

# Global variation in cancer incidence and mortality

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**Estimates of the global burden of new cases of cancer have been published for four time periods (1975, 1980, 1985, 1990) and have been presented for all sites combined and for the ten most common sites in men and women, along with possible risk factors and their control. Overall, an estimated 8.1 million new cases of cancer were diagnosed worldwide in 1990 and the number went up to 10.1 million cases by 2000. Even if the incidence rates were to remain unchanged, a large increase in absolute number of cases is a certainty because of the increase in population size and its ageing and poses a veritable time-bomb in public health terms, particularly for the developing countries. Prevention therefore can be considered to be one of the most important cancer-control strategies.**

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In a year, presently, a little over 10 million new cases of cancer and 6.4 million deaths due to cancer, have been estimated to occur globally, based on the rates for the year 1990 (refs 1, 2). Even with the assumption of no change in incidence/mortality rates over the decade, the absolute numbers have increased because of the steady increase in the world population and its progressive ageing, with major implications for cancer control.

## Global burden of cancer

Published global estimates of the number of new cases of cancer (burden) and the corresponding incidence rates are available for four time periods: 1975 (ref. 3), 1980 (ref. 4), 1985 (ref. 5) and 1990 (ref. 1). The burden of cases for the top ten sites for these four years is shown in Table 1 for men and Table 2 for women. All sites combined cancer cases are seen to be increasing steadily and from 1975 to 1990 the number has gone up by 45% in men and 31% in women. Furthermore, the total number of cases was estimated to be almost equally divided between the developed and the developing countries<sup>1,4,5</sup>. Of the 8.1 million cases estimated for 1990, 4.0 million occurred in the developed and 4.1 million (50.5%) in the developing countries<sup>1</sup>; while of the 5.18 million estimated deaths 55% (2.85 million) occurred in the developing countries<sup>2</sup>.

The top three cancer sites contributing to the overall burden in men have remained unchanged over 15 years (Table 1). The commonest was lung cancer, followed by

stomach and colorectal cancer. While in women breast cancer was the most common throughout the period and has increased in absolute numbers by 47% in 15 years (Table 2).

All through the review, the quoted incidence rates are age-standardized ones and the source for the 1990 site-wise incidence rates of individual registries, is the IARC Publication on *Cancer Incidence in Five Continents*<sup>6</sup>. Examples of some of the high and low site-wise incidence rates from various registries of the world have been provided in the Appendix. The cancer burden for the top 10 sites divided between the developed and the developing countries for 2 time periods, 1990 and 1985 is shown in Figures 1 and 2 for men and women respectively. Figures 3 and 4 show the 1990 estimates of the new cases of cancer of the ten most commonly affected sites in Indian men and women along with the estimated number of deaths.

## Cancer of the lung

Lung cancer is the leading cause of cancer in men. The 1990 global lung cancer incidence rate of 37.5 per 100,000, gave rise to 771.8 thousand cases, constituting 18% of all new cancer cases in men (Table 1). The increase in the burden of lung cancer in men over 15 years has been 66% since 1975 (Table 1). Although the incidence rate in men is lower in the developing countries (24.1 per 100,000 in 1990) than the developed ones (62.6 per 100,000 in 1990)<sup>1</sup>, it is to be noted that between 1985 and 1990, lung cancer burden of the developing countries went up by 25% (from 261,000 to 327,100), while that of the developed ones went up by only 7% (415,000 to 444,700) (Figure 1). Thus, the global increase in lung cancer cases in men is now being fuelled by the cases from the developing countries.

In Indian men the incidence rates are not as high as in some of the western countries and vary from 10 to 17 per 100,000 in urban areas<sup>6</sup>. Nonetheless, lung cancer is gaining in importance in certain registry areas of India, like Mumbai and Ahmedabad where it is the leading cancer site in men. Figure 3 shows that the estimated number of new cases of lung cancer ranks second after oral cancer, but is the leading site among the deaths due to cancer.

The incidence rate of lung cancer is much lower in women worldwide and ranks fifth in absolute number of new cases (Table 2). In 1990, a third of all lung cancer

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cases was in women and it constituted 7% of all cancers that women developed. Incidence rates in Indian women are also quite low (1.7 to 3.7 per 100,000)<sup>6</sup>.

There is a documented decline in incidence and mortality rates since 1991 in men in the US<sup>7</sup> and has been attributed to a decline in smoking prevalence. Several West European countries have also registered a decline, particularly in the younger cohorts of men<sup>8</sup>.

Tobacco smoking in any form whether it is cigarettes, which has long been established as a major risk factor, or cigars<sup>9</sup> or bidis<sup>10</sup> which is smoked on the Indian subcontinent, are all causatively associated with lung cancer, depending on the intensity of exposures, with 75% of new cases attributable to tobacco smoking<sup>11,12</sup>. With the expansion of sale of cigarettes in the developing world, one can predict an explosion in the number of lung cancer cases from this part of the world. Even the so-called low-tar low-nicotine cigarettes developed by the industry do not reduce the hazard as one would have

thought. A recent study<sup>13</sup> has clearly demonstrated that smokers tend to compensate and achieve essentially the delivery they desire by modifying their smoking behaviour. Thus the 'low-yield' filter cigarette is a misnomer and misleads the consumers and the regulators into complacency with regard to exposure levels. Only a complete elimination of this product would result in a substantial decline in the disease occurrence.

