DEVELOPMENT OF AN ATLAS OF CANCER IN INDIA

First All India Report: 2001 - 2002

Discussion

The Indian Council of Medical Research (ICMR) initiated a network of cancer registries under the National Cancer Registry Programme (NCRP) in 1981 and data collection commenced in these registries from 1st January 1982. Since then, the registries have provided information on incidence and patterns of cancer that in terms of quality and validity meet international standards. This is evidenced by the fact that the data from the population based cancer registries under the NCRP has been continuously published in successive volumes of the World Health Organization (WHO) publication - Cancer Incidence in Five Continents (Muir et al, 1987; Parkin et al, 1992, 1997, 2002). This volume is published every five years by the International Agency for Research on Cancer - the cancer research arm of the WHO. Data on childhood cancer and cancer occurrence in developing countries have also appeared in the Agency's publications (Parkin et al, 1988; Sankarnaryanan et al, 1998). The NCRP, itself has been bringing out its own annual and consolidated reports since 1982 (NCRP Reports, 1985… 2002). The preparation for the 1999-2000 report is underway. Besides, the registries under NCRP there are eight population based cancer registries with funds met from other sources. The data of some of these registries has also been published in Cancer Incidence in Five Continents.

Thus, in India, for cancer, and perhaps for only this disease, we have a systematic programme of data collation so as to have reliable incidence and mortality rates, thereby laying a foundation for scientific research - whether that research be epidemiological, basic, clinical or in cancer control. However, India being a vast country, extensive areas need to be covered. The NCRP cancer registries cover selected urban centres and just one rural pocket. The other population cancer registries also cover essentially urban centres except for parts of two districts in Kerala State and part of one district in Tamil Nadu State. Consequently, the patterns of cancer in several urban centres and rural regions remain largely unknown. Setting up of new registries throughout the country as in some Western countries would involve enormous cost in establishing and maintaining the same.

Therefore, under this project, a cost-effective design and plan using advances in modern electronic information technology, was conceived, to collate and process relevant data on cancer so as to fulfill the objectives of:

i) obtaining an overview of patterns of cancer in different parts of the country; and,

ii) calculating estimates of cancer incidence wherever feasible.

The data of the NCRP shows that 80-85% of registered cases of cancer has microscopy as the basis of diagnosis. Modern electronic information technology needed to be harnessed in a cost-effective way. Thus the department of pathology and pathologist became the focal point of data capture and the internet was identified as the primary communication medium for data acquisition and transmission. Internet as a tool for data collection on patient information was a unique concept being tried for the first time (in India and to the best of our knowledge anywhere else in the world) under the project.

A user friendly 'core proforma' for collecting the patient information was hosted on the web-site www.canceratlasindia.org. Internet Browser based data entry eliminated the need for software to be installed on every system and the hassles of administration and maintenance. Collaborating centres were given an individual login-ID and password with detailed instructions on entering the core patient information. Care was

taken to code/encrypt the data entered so that the identity or the nature of the data could not be deciphered by any one except those concerned with the project. This ensured confidentiality of patient information and security of data transmitted. The collaborating centres transmitted the required information (mainly patient identification details including area of living, and site and morphology of tumour) on all malignant cases reported by the department of pathology.

The successful working of this concept was reflected, first, in the data that was and is downloaded on a regular basis for the past two and a half years. The core data of approximately 1200-1500 cancer cases is received every week. Secondly, in the feedback received from the participating centres during the All India Workshop - 95% of the respondents, felt, that the web-site was easy to use and 80% of them had a fairly stable Internet connection. Thirdly, because most of the collaborating centres were able to transmit the required information as soon as a diagnosis was made, this report of 2001-2002 could be brought out fairly early (comparable to international standards). In due course the experience should enable us to provide the main tables of incidence rates and report soon after the end of the calendar year and then on-line. The fact that through this project, one could receive, analyse and provide the 2001-02 report in early 2004 posed problems for comparison, since international rates on a global basis were available only for 1993-97, and the rates of the PBCRs under NCRP were for the years 1997-99. However, from the epidemiological stand-point and knowing that incidence rates of cancer take several years before showing significant variations in time trends, these differences are unlikely to have notable impact in the interpretation of geographic patterns of cancer.

The data received through the web-site was downloaded periodically at the Coordinating Unit of the NCRP and the details of checks carried out have been described earlier (Chapter 2). Based on the above, a total of 2,17,174 microscopically diagnosed cancers for the two year period (1 January 2001 to 31 December 2002) from 105 centres across the country was taken up for analysis. The centres included the cancer registries under the NCRP and other functioning cancer registries. A condensed profile with tabular and graphic presentation of cancer patterns in these 105 centres is given in Chapter 7. This report is the culmination of sustained interest and efforts made by these participating centres.

