

## Childhood Cancer Incidence in India Between 2012 and 2014: Report of a Population-based Cancer Registry

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**Objectives:** To provide an overview of childhood cancer incidence in India between 2012-2014. **Methods:** Secondary data analysis on age-adjusted rates of cancer incidence for children (0-14 years) were collected from the report of the National Cancer Registry Programme in the year 2016. **Results:** Age-adjusted rates of childhood cancer incidence ranged from 18.5 per million in the state of Nagaland to 235.3 per million in Delhi for boys. The rates were 11.4 per million in East Khasi Hill district and 152.3 per million in Delhi for girls. Leukemia was the most predominant cancer for both boys and girls. Lymphoma was the second most common cancer in boys, and brain tumors in girls. **Conclusion:** Childhood cancer incidence is increasing in India compared to population-based cancer registry survey of 2009-2011. Cancers are mostly affecting 0-4 years age group, and there is a rising trend of Non-Hodgkin's lymphoma.

**Keywords:** Acute leukemia, Burden, Lymphoma, Malignancy.

More than 80% of the 200,000 new cases of childhood cancer annually are from the developing world [1]. In India, cancer is the 9th commonest cause for death among children aged 5-14 years [2]. As we progress in reducing infection-related childhood deaths, it is important to care for cancer-affected children who have increasing likelihood of cure with appropriate treatment. Since the fundamental step in this regard is to estimate the current epidemiology and burden of childhood cancer [3], we provide an updated overview for the years 2012-2014 based on the National Cancer Registry Program (NCRP) report that covered 30 population-based cancer registries (PBCRs). The 5 new PBCRs included in this latest review are Patiala, Pasighat, Papumpara district, Naharlagun excluding Papumpara and division of Manipur and Mizoram state registries into the state capital-based centers and peripheral centers [4].

### METHODS

The NCRP reports incidence rates and mortality at population level, methods of data collection and quality control measures [5]. Usually population-based registries source information from (i) treatment facilities, such as cancer centres and major hospitals, (ii) diagnostic services, especially pathological, hematological, biochemical and immunological laboratories; (iii) death registration system. Active collection involves registry personnel actually visiting the different sources and abstracting the data on special forms. Passive reporting

involves health-care workers completing the notification forms developed and distributed by the registry, or sending copies of discharge abstracts to the registry. The PBCRs use the PBCRDM 2.1 software applications installed at their institute to submit the data to NCRP. Relevant data from the hospital-based software application and the oncology modules transmitted by the hospitals through web-based portals can be routed to the PBCR data. PBCRDM 2.1 application can subject the data captured by them to different levels of checking, quality control, and duplicate checks and matching. Latest NCRP report (2016) provides data from 30 PBCRs covering <10% of the country's population [4]. The 30 PBCRs were categorized into 6 regions (**Table I**).

Childhood cancer incidence (CCI) is generally expressed per million (pm) children [4]. For both boys and girls, CCI as age-adjusted rates for 11 selected broad types of childhood cancers (leukemias, lymphomas, central nervous system (CNS) tumors, sympathetic nervous system (SNS) tumors, retinoblastoma, renal tumors, hepatic tumors, bone tumors, soft tissue sarcomas, germ cell tumors and others) have been described in this article.

### RESULTS

A rising trend in CCI in India has been observed ranging from 38-124 pm in 2001-2004, 11.3-159.6 pm in 2009-2011, and 6-860 pm in 2011-2014. However, childhood cancer recorded a marginal fall in proportion relative to

**TABLE I** CHILDHOOD CANCER INCIDENCES PER LOCATION OF THE REGISTRY

Registry location	Cancer incidence AAR pm (% of cancers in childhood out of all cancers)		
	Boys	Girls	Total
National data	4-551 (0.7-5.4)	2-309 (0.5-3.5)	6-860 (0.7-4.4)
*North	69-551 (2.4-5.4)	41-309 (1.3-3.2)	110-860 (1.8-4.4)
#South	102-158 (1.8-2.9)	82-108 (1.3-1.5)	184-240 (1.5-2.4)
§East	30 (1.1)	29 (1.1)	59 (1.1)
^West	12-156 (2-4.5)	12-89 (0.9-2.5)	24-245 (1.5-3.4)
‡Central	44-65 (2.6-2.9)	26-47 (1.5-1.9)	70-112 (2.4-2.6)
**North-east	4-71 (0.7-3.3)	2-51 (0.5-3.5)	6-116 (0.7-2.7)

