

DEPLETED URANIUM AND INCIDENCE OF CANCER IN BASRAH: A PRELIMINARY ECOLOGICAL STUDY

Laith A. Alrudainy¹, Narjis A. Ajeel¹, Hamid T. Al-Saad²

ABSTRACT

Background: Basrah has been exposed to massive environmental pollution during past years including depleted uranium (DU) as a consequence of military conflicts. Many studies have reported an increase in incidence of cancer in Basrah.

Objectives: To explore the ecological relationship between DU and cancer incidence in Basrah.

Material & methods: Basrah governorate was divided into seven geographical areas. Exposed areas to DU were dotted on the map of Basrah. Incidence rates of cancer were distributed in these seven areas. Statistical analysis included descriptive statistics and Spearman correlation analysis.

Results: This study did not find ecological correlation between incidence rate of cancer and level of exposure to DU in Basrah.

Conclusions: Although the result of the ecological study may be affected by the ecological fallacy, the power to generate hypothesis about the relationship between DU and cancer risk is still weak especially when taking into account the results of previous studies of uranium exposure and cancer risk. Further epidemiological studies are needed to clarify a possible carcinogenic effect of residential exposure to DU.

INTRODUCTION

Uranium is a natural and commonly occurring radioactive element which has three radionuclides. It has been used since the 1940s principally in the atomic energy industry, where reactor fuel rods are composed of refined ²³⁵U (half-life 704×10^6 years), and the waste product from this refining is DU, which is predominantly ²³⁸U (half-life 4470×10^6 years). Typically, DU contains some 0.2% of the fissionable ²³⁵U.^[1] Due to the high density of DU, about twice that of lead, it is used in many civilian and military applications. DU is used by the military for the production of distinctly powerful projectiles (e.g., bullets/penetrators). As the projectile pierces, it leaves behind its jacket dispersing DU dust into the environment during impact.^[2] Uranium metal is combustible and readily ignites when finely divided in air, a property known as pyrophoricity. Hence, when used militarily, or when present in an air crash or a fierce fire, the uranium may form large quantities of dust containing a mixture of uranium oxides that can be ingested or inhaled.^[3] Basrah is Iraq's second largest city; it is confronted with a range of environmental problems that are both immediate and severe, some can be directly linked with the effects of recent military conflicts.^[4] According to the Pentagon, about 300 metric tons of depleted uranium weapons were fired in the

Gulf war of 1991.^[5] In USA-Iraq War of 2003, the USA and UK Governments acknowledged that depleted uranium munitions have been used in Iraq (at least 150 tons of DU ammunition were used), the UK military used about 1.9 tons of depleted uranium in Basrah.^[6] DU decays mainly through emission of alpha particles that do not penetrate the external skin layers but may affect internal body cells (which are more susceptible to the ionizing effects of alpha radiation) when DU is ingested or inhaled.^[2] However, because DU is only weakly radioactive, very large amounts of dust (on the order of grams) would have to be inhaled for the additional risk of lung cancer to be detectable in an exposed group.^[7] Risks for other radiation-induced cancers, including leukaemia, are considered to be very much lower than for lung cancer.^[7] Despite this, many studies suggested that the use of DU during 1991 and 2003 had resulted in a significant increase in the incidence of malignant disease in Basrah.^[8,9] The key question therefore, and the most difficult to answer is whether or not DU is present at high enough levels to affect the Iraqi population. This opens the door to many possibilities, including resuspension of DU particles, ingestion of DU via food growing in contaminated soil, contamination of drinking water, and ingestion by children playing in the

¹Department of Community Medicine, College of Medicine, University of Basrah, Iraq.

²Department of Environmental Chemistry, Marine Science Center, University of Basrah.

soil. In planning a study on whether population exposed to DU had increased risk of cancer, the authors aimed to explore the ecological relationship between level of DU and cancer incidence in Basrah. The outcome of such a study will support or refute such a hypothesis.

