Trend of Leukemia in Ninawa/Iraq

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Abstract

To examine the time trend leukemia incidence rates by sex among age groups (0–19) and (20–≥70), in Ninawa/Iraq. Beginning with the Iran–Iraq and ended with the end of USA occupation. We analyzed the data for cancer of all types of leukemia combined (ICD 9th, codes 204-8), between 1st January 1980 and 31st December 2010 were taken from annual book series published from the Directorate of Health in Ninawa-Mosul Continuing Medical Education Center. This data was collected from all hospitals in Ninawa Province by the Mosul Cancer Registry. Population data were collected from the Central Organization for Statistics, Ministry of Planning. A study found that males aged 0-19 years are more sensitive than females from the first shock when an extremely major events occur, while females of the same age, sensitivity to a precarious situation or perilous position. In the 20 – ≥70 years age group, the consequences of economic crises and war influenced among males more than females. The Psychological factors, where the intense fear and the high risk which threatened the individuals who more sensitive and vulnerable to the first shock was caused increase in the incidence rates, in addition to economic crises.

Keywords: Leukemia incidence cancer; time trend; Ninawa/Iraq
1 Introduction

Iraq is a unique situation, in terms of the large number of wars and crises. In the last 31 years (1980-2010), Iraq has seen three wars, (Iran-Iraq war, 1980-88), (Gulf War, 1990-91), and (Iraq War, 2003) as well as Economic sanctions (1990-2003), Sectarian war (2006-2007) and American occupation (2003-2010). This variety of wars and crises have a negative impact on the people’s health. In the 1980’s the epidemiological situation of Iraq and its citizens was comparable with the situation in average developed countries. After 1990, the situation changed drastically [19] due to the Gulf War and the impact of economic sanctions [15].

Global and Domestic Media reports have emerged since the nineties of the last century and so far, talking about the high cancer rate. These reports indicated an increase in the number of cases of leukemia in Iraq, especially after the Iraqi war. Several Epidemiological studies were conducted for verifying the reliability of these reports and has specifically focused its analysis on the Basrah (which has seen three of Iraq’s wars over the last three decades) and Fallujah (which had seen a big battle in 2004 with US forces) cities. These studies have demonstrated increased leukemia incidence rates in Basrah and Fallujah. They found that the incidence rate has risen substantially for all types of leukemia, especially in children under 15 years old, which may be due to Depleted Uranium exposure [2, 4, 20, 21, 27-29].

Ninawa province, is located in the north of Iraq. The Mosul is the capital, it's Iraq’s second largest city. Ninawa is bordering Syria and Turkey [11]. Away from Baghdad 402 km and from Basrah 854 km. It has an area of 37,323 square kilometers and an estimated population of 3,221,096 in 2010 (see map, Figure 1). In the province, there is Ibn Al-Atheer Hospital, which is the only specialized treatment Leukemia cancer.

Ninawa as the province was far from the battlefields in the Basrah region of southern Iraq, and far from Fallujah, lies 50 miles (80 km) west of Baghdad [10]. Ninawa province had not seen a storming like Fullujah or battle like Basrah region and there is no indication of the presence of depleted uranium, however, there are reports indicate an increase in leukemia.

In Ninawa province, all types of Leukemia (204-8 LCD 9th revision, which adopted by the Iraqi Ministry of Health) represented 7.6% of all the types of cancer in 2010, while its 2.53% in 1980. It ranks eighth in term of all cancers during the period (1980-1990), increased by one rank (ninth) during (1991-2000) and being the most common cancer, its rank third after breast and lung cancer during (2001-2010). Between 1980 and 2010, Leukemia death represents (15.156%) of all types of cancer death during (1993-2010) (No leukemia deaths were recorded during the period 1980-1992). It causes more deaths than any other cancer among children under age 15, accounting (46.91%) of all cancer deaths in this age group, and represent 25.37% of leukemia deaths.
In this paper, we examined the time trend leukemia incidence rates by sex among age groups (0–19) and (20–≥70), in Ninawa, during 31 years (1980-2010). Beginning with the Iran–Iraq and ended with the end of USA occupation.

