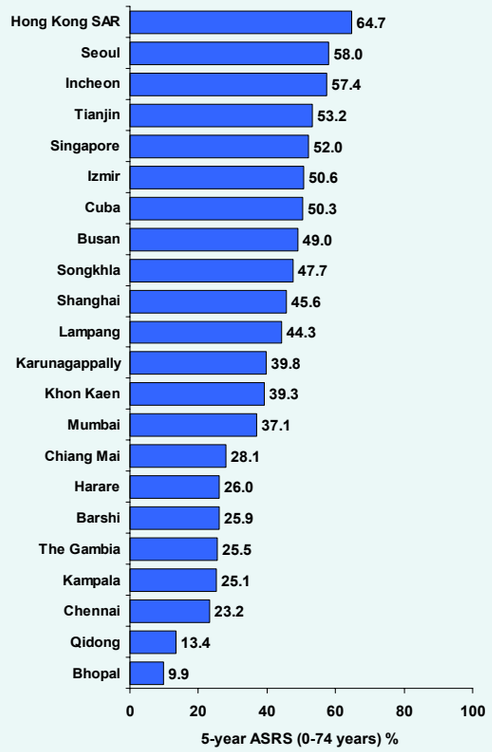


Figure 2s. Myeloid leukaemia (ICD-10: C92-94)

Figure 2r. Lymphoid leukaemia (ICD-10: C91)

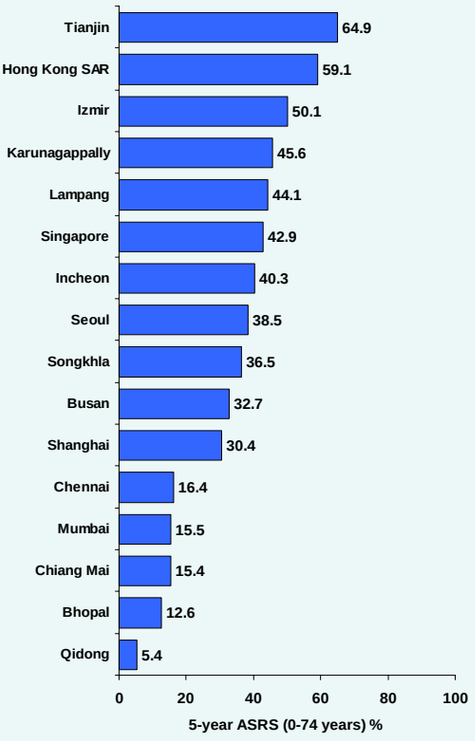


Figure 3. Localized and regional extent of disease among more and less developed health services, larynx cancer

Figure 3a. 5-year absolute survival

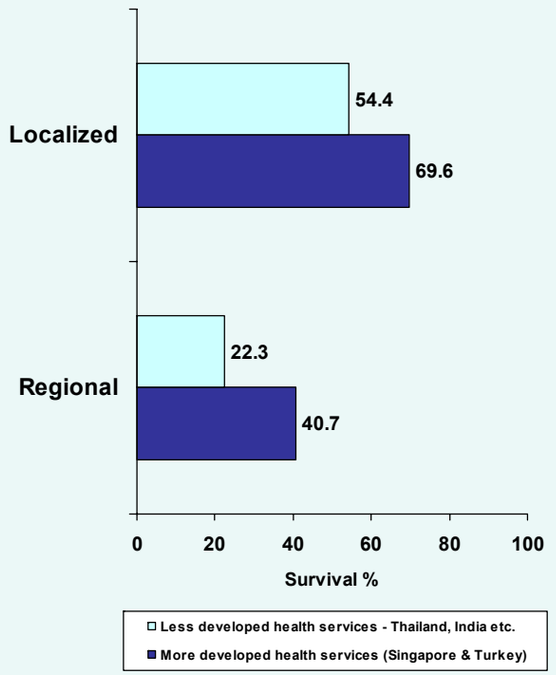
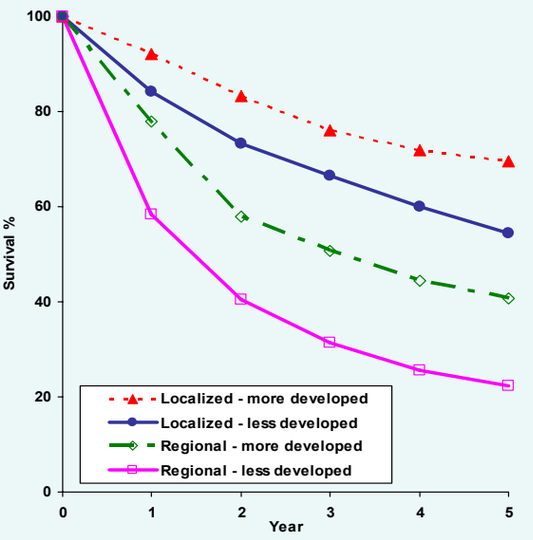


