

## **Original Article-III**

---

# Trends in Cumulative Risk For Life Time Development of Tobacco Related Cancers in India During 1982 to 2000

---

L. SATYANARAYANA, SMITA ASTHANA, K.C.SHARMA

---

### **ABSTRACT**

**Objective:** We studied trends in cumulative risk of developing Tobacco Related Cancers (TRC) in India during the years 1982 to 2000 .

**Method:** Data on age-specific cancer incidence rates of tobacco related cancers (TRC) were collected from National Cancer Registry Programme (NCRP) reports of population based cancer registries (PBCRs) from various cities of India. (Mumbai, Chennai, Bangalore, Bhopal, Delhi and Barshi) from 1982 or 1988 to 2000. Cumulative risks were computed using incidence rates from zero to 64 years of age for either sex in different registries for TRC sites. Trends were studied using linear regressions. Then the risk percents were converted into one in number of persons developing cancer and reported for the recent year of 2000.

**Results:** For the year 2000, the cumulative risk of TRC among males ranges from 0.96 percent in Barshi to 3.82% in Bhopal. The risk for females ranges from 0.47% in Barshi to 1.5% in Chennai. The risks of developing TRC are 1 out of 26 males in Bhopal and 1 out of 104 males in Barshi. For females, the risks are 1 out of 67 in Chennai and 1 out

of 213 in Barshi. The proportion of TRC risk out of all cancers is from 36.9% in Barshi to 56.9% in Bhopal among males. For females it ranges from 10.3% in Delhi to 16.8% in Chennai. Among Males, significant increasing trends observed for urinary bladder (Mumbai), esophagus (Chennai), Lip (Bhopal) and Mouth (Delhi). Significant increasing trends of TRC among females were for Lung (Bangalore, Chennai, Mumbai), urinary bladder (Mumbai, Barshi), oropharynx (Bangalore), hypopharnx (Bangalore) and Larynx (Bhopal).

**Conclusion:** Expand is much higher for males compared to females. Significant positive and negative trends were observed for various TRC sites in different registries. Trend evaluation of cumulative risks facilitates understanding of the changes in magnitude of cancer risk. However, changes in life time risk of developing cancer is likely to be affected by changes in risk factors, disease detection practices and aging of the population.

### INTRODUCTION

Seventeen million new cases of cancer are expected world wide by 2020 with three fourth of the cancer related deaths occurring in the developing part of the world.<sup>1</sup> It is well known that tobacco is the most important cause of avoidable cancer morbidity and early cancer mortality. WHO estimates that one out of two young people who start smoking and continue smoking throughout their lives will succumb to

---

Department of Epidemiology and Biostatistics Institute of Cytology and Preventive Oncology (ICMR) I-7, Sector-39, Noida (Uttar Pradesh) India.

Correspondence to : L. SATYANARAYANA  
E-MAIL: labanish@hotmail.com

tobacco related illness.<sup>2</sup> Tobacco-attributable mortality is projected to increase from 3.0 million in 1990 to 8.4 million in 2020 (9% of the world mortality burden).<sup>3</sup> In India the proportion of tobacco related cancers relative to all cancers ranges from 35% in Bangalore to 50% in Bhopal among males.<sup>4</sup> Cancers caused due to tobacco smoking are lung, urinary bladder, oral cavity (mouth and tongue), sino-nasal cavity, naso-pharynx, oro-pharynx, hypo pharynx, larynx, pancreas, esophagus, stomach, liver, uterine cervix and myeloid leukemia. Cancers of oral cavity, oro-pharynx, and esophagus are known to cause due to use of smokeless tobacco.<sup>5</sup> Lung cancer is one of the most common tobacco related cancer (TRC) diagnosed globally.<sup>6</sup> India's first cancer atlas shows that some parts of India have the world's highest incidence of another TRC viz., cancer of mouth.<sup>7</sup> Study of trends in tobacco related cancers would be of great help in planning the cancer control programs. There are studies<sup>8,9</sup> on trend analysis of cancer incidence rates of tobacco related and various other sites for Mumbai in India. Such analysis provides annual percent change in cancer incidence. Cumulative risk, an incidence rate based indicator is one of the important statistics and easily understandable. Trend assessment of cumulative risk gives the rate of change in risk. It is well-known that age-standardized incidence rates are very informative. The risk statistics is not a replacement of incidence rate. Nevertheless, when the risks are computed for various years their significance in trend should also be evaluated for risks. This communication attempts to report trends in cumulative risks for Tobacco related cancers.