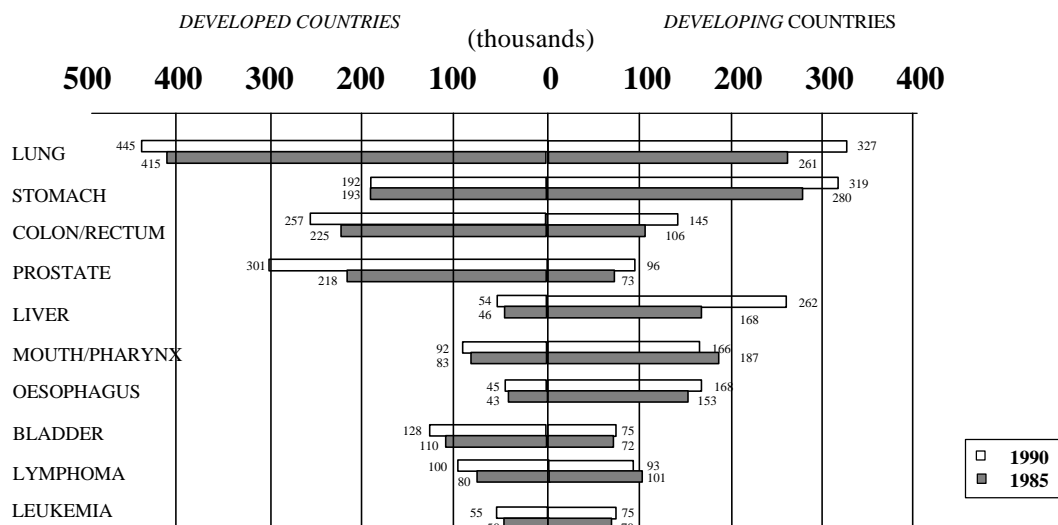
*Cancer of the stomach*

Stomach cancer is the second most common cancer in men (Table 1) and ranks fourth in women (Table 2). In men, the increase in number of cases over 1975 was only 20% and in women just 10%, and is attributable to population increase and its ageing, since the incidence rate of stomach cancer has been declining worldwide. Figures 1 and 2 show that all of the increase in the number of cases between 1985 and 1990, is contributed by the developing

**Table 1.** Estimated number of new cancer cases (thousands) worldwide in men, ranked (in parentheses) by 1990 order

Site of cancer (ICD: 9th)	1975	1980	1985	1990
Lung (162)	464.3(1)	513.6(1)	676.5(1)	771.8(1)
Stomach (151)	421.7(2)	408.8(2)	472.5(2)	510.0(2)
Colon and rectum (153-154)	251.2(3)	286.2(3)	331.0(3)	401.9(3)
Prostate (185)	197.7(5)	235.8(5)	291.2(4)	396.1(4)
Liver (155)	182.5(7)	171.7(7)	214.2(6)	316.3(5)
Mouth and pharynx (140-149)	232.9(4)	257.3(4)	269.6(5)	257.7(6)
Oesophagus (150)	194.0(6)	202.1(6)	195.9(7)	212.6(7)
Bladder (188)	130.7(8)	167.7(8)	181.7(8)	202.5(8)
Lymphoma (200-203)	129.5(9)	139.9(9)	180.8(9)	192.5(9)
Leukemia (204-208)	100.3(10)	106.9(10)	120.5(10)	130.3(10)
All sites (excluding skin) (140-208)	2968.5	3246.6	3849.4	4293.5

Source: Refs 1, 3-5.



**Figure 1.** Estimated number of new cases of cancer (in thousands) in developed and developing countries (males), 1985 (ref. 5) and 1990 (ref. 1).

countries. China, with an incidence rate of 43.6 per 100,000 in men and 19.0 per 100,000 in women, accounts for over 60% of the stomach cancer load of the developing countries<sup>1</sup>. The highest incidence rate of stomach cancer is reported from Japan (men, 77.9 per 100,000; women, 33.3 per 100,000)<sup>1</sup>. In India the incidence rate of stomach cancer varies from 6.8 to 15.9 per 100,000 in men and from 2.5 to 7.0 per 100,000 (ref. 6) in women and accounts for 5% of total cancer burden in men and 3% in women (Figures 3 and 4). The higher rates were reported by the urban registries of the southern part of the country, viz. Bangalore and Chennai.

The incidence and mortality rates of stomach cancer are declining in practically all populations for which statistics are available<sup>8</sup>. This is one site which shows an unplanned success of prevention. It is presumably the result of replacing traditional methods of food preservation and storage with refrigeration, together with increased consumption of fresh fruits and vegetables and consequent increase in intakes of vitamins like A, C and E. Though infection with *Helicobacter pylori* has been implicated in the causation of the disease<sup>14</sup>, it is not possible to assess

from the available literature whether the decline in stomach cancer incidence could be attributed to a decline in the infection by *H. pylori*.

