INDIAN LIFE-TABLE AND RADIO-CARCINOGENIC RISK ESTIMATES

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ABSTRACT

Using ICRP-27, BEIR III and GOFMAN coefficients for the radiation-induced cancer fatalities, age-specific radiocarcinogenic risk factors have been evaluated for the Indian urban male population based on the relative risk projection model. In an Indian urban male cohort population of occupational workers exposed continuously at a uniform rate of 0.01 Sv/y between ages 20 and 65, the life-long cancer risk estimates work out to be about 0.08%, 0.25% and 2.03% respectively. These are considerably less than that would be obtained for typical western populations of the world.

INDIAN LIFE-TABLE PARAMETERS

The Indian life-table (1) and the age-specific cancer mortality patten (2,3) are typical of a developing country with the average life-span and the cancer mortality rates being lower than those among the developed western nations. For the case of the Indian urban males, the surviving population N(A) at any given age A has been fitted in the expression :

$$N(A) = K \exp [\alpha \exp (\beta A)]$$

as suggested by David Maillie (4). Fig.1 gives the data points and the fitted curve with the values of the various constants applicable between ages 5 and 70. The age-specific cancer mortality rates have been taken as a mean for four Indian cities of Bombay, Madras, Nagpur and Poona as given by the National Cancer Registry (2) and the Indian Cancer Society (3). The age-specific cancer mortality rate C(A) at any given age A could be fitted in the expression :

$$C(A) = 0.79 \exp (0.0876\ A) \qquad 10 \leq A \leq 70$$

CANCER RISK COEFFICIENTS

Cancer risk coefficients from three different sources viz. ICRP-27(5), BEIR III (6) and GOFMAN (7) have been adopted in the present calculations as these seem to project respectively a conservative, moderate and generous estimate of the radio-carcinogenic risk in existing literature. For the sake of uniformity of approach and to see clearly the effect of the Indian life-table parameters, risk estimates are made assuming linear hypothesis and relative risk projection model. As ICRP-27 gives only age-specific absoluterisk coefficients, the life-long risk in a typical USA cohort population is first calculated and then expressed as fractional increase in spontaneous cancer mortality per 0.01 Sv for the surviving cohort from the age at exposure. BEIR III report also does not give directly any relative risk coefficients; however working back on the results given for relative risk projections, reasonable estimates of the coefficients could be made for the cases of 0, 20, 35 and 50 years of age at exposure on the same lines as suggested by David Maillie (4). The GOFMAN risk