2 Patients and Methods

The data for cancer of the all types of Leukemia (ICD 9th, codes 204-8) between 1st January 1980 and 31st December 2010 were taken from annual book series published from the Directorate of Health in Ninawa-Mosul Continuing Medical Education Center. This data was collected from all hospitals in Ninawa Province by the Mosul Cancer Registry [7]. Annual estimates of the population, by 5-year age-groups and by sex, were obtained from the Central Organization for Statistics, Ministry of Planning. The estimates according to the Population Census results as in 1977, 1987 and 1997 [3].

The data were analyzed with SAS (version 9.2; SAS Institute, Cary, NC) by Genmod procedure to fit the Poisson regression analysis of the data with a log link function. The regression equation is \( \ln(r) = a + \beta \times \text{year} \) Where \( \ln(r) \) is natural logarithm of the annual age-adjusted rate, \( a \) is intercept, \( \beta \) is unknown parameter to be estimated. \( \text{year} \) is calendar year. The response variable is the number of cancer incidence, which is a count variable, while the \( \text{years} \) as the independent variable.

For all analyses, the oldest year was taken as reference. The incidence rate and the annual percent change (APC) in incidence rates (with its 95% confidence interval -95% CI) were calculated for the two age groups and expressed per 100 000 persons. The average percent change (APC) is derived from the formula
\begin{equation}
\left(\exp(\beta) - 1\right) \times 100, \text{ where } (\beta) \text{ represents the slope of the fitted regression line.}
\end{equation}

In time trend analysis, the statistical significance of the time-trends in incidence rates were assessed using Poisson regression analysis. The point in time selected where trends significantly change direction.

3 Results

During 1980 to 2010, there were 1222 cases of leukemia of whom 250 female and 401 male cases diagnosed among age groups (0–19), and 265 female and 306 male cases diagnosed among age groups (20 - ≥70).

During the period (1980) and (2010), the incidence rates varied markedly by age and sex. In the 0 –19 age group, the incidence rates among females fluctuated without discernible pattern. Significantly increase by 16.04% (95% CI 0.7398%, 33.6691%) per year between (1980-1988) (Fig 2 and Table 1), decreasing afterwards until 1996 by 13.411% (95% CI -22.982%, -2.6504%) per year, climbed rapidly and peaked in the 2003 at 65.4421% (95% CI 7.0499%, 155.685 %) per year, dropped quickly until 2005 at 31.276% (95% CI -50.894 %, -3.8219%) per year, increased sharply and significantly from 2005-2009 at 28.2075% (95% CI 9.1363%, 50.6114%) per year, and appear to be decreasing again since then. The incidence rate significantly (p<0.0001) increased on average during the period 1980 to 2010 by 4.2046% (95% CI 2.5673%, 5.8681%) per year. The average number of leukemia incidence cases diagnosed each year during (1980-2010) increased from (0.4) to (8).

![Figure 2. Trend in incidence rates among Females, aged (0-19) in Ninawa/Iraq during the period from 1980 to 2010, the trend lines plotted independently.](image)
Trend of Leukemia in Ninawa/Iraq

Table 1. Annual Percent Change (APC) and Time-Period by sex and age during the period 1980-2010.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age group</th>
<th>Time Period</th>
<th>APC (%)</th>
<th>Lower CI</th>
<th>Upper CI</th>
<th>Pr &gt; ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>0-19</td>
<td>1980-82</td>
<td>↑ 186.067</td>
<td>37.064</td>
<td>497.051</td>
<td>0.0051</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1982-84</td>
<td>↓ -44.076</td>
<td>-66.277</td>
<td>-7.2597</td>
<td>0.0243</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1984-90</td>
<td>↑ 19.4169</td>
<td>4.8049</td>
<td>36.0661</td>
<td>0.0077</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1990-92</td>
<td>↓ -48.143</td>
<td>-66.560</td>
<td>-19.583</td>
<td>0.0034</td>
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<td></td>
<td></td>
<td>1992-03</td>
<td>↑ 10.5395</td>
<td>4.8816</td>
<td>16.5026</td>
<td>0.0002</td>
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<tr>
<td></td>
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<td>2003-06</td>
<td>↓ -17.617</td>
<td>-31.723</td>
<td>-0.5961</td>
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<td>20- ≥70</td>
<td>1980-95</td>
<td>↑ 10.3056</td>
<td>2.6090</td>
<td>18.5795</td>
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<td>1995-05</td>
<td>↑ 6.8877</td>
<td>1.2238</td>
<td>12.8685</td>
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<td>F</td>
<td>0-19</td>
<td>1980-88</td>
<td>↑ 16.0423</td>
<td>0.7398</td>
<td>33.6691</td>
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<td>1988-96</td>
<td>↓ -13.411</td>
<td>-22.982</td>
<td>-2.6504</td>
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<td>1996-01</td>
<td>↑ 31.5992</td>
<td>5.1472</td>
<td>64.7059</td>
<td>0.0165</td>
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<td>2001-03</td>
<td>↑ 65.4421</td>
<td>7.0499</td>
<td>155.685</td>
<td>0.0234</td>
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<td></td>
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<td>2003-05</td>
<td>↓ -31.276</td>
<td>-50.894</td>
<td>-3.8219</td>
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<td></td>
<td>2005-09</td>
<td>↑ 28.2075</td>
<td>9.1363</td>
<td>50.6114</td>
<td>0.0025</td>
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<td>20- ≥70</td>
<td>1980-92</td>
<td>↑ 14.7254</td>
<td>0.5335</td>
<td>30.9207</td>
<td>0.0415</td>
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<td>1992-96</td>
<td>↑ 40.4165</td>
<td>7.0045</td>
<td>84.2614</td>
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<td>-9.7984</td>
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<td>152.8</td>
<td>740.602</td>
<td>&lt;.0001</td>
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<td></td>
<td>2003-05</td>
<td>↓ -25.533</td>
<td>-43.719</td>
<td>-1.4712</td>
<td>0.0390</td>
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</table>