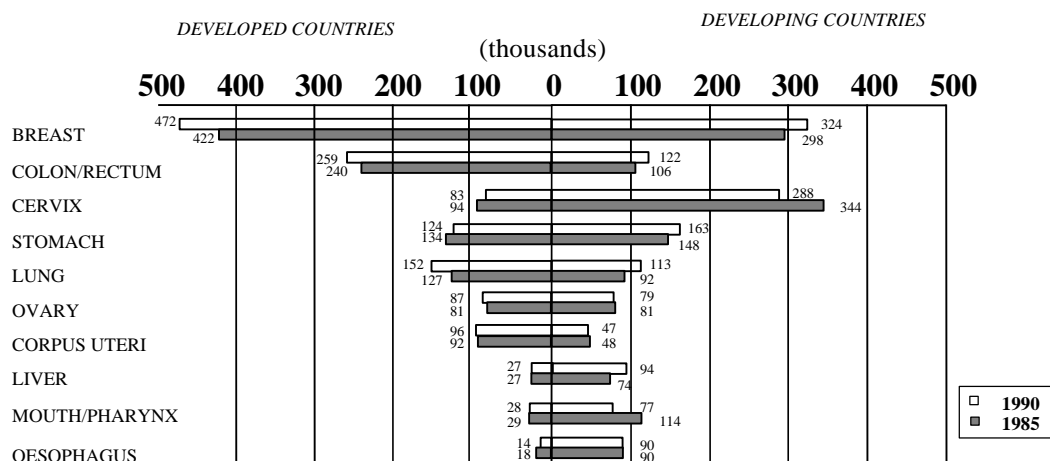
### Cancer of the colon and rectum

Globally, colorectal cancer is the third commonest cancer in men since 1975 (Table 1). In the developed countries it is now the second most common cancer after lung in men (Figure 1) and the 1990 age-standardized incidence rates range from 25.3 per 100,000 (Eastern Europe) to 45.8 per 100,000 (Australia)<sup>1</sup>. Incidence rates in Africa, except South Africa and South and Central Asia including India are quite low (2 to 8 per 100,000). Colorectal cancer burden has been steadily rising in women. It was the fourth commonest cancer in 1975 and has reached the second position by 1990, with about 49% increase in the number of cases globally over the 15 years (Table 2). As in men, the disease is more common in women of the developed countries than in the developing countries of Asia and Africa (Figure 2). In fact almost two-thirds of

**Table 2.** Estimated number of new cancer cases (thousands) worldwide in women, ranked (in parentheses) by 1990 order

Site of cancer (ICD: 9th)	1975	1980	1985	1990
Breast (174)	541.2(1)	572.1(1)	719.1(1)	795.6(1)
Colon and rectum (153-154)	255.6(4)	285.9(3)	346.5(3)	381.0(2)
Cervix (180)	459.4(2)	465.6(2)	437.3(2)	371.2(3)
Stomach (151)	260.6(3)	260.6(4)	282.3(4)	287.2(4)
Lung (162)	126.7(5)	146.9(6)	219.3(5)	265.1(5)
Ovary (183)	NA (>11)	137.6(7)	161.5(6)	165.5(6)
Corpus uteri (182)	NA (>11)	148.8(5)	140.0(8)	142.4(7)
Liver (155)	76.7(9)	79.4(12)	100.7(11)	121.1(8)
Mouth and pharynx (140-149)	106.6(6)	121.2(8)	142.8(7)	105.4(9)
Oesophagus (150)	102.3(7)	108.2(9)	107.6(10)	103.2(10)
All sites (140-208)	2901.8	3103.1	3774.2	3789.8

NA: Not available.  
Source: Refs 1,3-5.



**Figure 2.** Estimated number of new cases of cancer (in thousands) in developed and developing countries (females), 1985 (ref. 5) and 1990 (ref. 1).

## SPECIAL SECTION: CANCER

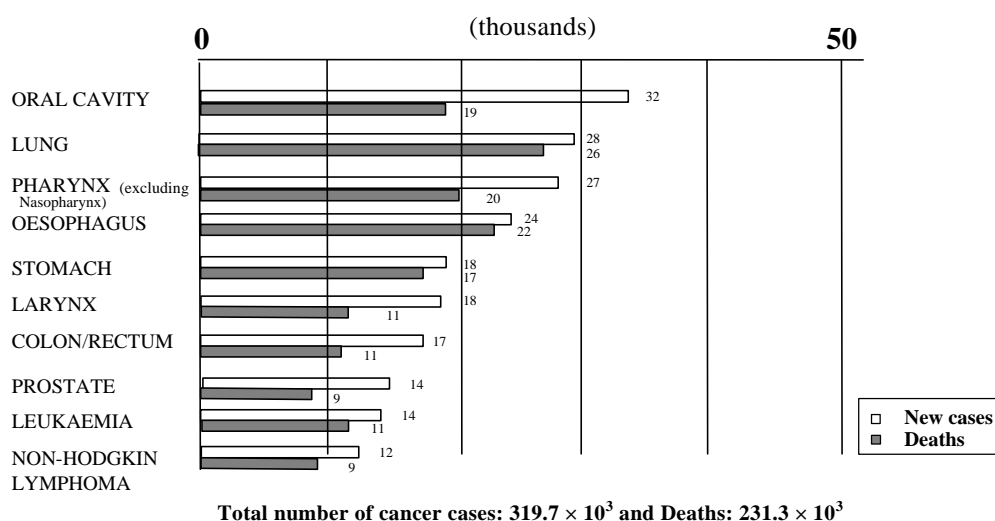
the estimated world total of 783,000 new cases in 1990 occurred in the developed countries (Figures 1 and 2).

In the US the incidence rate of colorectal cancer has been decreasing steadily since 1985 (ref. 7), and so has mortality, although the screening rates, by either fecal occult blood testing, sigmoidoscopy or proctoscopy, remain low. Mortality is also falling steadily in few other developed countries like Canada, Sweden, UK and some EC member states<sup>8</sup> and could be a reflection of improvements in earlier diagnosis and better treatment.