The reference manual - Cancer Incidence in Five Continents (Parkin et al, 2002) was used to group neoplasms by site (WHO, ICD-10, 1994), calculate incidence rates and determine leading sites of cancer. The Census of India publications gives the population according to five-year age group and gender by district. As per the 2001 census results, there were 593 districts in the country. Information on cancer cases also gives the name of the district for each case, apart from age, gender, site and type of cancer.

Cancer incidence is generally expressed as age-adjusted or age standardized (according to world population) incidence rate per 100,000 persons. Therefore, the district was taken as a unit for calculation of incidence rates, with one difference. Unlike the regular age adjusted incidence rates (AAR) used in PBCRs throughout the world, minimum age adjusted incidence rates (MAAR) based on microscopically diagnosed cancers of the districts is used here.

The most recent data (1997-99) from the established population based cancer registries (PBCR) is included for description and comparison. The MAAR of cancer (for microscopically diagnosed cases) in these PBCRs was also calculated so as to have a benchmark for analysis, and, as a baseline for comparison with the MAAR of the districts. Under the NCRP, the population based cancer registry at Barshi is the only registry as of now, that has given incidence rates representative of the rural population in the country. Majority of the districts in the country has predominantly semi-urban or rural population. The MAAR for Barshi (all sites) for the period 1997-99, is 36.21 and 45.02 per 100,000 for males and females respectively. Thus the MAAR of 36.2 has been used as the cut off level to select districts for observing and compare cancer incidence and patterns. In all there were 82 districts that had a MAAR higher than 36.2/100,000 for at least one of the two years (2001 or 2002) and in either sex.

The information on cancer cases obtainable from a specified district and the calculation of incidence rates (in this instance the MAAR of at least 36.2/100,000) to be usable or workable for measuring and depicting patterns of cancer in that district depends on a number of factors. The availability and accessibility of nearby facilities for cancer diagnosis and treatment is the most important. The participation in this project of centre or centres is crucial. If there is just one comprehensive centre in a region and that centre collaborates in the project then the chances of receiving information on almost all cancer cases in those districts is high. This becomes reflected in the MAAR. All the eleven cancer registries under the NCRP and the other Hospital and Population Based Cancer Registries (not as yet under the NCRP network) have contributed to the project. Since nearly all of these registries are located at established regional cancer centres the districts served by them are suitably represented. In addition, centres like the Tata Memorial Centre, Mumbai and Cancer Institute, Chennai draw patients from several other parts of the country. On the other hand, if there are several cancer diagnosis and treatment facilities in a particular area and only some of the centres are collaborating in the project, then the chances of the information on cancers giving practicable MAAR are slim. The literacy and the general health awareness of the population are among other factors that could contribute to the extent of coverage of data on cancers.

In all there were 82 districts that had incidence rates (MAAR) higher than 36.2/100,000 for at least one of the two years (2001 or 2002) and in either sex. Of the six PBCRs under NCRP, in males, Delhi PBCR had the highest MAAR of 103.0/100,000 for all sites (ICD-10: C00-C96) of cancer. There were ten districts under the project that had a MAAR higher than that of Delhi. These included six districts in Mizoram State, one in the state of Kerala, North and South Goa, and Chandigarh. Among the urban PBCRs, Bangalore had the lowest MAAR of 75.1 per 100,000. There were eight districts that were above this MAAR but below that of Delhi, PBCR. The remaining fifty-one districts listed had MAAR lower than the urban PBCRs but above that of the rural PBCR at Barshi. Among females, Delhi PBCR had the highest MAAR of 113.9/100,000. There were four districts that had MAAR higher than this. These were in Mizoram State (three districts) and Chandigarh. Among the urban PBCRs, Bhopal PBCR had the lowest MAAR of 94.0/100,000. There were three districts that had a higher MAAR than that of Bhopal. There were forty-four districts that had a MAAR above that of Barshi PBCR, which in females was 45.0/100,000.

Chapter 6 furnishes a summary of important specific sites of cancer. It is the key chapter that presents the essential results and outcome of this project. It acts as a ready reckoner, for comparison of the MAARs of the districts with that of the PBCRs and of international and national AARs as well. Highlights of some sites are given below.

Tongue- Males: Bhopal, PBCR has an AAR of 10.9 and Ahmedabad urban registry has also a high AAR of 9.3/100,00. The district of Aizawl in Mizoram State, has a slightly higher MAAR compared to Bhopal, PBCR. There are several districts throughout the country that have a higher MAAR compared to the urban PBCRs. Of particular importance seems to be the State of Gujarat. Several districts (Mahesana, Gandhinagar, Kheda, Ahmedabad, Anand, Bhavnagar, Sabarkantha and Banaskantha) show high incidence rates of tongue cancer.