MATERIALS AND METHODS

The study was conducted during the period extending between January to December 2008. Information related to population of Basrah was based on data available from Basrah health authorities and was obtained by personal communication. Information about cancer patients was based on all cases of cancer which were diagnosed by histopathologists or hematologists in Basrah during 2006 and were compiled by Habib et al,^[10] which included: name, age, sex, address, and type of cancer. The incidence rate (IR) is classically expressed as the average number of cancer cases occurring per 100000 persons each year.^[11] The calculation of the age-standardized incidence rate (ASIR) is an example of direct standardization, whereby the observed age-specific rates are applied to a standard population, and it is therefore essential that comparisons of cancer risk be made independent of the age profile of each population.^[11] The Data about the level of exposure to depleted uranium were collected from many sources.^[12,13,14] Exposed areas to DU were dotted on the map of Basrah. According to this map the exposed population was clearly distinguished from the non - exposed population to avoid dilution of cancer rates. To reach to this goal, Basrah governorate was divided into seven geographical areas according to the system used by the health authorities in which Basrah governorate is divided into health sectors. These areas are: Basrah city center, Abu-Alkaseeb (including Al-Fao), Al-Zubair, Al-Qurna, Al-Mudaina, Shatt-Alarab, and Al-Hartha. These seven areas were grouped according to the level of exposure to DU into 3 groups: exposed areas including: Basrah city center and Al-Zubair regions, less exposed area including Abu al Kaseeb and Al-Qurna, and not exposed area

including Al-Hartha, Shatt al Arab, and Al-Mudaina.

All data were analyzed using the SPSS, version 14 software. Statistical analysis included descriptive statistics and Spearman correlation analysis.

RESULTS

The total number of incident cancer cases registered in 2006 was 1469. The crude incidence rate (CIR) of all registered cancers among the population of Basrah was 66.1 per 100000 (57.4/100000 among males and 75.1/100000 among females), the 95% confidence interval around the CIR is 62.7–69.5/100000. The overall age-standardized incidence rate (ASIR) for all population in Basrah was 122.2/ 100000. The cumulative risk of all cancers among Basrah population was 10.8%. Table 1 shows the top ten cancers outlined in descending order of frequency for the whole population in Basrah, 2006.

Table 1. The top ten cancers among population in Basrah, 2006.

Type of cancer	No. of cases	% of total
Breast	292	19.9
Leukemia	103	7.0
Bladder	88	6.0
Non-Hodgkin Lymphoma (NHL)	75	5.1
Colo – rectal	74	5.0
Lung	64	4.4
Skin	57	3.9
Bone	51	3.5
Stomach	50	3.4
Soft tissue	46	3.1

The top five cancers among males and females were also outlined in (Figures 1 and 2) respectively.