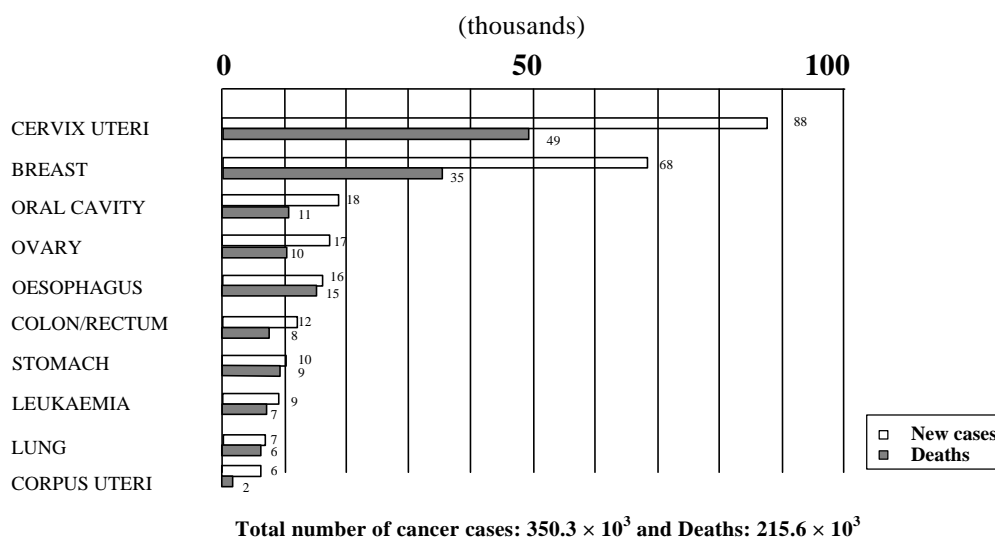
### Cancer of the prostate

Cancer of the prostate ranks as the fourth most common cancer in men globally, with an estimated 396,100 new

cases a year in the 1990, which is almost a 100% increase over the 1975 estimate (Table 1). It is much more common in the developed countries, encompassing almost 75% of total number of cases, than in the developing countries (Figure 1). In 1990, the global range in incidence was over 80-fold with age-standardized rate of 92.4 per 100,000 reported for North American men, to 1.1 per 100,000 in Chinese men<sup>1</sup>. Some of the geographic variation in incidence may be the result of differences in the rate of detection of latent tumours. Incidence is generally low until the age of 50, in most populations and then increases rapidly with age. Almost 75–80% of cases occur in elderly men (65+). Incidence rates of prostate cancer are low in Asian and North African countries, ranging from 1 to 9 per 100,000. Some of the highest



**Figure 3.** Estimated number of new cases and deaths due to cancer in India, 1990 (males). Source: IARC website [www-dep.iarc.fr](http://www-dep.iarc.fr) (updated 19.01.2001).



**Figure 4.** Estimated number of new cases and deaths due to cancer in India, 1990 (females). Source: IARC website [www-dep.iarc.fr](http://www-dep.iarc.fr) (updated 19.01.2001).

rates are reported from North American population, particularly among US Blacks, the rate going up to 141 per 100,000 (ref. 6).

Improvement in diagnostic practice could be the main reason for the observed increase in the prostate cancer cases, particularly in North American men, where it accounts for 27% of new cases and 12% deaths from cancer<sup>1,2</sup>. However, the recent US data on trends indicate a decline in not only prostate cancer incidence but also in mortality<sup>7</sup>, which could be attributed to better treatment and perhaps diagnosis at earlier stage.

### *Cancer of liver*

Globally, primary liver cancer ranked seventh in men in 1975 and by 1990 it reached the fifth position (Table 1), with a 73% increase in the burden. Liver cancer is common in South East Asia and Africa and 54% of the total number of 437,400 new cases of liver cancer that occurred in 1990, men and women combined, were from China alone. The developed countries contribute 19% of the total cases with age standardized incidence rate of 7.6 per 100,000 in men and 2.6 per 100,000 in women<sup>1</sup>. The corresponding rates in the developing countries were 17.9 and 6.2 per 100,000 (ref. 1). Particularly high incidence rates were reported from China and Thailand in Asia, and from Mali and Zimbabwe in Africa<sup>6</sup>. In women, the high rates were found in same populations but were much lower than that reported in men (see Appendix). Migrant Chinese in USA, however, have lower rates although still higher than that among whites of the same population.

Besides the role of aflatoxin contamination of food, smoking and alcohol, chronic infection with hepatitis B virus (HBV) in the etiology of liver cancer is well established<sup>15</sup>, particularly in high-risk areas. Over 50% of the new cases occurring globally have been attributed to HBV infection<sup>16</sup>. Surprisingly, the incidence rate of liver cancer is very low in Indian population, ranging from 2 to 3 per 100,000 in men and even lower in women<sup>6</sup>, and it does not figure among the top 10 sites of either sex (Figures 3 and 4).

Vaccine trials against HBV are underway in Gambia<sup>17</sup>. A reduction in the incidence rate of liver cancer in children in Taiwan has also been reported after introduction of mass vaccination of newborn against HBV<sup>18</sup>.