Mouth - Males: Again Bhopal, PBCR has a high AAR of 9.6/100,000. There were five districts that had a higher MAAR than that of Bhopal, PBCR. Wardha district in Maharashtra State has a MAAR of 14.1. Of the other four districts that had a higher MAAR than Bhopal, two were in Tamil Nadu State and two in Kerala State. At least twentysix other districts across the country had a higher MAAR than that of the other PBCRs. Other than several districts in Tamil Nadu State, many districts in Assam State (Kamrup, Goalpara, Darrang, Nalbari, Marigaon, Jorhat) showed a high MAAR.

Hypopharynx - Males: Among the PBCRs the AAR of cancer of the hypopharynx is high in Bhopal and Ahmedabad urban PBCR. Aizawl district in Mizoram State had a higher MAAR (16.1/100,000). Besides, numerous districts in Assam State (Dibrugarh, Kamrup, Darrang, Jorhat, Nalbari, Golaghat, Barpeta, Sibsagar, Goalpara to name a few) had high incidence rates.

Oesophagus - Males: The urban PBCRs have AARs varying from 6.3 to 10.3/100,000. The district-wise comparison of MAAR showed that Aizawl had a higher MAAR (26.7/100,000). Several districts especially in Assam and Karnataka State had MAAR comparable with the rates in the urban PBCRs. The districts of North and South Goa also had high MAARs.

Stomach - Males: Among males, Chennai and Bangalore PBCRs have had cancer stomach as the leading site of cancer since the commencement of the NCRP in 1982. But the AARs in these urban areas have been much lower than that seen in Japan or in other high incidence areas of the world. The district wise comparison of MAARs with that of Chennai and Bangalore showed that the district of Sercchip in Mizoram State had eight and a half times higher rate of stomach cancer than that of Chennai. Several districts in the North Eastern states of Mizoram, Nagaland, Manipur and Sikkim had MAARs equivalent to the AARs of high incidence regions of the world.

Gall Bladder - Females: Delhi females have shown a high incidence rate (AAR: 10.6/100,000) of cancer of the gall bladder. The district-wise comparison showed that Imphal East and West districts of Mizoram State and the Union Territory of Chandigarh had comparable incidence rates.

Lung - Males: The district-wise figures revealed that Aizawl in Mizoram State and Imphal West in Manipur State, had 1½ times the MAAR of the highest urban PBCR - Delhi (11.5/100,000). Further nine other districts had MAARs higher than the MAAR of Delhi.

Lung - Females: Except in Mumbai PBCR, cancer of the lung in females has not been a leading site of cancer in women, in the PBCRs under NCRP. Even the rate (AAR of 4.2/100,000) in Mumbai is lower than that seen in Indians in Singapore and in other women in areas of high incidence in the world. Observation of the MAARs in the districts showed that Aizawl women had almost ten times (26.2 compared to 2.8/100,000) the MAAR of women in Mumbai. Imphal West and East in Mizoram State and South Goa had much higher MAARs than that seen in Mumbai.

Breast - Females: Cancer of the breast has been replacing cancer of the cervix as the leading site of cancer in all urban PBCRs, except Chennai and the AARs of this site of cancer have also been on the rise. Among the Indian PBCRs, Delhi has the highest AAR of breast cancer. At least four districts led by Chandigarh (followed by North Goa, Aizawl in Mizoram State and Panchkula in Haryana State) had higher MAAR than that of Delhi. The rates were also similar in South Goa and three districts (Kollam, Thiruvananthapuram, Thrissur) in Kerala State.

Cervix Uteri: Chennai PBCR has had the highest incidence rate of cervical cancer among the Indian PBCRs. The district-wise MAARs indicate a region of high incidence rates even higher than Chennai in the North Eastern districts of Tamil Nadu State including Pondicherry which had the highest MAAR of 39.2/100,000.

Penis: In the Indian PBCRs penile cancer has been high in Chennai and Barshi. A high incidence of penile cancer was seen in the north eastern districts of Tamil Nadu and Villupuram district had a high MAAR of 3.1/100,000.

Thyroid - Females: Of the PBCRs under NCRP, Bangalore PBCR has shown the highest AAR of cancer of the thyroid. The PBCR at Thiruvananthapuram has shown a high incidence of cancer of the thyroid where it is the third leading site of cancer. Similarly, the district-wise distribution showed a higher MAAR in Thiruvananthapuram district, with a belt of high incidence right from the southern tip of the country - Kanniyakumari in Tamil Nadu State along the coast of the States of Kerala and Karnataka extending on to South Goa.