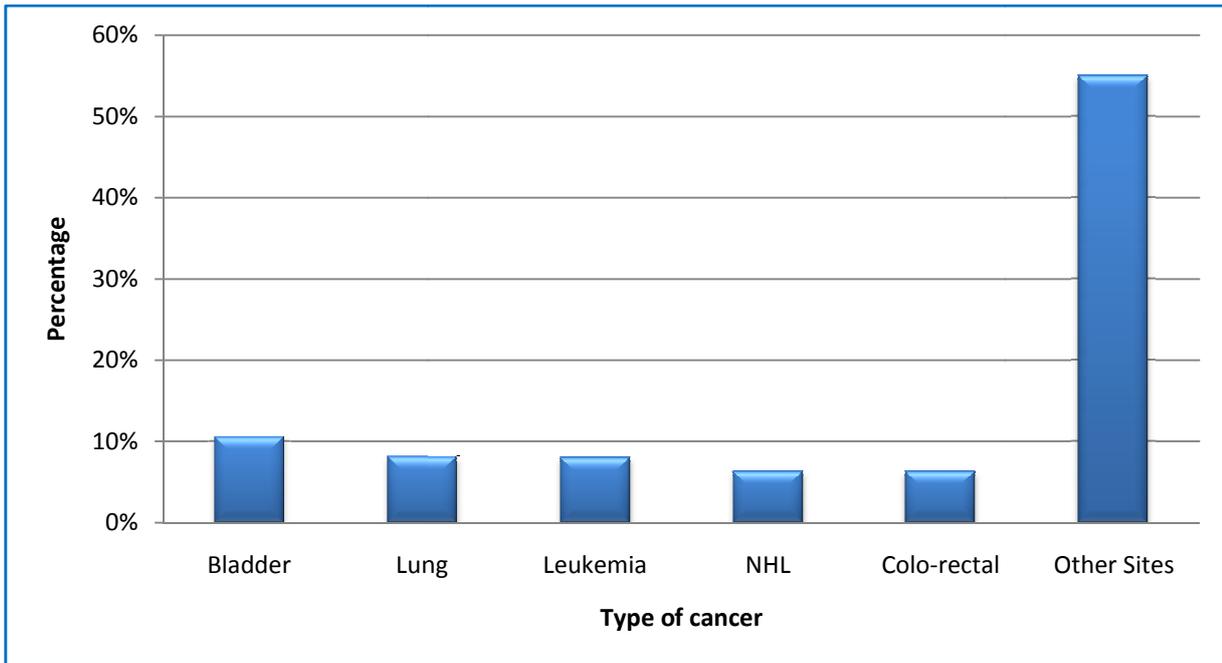


Fig 1. Percentage distribution of most frequent types of cancer among males in Basrah, 2006.

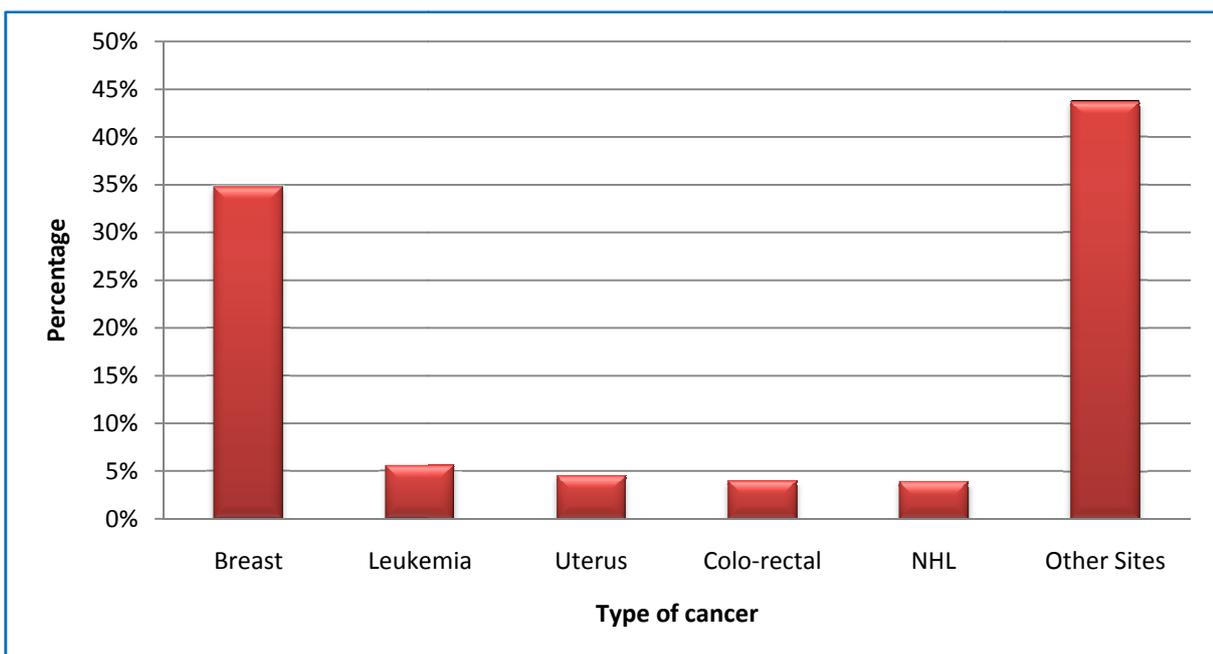


Fig 2. Percentage distribution of most frequent types of cancer among females in Basrah, 2006.