\*Delhi, Patiala; #Bangalore, Chennai, Thiruvananthapuram, Kollam; §Kolkata; ^Barshi Rural, Barshi Expanded, Mumbai, Aurangabad, Wardha, Ahmedabad, Pune; ‡Bhopal, Nagpur; \*\* Cachar District, Dibrugarh District, Kamrup urban district, Imphal west district, Manipur state excluding Imphal west, Aizawl district, Mizoram state excluding Aizawl, Sikkim state, East Khasi Hill district (Meghalaya), Tripura state, Nagaland, Papumpara district, Naharlagun excluding Papumpara, Pasighar; AAR pm: age-adjusted rate per million population.

cancers in all age groups; from 3.2% in 2001-2004, to 3.1% in 2009-2014 and 2.5% in 2011-2014. The minimum and maximum age-adjusted rates per million CCI from the 30 PBCRs and of the 11 broad types of childhood cancers along with their most common subtypes from 8 major registries have been presented in **Tables I** and **Web Table I**, respectively. **Tables II** and **III** presents CCI data divided in various age categories.

In boys, the relative proportion of childhood cancer was lowest in Nagaland PBCR (North-east region) (0.7%) and highest in Delhi PBCR (North region) (5.4%). In girls, it varied from 0.5% in East Khasi Hill district PBCR (North-east region) to 3.5% in Naharlagun excluding Papumpara PBCR (North-east region). For both sexes, it varied from 0.7% in East Khasi Hill district PBCR to 4.4% in Chennai PBCR (South region). Male pediatric cancer had the highest incidence among 0-4 years age group in North, South and North-East regions and among 10-14 years age group in East, West and Central regions. Female pediatric cancers had the highest incidence among 0-4 years age group in North, West and East regions and among 10-14 years age group in South, Central and North-East regions. The highest incidence of cancer occurred in 0-4 years age group for males and both sexes combined and 10-14 years age group for females separately. Leukemia was the most predominant childhood cancer with highest incidence among 0-4 years for both sexes, 70% being lymphoid leukemia. Both Hodgkin's and Non-Hodgkin's disease had the highest incidence among 10-14 years age group for both sexes. 54% of all lymphomas were Non-Hodgkin's disease. CNS tumours had the highest incidence among 5-9 years of age group for both sexes. Genitourinary, eye and liver tumours had highest incidence among 0-4 years age group while bone and gastrointestinal tumours had

highest incidence among 10-14 years age group for both sexes.

## DISCUSSION

The overall incidence of pediatric cancer has risen compared to the previous reviews, but the proportion of childhood cancer relative to cancers in all age groups have marginally reduced. Rapid industrialization and urbanization, acquired genetic mutations due to pollution, industrial disasters, rampant insecticides use in the agricultural sector, tobacco and gutka addiction among child labourers from lower socio-economic class and ozone layer depletion have been postulated as causes for rising pediatric cancer incidence [5]. The reported incidence of childhood cancer in males (4-556 pm) is higher than in females (2-309 pm); the ratio being 1.6:1, which is higher than in the developed world (1.2:1), possibly reflecting gender bias in seeking healthcare [3,6]. Leukemia remains the most common pediatric

**TABLE II** AGE-WISE DISTRIBUTION\* OF CHILDHOOD CANCER ACROSS DIFFERENT REGIONS IN INDIA

Regions	Age group (y)					
	0-4		5-9		10-14	
	Male	Female	Male	Female	Male	Female
National data	725	436	655	370	672	461
North	212	118	210	119	188	113
South	181	108	129	84	157	122
East	8	11	10	9	12	9
West	157	93	148	75	165	90
Central	36	25	35	18	38	30
North-East	131	81	123	65	112	97

\*Age-adjusted rates per million.