## METHODS

The data for this study on Tobacco Related Cancers (TRC) were obtained from Indian National Cancer Registry Programme (NCRP) population based reports.<sup>4,10-12</sup> The NCRP brings out a comprehensive annual report containing various data summaries such as incidence rates

and mortality rates. The availability of data in different cities of the country is dependent on the initiation of the registry in a particular area. Data for the years 1982 to 2000 are available for Mumbai, Chennai and Bangalore. For Bhopal, Delhi and Barshi (rural registry) data were available from the year 1988. Tobacco related cancer incidence rates among males and females are considered for computation of cumulative risk. Age-specific annual cancer incidence rates from 0 to 64 years for either sex in different registries for various TRC sites were used for computations. The TRC sites<sup>13</sup> considered in this study were- lung (C33-34), esophagus (C15), hypo pharynx (C12-13), mouth (C03-06), Tongue (C01-02), Larynx (C32), urinary bladder (C67), oro-pharynx (C10), and lip (C00). Cumulative risks are computed using the following formula. Cumulative risk =  $100 \times [1 - \exp(-\text{cum.rate}/100)]$  where Cumulative rate =  $[5 \times \sum(\text{ASpR}) \times 100] / 100,000$  and ASpR is age specific incidence rate.

The trends among risks of developing cancer in different registries for each site were studied using linear regression analysis. Significance of the trend coefficients is assessed at 1% probability.

## RESULTS

The magnitudes of cumulative risks and their converted statistics as one in number of persons develop cancer were depicted in Table-1. The computed risks of TRC ranged from 0.96 percent in Barshi to 3.82% in Bhopal for males. The risk for females ranged from 0.47% in Barshi to 1.49% in Chennai. The risks of developing TRC were 1 out of 26 males in Bhopal to 1 out of 104 males in Barshi. Among females the risks were 1 out of 67 females in Chennai to 1 out of 213 in Barshi. The proportion of TRC risk out of all cancers was from 36.9% in Barshi to 56.9% in Bhopal for males. For females it ranged from 10.3% in Delhi to 16.8% in Chennai. Cumulative risk of TRC was much greater in males as compared to females.

**Table 1: Risk of developing Tobacco Related Cancers (TRC) among males and females for the year 2000 in India**

| Cancer Registry | MALES      |                      | FEMALES    |                      |
|-----------------|------------|----------------------|------------|----------------------|
|                 | Cum.risk % | Risk(1out of number) | Cum.risk % | Risk(1out of number) |
| Bangalore-TRC   | 2.13       | 47                   | 1.24       | 81                   |
| -AC             | 5.21       | 19                   | 8.0        | 13                   |
| TRC/AC%         | 40.9       | -                    | 15.5       | -                    |
| Barshi-TRC      | 0.96       | 104                  | 0.47       | 213                  |
| -AC             | 2.60       | 38                   | 3.46       | 29                   |
| TRC/AC%         | 36.9       | -                    | 13.6       | -                    |
| Bhopal-TRC      | 3.82       | 26                   | 1.15       | 87                   |
| -AC             | 6.71       | 15                   | 7.93       | 13                   |
| TRC/AC%         | 56.9       | -                    | 14.5       | -                    |
| Chennai-TRC     | 3.21       | 31                   | 1.5        | 67                   |
| -AC             | 7.27       | 14                   | 8.9        | 11                   |
| TRC/AC%         | 44.2       | -                    | 16.8       | -                    |
| Delhi-TRC       | 2.75       | 36                   | 0.89       | 112                  |
| -AC             | 6.45       | 15                   | 8.65       | 12                   |
| TRC/AC%         | 42.6       | -                    | 10.3       | -                    |
| Mumbai-TRC      | 2.53       | 40                   | 1.16       | 86                   |
| -AC             | 5.57       | 18                   | 7.57       | 13                   |
| TRC/AC%         | 45.4       | -                    | 15.3       | -                    |

Cum Risk%: Cumulative Risk percent, TRC: Tobacco related cancer, AC: All cancers  
Cumulative risk for all Cancers obtained from NCRP report.

Trend analysis is presented in Table-2 for females and in table 3 for males. The observations of cumulative risk trends those found to be statistically significant for each TRC site in different registries among males and females are described in the following paragraphs.

**Lung:** Risk for lung cancer among males did not show any significant change, while increasing trends were observed among females for Bangalore, Chennai and Mumbai registries.

**Esophagus:** This cancer is on decline in females of Mumbai and Bhopal and Delhi and in males

of Mumbai. there was increasing trend for this cancer among males in Chennai cancer registry.

