

## Chapter 13

# Cancer survival in Bhopal, India, 1991–1995

Dikshit R, Kanhere S and Surange S

### Abstract

The Bhopal population-based cancer registry was established in 1986 under the national cancer registry programme to investigate the after-effect of a gas leak in 1984. Cancer registration is done entirely by active methods. The registry is contributing data on survival for 16 cancer sites or types registered during 1991–1995. Follow-up of cases was done by active methods with median follow-up time ranging between 8–44 months for different cancers. The proportion with histologically verified diagnosis for various cancers ranged between 61–100%; death certificates only (DCOs) comprised 0–2%; 50–92% of total registered cases were included for survival analysis. The 5-year age-standardized relative survival rates for common cancers were mouth (34%), cervix (31%), breast (25%), tongue (12%), oesophagus (3%) and lung (1%). The 5-year relative survival by age group showed that survival was the highest in the youngest age group (45 years and below) for a majority of cancers. A decreasing survival with increasing clinical extent of disease was noted for most cancers studied.

### Bhopal cancer registry

The Bhopal population-based cancer registry is the only one of its kind in the central part of India. It was established in 1986 as a special purpose registry at the Gandhi medical college, Bhopal, under the national cancer registry programme, to investigate the after-effect of the gas leak in 1984. Data from the registry have been regularly published by the Indian Council of Medical Research [1]. The method of cancer registration is entirely done by active methods. The registry staff visits the various medical institutions in and around Bhopal city for data collection by direct interview of cases and/or from medical records [2]. The registry covers an area of 285 km<sup>2</sup> and caters to an entirely urban population of about 1.4 million in 2001 with a sex ratio of 893 females to 1000 males. The average annual age-standardized incidence rate is 114 per 100 000 among males and 104 per 100 000 among females with a lifetime cumulative risk of one in 10 of developing cancer for both sexes in the period 1999–2001. The leading site of cancer among males is the lung followed by oral cavity and oesophagus. The ranking among females is breast followed by cervix and oral cavity [1].

The registry is contributing data on survival from cancer for the first time in this volume of the IARC monograph on *Cancer Survival in Africa, Asia, the Caribbean and Central America*. Data on survival from 16 cancer sites or types registered during 1991–1995 are reported.

### Data quality indices (Table 1)

The proportion of cases with histological confirmation of cancer diagnosis in this series is 84%, from 100% for non-Hodgkin lymphoma and lymphoid leukaemia to 61% for lung cancer. Cases without any follow-up comprised 19%, with a low of 6% (colon cancer) and a high of 48% (non-Hodgkin lymphoma). The exclusion of cases from the survival analysis ranged between 8% and 50%. Thus, 50–92% of the total cases registered are included in the estimation of the survival probability.

### Outcome of follow-up (Table 2)

Follow-up has been carried out predominantly by active methods. These included abstraction of cancer mortality information from the hospitals and the vital statistics division records. The abstracted data are first matched with the incident cancer database. The follow-up information for the unmatched incident cases is then obtained through house visits.

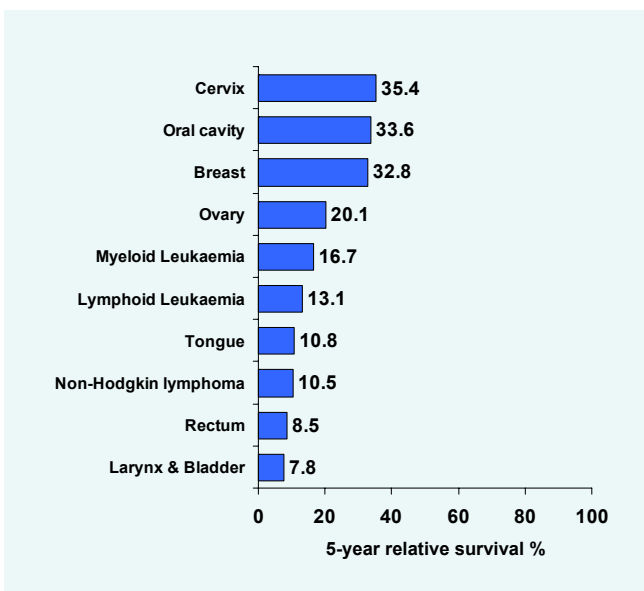
The closing date of follow-up was 31<sup>st</sup> December 2000. The median follow-up (in months) ranged between 8.3 for cancer of the oesophagus and 44.1 for cancer of the cervix. No partial information is available on follow-up within five years from the incidence date. Cases with no follow-up have been excluded; hence, all the reported cases have a complete follow-up at five years from the incidence date.