**WHAT THIS STUDY ADDS?**

- Incidence of childhood cancer in India has risen compared to previous reviews, with highest incidence occurring between 0-4 years.

**TABLE III** INCIDENCE\* OF COMMON TYPES OF CANCERS IN CHILDREN

Diseases	Age group (year)						Total incidence
	0-4		5-9		10-14		
	Male	Female	Male	Female	Male	Female	
Leukemia	33.0	17.9	28.5	15.3	23.3	13.3	131.3
Lymphoid leukemia	25.7	13.0	19.6	11.0	15.9	6.9	92.1
Myeloid leukemia	5.1	3.2	6.7	3.2	5.0	5.3	28.5
Unspecified leukemia	2.2	1.7	2.2	1.1	2.4	1.1	10.7
Lymphoma	3.8	1.9	10.8	3.4	13.0	4.9	37.8
Non-Hodgkins lymphoma	2.3	1.4	4.8	2.1	7.2	2.7	20.5
Hodgkins lymphoma	1.5	0.5	6.0	1.3	5.8	2.2	17.3
CNS tumor	5.5	4.4	8.7	6.5	7.9	4.7	37.7
Genitourinary tumors	8.4	5.1	2.0	2.5	1.6	5.2	24.8
Bone tumors	2.6	1.7	3.5	2.7	7.7	6.2	24.4
Eye tumors	7.7	5.1	1.8	0.5	0.1	0.3	15.5
Gastrointestinal tumors	0.5	1.0	1.6	0.8	1.8	1.0	6.7
Liver tumors	2.9	1.5	0.6	0.3	0.3	0.1	5.7

\*Age-adjusted rates per million population.

cancer for both sexes, followed by lymphoma and CNS tumours in males. However, CNS tumours exceed lymphomas in females. In the developed world, CNS tumours are the second most common cancer (22-25%) and lymphomas are third (10%) [7]. Non-Hodgkin's disease exceeds Hodgkin's disease in this review, a pattern similar to the developed world, although previous reports [3] from India had noted higher incidence of Hodgkin's disease.

Limitations of this analysis is that the PBCR data includes <10% of the population with inadequate rural representation (except Barshi rural registry), since majority of the PBCRs are based in bigger cities. Also, the distribution of PBCRs is highly non-uniform across the country with fewer registries in the North and East regions. Hospitals in major cities like Delhi cater to larger population referred from nearby and distant states and hence, report higher CCI. Information of incidence of different subtypes of CNS, hepatic, renal and bone tumors is available in data from hospital-based registries of 8 important cities only and not from other PBCRs.

The considerable inter-regional variation in incidence

and mortality rates across India suggests a possibility of deficiency in ascertainment of cases and death notification, and variability of compliance to cancer registration particularly in the rural areas [3]. Studies based on data of different PBCRs in India are few [8-13]. This will serve as a reference source for researchers and would also act as stimulus for further research on the epidemiology of childhood cancer.

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**REFERENCES**

1. Barr R, Riberio R, Agarwal B, Masera G, Hesseling P, Magrath I. Pediatric oncology in countries with limited resources. In: Pizzo PA, Poplack DG, eds. Principles and Practice of Pediatric Oncology, 5<sup>th</sup> edition. Philadelphia; Lippincot Williams and Wilkins. 2006.p.1605-17.
2. Summary- Report on causes of death: 2001-2003 in India. Available from:[http://censusindia.gov.in/Vital-Statistics/Summary\\_Report\\_Death\\_01\\_03.pdf](http://censusindia.gov.in/Vital-Statistics/Summary_Report_Death_01_03.pdf). Accessed November 24, 2016.

