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Environmental pollutions associated to conflicts in Iraq and related health problems

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Abstract: Several wars and a 13-year embargo as well as several years of civil war with the recent war on terrorism have cumulatively damaged Iraq's land, air, water, and health infrastructure. The sand particles in Iraq contain toxic substances, which dates back to the pollution caused by military actions that disassemble the desert sands and turn it into light dust. This dust reaches cities as dust storms that effect most Iraqi cities. The presence of depleted uranium (DU) in the Iraqi food chain is documented by measuring the uranium in animals organs in different Iraqi cities with the highest concentration in the south of Iraq. One of the major sites of pollution in Iraq is the Al-twaitha nuclear research site. The nuclear research reactors were destroyed in the 1991 Gulf War. Barrels containing radioactive materials and sources were stolen from the site in the 2003 war. This resulted in considerable radioactive pollution at the site and in its surrounding areas. Soil sample have been found to be contaminated by Cs-137and Co-60. Cancer and birth defects are most associated with the environmental pollution caused by the conflicts. All studies related to this by Iraqi researchers are discussed in this review. From studying the Iraqi scientific publications, we can conclude that Basrah, Baghdad, Faluja, Mosul and Thi-Qar are the most effected cities in Iraq. This review concludes that the presence of a heavily contaminated environment with war related pollutants in most of the Iraqi cities needs much attention and huge effort to reduce the related health problems.

Keywords: Baghdad; birth defects; cancer; Gulf War.

Introduction

Three major wars and a 13-year embargo as well as several years of civil war with recent war on terrorism have cumulatively damaged Iraq's land, air, water, and health infrastructure [1]. Iraq has suffered greatly from these conflicts which have had a huge impact on the environment [2]. Several studies have shown a link between the Iraqi wars and the increase in the incidence of cancer and predicted future increase in such diseases due to the pollutants associated with war [2, 3]. Moreover, there were increases in birth defects that were linked to bombarded Iraqi cities [4]. Severe contamination of water, soil, and air can occur after bombardment [5]. There were direct and indirect effects of these wars on the environment, the direct effect was the waste and pollutants resulting from the bombs and missiles and war related chemicals. While the indirect effects were represented by the destruction of the infrastructure [6]. Our current study is based on data collected by Iraqi researchers from different independent Iraqi institutes, universities, research centres and from different disciplines. All these efforts are individual research work and it is not from governmental directed programs. We did not include official governmental data from the ministry of environment or ministry of health to avoid any political influence that may or may not be present.

Environmental pollutants as a result of the conflicts

Sand particles in Iraq contain toxic substances, which date back to the pollution caused by military actions that disassemble the desert sands and turn it into light dust. This dust reach cities as dust storms that effect most Iraqi cities [7]. Sand storms in Baghdad have been found to carry low levels of uranium that can have cumulative effects [8]. Metal contamination was recorded in heavily bombarded Iraqi cities like Basrah and Fallujah and has been linked to the epidemic of congenital birth defects in Iraq. Lead (Pb) and mercury (Hg) were the major metals detected along with uranium [9]. While very low environmental contamination was found in the north of Iraq where these cities not involved in conflicts after the Iraq-Iran War [10]. In the USA-Iraq War of 2003, the USA and UK governments stated that depleted uranium munitions had been

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used in Iraq (at least 150 tons of depleted uranium [DU] ammunition were used) [11]. Uranium is a natural radioactive element that has been used in the atomic energy industry and DU is the waste product of this use [12]. DU is used by the military for the production of powerful projectiles (e.g. bullets). As the projectile pierces, it leaves DU dust in the environment on impact and contains uranium oxides that can be ingested or inhaled [13, 14]. DU has been reported to be present in several places in Iraq [15]. DU in soil can lead to an accumulation in the food chain and is ingested by humans (Figure 1) [6]. The presence of DU in the Iraqi food chain has been documented by measuring the uranium in the sheep organs in different Iraqi cities with the highest concentration in the south of Iraq [16]. Moreover, the air born pollutants are linked to traffic density and private generators [17]. Hydrocarbons are the major pollutant released to the air [17] and are inhaled by the people causing serious diseases.