## Survival statistics

### All ages and both sexes together (Table 3)

The 5-year relative survival is the highest in cervix cancer (35%) and the lowest in lung cancer (1%). The survival figures for head and neck cancers are oral cavity (34%), tongue (11%) and hypopharynx (2%). The rank order among the gastrointestinal tract cancers is rectum (9%), colon (7%), oesophagus (4%) and stomach (3%). The survival from non-Hodgkin lymphoma is 11%, lymphoid leukaemia is 10% and myeloid leukaemia is 17%.

**Figure 1a. Top ten cancers (ranked by survival), Bhopal, India, 1991–1995**



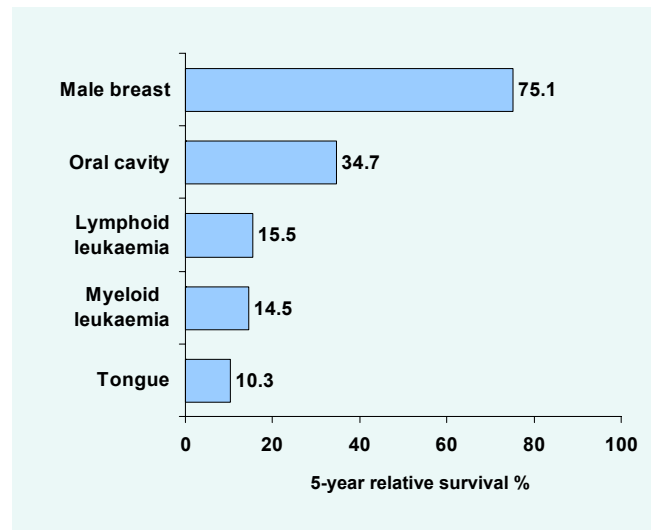
The 5-year age-standardized relative survival (ASRS) probability for all ages together was observed to be less than the corresponding unadjusted one barring a few exceptions. The 5-year ASRS (0–74 years of age) was observed to be higher than the corresponding ASRS (all ages) for all cancers.

### Sex

#### Male (Table 4a)

The 5-year relative survival was the highest for male breast cases (75%; 3 cases) followed by oral cavity (35%) and lymphoid leukaemia (16%). Survival from cancer of the urinary bladder and lymphoid leukaemia was noticeably higher among males than females.

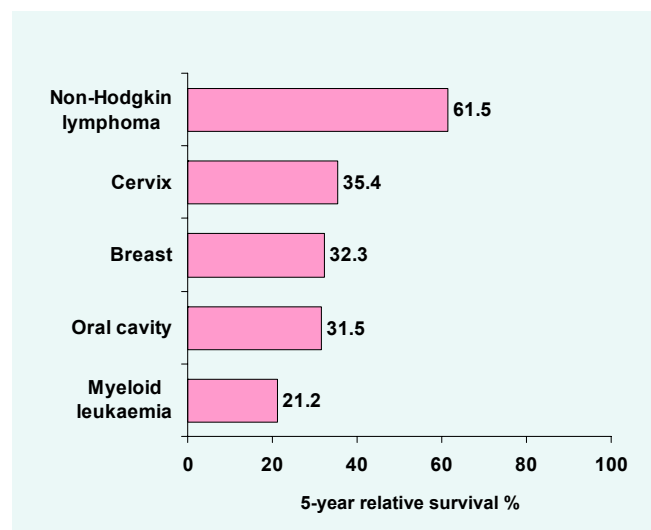
**Figure 1b. Top five cancers (ranked by survival), Male, Bhopal, India, 1991–1995**



#### Female (Table 4a)

Non-Hodgkin lymphoma (61%; 5 cases) tops the ranking by 5-year relative survival; the others in order are cervix (35%), breast (32%) and oral cavity (31%). Survival was distinctly higher among females than males with non-Hodgkin lymphoma.

