



The incidence of childhood leukemia in Armenia (1991-2002)

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The incidence of leukemia in children aged from 0 to 14 years in Armenia was analyzed for the period from 1991 to 2002. During 12 years the incidence of leukemia was not changed substantially. The crude rate of the incidence of leukemia was comparable with data of many countries. But at the same time a comparatively high male/female incidence ratio was registered, which was also comparable with incidence ratio in some of both developed and developing countries. It may be supposed that the incidence of leukemia in children in Armenia is not connected with parental exposure to chemicals.

KEY WORDS: *Leukemia; Pediatric; Incidence; Armenia*

INTRODUCTION

It is well known that parental exposure to occupational hazards could contribute to the risk of cancer including leukemia in offspring. Recent publication of Children's Cancer Group, USA (1), and some other investigations (2) showed the important role of certain chemical agents in development of children's leukemia. Before 1988 Armenian SSR was a developed, industrial part of the USSR and had a lot of chemical plants. Industrial processes, products and semi-products in some of them were carcinogenic or supposed to be carcinogenic for humans. In addition, many products and semi-products of these plants were mutagenic (3). During the period from 1988 to 1994 not all plants worked, and now they work only partially (8%-10% at the level of 1988). As children's leukemia is supposed to be connected with exposure to chemicals, Armenia is a good model to study the influence of chemical industry on children's leukemia incidence. Another advantage to study this problem is that Armenia, since 1988 until now, is practically a monoethnic Republic, although before 1988 only 88% of population was Armenian. The incidence of leukemia in Armenian SSR was the highest in the USSR in the period from 1980 to 1985 (4, 5). The crude rate (CR) of incidence of leukemia was 8.2, and it was 1.6-fold higher than the mean CR in the USSR (4, 5). It concerned the

incidence of leukemia (IL) both in adults and children. In 2001, about 40% of all malignancies in children was leukemia (CR were 3.2 and 8.1, respectively; Prof. G. Badalyan, personal communication). The aim of the present work was to analyze the IL in children (aged 0-14) in 1991-2002.

MATERIALS AND METHODS

The data presented in this communication are based on the official data obtained from the Center of Hematology, Yerevan, Armenia, where all leukemia patients are diagnosed and treated. The types of leukemia were classified according to ICD-10 (C91.0 - acute lymphoid leukemia, C91.1 - acute myeloid leukemia, and C92.0 - chronic myeloid leukemia).

As it was indicated in our recent articles (6,7), it is impossible to standardize the data concerning cancer incidence, because the data of the last general census of the population in Armenia was carried out in 2001, but the results are still not known. The only published figure is the population of Armenia - 3 millions. Hence, all our calculations presented in previous papers (6,7) are very close to reality. Because of the absence of relevant data we operate only with CR.

RESULTS AND DISCUSSION

The data concerning the IL in children are presented in Table 1. The analysis of these data showed that the IL had no any regularity during the observed period of time. It was maximum in 1991 (5.4 per 100 000 children of both sexes) and minimum in 1999 (2.6). Also, no regularity was registered in male/female ratio of incidence. Generally, it was higher in males than in females (mean

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incidence was 1.6). Only in 2000 the incidence was higher in females. The mean CR for observed period was 3.7 for both sexes. It was almost the same as in the period from 1981 to 1985 (3.8). So we can conclude that the IL in Armenia did not change or changed but not substantially during 20 years. The IL has ethnic peculiarities, and it varies worldwide. The CR was very low in Concordia, Argentina (0.35 for both sexes, 1994) and comparatively low in Uganda (1.9, 1994) (8). It was almost the same as in Armenia (CR=3.5) in Osaka, Japan (1992) (8), Cuba (1998) (9), and in Bulgaria (3.9, 1996) (10).