Trend among males were more complex, fluctuated with no clear pattern, rates climbed dramatically between 1980 and 1982 by 186.067% (95% CI 37.0641%, 497.051%) per year (Fig 3 and Table 1), decreased sharply from 1982 to 1984 by 44.076% (95% CI -66.277%, -7.2597 %) per year, increased significantly by 19.4169% (95% CI 4.8049%, 36.0661%) per year from 1984-1990, decreased steeply by 48.143 % (95% CI -66.560%, 19.583%) per year from 1990-1992, steadily increased and significantly until 2003 by 10.5395% (95% CI 4.8816 %, 16.5026%) per year, decreased significantly until 2006 by 17.617 %(95% CI -31.723%, -0.5961 %) per year and then leveled off. The incidence rates increased significantly (p=0.0016) over our study period, with an annual percentage change by about 1.91% (95% CI 0.7192%, 3.1135%). The average number of leukemia incidence cases diagnosed each year during (1980-2010) increased from (0.498) to (5.73).
Figure 3. Trend in incidence rates among Males, aged (0-19) in Ninawa/Iraq during the period from 1980 to 2010, the trend lines plotted independently.

In the 20 – ≥70 years age group. Among females. From 1980 to 1992, rates increased steadily and significantly by 14.7254% (95% CI 0.5335%, 30.9207%) per year (Fig 4 and Table 1), increased sharply until 1996 at 40.4165% (95% CI 7.0045%, 84.2614%) per year, decreased sharply and significantly until 2000 by 29.189% (95% CI -44.412%, -9.7984%) per year, climbed dramatically by 360.981% (95% CI 152.799 %, 740.602%) per year between 2000 and 2003, decreased sharply until 2005 by 25.533% (95% CI -43.719%, -1.4712%) per year, then leveled off. The incidence rate significantly (p<0.0001) increased on average during the period 1980 to 2010 by 8.9331% (95% CI 6.9799%, 10.9219%) per year. The average number of leukemia incidence cases diagnosed each year during (1980-2010) increased from (0.754) to (8.3).
Among males, rates increased steadily and significantly until 1995 by 10.3056% (95% CI -2.6090%, 18.5795%) per year (Fig 5 and Table 1), increased significantly by 6.8877% (95% CI 1.2238%, 12.8685%) per year until 2005, then leveled off. The incidence rate significantly (p<0.0001) increased on average during the period 1980 to 2010 by 8.3330% (95% CI 6.5634%, 10.1320%) per year. The average number of leukemia incidence cases diagnosed each year during (1980-2010) increased from (0.326) to (8.82).

Figure 5. Trend in incidence rates among Males, aged (20- ≥70) in Ninawa/Iraq during the period from 1980 to 2010, the trend lines plotted independently.