Limitations of the Report

A massive exercise such as this project on developing an atlas for cancer in a vast country like India with varied types of populations, differing literary and socioeconomic status has its limitations.

Coverage: The coverage of the 35 states and union territories of the nation is far from complete. In several states such as UP, Bihar, Jharkand, Chattisgarh etc. there were hardly any districts where there was information on cancer cases based on which the patterns could be described. Even in some of the comparatively 'better covered' states the cancer patterns could not be characterized in several districts in each of these states. In brief, in only 82 of the 593 districts, a picture of the incidence and pattern of cancer could be provided. This is one of the main reasons why this project needs continuity.

Measurement based on Minimal or Microscopic Age Adjusted Incidence Rates: The fact that only Minimal Age Adjusted Incidence Rates (MAAR) in exchange for the standard Age Adjusted Incidence Rates (AAR) was provided is the other major limitation. Thus, no active effort could be made to get the cases of cancer diagnosed through means other than microscopic. This would have required lot more resources and involvement of several additional clinical departments and personnel therein in each collaborating institution. The advantages of using MAAR are that core information on microscopically confirmed cases can be obtained from a single source within a hospital and therefore with minimal cost and effort. Moreover, microscopy is the basis of diagnosis and treatment of cancer. The other advantage of a pathology based approach was the chances of including prevalent cases are less likely. In a population based approach, there are more chances of including old cases especially in the first year of operation. Obtaining details of cancer cases diagnosed through other means requires scrutiny of records in multiple departments, critical review of the same by a medical person or a trained tumour registrar, with at times further clarification from the treating clinician before arriving at a final diagnosis of cancer. All this involves, especially in the Indian set-up, considerable time, effort, cost and expertise. Cancer registries under the NCRP as in registries elsewhere in the world include cases with cancer as a diagnosis on the death certificates that are not matched with registered incident cases. Such cases are categorised as cases diagnosed through 'Death Certificate Only' (DCO). Collation of mortality data and identifying mortality records with cancer as an antecedent or associated cause is a major exercise of population based cancer registries. The second factor in providing only MAAR was incomplete coverage of the specific geographic area. Unlike the working of PBCRs, no systematic attempt was made to actively visit every diagnostic and treatment centre in the region to record all diagnosed/treated cancers. Therefore, while the MAAR provides a ready and quick assessment of the burden of cancer it is an underestimate of the actual incidence of cancer in that specific population or geographic area.

All in all, the incidence rates provided are truly minimal. But what makes this information valid whether for scientific or administrative purposes?

First and 'fortunately' in our country for the disease - cancer, an established network of cancer registries (under the NCRP and others) is functioning for over 20 years. These registries have established over the years, not only sound functioning, but also provided consistent internationally accepted incidence rates and patterns of cancer albeit in few centres. Thus, a baseline data is available for ready comparison. Second, the system of registration and certification of cause of death in our country does not help in providing reliable cancer specific mortality rates to assess incidence or patterns of cancer in the country. Third, the medical information (as represented by the patient medical records) in most institutions in our country are inadequate to provide information on disease, especially on a population basis. Hence the need for special efforts to create and develop a system of specific disease registers - whether for research, administration or disease control. A scheme that will sustain and furnish the required information for all of the aforementioned reasons is essential.

Cost

Advances in electronic information technology have to be harnessed to deliver quality and complete valid data. The project was extremely cost-effective. The amount spent per cancer case under the PBCRs of the ICMR is on the average Rs 350 for the urban areas and Rs 4,500 for the rural registry. Under this Project the cost per case worked out to approximately Rs 24.

After all, in this study the MAAR was found to be a fairly dependable cost effective measure of incidence and patterns of cancer in diverse districts of the country. Since several parts show minimum incidence rates higher than that observed in the established registries there appears a need for a pragmatic appraisal of the utility and validity of MAARs in the Indian context.

Future Scope of the Project

The advent of Information Technology (IT) has had its impact in several fields. In a developing country like India, its reach in the health sector has been visible in components of diagnostic reports and as part of patient management tools, especially in the private sector. The diffusion of IT has, however, been negligible in gathering health information or consolidating existing information to either influence health care delivery or foster health informatics as an instrument towards disease control or research.

The reasonably successful outcome of this project opens the doors for manifold possibilities. Some of those, which are of direct relevance to this study, are outlined below.

A. On-line dynamic generation of Incidence Rates

During the next few months a plan has been drawn to make available the basic incidence tables and map dynamically on the web-site. The completeness and validity of this information would of-course depend on the speed and promptness with which centres transmit data.