**Figure 1c. Top five cancers (ranked by survival), Female, Bhopal, India, 1991–1995**



#### Age group (Table 4b)

The 5-year relative survival analysis by age group indicates that no case aged 75 years and above at diagnosis has survived 5 years after diagnosis. The number of cases was also the least in this age group. Survival was the highest in the younger age group of 45 years and below for a majority of cancers.

### Extent of disease (Table 5; Figure 2)

A majority of cases with tongue and oral cavity cancers were diagnosed with a regional spread of disease (56%). For cancers of the colon and rectum, most cases presented with a localized disease (38% and 41%). For breast cancer, both localized (43%) and regional (44%) disease constituted equal proportions. Two thirds of ovarian cancers were diagnosed at a localized stage and 70% of cervix cancers had a regional spread. The extent of disease was unknown in 1–17%. The 5-year absolute survival by extent of disease revealed that none of the cases with distant metastasis at diagnosis survived 5 years for any cancer. Breast cancer cases with unknown extent of disease and ovarian cancer cases with regional spread had a higher or same 5-year survival probability as that of a localized disease.

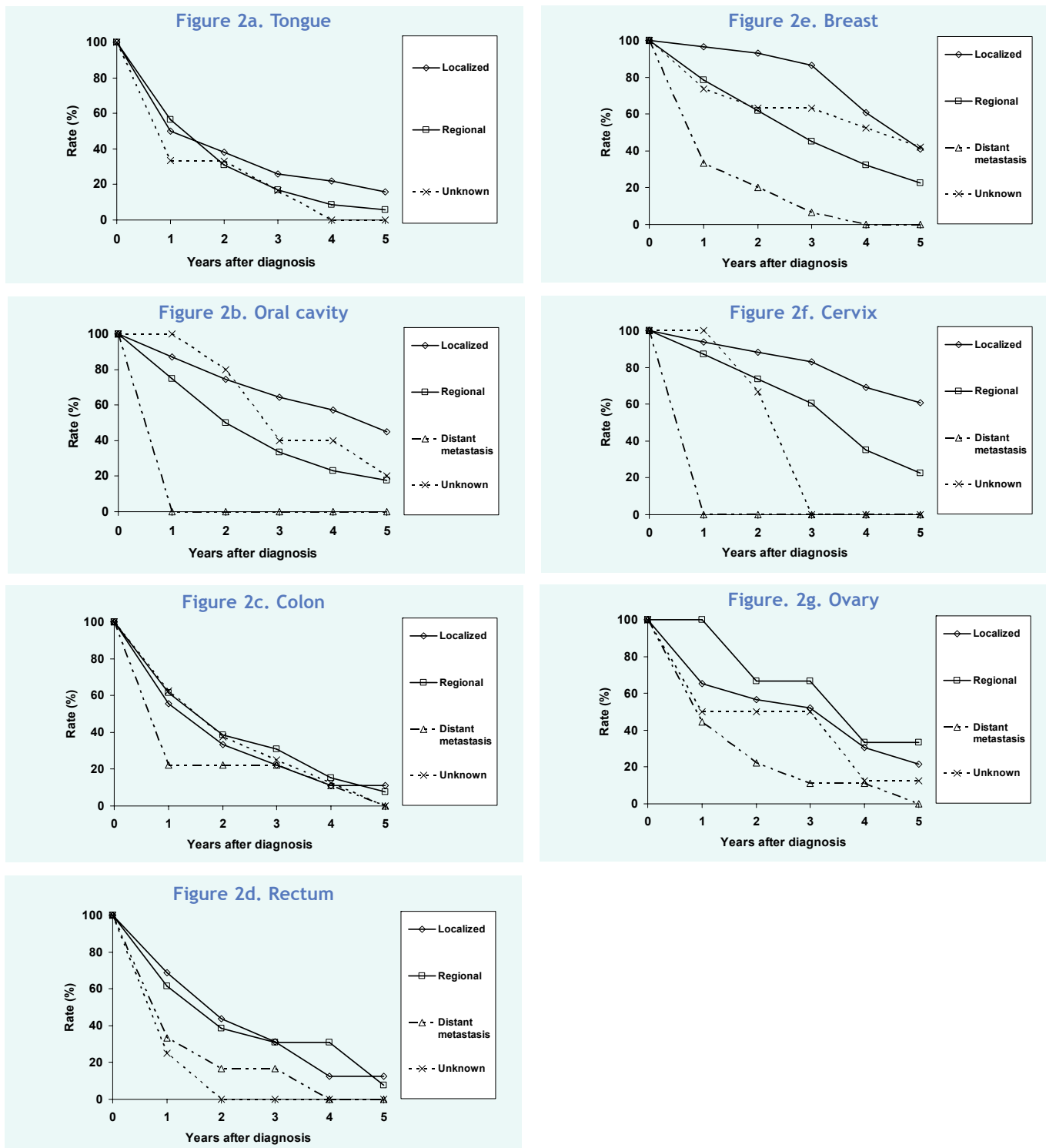
### Acknowledgements

The authors are grateful to all the staff of Bhopal Cancer Registry for their excellent work.

### References

1. *National Cancer Registry Programme. Consolidated report of population-based cancer registries: 1999–2001.* Indian Council of Medical Research, New Delhi, 2004.