### *Cancer of the mouth and pharynx*

Mouth and pharynx cancers (ICD 9th: 140–149) include three main categories, viz. oral cancer (ICD 9th: 140–145), nasopharyngeal cancer (ICD 9th: 147) and pharyngeal cancer other than the nasopharynx (ICD 9th: 146, 148, 149), with distinct etiological and geographical features.

It is seen that the global load of new cases of cancer of the mouth and pharynx has not changed greatly in both men and women over the 15 years (Tables 1 and 2).

Between 1985 and 1990 the estimated global incidence rate has declined from 14.0 to 12.1 per 100,000 in men and from 6.5 to 5.1 per 100,000 in women<sup>1,5</sup>. Over a third of oral cancer and a little under half (45%) of pharyngeal cancer (other than nasopharynx) that occurred in 1990, have been the contribution of the countries of South Central Asia which includes the Indian subcontinent<sup>1</sup>. Cancer of the lip, however, is not so common in Asians and the incidence rates are well below 1 per 100,000. Particularly high incidence rates (up to 13 per 100,000) have been reported for Australian and Canadian populations<sup>6</sup>. As for nasopharyngeal cancer, of the 57,500 new cases that occurred globally in 1990 almost 45% was from China<sup>1</sup>.

In India, oral and pharyngeal cancers combined are the leading cancer sites in men and account for 19% of the estimated total of 319.7 thousand cancer cases (Figure 3). While in women these sites account for about 7% of 350.3 thousand total cases and ranks third after cancers of the breast and cervix (Figure 4). However, according to the data of the Bombay Cancer Registry, the incidence rate of oral and pharyngeal cancer in Mumbai city has been slowly but steadily declining, both in men and women<sup>8</sup>.

The important etiological factors for oral and pharyngeal cancers have long been established and are smokeless tobacco-use, smoking and alcohol, along with poor nutrition. Association of cigarette smoking and alcohol intake with cancers at these sites has mostly been reported from western countries, while tobacco chewing and smoking have been implicated in studies from South Asia. Exhaustive reviews on the topic have been published by IARC<sup>19,20</sup>. Estimates varying from 61% to 79% of oral and pharyngeal cancers have been attributed to tobacco use alone<sup>12</sup> and 75% with smoking plus alcohol drinking<sup>21,22</sup>. Control of these risk factors therefore would lead to a substantial decline in the disease.

Cancer of the nasopharynx has been linked to Epstein-Barr virus infection<sup>23</sup>. Some studies have also implicated traditional dietary practices and cooking methods for the increase in risk in the Chinese population<sup>24</sup>.

### *Cancer of the oesophagus*

Like the cancers of the mouth and pharynx, the global burden of cancer of the oesophagus has not changed substantially both in men and women over the 15-year period (Tables 1 and 2). In the developing countries it is the fourth most common cancer in men (Figure 1), with an annual incidence rate of 12.2 per 100,000, while in the developed countries the rate is 6.4 per 100,000 (ref. 1). Besides the African and Chinese populations, the Blacks in the US also exhibit high rates (up to 20 per 100,000 in men)<sup>6</sup>. Some of the highest incidence rates – over 150 per 100,000 – have been reported earlier from the Caspian region of Iran<sup>25</sup>.

In Indian men and women, oesophagus is the fourth and fifth leading cancer site respectively (Figures 3 and 4).

The annual incidence rate varies from 4.6 to 10.8 per 100,000 in men and 1.3 to 8.5 per 100,000 in women<sup>6</sup>. Again a decline in incidence rate has been reported for men and women of the city of Mumbai, according to the data of Bombay Cancer Registry<sup>8</sup>. A decline in the incidence rate among the Chinese population has also been observed according to the data of Shanghai Registry<sup>8</sup>.

The two major preventable risk factors for oesophageal cancer are tobacco-use and alcohol intake. In many analytical epidemiological studies the association of the disease with poverty and poor nutrition has been consistently reported. The over 30-fold difference between the high and low incidence rates (see Appendix) indicates a large potential for preventing oesophageal cancer.

### *Cancer of the bladder*

Cancer of the urinary bladder ranks eighth in men (Table 1) but does not figure among the top 10 sites in women (Table 2). The global burden of yearly occurrence of new cases in men has gone up by 55% in 15 years and almost all the increase is seen in the developed countries (Figure 1). Geographical variation in incidence is more than 10-fold, with a rate of 23.8 per 100,000 for the year 1990 in North American men, to a low rate of 2.7 per 100,000 in Melanesian men<sup>1</sup>. Equally high incidence rates are also reported from North Africa, which has been attributed to the presence of urinary schistosomiasis. Incidence rates are low in Indian men, varying from 2.6 to 4.8 per 100,000 in urban areas<sup>6</sup>, and the site does not figure among the ten most common ones (Figure 3).

Incidence rates of bladder cancer are rising in men in almost all the European populations<sup>8</sup>, but in the US it has started registering a decline since 1988 (ref. 7). Mortality rates in the US population and a few European populations have also shown a decline<sup>7,8</sup>.

Tobacco smoking is considered to be one of the causes of bladder cancer, and a number of organic chemicals used in industry are known to be carcinogenic to the bladder. Chemical and dyestuff manufacturers are at particularly high risk of bladder cancer<sup>26</sup>. Legislation prohibiting the manufacture of carcinogenic chemicals like 2-naphthylamine and benzidine has been enacted in several, mostly western, countries. In India, their usage is restricted and regulated by the government.