3. Arora RS, Eden T, Kapoor G. Epidemiology of childhood cancer in India. *Indian J Cancer*. 2009;46:264-73.
  4. Three year of the population based cancer registries 2012-2014: Report of PBCRs; national cancer registry programme, Indian council medical research, Bengaluru 2016. Available from: [http://ncrpindia.org/Reports/PBCR\\_2009\\_2011.aspx](http://ncrpindia.org/Reports/PBCR_2009_2011.aspx). Accessed 24 November, 2016.
  5. Childhood cancer doubles in a decade. *The Times of India City* 2013 Feb 09;Kolkata: p8 (col4).
  6. Dorak MT, Karpuzoglu E. Gender differences in cancer susceptibility: an inadequately addressed issue. *Front Genet*. 2012;28:268.
  7. Gurney JG, Bondy ML. Epidemiology of childhood cancer. In: Pizzo PA, Poplack DG, eds. *Principles and Practice of Pediatric Oncology*, 5th edition. Philadelphia; Lippincot Williams and Wilkins. 2006.p.2-14.
  8. Satyanarayana L, Asthana S, Labani PS. Childhood cancer incidence in India: A review of population –based cancer registries. *Indian Pediatr*. 2014;51:218-20.
  9. Datta K, Choudhuri M, Guha S, Biswas J. Childhood cancer burden in part of eastern India-population based cancer registry data for Kolkata (1997-2004). *Asia Pac J Cancer Prev*. 2010;11:1283-8.
  10. Swaminathan R, Rama R, Shanta V. Childhood cancers in Chennai, India, 1990-2001: incidence and survival. *Int J Cancer*. 2008;122:2607-11.
  11. Yeole BB, Kurkure AP, Koyande SS. Geographic variation in cancer incidence and its patterns in urban Maharashtra, 2001. *Asian Pac J Cancer Prev*. 2006;7:385-90.
  12. Yeole BB, Advani SH, Sunny L. Epidemiological features of childhood cancers in greater Mumbai. *Indian Pediatr*. 2001;38:1270-7.
  13. Nandakumar A, Anantha N, Appaji L, Swamy K, Mukherjee G, Venugopal T, *et al.* Descriptive epidemiology of childhood cancers in Bangalore, India. *Cancer Causes Control*.1996;7:405-10.
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**WEB TABLE I** AGE-ADJUSTED RATES PER MILLION OF CHILDHOOD CANCER INCIDENCE OF BROAD TYPES OF CHILDHOOD CANCER AND THEIR SUBTYPES FOR & MAJOR REGISTRIES\* IN INDIA

<i>Most common subtype</i>		<i>Studied subtypes</i>		
Leukemias	Male	Female	Acute lymphoblastic leukemia	
	18-456 (37.5-50.5)	7-186 (24.8-46.7)	Male	Female
Lymphomas and Reticuloendothelial neoplasms	Male	Female	Non-Hodgkin's disease	
	7-120 (10.9-19.5%)	2-31 (5.1-13.2%)	Male	Female
CNS tumors	Male	Female	Primitive neuroectodermal tumor (PNET)	
	5-106 (3.6-13%)	5-60 (5.6-13.8%)	Male	Female
SNS tumors	Male	Female	Neuroblastoma and ganglioneuroma	
	1-48 (0.5-8.3%)	1-27 (0.8-7.2%)	Male	Female
Retinoblastoma	Male	Female		
	1-48 (0.2-8.6%)	2-43 (1.2-19.4%)		
Renal tumors	Wilm's tumour		Male	Female
	Male	Female	Male	Female
Hepatic tumors	Hepatoblastoma		Male	Female
	Male	Female	Male	Female
Bone malignancies	Osteosarcoma		Male	Female
	Male	Female	Male	Female
Soft tissue sarcomas	Rhabdomyosarcoma and embryonal sarcoma		Male	Female
	Male	Female	Male	Female
Germ cell tumors	Male	Female		
	2-15 (1.3-4.2%)	1-12 (0.8-4.5%)		
Others	Male	Female	Male	Female
	8-60 (1.47-5.6%)	6-52 (3.53-9.07%)	3-19 (0.6-6.3%)	1-13 (1.2-4.5%)

\*Delhi, Mumbai, Chennai, Guwahati, Dibrugarh, Thiruvananthapuram, Bangalore, Chandigarh.