4 Discussion

This paper is the first to describe leukemia incidence rates in Ninawa/Iraq, which in our study period, the country has seen three consecutive decades of war and United Nations sanctions against Iraq. Beginning with the Iran–Iraq war (1980-1988), the Invasion of Kuwait (1990), the Second Gulf War (1991), United Nations sanctions against Iraq (1990-2003), Iraq War (2003) and followed by seven years of occupations. In these wars, many weapons were used, chemical weapons were used extensively during the Iran-Iraq war [23], US and British coalition forces used Depleted Uranium Ammunition three times in Iraq, first, in Operation Desert Storm in 1991 to eject Iraqi forces from Kuwait [15], second, during the 2003 Iraq War [26], third, in March and November 2004 were the prohibited weapons used inside Fallujah city [8].

Ninawa as the province was far from the battlefields in the Basrah region of southern Iraq, which has seen three of Iraq’s wars over the last three decades, and far from Fallujah, lies 50 miles (80 km) west of Baghdad which had seen a big battle in 2004 with US forces in the city. Ninawa province had not seen a storming like Fullujah or battle like Basrah region, but deployed the US troops and wage operations against counterinsurgency. Although, our results revealed a significant rise in the incidence rate.
The health of the Ninawa people has fluctuated as a reflection of those whose affected by years of wars, economic sanctions and occupation. In the 0 –19 age group, among females, rates increased steadily during the eight years Iran - Iraq war (1980 - 1988), peaked at 2003 (Iraq war), most of economic sanctions years (1996-2003) and finally increased during the period between 2005 and 2009 (The cautious calm prevailed in the Ninawa province after the fall of Saddam Hussein's regime in 2003 until end of 2004 where the U.S. forces began an operations against counterinsurgency). Among males, rates increased and peaked at the beginning of the Iran-Iraq war (1980-1982), Invasion of Kuwait (1990), the Second Gulf War (1991) and Iraq war (2003), also increased during the period from 1992 (after one year of economic sanctions against Iraq) to 2003.

In the 20 –70 age group, among females, the rates increased steadily during the period from 1980 to 1992 (Iraq war), Invasion of Kuwait (1990), the Second Gulf War (1991), change direction upwards until 1996, increased dramatically during the period between 2000 to 2003. Among males, the rates increased steadily during the period between 1980 to 1996, change direction upwards until 2005 and has not yet declined during these two time periods.

The rates among all age/sex groups, increased until the end of the 1980s or the beginning of 1990s, except among males (0-19) age group, for whom rates decreased during the period from 1982-1984, then it increased until 1990. The rates decreased among females and males, (0-19) age groups, from (1988-1996) and (1990-1992) respectively. While the rates among (20- ≥70) females, decreased from (1996-2000). The rates among all age/sex groups, increased dramatically until 2003, except males (20 - ≥70), for whom rates increased until 2005. During 2003 until around 2005, rates declined sharply among all groups except males 20 - ≥70), for whom rates not significantly decreased until 2010. In contrast, rates among males (0-19) age group and females (20- ≥70) increased not significantly from around 2005 until 2010. The only group of females (0-19) age group, for whom rates significantly increased during the period between 2005 and 2009.

A study found that males aged 0-19 years are more sensitive than females from the first shock when an extremely major events, while females of the same age, sensitivity to a precarious situation or perilous position. In the 20 – ≥70 years age group, the consequences of economic crises and war influenced among males more than females.

In this paper, probably the Psychological factors, where the intense fear and the high risk which threatened the individuals who more sensitive and vulnerable to the first shock is cause increase in the incidence rates, in addition to economic crises and without neglecting other factors that possible causes of adult leukemia (exposure to radiation [6], chemical [12], or benzene [24], inherited syndromes (Down syndrome) [1], virus infection [13], ethnicity/gender [14], cigarette smoking [16] or the causes of childhood leukemia, in addition of the causes that mentioned for adults except cigarette smoking. A socioeconomic status in some studies [22], birth weight and birth order in early childhood (ages 0-4 years) with the hypothesis that delayed exposure to infections in infancy [30].
The factors of exposure to radiation, chemical, benzene and cigarette smoking do not lead to increase the risk of cancer suddenly. It takes many years after exposure to develop the cancer [5, 9, 18, 24].

It is suggested that future studies evaluates the trend leukemia cancer in all the cities in Iraq according to the proximity and distance from areas where battles took place and compare them with the Kurdistan governorates, which was stable over the past twenty years.

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References


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