It needs to be mentioned that since the prevalence of exposure to industrial chemicals would be restricted to only a small proportion of the population, the consequent contribution of this risk-factor to the yearly burden of new cases will be small.

### *Lymphoma*

Publications providing the global incidence data for 1975 (ref. 3), 1980 (ref. 4) and 1985 (ref. 5) have grouped

Hodgkin's disease (ICD 9th: 201), non-Hodgkin lymphoma (ICD 9th: 200, 202) and multiple myeloma (ICD 9th: 203) into one category as lymphoma, and the same grouping has been retained in Table 1.

The burden of new cases of lymphoma per year has increased by 30% in men between 1975 and 1990, and globally is the ninth most frequently occurring cancer in men (Table 1, 1990 data). Non-Hodgkin lymphoma contributed the most number of cases (66%) to the total lymphoma cases and the annual incidence rate in men in the developed countries was 9.6 and in the developing countries 3.7 per 100,000 for the year 1990 (ref. 1).

Incidence of non-Hodgkin lymphoma has been rising steadily, in both the sexes, in almost all parts of Europe and Australia<sup>8</sup>. Mortality has also been increasing, but less rapidly than incidence<sup>8</sup>. A similar picture is noticed in the US population, particularly in women<sup>7</sup>.

Hodgkin's disease and multiple myeloma are relatively less common than non-Hodgkin lymphoma, and the estimated global incidence rates are less than 2 per 100,000 in men and women<sup>1</sup>.

No practical preventive measures, however, are known except for Burkitt's lymphoma (BL). In African population, BL is associated with endemic malaria and there is some evidence that eradication of malaria could lead to a decline in incidence of BL<sup>27</sup>.

### *Leukaemia*

Leukaemias comprise about 3% of all malignancies worldwide and show little geographic variation in incidence rates. The four types of leukaemias are characterized by their clinical behaviour and cell type of origin, as acute or chronic and myeloid or lymphocytic. Somewhat higher incidence rates are reported for North American, European and Australian populations, with rates ranging between 10 per 100,000 in men and 6 per 100,000 in women<sup>1</sup>. In the developing countries, including India, the rates are 3 to 4 per 100,000 (refs 1, 6).

Acute lymphoblastic leukaemia is a common childhood malignancy, while chronic lymphoblastic leukaemia (CLL) is rare before the age of 50. CLL is also rare in Asian populations.

Ionizing radiation is one of the risk factors for leukaemia, except for CLL. Benzene exposure in industrial setting is another risk factor. Genetic conditions like Down's syndrome and certain chromosomal abnormalities are also associated with increased risk of leukaemia. Again, no practical avenues of prevention are known.

### *Cancer of the breast*

Breast cancer is the leading cause of cancer in women worldwide (Table 2), both in the developed and developing countries. (Figure 2: 1990 data). Just five years ago,

the breast cancer ranked second after cervix in the developing countries. (Figure 2: 1985 data) The burden of new cases between 1975 and 1990 has gone up by 47% (Table 2).

Populations at high risk of breast cancer are from countries of North America, with incidence rates of US white women going up to 103.7 per 100,000 (ref. 6). High rates are also reported from Europe and Australia<sup>6</sup>. While in countries like India, Japan (though developed), China and those of Africa, the highest recorded incidence rates from the various regional registries for the year 1990, are 23.5, 33.4, 26.5 and 29.5 per 100,000 respectively<sup>6</sup>; which are more than 50% lower than the few 'low' rates of high risk populations. Despite the low incidence rates, almost 40% of the 1990 global cancer burden (Figure 2) and 45% of deaths due to the disease occurred in the developing countries<sup>2</sup>. In India it is the second most common cancer after cervix (Figure 4), accounting for 19% of the total cancer burden in women.

The incidence rate in Asian women has been rising<sup>8</sup> and is associated with a shift towards a more westernized lifestyle. The Bombay Cancer registry has also recorded a consistent rise in the incidence of breast cancer, which has now overtaken cervical cancer, to be the leading cancer in women of Mumbai. Among the developed countries, the incidence rates of breast cancer of American women which had been rising steadily<sup>8</sup> have shown little change in the 1990s, while death rates have declined by about 2 per cent per year since 1990 with a sharp drop since 1995 (ref. 7), probably attributable to early diagnosis and proper treatment. In some European countries also like Switzerland, incidence seems to have plateaued<sup>8</sup>.

The important risk factors implicated since long, in several epidemiological studies are earlier age at menarche, later age at first full-term pregnancy, low parity and later age at menopause<sup>28,29</sup>. The increase in risk with these reproductive factors has been attributed to the pattern of exposure to estrogen, which is supported by the decrease in risk associated with early bilateral oophorectomy, increase in risk with extended use of hormone replacement therapy, obesity and high fat diet (though not conclusive)<sup>29,30</sup>. Other associated risk factors are excessive alcohol-intake and exposure to ionizing radiation<sup>29</sup>. Recent studies have shown that physical activity has protective effect<sup>31</sup>. Family history of breast cancer increases the risk 2-to 3-fold, and the role of some genes, viz. *BRCA-1* and *BRCA-2*, in the predisposition to the disease has been identified<sup>32,33</sup>, but only 5% to 10% of breast cancer cases are due to inherited (germline) mutation.