Figure 3b. Absolute survival



	More developed		Less developed	
	Localized	Regional	Localized	Regional
% cases	34.0	19.0	25.0	60.0

Figure 4. Localized and regional extent of disease among more and less developed health services, large bowel cancer

Figure 4a. 5-year absolute survival

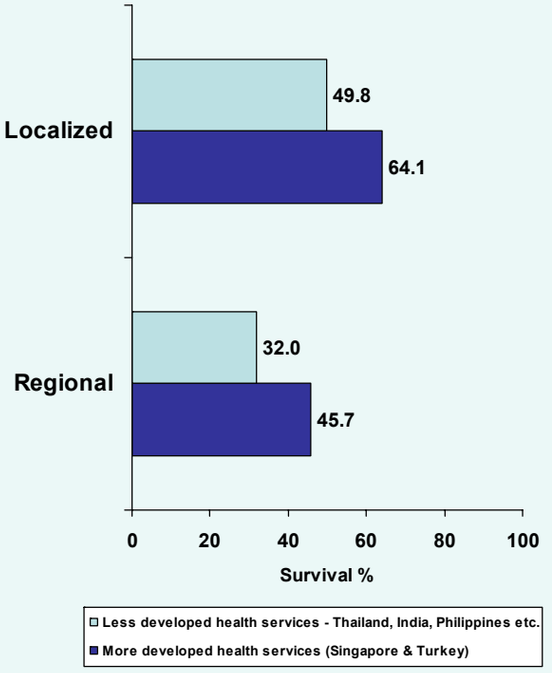
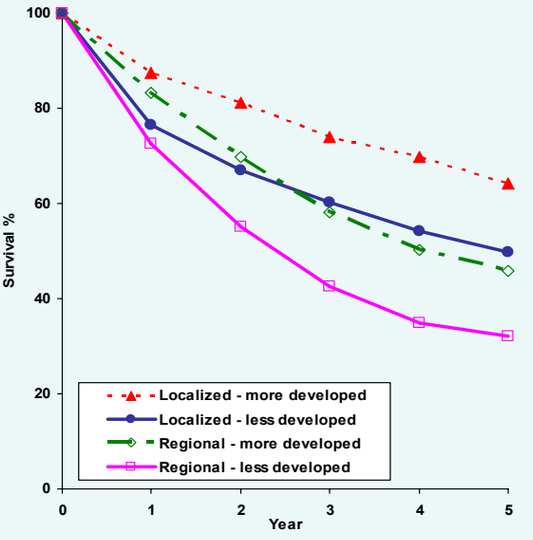


Figure 4b. Absolute survival



	More developed		Less developed	
	Localized	Regional	Localized	Regional
% cases	26.0	27.0	29.0	34.0

Figure 5. Localized and regional extent of disease among more and less developed health services, breast cancer