2. *Bhopal Cancer Registry. Incidence of cancer morbidity and mortality in Bhopal Urban Agglomerate: 1995–1999.* Gandhi Medical College, Bhopal, 2003.

Figure 2. Absolute survival (%) from selected cancers by extent of disease, Bhopal, India



**Table 1. Data quality indices - Proportion of histologically verified and death certificate only cases, number and proportion of included and excluded cases by site: Bhopal, India, 1991–1995 cases followed-up until 2000**

Site	ICD-10	Total registered	%		Excluded cases					Included cases	
			HV	DCO	DCO	Follow-up	Others	Total	%	No.	%
Tongue	C01-02	151	90.1	0.7	1	20	3	24	15.9	127	84.1
Oral cavity	C03-06	204	89.2	0.0	0	32	0	32	15.7	172	84.3
Hypopharynx	C12-13	131	92.4	0.0	0	13	0	13	9.9	118	90.1
Oesophagus	C15	189	83.1	1.6	3	22	1	26	13.8	163	86.2
Stomach	C16	87	65.5	0.0	0	11	1	12	13.8	75	86.2
Colon	C18	52	90.4	1.9	1	3	0	4	7.7	48	92.3
Rectum	C19-20	52	80.8	1.9	1	11	1	13	25.0	39	75.0
Larynx	C32	70	87.1	1.4	1	9	0	10	14.3	60	85.7
Lung	C33-34	253	60.5	1.6	4	31	2	37	14.6	216	85.4
Breast	C50	348	87.9	0.6	2	84	1	87	25.0	261	75.0
Cervix	C53	380	83.4	0.3	1	46	1	48	12.6	332	87.4
Ovary	C56	104	82.7	0.0	0	34	1	35	33.7	69	66.3
Urinary bladder	C67	52	84.6	0.0	0	6	0	6	11.5	46	88.5
Non-Hodgkin lymphoma	C82-85+C96	60	100.0	0.0	0	29	1	30	50.0	30	50.0
Lymphoid leukaemia	C91	45	100.0	0.0	0	13	0	13	28.9	32	71.1
Myeloid leukaemia	C92-94	85	96.5	2.4	2	8	0	10	11.8	75	88.2

HV: histologically verified; DCO: death certificate only

**Table 2. Number and proportion of cases by vital status and median follow-up (in months) by site: Bhopal, India, 1991–1995 cases followed-up until 2000**