Despite these factors associated with the development of breast cancer, a large proportion of cases cannot be attributed to known risk factors. The preventive strategy therefore lies in identifying risk factors that can be modified to reduce the risk and also in developing reliable screening methods for detecting and characterizing early

cancers and pre-cancerous breast lesions, such that they are implementable in the large populations of the developing countries as well.

### *Cancer of the cervix uteri*

Cervical cancer was the second most common cancer after breast in women globally till 1985, and dropped a rank in 1990. Almost 80% of cervical cancer cases were diagnosed in the developing countries, where it was the most common cancer of women till 1985 (Figure 2). The high risk populations are in Africa, Latin America and countries of Asia like India, Thailand, Philippines and Korea<sup>6</sup>. It is the leading cause of cancer morbidity and mortality in Indian women, accounting for 25% of new cases and 23% of deaths due to cancer (Figure 4). Incidence rates reported for the Chinese population, unlike other developing countries, are quite low and lie between 2 and 4 per 100,000 (ref. 6). Low incidence rates, varying from 4 to 6 per 100,000, are also reported from Israel for Jewish women<sup>6</sup>. In the developed countries, the incidence rates are generally below 14 per 100,000 except Poland<sup>6</sup>.

Time trend studies have shown a large overall decline in incidence rates in women in North America, most of European countries and also in Asian countries<sup>8</sup>. In India, Bombay Cancer Registry has recorded a consistent decline in rates<sup>8</sup> without any well organized screening programmes in place. Mortality rates have also registered a decline in the developed countries<sup>8</sup>.

Among the risk factors implicated in the etiology of cervical cancer, infection with human papilloma virus (HPV), particularly subtypes 16 and 18 (ref. 34), has been identified as the most likely cause, supporting the view that the disease is sexually transmitted. Other risk factors include early age at first intercourse, multiple sexual partners and low socio-economic status<sup>24</sup>.

Cancer of the cervix is probably the most preventable major form of cancer. It has been suggested that the use of barrier contraceptive may be protective<sup>35</sup>. Cytological screening programmes have been demonstrated to be effective<sup>36</sup> in the developed countries and are probably responsible for the observed decline in the disease. Other low-cost methodologies are in the process of being developed for screening of cervical cancer in the large populations at high risk, in the developing countries<sup>37,38</sup>.

### *Cancer of the ovary and corpus uteri*

Cancer of the ovary and corpus uteri are the sixth and seventh most frequent cancer in women worldwide and each site accounts for less than 5% of all cancers in women (Table 2). Ovarian cancer occurs equally frequently in the developed and developing countries, while two-thirds of cancer of the corpus uteri occur in the developed countries (Figure 2).

The incidence rate of ovarian cancer is higher in the developed countries (around 10 per 100,000) except Japan, than the developing countries (less than 5 per 100,000)<sup>1</sup>. The higher the number of ovulatory cycles, the greater is the risk of the disease. Therefore factors associated with suppression of ovulation such as pregnancy and oral contraceptive-use have a protective effect<sup>39</sup>.

The incidence rate of corpus uteri is high in North American and European countries and is generally between 10 and 20 per 100,000, while in Japan and the developing countries the rate is generally below 5 per 100,000 (ref. 6). The known risk factors are broadly similar to those implicated in breast cancer, viz. early menarche and late menopause, low parity, obesity, high fat diet and use of oestrogens for relief of menopausal symptoms<sup>24</sup>.

Decline in the incidence and mortality rates, for both the sites, is observed for the American population, particularly in white women<sup>8</sup>. Decline in incidence is also noticed in a few western European populations, but not in Asian populations<sup>8</sup>.

**Conclusion**

The main emphasis of the review has been on the actual number of new cases of cancer (burden)<sup>1,3-5</sup>, which is based on the incidence data published by IARC from the worldover. The quality of the data varies enormously among different areas of the world and so would the accuracy of the estimates of the burden. Cancer mortality data from the developing countries would probably suffer from even greater disadvantage as a proxy measure of risk of acquiring the disease. Besides, the case fatality between the populations compared is rarely equal and therefore the mortality data have been cited selectively. The number of cases worldwide is undoubtedly rising as a result of popu-

lation increase and ageing, and probably so is the overall incidence rate. Comparisons of global estimates between different time periods need to be done with some caution because the sources of information do not remain the same.

Variation in incidence between different regions of the world in a particular type of cancer is much greater than all-sites cancer, which has led to the view that much of human cancer is caused by environmental factors – human behaviour, habits and lifestyle as well as external factors over which the individual has no control. On the basis of differences observed between the highest and the lowest incidence rates for various sites of cancer and the shift in incidence pattern of migrant populations towards the host country, it has been estimated that almost 80% of all human cancers have a large environmental component, and are therefore preventable.

The impact of control of exposure, on a global scale, can only be felt if a large proportion of the population is exposed. Therefore the greatest impact to reduce the burden of cancer would result from the control of tobacco use, leading to reduction in tobacco-related cancers and from control of HPV infection, leading to reduction of cervical cancer. A recent dose-escalation trial to evaluate the safety and immunogenicity of a vaccine developed from a specific HPV16 protein has given promising results<sup>40</sup>. The HBV vaccination programme if successful will lead to lowering of liver cancer burden, and the greatest impact would be felt in the developing countries where almost three-quarters of world's cases are diagnosed. Failing primary prevention, screening methods for early detection, which are feasible and applicable in the developing countries as well, could result in lowering the burden. With expansion in absolute number of cases of cancer set to continue, the role of prevention in cancer-control strategies would therefore remain central.