B. Increase Coverage - Establishing Descriptive Cancer Epidemiology

1. More areas and States especially in the North, East and West have to be covered. There are 593 districts in the country and comparable incidence rates and patterns could be estimated in only 82 districts leaving vast portions uncovered;
2. Some of the states and union territories have the scope of having a cancer map to cover the entire state with additional yet minimal efforts;
3. Verification and stability of incidence rates so determined in the existing districts;
4. Derivation of more localized incidence rates at the tehsil/taluk levels;
5. Institute full fledged Population Based Cancer Registries in identified areas;

C. Based on the findings of this study a variety of Analytic Epidemiological studies with laboratory component can be done in the respective areas

D. Pathological Studies

If pathology is the basis of diagnosis of cancer the pathologist has been the basis of the success of this project. Therefore, for the pathologist, there are several uses and extended uses of this project with specific use of the web. Apart from have a ready analysis of cancers by type and morphology, the canceratlasindia web-site could be well utilised for exhibiting microphotographs of unusual cancer cases or diagnostic problems or for standardisation of morphological diagnosis. The website could also be used to study morphological patterns as related to prognosis and such studies could be undertaken relatively easily in collaboration with several institutions.

E. Patterns of Cancer Patient Care and Survival

The concept of using a web-site for gathering information and the internet as a medium of transmission has also found application in the study on "Patterns of Cancer Patient Care and Survival" for specific sites of cancer.

F. Cancer Control and Health Services Research

The cancer registry is central to any rational programme on control of cancer (Muir C.S.1985). So the cancer data through the cancer atlas could act as critical baseline information for monitoring and evaluation of cancer control programmes.

G. Initiation and Development of the new field of Health Informatics with specific reference to cancer and cancer research

Conclusion

One may emphasize that this is the first outcome of a two-year activity using a hitherto untried methodology. Consistency of methods and continuity over time, are essential components that need to be maintained.

In conclusion three essential features stand out:

1. The results presented throw a whole new set of cancer incidence and patterns demonstrating the immense potential of the system and the numerous possibilities for cancer research and control. It has identified hot spots of high incidence, recognised belts of geographic areas with specific types of cancer and discerned likely zones for establishing population based cancer registries.
2. The project was extremely cost-effective.
3. The concept of using web-based design and approach with on-line transmission of cancer data has worked - a major advance for using Information Technology in Medicine - Measuring Disease Burden and Health Informatics.

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Appendix I

DEVELOPMENT OF AN ATLAS OF CANCER IN INDIA

A Project of the NCRP - ICMR Supported by the WHO

Core Proforma

1. NAME OF PARTICIPATING CENTRE: CENTRE CODE: ☐☐☐

   Name of Other Institution *(if from other source)*

2. REGISTRATION NUMBER:..... ☐☐☐☐☐☐

3. HOSPITAL REGISTRATION NUMBER:..... ☐☐☐☐☐☐

4. FULL NAME OF PATIENT:

5. AGE (in years):..... ☐☐ GENDER: *(Tick ✓ one)* Male ☐ Female ☐

6. NAME OF FATHER: _____ NAME OF MOTHER: _____

   NAME(S) OF SON(S): _____

7. NAME OF HUSBAND/WIFE: _____

   NAME(S) OF DAUGHTER(S): _____

8. PLACE OF RESIDENCE:

Permanent Address

Urban Areas (Towns/Cities)

House No:

Road/Street Name: _____

Area/Locality: _____

Town/City: _____

Non-urban/Rural Areas

Name of Gram Panchayat/Village, etc:

_____

Name of Sub-Unit of District (Taluk/Tehsil/Other):

_____

Name of District (IN CAPITALS): _____

Postal Pin Code..... ☐☐☐☐☐☐

Duration of Stay (in years) at Permanent Address..... ☐☐

Telephone No (if any):

Local Address (if any, for non-resident patients) - record below as per details above

9. Relationship of Respondent (regarding Information on Items 1-8 above) to Patient? *(Tick ✓ one)*

(1) Self (Patient) ☐ (2) Family Member ☐

(3) Friend ☐ (4) Others (specify) ☐

10. Type of Microscopic Slide *(Tick ✓ one)*

(1) Histopathology ☐ (2) Blood Smear ☐

(3) Bone Marrow Smear ☐ (4) Cytology Smear ☐

(5) FNAC Smear ☐ (6) Other ☐

Pathology / Slide No(s).