Site	ICD-10	Cases included	Dead		Alive		Complete FU		Median FU (in months)
			No.	%	No.	%	No.	%	
Tongue	C01-02	127	124	97.6	3	2.4	127	100.0	12.7
Oral cavity	C03-06	172	145	84.3	27	15.7	172	100.0	34.0
Hypopharynx	C12-13	118	117	99.2	1	0.8	118	100.0	11.8
Oesophagus	C15	163	161	98.8	2	1.2	163	100.0	8.3
Stomach	C16	75	75	100.0	0	0.0	75	100.0	8.7
Colon	C18	48	47	97.9	1	2.1	48	100.0	13.1
Rectum	C19-20	39	36	92.3	3	7.7	39	100.0	12.6
Larynx	C32	60	59	98.3	1	1.7	60	100.0	18.8
Lung	C33-34	216	215	99.5	1	0.5	216	100.0	8.5
Breast	C50	261	216	82.8	45	17.2	261	100.0	42.5
Cervix	C53	332	288	86.7	44	13.3	332	100.0	44.1
Ovary	C56	69	64	92.8	5	7.2	69	100.0	26.0
Urinary bladder	C67	46	46	100.0	0	0.0	46	100.0	13.1
Non-Hodgkin lymphoma	C82-85+C96	30	28	93.3	2	6.7	30	100.0	8.4
Lymphoid leukaemia	C91	32	30	93.8	2	6.3	32	100.0	9.9
Myeloid leukaemia	C92-94	75	71	94.7	4	5.3	75	100.0	19.0

FU: follow-up

**Table 3. Comparison of 1-, 3- and 5-year absolute and relative survival and 5-year age-standardized relative survival by site: Bhopal, India, 1991–1995 cases followed-up until 2000**

Site	ICD-10	Cases included	% Absolute survival			% Relative survival			% ASRS at 5-years	
			1-year	3-year	5-year	1-year	3-year	5-year	all ages	0-74 years
Tongue	C01-02	127	52.8	20.5	9.4	54.8	22.6	10.8	11.7	13.1
Oral cavity	C03-06	172	80.2	45.9	29.1	83.0	50.4	33.6	33.9	37.5
Hypopharynx	C12-13	118	50.8	16.9	1.7	52.7	18.6	2.0	1.7	2.0
Oesophagus	C15	163	36.2	12.9	3.1	37.6	14.1	3.5	2.7	3.6
Stomach	C16	75	38.7	5.3	2.7	39.8	5.8	2.9	2.8	3.8
Colon	C18	48	52.1	25.0	6.3	53.9	27.1	7.0	3.2	5.2
Rectum	C19-20	39	56.4	25.6	7.7	58.0	27.2	8.5	4.0	6.5
Larynx	C32	60	61.7	23.3	6.7	63.6	25.4	7.8	12.5	15.7
Lung	C33-34	216	33.3	6.9	0.9	34.7	7.7	1.1	0.8	1.0
Breast	C50	261	83.1	62.1	30.7	84.5	64.8	32.8	25.3	30.6
Cervix	C53	332	88.9	66.0	33.1	90.3	68.8	35.4	30.8	34.5
Ovary	C56	69	63.8	47.8	18.8	64.8	49.7	20.1	15.8	18.9
Urinary bladder	C67	46	54.3	17.4	6.5	57.1	19.6	7.8	6.0	9.7
Non-Hodgkin lymphoma	C82-85+C96	30	33.3	16.7	10.0	33.9	17.3	10.5	8.8	9.9
Lymphoid leukaemia	C91	32	46.9	31.3	12.5	47.5	32.1	13.1	10.4	12.6
Myeloid leukaemia	C92-94	75	61.3	33.3	16.0	62.0	34.3	16.7	12.3	14.2

ASRS: age-standardized relative survival

**Table 4a. Site-wise number of cases, 5-year absolute and relative survival by sex: Bhopal, India, 1991–1995 cases followed-up until 2000**