**Hypopharynx:** This cancer showed declining trend in Mumbai for both sexes while increasing trends were observed for registry females in Bangalore.

**Mouth:** Risk for Mouth cancer was on decline for both sexes in Bangalore registry and for females in Chennai registry. There was an increasing trend for this cancer in Delhi males.

**Tongue:** Risk for this cancer was on decline in both sexes in Mumbai.

**Table-2. Significant Trends in cumulative risk for Tobacco related cancers among females for various registries in India during 1982-2000**

| REGISTRY  | POSITIVE (Increasing) TRENDS |        |        |         | NEGATIVE (Decreasing) TRENDS |         |         |          |
|-----------|------------------------------|--------|--------|---------|------------------------------|---------|---------|----------|
|           | SITE                         | trend  | pvalue | R-squar | Site                         | Trend   | P value | R-Square |
| Bangalore | Orophar                      | 0.0016 | 0.089  | 31.9    | Pharynx                      | -0.0013 | 0.075   | 34.4     |
|           | Hypophar                     | 0.0037 | 0.032  | 45.5    | Mouth                        | -0.023  | 0.02    | 45       |
|           | Lung                         | 0.0041 | 0.029  | 46.7    |                              |         |         |          |
| Barshi    | U.Bladder                    | 0.0037 | 0.053  | 76.4    |                              |         |         |          |
|           |                              |        |        |         |                              |         |         |          |
| Bhopal    | Larynx                       | 0.0059 | 0.042  | 79.6    | Oesophagus                   | -0.03   | 0.067   | 63       |
|           |                              |        |        |         | Oroph                        | -0.0061 | 0.083   | 68.7     |
| Chennai   | Lung                         | 0.0078 | 0.012  | 56.9    | Lip                          | -0.0012 | 0.013   | 55.8     |
|           |                              |        |        |         | Mouth                        | -0.015  | <0.001  | 87       |
|           |                              |        |        |         |                              |         |         |          |
| Delhi     |                              |        |        |         | Oesophagus                   | -0.009  | 0.034   | 76       |
|           |                              |        |        |         |                              |         |         |          |
|           |                              |        |        |         |                              |         |         |          |
| Mumbai    | Lung                         | 0.0078 | 0.058  | 37.9    | Hypop                        | -0.0045 | 0.053   | 39.2     |
|           | U.Bladder                    | 0.0019 | 0.056  | 38.4    | Oesophagus                   | -0.011  | 0.004   | 62       |
|           |                              |        |        |         | Tongue                       | -0.002  | 0.055   | 31       |

Larynx: Declining risk among males was observed in Barshi and Mumbai registry while it was increasing in Bhopal females.

Oropharynx: Declining trends for this cancer were observed in males in Bhopal and for males in Mumbai registry. Whereas for females in Bangalore registry there was an increasing trend.

Urinary Bladder: Increasing trends were observed for both sexes in Mumbai Cancer registry. There was increasing trends among females for this site in Barshi registry.

Lip: The risk of this cancer is on increase for Bhopal males and on decline for Chennai females.

**DISCUSSION**

Trends in cumulative risk of developing Tobacco related cancers were assessed. The data used for this purpose was from the reports of National Cancer Registry Programme, Indian Council of Medical Research (ICMR) which compiles data from various population based registries from India. The data from a recent NCRP report on North-eastern states of India are not included in the study. The quality of the registry data as such is reasonably good as demonstrated by various indicators for Mumbai registry.<sup>14</sup> We studied trends in an incidence-based statistic called cumulative risk. We attempted to estimate the cumulative risks for various Tobacco related cancers (TRC) and studied their trends during the year 1982-2000

**Table-3. Significant Trends in cumulative risk for Tobacco related cancers among males for various registries in India during 1982-2000**