11. Anatomical Site of Specimen/Biopsy/Smear: _____

12. Complete Pathological Diagnosis

Primary Site of Tumour - Topography: _____

(include sub-site if any)

Morphological Diagnosis: _____

13. Coding According to ICD-O-3

Primary Site of Tumor - Topography:..... ☐☐☐☐

Primary Histology - Morphology:..... ☐☐☐☐☐☐

If morphology is that of metastasis mention Primary Site above and

Secondary Site of Tumour (Site of Biopsy/Smear):..... ☐☐☐☐

Morphology of Metastases:..... ☐☐☐☐☐☐

If the morphology diagnosis is only that of metastatic site, mention the Primary Site as taken by the treating clinician either through discussion or from case record

14. Date of Report:..... ☐☐☐☐☐☐

If there is an earlier report of malignancy in the same patient mention that date as well or attach another form

15. Name of Person Completing Form (In Capitals): _____

16. Signature: Date:..... ☐☐☐☐☐☐

d d / m m / y y

Appendix II

Definitions, Statistical terms and Methods used in Calculations

Cancer Case: All neoplasms with a behaviour code of '3' as defined by the International Classification of Diseases – Oncology, (Third edition, WHO, 2000) are considered reportable and therefore registered.

Age-Group: The age groups used for estimating populations as well as grouping cancer cases is as per the WHO guidelines which is 0-4, 5-9, 10-14….75+. According to the same definition the age group 0-14 constitutes childhood cancer.

Incidence: Cancer incidence denotes new cases diagnosed in a defined population in a specified time period. For this report all cancer cases diagnosed from 1 January 2001 to 31 December 2002 in the different geographic areas covered by the different districts are included.

Rates: Rates for cancer are always expressed per 100,000 population. For childhood cancer this may be expressed as per one million, but the latter is not used in this report.

Crude Incidence Rate (CR): This refers to the rate obtained by division of the total number of cancer cases by the corresponding estimated population (mid-year) for that respective geographic area and multiplying by 100,000.

$$CR = \frac{\text{New cases of cancer of a particular year}}{\text{Estimated population of the same year}} \times 100{,}000$$

Age Specific Rate (ASpR): This refers to the rate obtained by division of the total number of cancer cases by the corresponding estimated population in that age group and sex/site/geographic area/time period and multiplying by 100,000.

$$ASpR = \frac{\text{New cases of cancer of a particular year in the given age group}}{\text{Estimated population of the same year for the given age group}} \times 100{,}000$$

Age Adjusted or Age Standardised Rate (AAR): Most cancers increase to occur as age increases. Therefore the higher the proportion of older population the higher the number of cancers. Most developed and western countries have a higher proportion of older population. So in order to make rates of cancer comparable between developed and developing countries a world standard population that takes this into account is used to arrive at age adjusted or age standardised rates. The world standard population approximates the proportional age distribution of the world. The AAR in this report is calculated according to the direct method (Boyle and Parkin, 1991) by obtaining the age specific rates and applying these rates to the standard population in that age group.

$$AAR = \frac{\sum_{i=1}^{A} a_i \, w_i}{\sum_{i=1}^{A} w_i}$$

where:

a_i is the age specific rate (AspR) in age class i;

w_i is the standard population in age class i;

A represents the number of age intervals.

Or expressed in more simpler terms thus:

$$AAR = \sum \frac{(ASpR) \times (\text{No. of persons in Std. world population in that 5 yr. age group})}{100{,}000}$$

Census and Population Estimation

The five year age group populations of 1991 and Total Population of 2001 census have been used in this report to calculate the estimates of population for the years 2001 and 2002.

The major source of information for population analysis is census data. The term census is often used to denote population counts of all kinds. A census is an enumeration at a specified time of individuals inhabiting a specified area, during which particulars are collected regarding age, sex, marital status, occupation, religion etc. In most countries of the world, population census is undertaken generally at ten year intervals. In India, the census count was taken hitherto as of sunrise on 1st March every year.

The fundamental deficiency of the census method is that it is impossible to get intercensal years information. As population is liable to change every instant due to birth, death, immigration and emigration, the population at any given time period can only be obtained as an estimate. Population estimation is possible for the year which falls in between two-census dates (i.e.) atleast two census information should be known. Most annual rates are computed by using the population estimate referring to 1st July (Mid-Year Population).

Each census data has age distribution starting from 0-4, 5-9,..... ANS. The ANS is the column where age not specified. While estimating population ANS is also estimated, but for calculating rates such as CR and AAR, ANS is completely omitted.

We have different methods for making population estimates of which most commonly used method is Arithmetic Progression method.

Increase in 10 year = Census Population 2001 — Census Population 1991

In this method it is assumed that the population increases or decreases by a constant figure year to year, between any two census years. This assumption however need not be correct. Nevertheless, the method has simplicity and the estimates have been checked by actual surveys to be reasonably correct.