Figure 3, represents the regional distribution of DU and incidence rates of cancer in Basrah. In 2003 the highest level of DU was found in Basrah city center while in 1991 the highest level was in Al-Zubair area. The three geographic regions with the highest IR were

Basrah city center at 83.2/100000, Shatt al Arab region at 78.0/100000, and AL-Hartha region at 69.1/100000. It can be seen that the area with highest level of exposure to DU in 1991 (Al-Zubair area) had the lowest incidence rate of cancer.

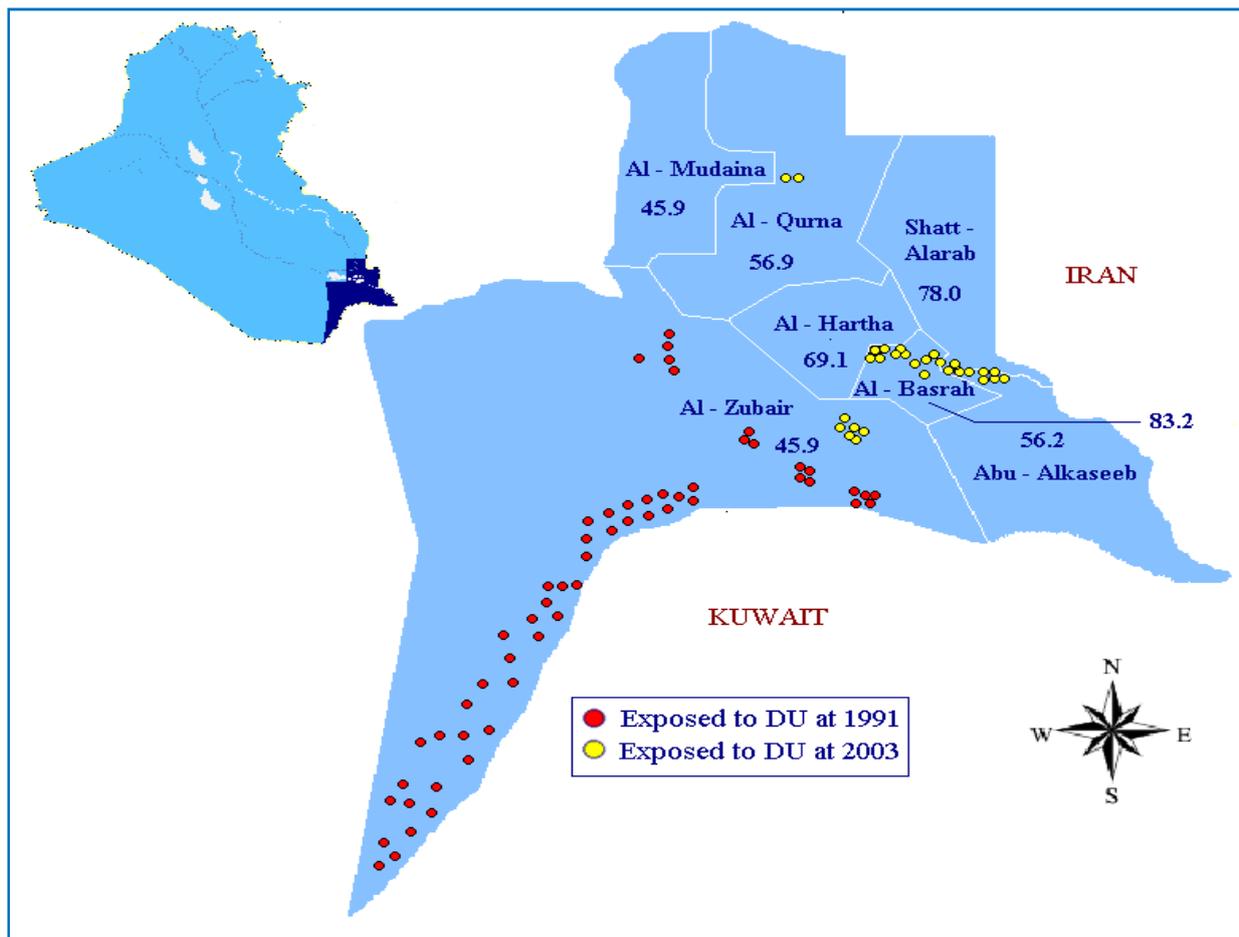


Fig 3. Distribution of DU [12,13,14] in 1991 and 2003 and incidence rate per 100000 population of cancer by region in Basrah in 2006.

The correlation between level of DU and incidence rate of cancer was statistically not significant ($r = -0.01, P > 0.05$) (Figure 4).

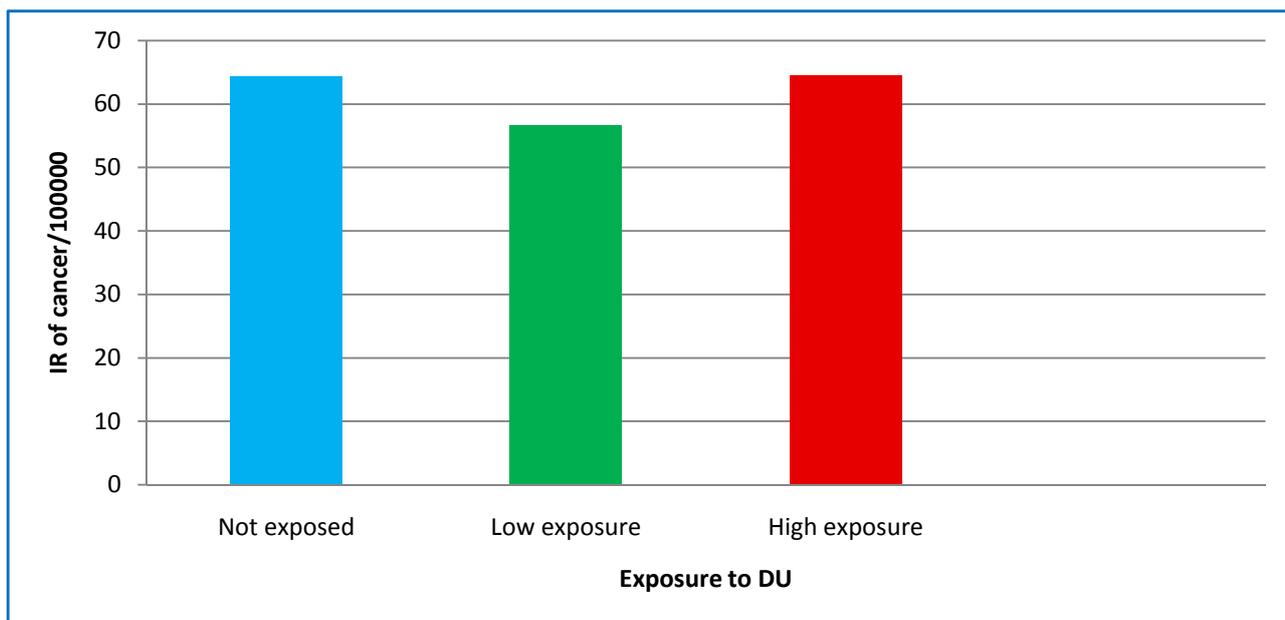


Fig 4. Spearman correlation between the average level of exposure to DU and incidence rate of all cancers in Basrah. ($r = -0.01, P = 0.98$).