Table 1. Number of leukemia cases and crude rates of incidence in children of Armenia (1991-2002)

Year	Total number of cases (crude rate)	Number of cases in females (crude rate)	Number of cases in males (crude rate)
1991	53 (5.4)	19 (3.9)	34 (7.0)
1992	43 (4.3)	16 (3.2)	27 (5.6)
1993	42 (4.1)	14 (2.8)	28 (5.5)
1994	34 (3.4)	10 (2.0)	24 (4.8)
1995	39 (3.8)	13 (2.6)	26 (5.1)
1996	31 (3.0)	11 (2.1)	20 (3.9)
1997	40 (3.9)	17 (3.3)	23 (4.5)
1998	39 (3.8)	15 (2.9)	24 (4.6)
1999	27 (2.6)	7 (1.3)	20 (3.8)
2000	34 (3.3)	22 (4.2)	12 (2.3)
2001	34 (3.2)	15 (2.8)	19 (3.6)
2002	42 (4.0)	19 (3.6)	23 (4.3)
Mean	38.2 (3.7)	14.8 (2.9)	23.3 (4.6)

In many countries the CR of the IL was comparable with Armenia. For example, in 1992 it was 4.3 for both sexes in Armenia, 4.4 in New South Wales, Australia, 4.8 in Quebec, Canada, 4.5 in Finland, 4.6 in Los Angeles County, USA (the mean for all ethnic groups) (8). But among the ethnic groups the IL varied substantially. For example, the CR was 5.8 in Hispanic whites, 1.8 in Afro-Americans, 1.7 in Chinese, 7.1 in Japanese, and 6.8 in Filipinos (8). It is of interest to compare the IL in Armenia with data of another former Soviet Republic, Estonia, where along with Armenia, comparatively high IL was registered from 1981 to 1985 (3.3) (4, 5). In 1992 it was 3.1 (8), in 1998 - 2.9 (11), and in 1999 - 3.4 (12). These data are close to the IL in Armenia.

The data presented show that the IL in children does not vary substantially worldwide. It is noteworthy that the range of IL in adults is about six to eightfold higher, the highest being in North America (13). As mentioned above, the IL in children in Armenia is comparable with the IL in the USA and Canada.

The mean male/female ratio of the IL was 1.6 in Armenia for the observed period. Only in 2000 it was higher in females than in males (0.55). This ratio was close to the ratios in Bulgaria (1.4, 1996) (10), in Los Angeles County, USA (1.5 for all ethnic groups), and in Madras, India (1.8) (8). Comparatively low ratios were observed in Finland, in Manitoba, Canada, and in Uganda (0.5-0.9) (8). Comparatively high ratios were observed in Shanghai, China and Belem, Brazil (2.1-2.2), (8). In former Soviet

Republics Latvia (8) and Estonia the ratio was close to 1 in 1992 and in 1998 (8, 11).

The mentioned ratio has also some ethnic peculiarities because it was 1.2 in Hispanic and non-Hispanic whites and Afro-Americans, 0.5 in Japanese, 0.3 in Chinese, and 0.9 in Filipinos living in Los Angeles County (8). It is noteworthy that in the same ethnic groups living in various countries, the ratio sometimes varies substantially. For example, sevenfold difference was observed in the ratio of Chinese living in Los Angeles County, and in Chinese living in Shanghai, China (0.3 and 2.2, respectively) (8).

It is supposed that childhood leukemia, especially ALL, is connected with paternal exposure to some chemical agents (1,2). It is possible through some mechanisms. These include carcinogenic or mutagenic damage to germ cells of either father or mother prior to pregnancy, to the developing fetus through transplacental transmission during gestation, and/or directly to children during the postnatal period by contaminated breast milk or environmental contamination from parents' working clothes (1,2). Until 1988 Armenia had a developed chemical industry. But since that time, no chemical plant acted until 1995. Now the chemical industry of Armenia acts only partially (8%-10% of former activity in 1988). So it may be supposed that the IL, especially ALL, is not connected with activity of chemical industry, because the IL was almost the same during more than 20 years.

In conclusion, the IL in children in Armenia was not changed substantially during 20 years. The crude rate of the IL is comparable with data of many countries. But at the same time there was registered comparatively high male/female incidence ratio also comparable with the incidence in some of both developed and developing countries. It may be supposed that the IL in children in Armenia is not connected with parental exposure to chemicals.

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