Figure 5a. 5-year absolute survival

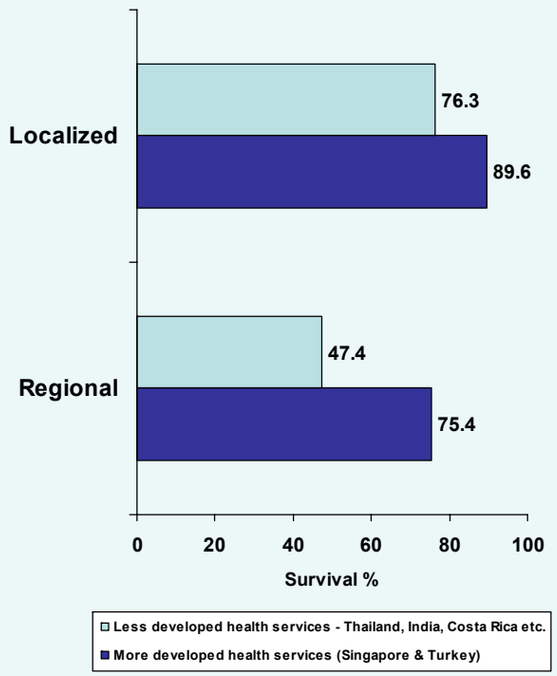
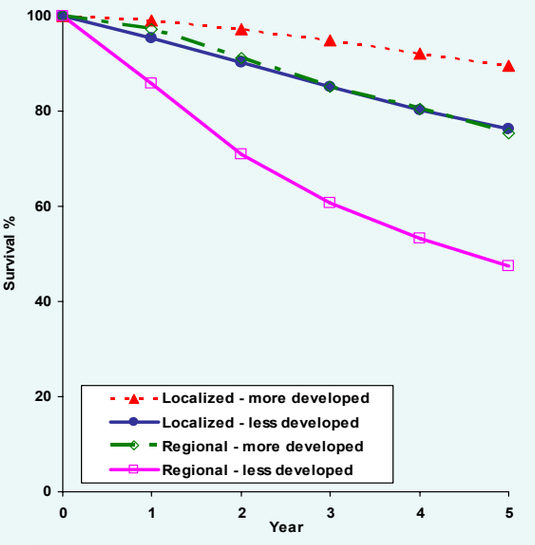


Figure 5b. Absolute survival



	More developed		Less developed	
	Localized	Regional	Localized	Regional
% cases	17.0	32.0	26.0	47.0

Figure 6. Localized and regional extent of disease among more and less developed health services, cervix cancer

Figure 6a. 5-year absolute survival

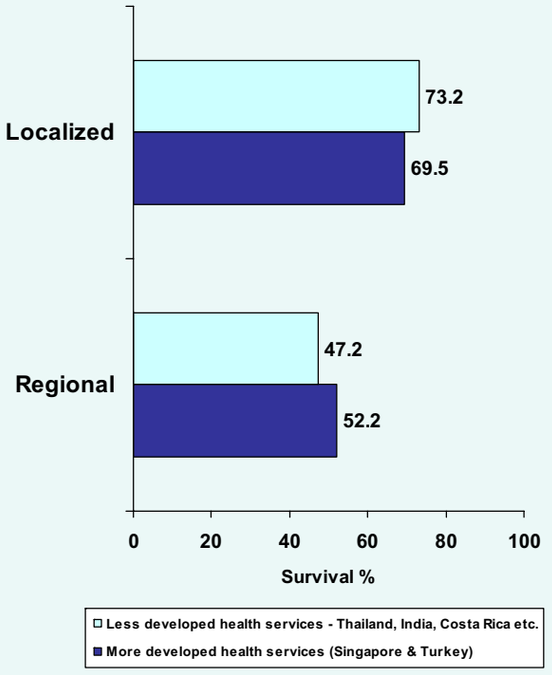
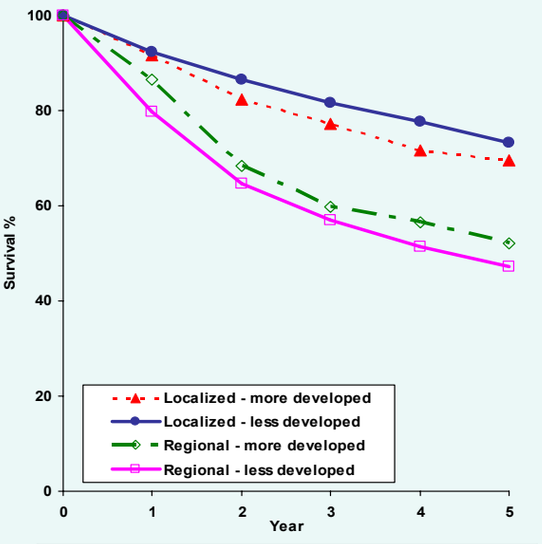


Figure 6b. Absolute survival



	More developed		Less developed	
	Localized	Regional	Localized	Regional
% cases	42.0	13.0	20.0	64.0

Figure 7. Localized and regional extent of disease among more and less developed health services, ovary cancer