| REGISTRY  | POSITIVE (Increasing) TRENDS |        |        |         | NEGATIVE (Decreasing) TRENDS |         |         |          |
|-----------|------------------------------|--------|--------|---------|------------------------------|---------|---------|----------|
|           | SITE                         | trend  | pvalue | R-squar | Site                         | Trend   | P value | R-Square |
| Bangalore |                              |        |        |         | Mouth                        | -0.009  | 0.024   | 43       |
| Barshi    |                              |        |        |         | Larynx                       | -0.008  | 0.08    | 59       |
| Bhopal    | Lip                          | 0.0026 | 0.071  | 71.4    |                              |         |         |          |
|           |                              |        |        |         | Orophar                      | -0.026  | 0.093   | 66.4     |
| Chennai   | Oesophagus                   | 0.009  | 0.013  | 50      |                              |         |         |          |
| Delhi     | Mouth                        | 0.003  | 0.089  | 56      |                              |         |         |          |
| Mumbai    | U.Bladder                    | 0.0043 | 0.099  | 30.3    | Hypopharynx                  | -0.017  | 0.015   | 49       |
|           |                              |        |        |         | Oesophagus                   | -0.015  | 0.001   | 76       |
|           |                              |        |        |         | Larynx                       | -0.008  | 0.013   | 51       |
|           |                              |        |        |         | Tongue                       | -0.008  | <0.001  | 90       |
|           |                              |        |        |         | Oropharynx                   | -0.0045 | 0.078   | 33.8     |
|           |                              |        |        |         | Pharynx                      | -0.0034 | 0.01    | 58.2     |

for various registries in India. Further, estimated risks in terms of one in number of persons developing cancer were presented.

A study of Greater Bombay carried out trend analysis for 30 cancer sites for both the sexes using age incidence data for the period 1968 to 1987.<sup>8</sup> So far Tobacco related cancers is concerned, this trend analysis showed a decline in trend for the cancers of the tongue, mouth, oropharynx, esophagus, and larynx in both sexes.

Recently, Mumbai Cancer Registry<sup>9</sup> estimated the time trends in the incidence and the risk of developing an oral cancer in Mumbai, for the 15-year period from 1986 to 2000. For evaluation of the trend, they applied a linear regression model based on the logarithm of the observed incidence rates. In males, a

statistically significant decreasing trend in the overall age-adjusted incidence rates was observed during the period 1986 to 2000. The probability estimates indicate that one out of every 57 men and one out of every 95 women will contract any oral cancer at some time in their whole life and 97% of the chance is after he or she completes the age of 40 years. A study on head and neck cancers showed decreasing trends of oral cancers in urban females and rural males in India.<sup>15</sup> In our study, mouth cancer was found to have declining trends in Bangalore registry among both males and females. In Chennai, among females also significant declining trends were observed for this site. Contrary to this Delhi registry showed an increasing trend in mouth cancer among males. This might be due to high tobacco use in this region.

A population based cancer registry in Spain<sup>16</sup> studied trends in smoking-related cancer incidence during 1980-96. It was observed that all smoking related cancers (combined) increased significantly for both sexes. No increase was observed for larynx and esophagus in men or women. In another study during the period 1979-2003, esophageal cancer showed a steady decrease in age-standardized incidence rates for both males and females in Hong Kong.<sup>17</sup> This finding was supported by our study with significant declining trends of esophagus cancer among both males and females in Mumbai and among females in Delhi and Bhopal. Chennai showed an increasing trend for esophageal cancer among males.

Population-based cancer registry in China,<sup>18</sup> studied the trends in incidence rates of the major cancer sites for a 25-year period, 1978-2002. The leading TRC sites reported were lung and esophagus. Lung cancer was shown to have increasing incidence during the study period. According to the present study the major TRC viz., lung cancer showed no significant change in trend among males. This finding of stationary high magnitude of TRCs among males despite increasing consumption of cigarettes demands an explanation. Contrary to this, Lung cancer among females showed significant upward trends. The reason could be that females were more susceptible for carcinogens of tobacco. Smoking is more prevalent among men than among women in India and women tend not to smoke but many use smokeless tobacco.<sup>1</sup> A recent epidemiological study on lung cancer and women showed that the patient population in lung cancer was changing from mostly male smokers to include women and non-smokers.<sup>19</sup> The study recommended for an urgent need to increase awareness and research funding for improving lung cancer care, particularly in women.

Tobacco use is highly prevalent in India.<sup>20</sup> High prevalence of tobacco is also seen among school students as observed from GYTS (Global Youth Tobacco Surveys) in India and various other countries. A primary prevention trial in Mumbai<sup>21</sup> showed a significant decline in incidence rates of leukoplakia with the increased prevalence of stoppage of tobacco use. A recent study on tobacco consumption and bladder carcinoma showed that the increase in incidence did not relate with higher tobacco consumption currently and attributed that it might be related with other genetic or environmental factors.<sup>22</sup>

Urinary bladder cancer data of Mumbai in our study showed increasing trends in both sexes while all the other tobacco related cancers showed declining trends. The reason for this could also be due to the factors other than tobacco use.