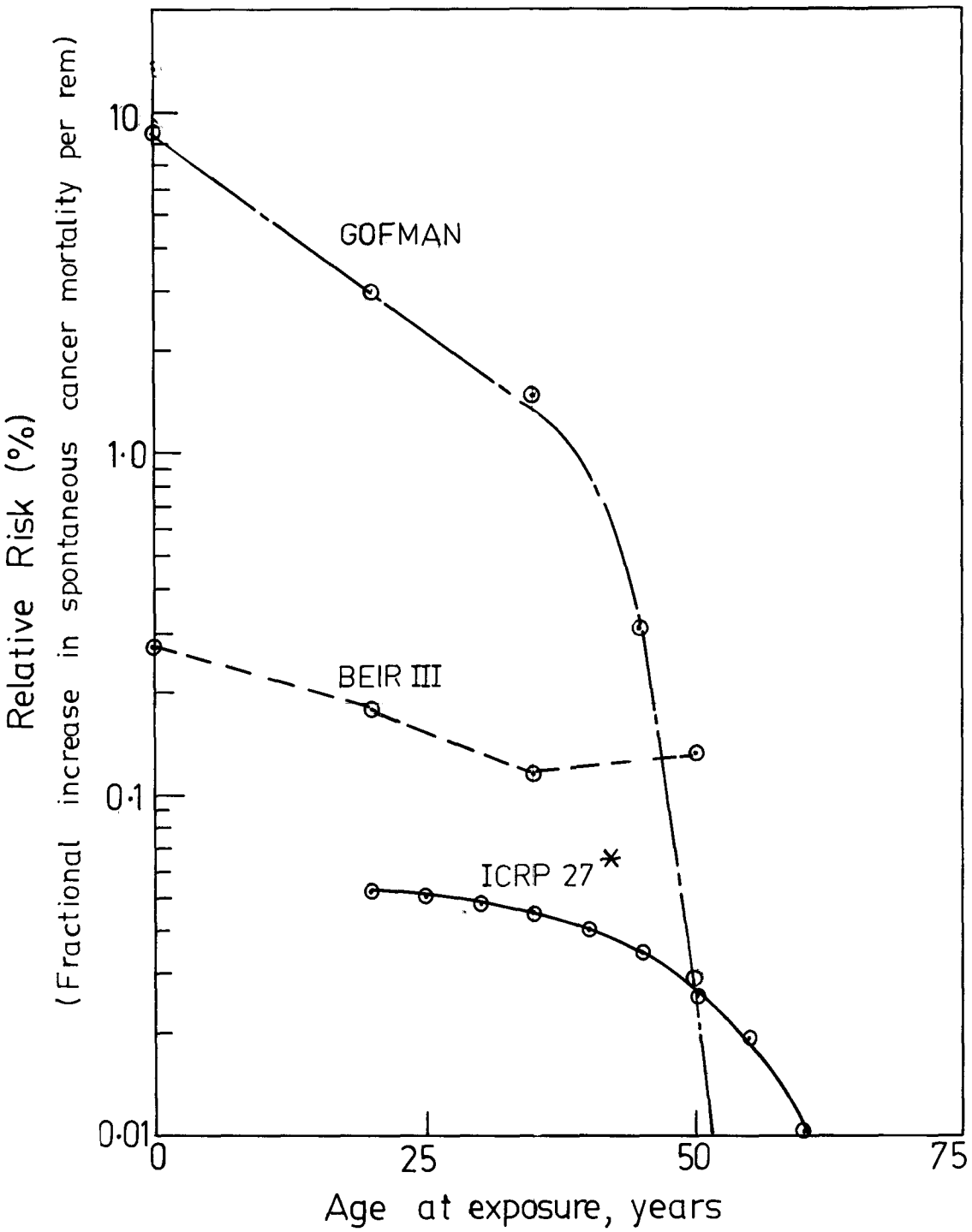

FIG. 2 - AGE SPECIFIC RELATIVE RISK COEFFICIENTS FOR MALES ESTIMATED FROM DIFFERENT LITERATURE SOURCES (* see text)