Figure 7a. 5-year absolute survival

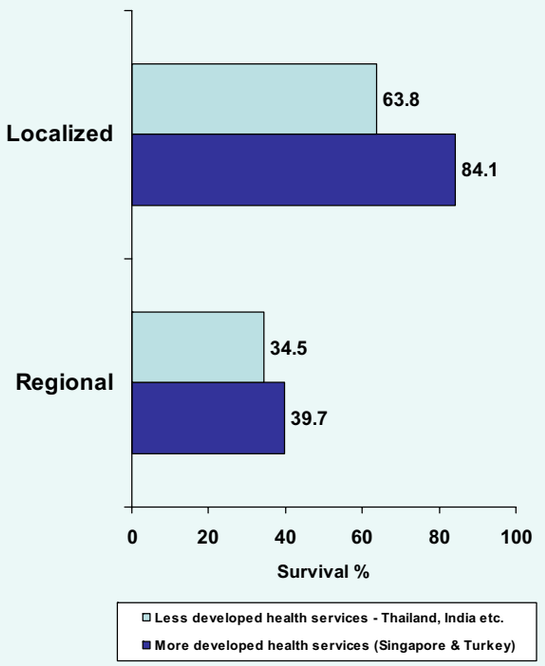
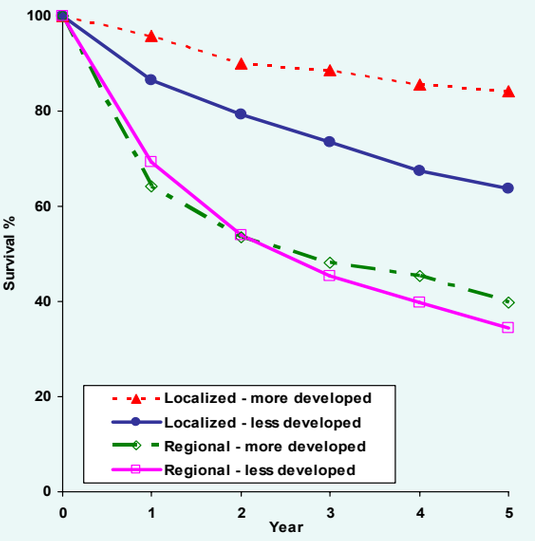


Figure 7b. Absolute survival



	More developed		Less developed	
	Localized	Regional	Localized	Regional
% cases	40.0	4.0	22.0	27.0

Figure 8. Localized and regional extent of disease among more and less developed health services, bladder cancer

Figure 8a. 5-year absolute survival

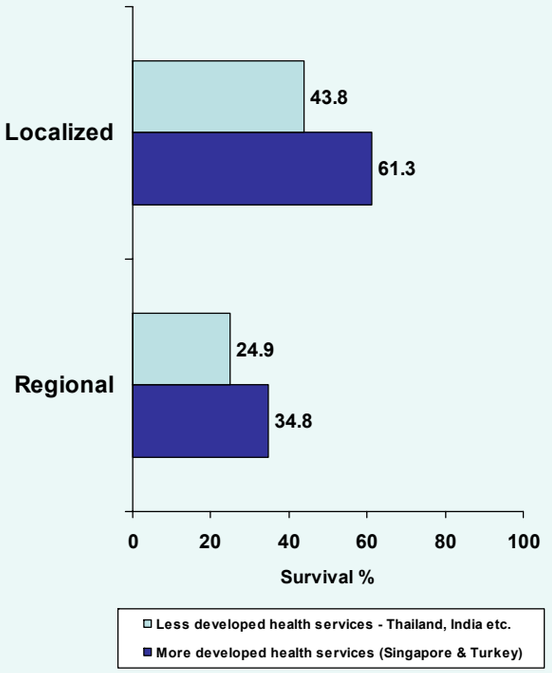
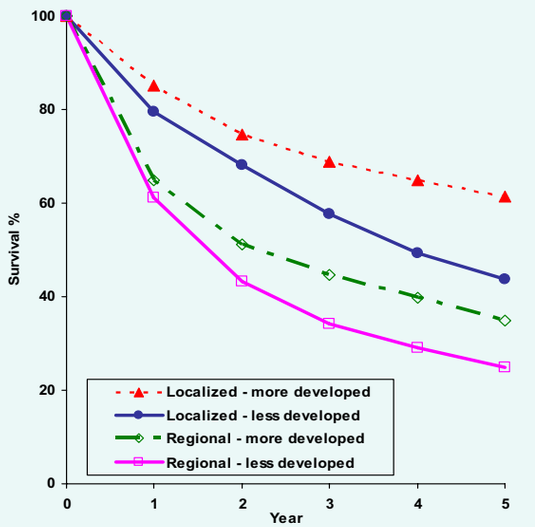