Here we use the method, which is similar to Arithmetic Progression method. The difference between the population figures of the two census gives the total increase of the population in ten years. Assuming the same relative proportion of five-year age group of census 1991 population to 2001, we estimate five-year age group for 2001. Then dividing the product of the difference value between census 2001 and 1991 and estimated five-year age group of 2001 by 100 gives the 10-year increase for each specific age group.

$$\text{10 year increase in 1991 census} = \text{Relative proportion of 1991 for each specific age group} \times \frac{\text{Census Population of 2001} - \text{Census Population of 1991}}{100}$$

From 10-year increase, 4-month increase in population can be obtained by multiplying with 4/120.

4 month increase = 10 year increase × (4/120)

Then the addition of 10 year and 4 month increase to census 1991 population gives the mid-year 2001 population.

Mid-year 2001 estimated population = Census 1991 + 10 yr increase in population + 4 month increase in population

Similarly 16-month increase in population is obtained by multiplying 16/120 to 10 year increase population.

16 month increase = 10 year increase × (16/120)

The addition of 10 year and 16 month increase population to census 1991 gives the mid-year 2002 population.

Mid-year 2002 estimated population = Census 1991 + 10 yr increase in population + 16 month increase in population

Assuming that this annual and monthly change occurs uniformly, we calculate the growth of the population from the last census to the time when the estimate is required. This method can also be used to estimate the population of any year after the last census.

Appendix III

List of Topography sites with ICD-10 code with mode of grouping for determining leading sites of cancers and acronyms used in figures of bar charts.

Site Code (ICD-10)	Topography Site Name	Grouped Name	Acronym
C00	Malignant neoplasm of lip	Lip	Lip
C01	Malignant neoplasm of base of tongue	Tongue	Tongue
C02	Malignant neoplasm of Other and unspecified parts of tongue		
C03	Malignant neoplasm of gum	Mouth	Mouth
C04	Malignant neoplasm of floor of mouth		
C05	Malignant neoplasm of palate		
C06	Malignant neoplasm of other and unspecified parts of mouth		
C07	Malignant neoplasm of parotid gland	Salivary glands	Salivary Gl.
C08	Malignant neoplasm of other and unspecified major salivary glands		
C09	Malignant neoplasm of tonsils	Tonsils	Tonsil
C10	Malignant neoplasm of oropharynx	Other Oropharynx	Oth. Oroph.
C11	Malignant neoplasm of nasopharynx	Nasopharynx	Nasopharynx
C12	Malignant neoplasm of pyriform sinus	Hypopharynx	Hypopharynx
C13	Malignant neoplasm of hypopharynx		
C14	Malignant neoplasm of other and ill-defined sites in the lip, oral cavity and pharynx	Pharynx unspecified	Pharynx Uns.
C15	Malignant neoplasm of oesophagus	Oesophagus	Oesophagus
C16	Malignant neoplasm of stomach	Stomach	Stomach
C17	Malignant neoplasm of small intestine	Small Intestine	Small Intestine
C18	Malignant neoplasm of colon	Colon	Colon
C19	Malignant neoplasm of rectosigmoid junction	Rectum	Rectum
C20	Malignant neoplasm of rectum		
C21	Malignant neoplasm of anus and anal canal	Anus etc	Anus
C22	Malignant neoplasm of liver and intrahepatic bile ducts	Liver	Liver
C23	Malignant neoplasm of gallbladder	Gallbladder etc	Gallbladder
C24	Malignant neoplasm of other and unspecified parts of biliary tract		
C25	Malignant neoplasm of pancreas	Pancreas	Pancreas
C26	Malignant neoplasm of other and ill defined digestive organs	Others & Unspecified	O&U
C30	Malignant neoplasm of nasal cavity and middle ear	Nose, Sinuses etc	Nose
C31	Malignant neoplasm of accessory sinuses		
C32	Malignant neoplasm of larynx	Larynx	Larynx
C33	Malignant neoplasm of trachea	Lung etc	Lung
C34	Malignant neoplasm of bronchus and lung		
C37	Malignant neoplasm of thymus	Other thoracic organs	Oth. Tho. Org
C38	Malignant neoplasm of heart, mediastinum and pleura		
C39	Malignant neoplasm of other and ill-defined sites in the respiratory system and introthrocic organs	Others & Unspecified	O&U
C40	Malignant neoplasm of bone and articular cartilages of limbs	Bone	Bone
C41	Malignant neoplasm of bone and articular cartilages of other and unspecified sites		
C43	Malignant melanoma of skin	Melanoma of skin	Melanoma of skin