DISCUSSION

In comparison with other countries, the cancer incidence in Basrah was lower than in Egypt, nearly equal to incidence of cancer in Saudi Arabia and Iraq, and slightly higher than in Jordan and Kuwait.^[15] Our results suggest that the incidence of cancer in Basrah is in the mid position in comparison with adjacent countries. This finding may be attributed to either underestimation of cancer incidence in Basrah or that the exposure to DU during past years did not reach to the harmful level. On the other hand, the pattern of cancer in Basrah was greatly different from that worldwide. This figure prompts us to repeat our question about the effect of environmental pollution on modulating the types of cancer rather than the incidence of cancer. Studies have shown that, the level of radiation in different areas in Basrah has been increased several times since 1991. In 1996 a study showed that people in the western part of Basrah City received a total whole body radioactive dosage of (442-577) mSv, mostly in the first six months of 1991 Gulf War military operations.^[12] In 1999-2000 a follow-up exploration program in the same area was done, and results of this program indicated the existence of slightly higher radioactivity in some of the areas, but generally sand storms and the weathering process contributed to the dispersion of these contaminants to nearby populated areas in Basrah.^[13] In 2005 another study, measured the level of depleted uranium in 1187 samples, and the results indicated that the level of depleted uranium in soil samples near the destroyed targets in Basrah ranged from 4.82 to 4632.19 Bq/kg.^[14] The present study did not find a significant correlation between the level of DU in exposed area in Basrah and the incidence rate of cancer. Although this result may be due to the ecological fallacy, yet the power to generate hypothesis about the relationship between DU and cancer risk is still weak especially when taking into account the results of previous studies of uranium exposure and cancer risk.^[16,17] This is in agreement with two recent reviews of uranium exposure and cancer risk addressed overall cancer mortality and also lung, lymphoid, and bone cancer mortality, those most likely to be related to internal uranium exposure. The first, by the US Center for Disease Control and

Prevention/Agency for Toxic Substances and Disease Registry, concluded that "no significant differences in cancer of the lungs were found between workers who were occupationally exposed to uranium and control populations."^[18] The second was a review of health effects of uranium conducted by the US National Academy of Sciences Institutes of Medicine which evaluated existing epidemiological studies more rigorously and gave relative weight to the studies' strengths and weaknesses in their assessments. Regarding the lung cancer risk, the committee concluded that there was limited/suggestive evidence of no association between exposure to uranium and lung cancer at cumulative internal dose levels lower than 200 mSv.^[19] This roughly corresponds to the burden occurring from a full year's exposure to a dusty indoor uranium workshop environment.^[20] For both lymphatic and bone cancers the committee concluded that there was inadequate or insufficient evidence to determine whether an association does or does not exist with uranium exposure. Most of the studies cited did not show an excess, but there was also inadequate evidence to dismiss the possibility.^[21] Another evidence comes from a small surveillance study of US Gulf war veterans who were victims of friendly fire with depleted uranium. About 15 of these veterans possessed retained metal fragments of depleted uranium in soft tissue and were excreting raised uranium concentrations in their urine. None of these veterans had leukaemia, bone cancer, or lung cancer.^[22] Other measurements carried out at many sites in Kuwait showed that DU does not pose a radiological hazard to the population of Kuwait. No person who might have received doses from exposure to residues of DU was identified, either by the authorities of Kuwait or in the international atomic energy agency (IAEA) investigation. The study concluded that, the estimated annual radiation doses that could arise in the areas where residues do exist are of the order of a few mSv, well below the annual doses received by the population of Kuwait from natural sources of radiation in the environment and far below the action level of 10 mSv suggested by the International Commission on Radiological Protection as a criterion to establish whether remedial actions

are necessary. On the other hand, prolonged contact with these DU residues is the only possible exposure pathway that could result in exposures of radiological significance. As long as access to the areas remained restricted, the likelihood that members of the public could pick up or otherwise come into contact with these residues is low.^[23]

In conclusions, despite the problem of ecological fallacy and the incompleteness of data, yet the power to generate a hypothesis about the relationship between DU and cancer risk is still weak especially when taking into account the results of previous studies of uranium exposure and cancer risk that refute such association. There is still insufficient scientific knowledge, and new epidemiological studies are needed to clarify a possible carcinogenic effect of residential exposure to DU.

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