Figure 8b. Absolute survival



	More developed		Less developed	
	Localized	Regional	Localized	Regional
% cases	53.0	7.0	42.0	33.0

Figure 9. Survival among grouped countries with varied development of health services, Hodgkin lymphoma

Figure 9a. 5-year absolute survival

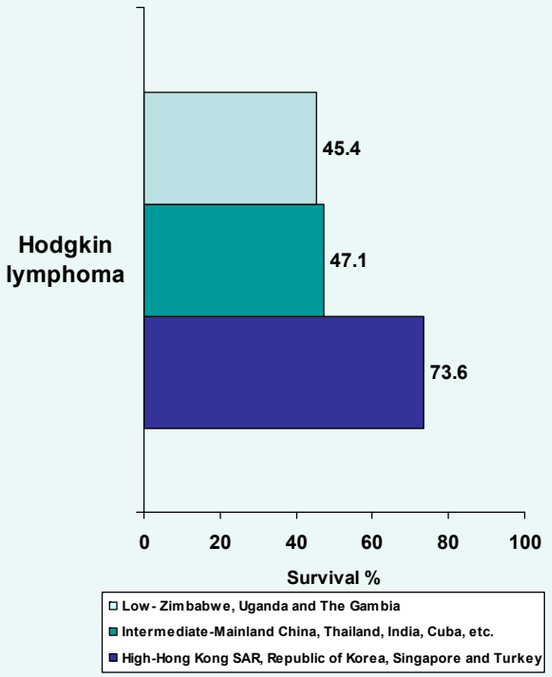


Figure 9b. Absolute survival

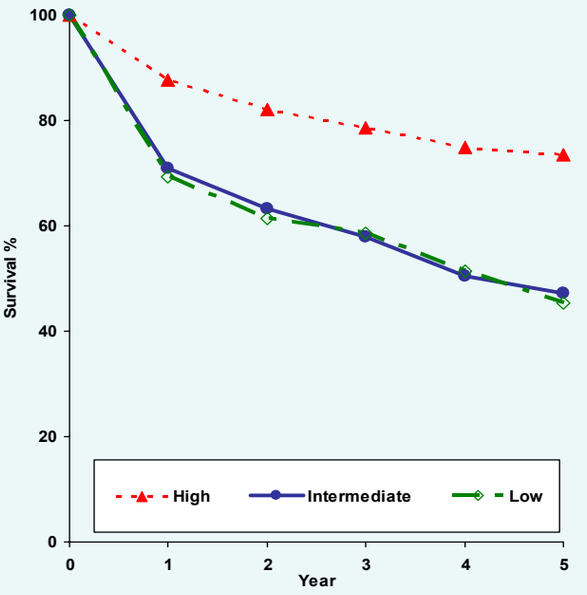


Figure 10. Survival among grouped countries with varied development of health services, non-Hodgkin lymphoma

Figure 10a. 5-year absolute survival

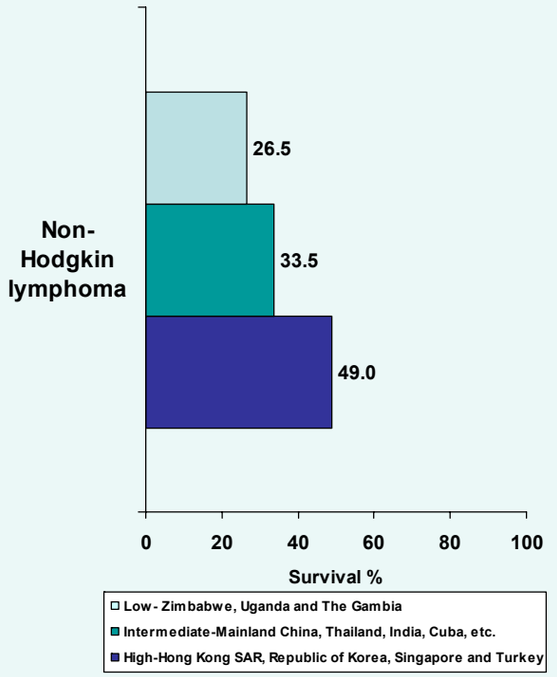


Figure 10b. Absolute survival