A recent trend analysis reported for some TRC sites of almost same study period (1982-2001) in Greater Mumbai<sup>1</sup> showed trends in age-adjusted incidence as comparable to the trends observed for cumulative risks in the present study. Trend evaluation of cumulative risks is expected to give same picture of trends as that of age-standardized incidence rates. In addition it also facilitates understanding of the changes in magnitude of cancer risk. However, changes in life time risk of developing cancer is likely to be affected by changes in risk factors, disease detection practices and aging of the population.

#### REFERENCES:

1. *Cancer Awareness, prevention and control: Strategies for South Asia. (UICC -2006).*
2. *WHO (1998). Press Release WHO/42. Growing up without tobacco. World No-Tobacco Day 1998.*
3. *Murray CJ, Lopez AD. Alternative projections of mortality and disability by cause 1990-2020: Global Burden of disease study. Lancet 1997;349:1498-504.*
4. *NCRP (2005): Two -year report of the population based cancer registries 1999-2000: Incidence and distribution of cancer, Indian Council Medical Research, New Delhi 2005.*

5. *IARC monographs on the evaluation of carcinogenic risk to humans tobacco smoking and involuntary smoking, IARC, Lyon, 2004:83.*
6. *Parkin DM, Bray F, Ferlay J and Pisani P. Global Cancer Statistics, 2002 CA Cancer J Clin 2005;55:74-108.*
7. *Mudur G. India has some of the highest cancer rates in the world. BMJ. 2005;330:215.*
8. *Yeole BB. Trends and predictions of cancer incidence cases by site and sex for Mumbai. Indian J Cancer. 1999;36:163-78.*
9. *Sunny L, Yeole BB, Hakama M, et al. Oral cancers in Mumbai, India: a fifteen years perspective with respect to incidence trend and cumulative risk. Asian Pac J Cancer Prev. 2004;5:294-300.*
10. *Annual report 1982-89: National Cancer Registry, Indian Council of Medical Research New Delhi, 1985-1989. (www.icmr.org.in) Biennial Report 1988-89: National Cancer Registry Programme, Indian Council of Medical Research New Delhi, 1992.*
11. *Consolidated Report of the Population based Cancer Registeries 1990 -1996: National Cancer Registry Programme, Indian Council of Medical Research Bangalore, 2001.*
12. *Two Year Report of the Population based Cancer Registeries 1997-1998. National Cancer Registry Programme, Indian Council of Medical Research banglore , 2002.*
13. *IARC monographs . Overall evaluation of carcinogenicity: updating of IARC monograph vol 1-42: IARC monograph on the evaluation of carcinogenic risk to humans. IARC, Lyon, 1987;357-61.*
14. *Yeole BB, Advani SH, Sunny L. Epidemiological features of childhood cancers in Greater Mumbai. Indian Pediatr 2001;38:1270-1277.*
15. *Elango JK, Gangadharan P, Sumithra S, Kuriakose MA. Trends of head and neck cancers in urban and rural India. Asian Pac J Cancer Prev. 2006;7:108-12.*
16. *Borras J, Borras JM, Galceran J, Sanchez V, Moreno V, Gonzalez JR. Trends in smoking related cancer incidence in Tarragona, Spain, 1980-96. Cancer causes and control 2001;12:903-8.*
17. *Tse LA, YU IT, Mang OW. Time trends of esophageal cancer in Hong Kong: age, period and birth cohort analyses. Int J Cancer 2007;120:853-8.*
18. *Chen JG, Zhu J, Parkin DM, Zhang YH, Lu JH, Zhu YR, Chen TY. Trends in the incidence of cancer in Qidong, China, 1978-2002. Int J Cancer. 2006;119(6):1447-54.*
19. *Belani CP, Marts S, Schiller J, Socinski MA. Women and Lung cancer: Epidemiology, tumour biology, and emerging trends in clinical research. Lung Cancer 2007;55:15-23.*
20. *International Institute for population Sciences (IIPS). National Family Health Survey (NFHS - 2) India, 1998-1999. Mumbai, IIPS; 2000. p. 16-23.*
21. *Gupta PC, Mehta FS, Pindborg JJ, Bhonsle RB, Murti PR, Daftary DK, Aghim MB: Primary prevention trial of oral cancer in India: a 10 year follow up study. J Oral Pathol Med. 1992;21(10):433-9.*
22. *Santos Arrontes D, Fernandez ArJona M, Valer Lopez-Fando et al. Tobacco consumption and bladder cancer mortality in Spain. Arch Esp Urol. 2006;59(2):141-5.*