**Appendix.** Examples of high and low cancer incidence rates in various populations\*

Site of cancer (ICD: 9th)	Sex	High cancer incidence		Low cancer incidence	
		Population	Rate	Population	Rate
Mouth (143–145)	M	France, Bas-Rhin	12.4	Peru, Lima	0.5
		India, Trivandrum	10.8	Israel: All Jews	0.8
		Italy, Trieste	8.4	UK, South Western	0.9
	F	India, Madras	8.9	Spain, Zaragoza	0.2
		Singapore: Indians	3.6	Japan, Yamagata	0.3
		Thailand, Khon Kaen	3.0	China, Tianjin	0.4
Oesophagus (150)	M	Zimbabwe, Harare: African	30.4	Italy, Ragusa	1.0
		France, Calvados	22.3	Thailand, Khon Kaen	1.5
		US, Connecticut: Black	20.1	Canada, Alberta	2.6
	F	Uganda, Kyadondo	8.7	Spain, Murcia	0.4
		India, Bangalore	8.5	Slovakia	0.5
		US, Atlanta: Black	4.9	US, Iowa	0.8



Site of cancer (ICD: 9th)	Sex	High cancer incidence		Low cancer incidence	
		Population	Rate	Population	Rate
Stomach (151)	M	Japan, Yamagata	95.5	Thailand, Khon Kaen	4.1
		Korea, Kangwha	65.9	US, Atlanta: White	5.2
		China, Shanghai	46.5	India, Bombay	7.7
	F	Japan, Yamagata	40.1	Thailand, Khon Kaen	2.1
		Korea, Kangwha	25.0	US, Iowa	2.2
		Italy, Romugna	22.8	India, Bombay	3.8
Colorectal (153–154)	M	New Zealand: Non-maori	51.3	Algeria, Setif	3.1
		Canada, Nova Scotia	47.8	India, Madras	5.6
		US, Detroit: White	46.5	Thailand, Chiang Mai	7.2
	F	New Zealand: Non-maori	40.8	Mali, Bamako	2.1
		Canada, Newfoundland	38.3	India, Trivandrum	3.3
		US, Los Angeles: Black	36.5	Thailand, Khon Kaen	5.2
Liver (155)	M	Thailand, Khon Kaen	97.4	Canada, Newfoundland	1.0
		China, Qidong	72.1	UK, East Anglia	1.1
		Mali, Bamako	51.1	The Netherlands	1.6
	F	Thailand, Khon Kaen	39.0	Canada, Newfoundland	0.6
		Zimbabwe, Harare: African	19.2	UK, South Western	0.8
		China, Qidong	19.1	US, Iowa	1.0
Lung (162)	M	US, New Orleans: Black	110.8	Uganda, Kydondo	4.2
		UK, Scotland	88.9	India, Bangalore	8.1
		Canada, Quebec	82.5	Ecuador, Quito	10.1
	F	US, San Francisco: White	40.4	India, Bangalore	1.7
		France, Isere	35.9	Algeria, Setif	2.9
		UK, Scotland	33.7	Ecuador, Quito	3.6
Breast (174)	F	US, Los Angeles: White	103.7	Korea, Kangwha	7.1
		France, Isere	85.9	Thailand, Khon Kaen	8.4
		Western Australia	72.9	India, Barshi, Paranda and Bhum	8.7
		Zimbabwe, Harare: African	67.2	Italy, Macerata	2.8
Cervix (180)	F	Brazil, Belem	64.8	China, Shanghai	3.3
		India, Madras	38.9	Finland	3.6
		US, Atlanta: Black	142.3	Vietnam, Hanoi	1.2
Prostate (185)	M	Switzerland, Zurich	65.4	China, Tianjin	1.9
		Western Australia	52.8	India, Madras	3.6
		Italy, Trieste	38.7	Vietnam, Hanoi	1.7
Bladder (188)	M	Switzerland, Geneva	32.5	Algeria, Setif	1.8
		US, Connecticut: White	28.4	India, Trivandrum	2.6
		Zimbabwe, Harare: African	12.5	Thailand, Khon Kaen	0.5
	F	Italy, Trieste	9.4	China, Qidong	0.7
		UK, Scotland	7.5	India, Bangalore	0.8
		US, San Francisco: White	25.0	Mali, Bamako	2.6
Non-Hodgkin lymphomas (200, 202)	M	Italy, Trieste	15.5	Thailand, KhonKaen	2.7
		Australia, Capital Territory	14.2	China, Shanghai	4.3
		Italy, Ferrara	11.5	Mali, Bamako	0.8
	F	US, San Francisco: White	11.0	India, Madras	2.0
		Canada, Manitoba	10.7	China, Shanghai	2.5

Contd . . .

## (Appendix. Contd.)

Site of cancer (ICD: 9th)	Sex	High cancer incidence		Low cancer incidence	
		Population	Rate	Population	Rate
Leukaemia (204–208)	M	Italy, Trieste	15.0	Uganda, Kyadondo	0.7
		South Australia	13.3	India, Madras	3.0
		US, Detroit: White	12.7	China, Qidong	3.8
	F	Canada, Yukon	11.7	Uganda, Kyadondo	1.2
		Italy, Trieste	9.0	India, Madras	2.0
		South Australia	8.9	Brazil, Belem	2.7

\*Numbers given are age-standardized (world) annual incidence rates per 100,000 population.

Source: ref. 6.

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