Site Code (ICD-10)	Topography Site Name	Grouped Name	Acronym
C44	Other malignant neoplasms of skin	Other skin	Other skin
C45	Mesothelioma	Mesothelioma	Mesothelioma
C46	Kaposi sarcoma	Kaposi sarcoma	Kaposi sarcoma
C47 C49	Malignant neoplasm of of peripheral nerves and autonomic nervous system Malignant neoplasm of other connective and soft tissue	Connective and soft tissue	Conn. Tissue
C48	Malignant neoplasm of retroperitoneum and peritoneum	Others & Unspecified	O&U
C50	Malignant neoplasm of breast	Breast	Breast
C51	Malignant neoplasm of vulva	Vulva	Vulva
C52	Malignant neoplasm of vagina	Vagina	Vagina
C53	Malignant neoplasm of cervix uteri	Cervix Uteri	Cervix Uteri
C54	Malignant neoplasm of corpus uteri	Corpus Uteri	Corpus Uteri
C55	Malignant neoplasm of uterus, part unspecified	Uterus unspecifed	Uterus Uns.
C56	Malignant neoplasm of ovary	Ovary	Ovary
C57	Malignant neoplasm of other and unspecified female genital organs	Other female genital organs	Oth. Fem. Gen.
C58	Malignant neoplasm of placenta	Placenta	Placenta
C60	Malignant neoplasm of penis	Penis	Penis
C61	Malignant neoplasm of prostate	Prostate	Prostate
C62	Malignant neoplasm of testis	Testis	Testis
C63	Malignant neoplasm of other and unspecified male genital organs	Other male genital organs	Oth. Male Org.
C64	Malignant neoplasm of kidney, expect renal pelvis	Kidney	Kidney
C65	Malignant neoplasm of renal pelvis	Renal pelvis	Renal Pelvis
C66	Malignant neoplasm of ureter	Ureter	Ureter
C67	Malignant neoplasm of bladder	Bladder	Bladder
C68	Malignant neoplasm of other and unspecified urinary organs	Other urinary organs	Oth. Uri. Org.
C69	Malignant neoplasm of eye and adnexa	Eye	Eye
C70 C71 C72	Malignant neoplasm of meninges Malignant neoplasm of brain Malignant neoplasm of spinal cord, cranial nerves and other parts	Brain, Nervous system etc	Brain, NS.
C73	Malignant neoplasm of thyroid gland	Thyroid	Thyroid
C74	Malignant neoplasm of adrenal gland	Adrenal gland	Adrenal Gland
C75	Malignant neoplasm of other endocrine glands and related structures	Other endocrine	Oth. Endocrine
C76	Malignant neoplasm of other and ill -defined sites	Others & Unspecified	O&U
C81	Hodgkin's disease	Hodgkin's disease	Hodgkins Dis.
C82 C83 C84 C85 C96	Follicular (nodular) non-Hodgkin's lymphoma Diffuse non-Hodgkin's lymphoma Peripheral and cutaneous T-cell lymphomas Other and unspecified types of non-Hodgkin's lymphoma Other and unspecified Malignant neoplasms of lymphoid, haematopoietic and related issue	Non-Hodgkin's lymphoma	NHL
C88	Malignant immunoproliferative diseases	Immunoproliferative diseases	Imm. Dis.
C90	Multiple myeloma and malignant plasma cell neoplasms	Multiple myeloma	Multi. Myel.
C91	Lymphoid leukaemia	Lymphoid leukaemia	Lymph. Leuk.
C92 C93 C94	Myeloid leukaemia Monocytic leukaemia Other leukaemias of specified cell type	Myeloid leukaemia	Myel. Leuk.
C95	Leukaemia of unspecified cell type	Leukaemia unspecified	Leuk. Uns.

Appendix IV

List of States/Union Territories with code (according to Census of India, 2001) and acronyms used in figures of bar charts against names of districts.

State Code	Name of State/Union Territory*	Acronym
1	Jammu & Kashmir	JK
2	Himachal Pradesh	HP
3	Punjab	PB
4	Chandigarh *	CH
5	Uttaranchal	UL
6	Haryana	HR
7	Delhi *	DL
8	Rajasthan	RJ
9	Uttar Pradesh	UP
10	Bihar	BH
11	Sikkim	SK
12	Arunachal Pradesh	AR
13	Nagaland	NL
14	Manipur	MR
15	Mizoram	MZ
16	Tripura	TR
17	Meghalaya	MG
18	Assam	AS

State Code	Name of State/Union Territory*	Acronym
19	West Bengal	WB
20	Jharkhand	JH
21	Orissa	OR
22	Chhatisgarh	CG
23	Madhya Pradesh	MP
24	Gujarat	GJ
25	Daman & Diu *	DD
26	Dadra & Nagar Haveli *	DN
27	Maharastra	MH
28	Andhra Pradesh	AP
29	Karnataka	KA
30	Goa	GA
31	Lakshadweep *	LK
32	Kerala	KL
33	Tamil Nadu	TN
34	Pondicherry *	PY
35	Andaman & Nicobar Islands *	AN

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