Site	ICD-10	Cases included	Male			Female		
			% 5-year survival			% 5-year survival		
			No.	Abs	Rel	No.	Abs	Rel
Tongue	C01-02	127	112	8.9	10.3	15	13.3	14.4
Oral cavity	C03-06	172	110	30.0	34.7	62	27.4	31.5
Hypopharynx	C12-13	118	103	1.9	2.3	15	0.0	0.0
Oesophagus	C15	163	99	4.0	4.6	64	1.6	1.7
Stomach	C16	75	47	4.3	4.7	28	0.0	0.0
Colon	C18	48	31	6.5	7.4	17	5.9	6.2
Rectum	C19-20	39	21	4.8	5.4	18	11.1	11.7
Larynx	C32	60	51	5.9	6.9	9	11.1	12.6
Lung	C33-34	216	183	1.1	1.3	33	0.0	0.0
Breast	C50	261	3	66.7	75.1	258	30.2	32.3
Cervix	C53	332				332	33.1	35.4
Ovary	C56	69				69	18.8	20.1
Urinary bladder	C67	46	36	8.3	10.1	10	0.0	0.0
Non-Hodgkin lymphoma	C82-85+C96	30	25	0.0	0.0	5	60.0	61.5
Lymphoid leukaemia	C91	32	27	14.8	15.5	5	0.0	0.0
Myeloid leukaemia	C92-94	75	50	14.0	14.5	25	20.0	21.2

Abs: absolute survival; Rel: relative survival

**Table 4b. Site-wise number of cases and relative survival by age group: Bhopal, India, 1991–1995 cases followed-up until 2000**

Site	ICD-10	Cases included	Number of cases by age group					Relative survival by age group				
			< 45	45-54	55-64	65-74	> 75	% 5-year survival				
								< 45	45-54	55-64	65-74	> 75
Tongue	C01-02	127	16	29	43	27	12	44.9	7.4	8.2	0.0	0.0
Oral cavity	C03-06	172	20	57	43	39	13	61.5	35.5	40.5	14.1	0.0
Hypopharynx	C12-13	118	16	31	38	22	11	0.0	3.5	3.1	0.0	0.0
Oesophagus	C15	163	18	43	46	38	18	11.4	7.4	0.0	0.0	0.0
Stomach	C16	75	10	29	15	16	5	20.3	0.0	0.0	0.0	0.0
Colon	C18	48	8	14	14	8	4	12.7	15.1	0.0	0.0	0.0
Rectum	C19-20	39	7	10	15	6	1	14.6	10.5	7.8	0.0	0.0
Larynx	C32	60	5	15	30	6	4	20.6	0.0	3.9	44.2	0.0
Lung	C33-34	216	20	44	74	58	20	0.0	4.9	0.0	0.0	0.0
Breast	C50	261	80	90	61	22	8	44.5	29.0	35.1	5.9	0.0
Cervix	C53	332	114	109	70	30	9	51.7	33.5	20.8	17.9	0.0
Ovary	C56	69	29	18	13	7	2	28.0	17.3	8.7	22.9	0.0
Urinary bladder	C67	46	1	11	16	9	9	0.0	9.6	7.2	15.4	0.0
Non-Hodgkin lymphoma	C82-85+C96	30	12	9	6	3	0	16.9	11.7	0.0	0.0	
Lymphoid leukaemia	C91	32	25	2	3	1	1	12.2	0.0	39.2	0.0	0.0
Myeloid leukaemia	C92-94	75	54	10	8	1	2	18.8	10.7	14.1	0.0	0.0

**Table 5. Proportion of cases and 5-year absolute survival by extent of disease and site: Bhopal, India, 1991–1995**

Site	ICD-10	Cases included	% of cases by extent of disease				% 5-year absolute survival			
			Localized	Regional	Dist. met.	Unknown	Localized	Regional	Dist. met.	Unknown
Tongue	C01-02	127	39.4	55.9	0.0	4.7	16.0	5.6		0.0
Oral cavity	C03-06	172	40.7	55.8	0.6	2.9	45.7	17.7	0.0	20.0
Colon	C18	48	37.5	27.1	18.8	16.7	11.1	7.7	0.0	0.0
Rectum	C19-20	39	41.0	33.3	15.4	10.3	12.5	7.7	0.0	0.0
Breast	C50	261	42.9	44.1	5.7	7.3	41.1	22.6	0.0	42.1
Cervix	C53	332	28.3	70.5	0.3	0.9	60.6	22.7	0.0	0.0
Ovary	C56	69	66.7	8.7	13.0	11.6	21.7	33.3	0.0	12.5

*Dis. met.: distant metastasis*