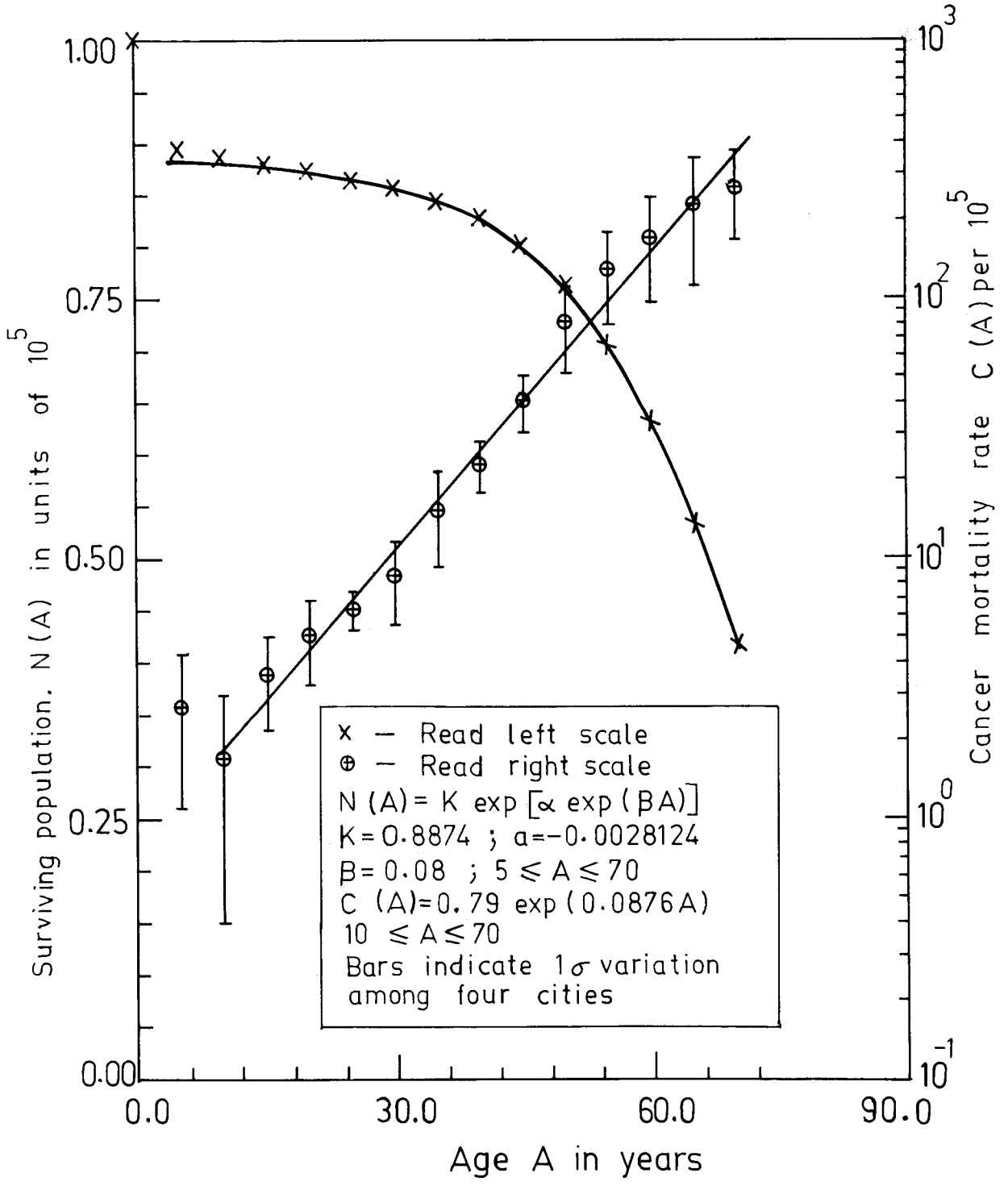

FIG.1,- POPULATION COHORT LIFE-TABLE AND AGE SPECIFIC CANCER MORTALITY RATES FOR INDIAN URBAN MALES

coefficients have been modified to the Indian life-table as per procedures given in (7). The age-specific relative risk coefficients thus obtained from the above three data sources are given in Fig.2.

RESULTS

Using the factors given in Fig.2, sample calculations have been made to obtain risk estimates for an assumed occupational exposure history for a population cohort starting from age 20. Although an Indian worker retires at about 60 years of age, for ready international comparison purposes, exposures have been considered upto age 65; the latter exposures however do not increase the cancer risk significantly. The results are presented in Table 1.

Table 1: Cancer risk estimates for an occupational exposure history of 0.01 Sv/y between ages 20 and 65

Population Cohort	Life long cancer risk estimates		
	ICRP 27	BEIR III	GOFMAN
U.S.A Males	0.58%	1.10%	5.65%
India Urban Males	0.08%	0.25%	2.22%

It is obvious that the relative risk projection model would predict far less cancer risk to the Indian occupational worker.

REFERENCES

1. Registrar General of India (1982) : Sample Registration Bulletin, Ministry of Home Affairs, New Delhi.
2. National Cancer Registry (1982) : Annual Report, Indian Council of Medical Research, New Delhi.
3. Indian Cancer Society (1984) : Cancer morbidity and mortality in Greater Bombay 1983, in Poona City Agglomeration 1978-80, in Nagpur 1980-82. (Courtesy : Bombay Cancer Registry).
4. David Maillie, H (1983) : Life-table factors for use in estimating the cancer risk of radiation exposure to workers, Health Physics 44, 317.
5. ICRP-27 (1978) : Problems involved in developing an index of Harm, Pergamon Press, Oxford.
6. BEIR III (1980) : The effects on pupulations of exposure to low levels of ionising radiation, National Academy Press, Washington D.c.
7. GOFMAN, J.w (1983) : Radiation and Human Health, Pantheon Books, New York.