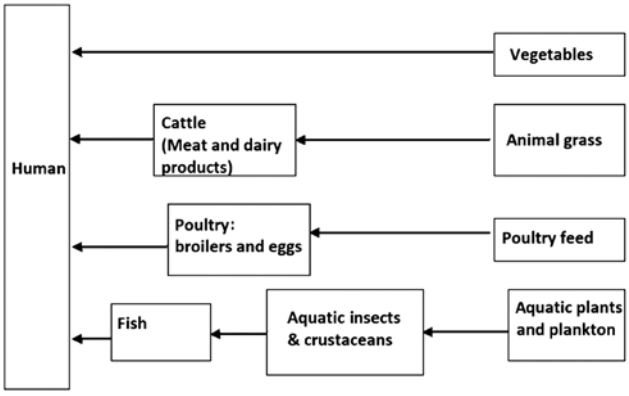

Figure 1: How the pollutant presence in soil can lead to accumulation in the food chain and is ingested by human [6].

Case study

One of the major sites of pollution in Iraq is the Al-twaitha (Nuclear Reactor Tammuz-2) nuclear research site (Figure 2). This area is located 20 km southeast Baghdad in the Tigris valley [19]. The nuclear research reactors located at the Al-Twaitha site was destroyed in the 1991 Gulf War. Barrels containing radioactive materials and sources were stolen from the site in the 2003 war [15]. This resulted in considerable radioactive pollution in the site and its surrounding areas [20]. Soil samples were found to be contaminated by Cs-137and Co-60 [18, 21]. The tested values of absorbed radioactive dose rate exceed the permitted level by (9500) times [22]. The surveys and laboratory results indicated that the fuel fabrication facility (FFF) in one of the destroyed nuclear facilities was contaminated with uranium-238 and uranium-235 [23].

Figure 2: Destroyed nuclear reactor Tammuz-2 at Al-twaitha nuclear research site [18].

AL-Tameemi carried out a multi-step risk assessment study on the exposure of the local inhabitants living in the vicinity of the Al-Twaitha nuclear research site to uranium-235 through environmental pathways (inhalation of air and ingestion of contaminated food) to characterize the possible health hazards. The possibility of developing tumors in the nearby population due to uranium-235 exposure was evaluated at 0.14 latent cancer fatalities per million exposed individuals. He found that the risk of developing breast cancer is the largest in comparison with cancers of other body organs. Radiation injury such as genetic damage were expected to occur at a rate of 1850 per million exposed individuals in the offspring of the studied population due to irradiation of the gonads [24].

A recent study [25] aimed to investigate the genotoxicity of workers who were exposed to radiation at the Al-Tuwaitha site due to decommissioning and radioactive contamination during January 2010 to December 2011. The results suggest that the accumulation of genetic damage is detectable in peripheral blood lymphocytes of radiated workers at the Al-Tuwaitha site. In another study by Al-Rekabi et al. [26], they recorded the effect of radiation and pollution in the same surrounding Al-Tuwaitha area on Iraqi sheep fertility, the physical characteristic of the semen and cytogenetic changes and chromosomal aberrations on lymphocyte cells. Their results indicated the presence of chromosomal changes with a high significance in sister chromatid exchange. There was a decrease in fertility and number of births in ewes in the Al-Tuwaitha area. Furthermore, there was a very interesting paper that confirms the effect of pollution on the ecological system in this area, the wild populations of the vinegar fly *Drosophila melanogaster* Meigen from Tuwaitha were investigated for the frequency of dominant lethality, this parameter was investigated through the fecundity and the egg hatchability rate that were considered as the main indicators for the presence of mutation. The results showed a significant decrease in fecundity. The hatchability rate decreased significantly in Tuwaitha when compared with other parts of Baghdad which confirm the presence of side effects [27].

Diseases associated with the conflicts environmental pollutions

Cancer

A group of Iraqi researchers [28] found depleted uranium concentration in tissues, bones, and blood of cancer patients. Specimens collected from the middle and south of Iraq have been contaminated with depleted uranium is related to war zones and they found all the studied samples contain high concentrations of depleted uranium (more than the international standard) when compared with noncancerous diseases. Another researcher [29] measured the concentration of uranium crystals (UC) in the urine of breast cancer patients in Baghdad and compared them to healthy people. The cancer patients had a higher average of UC 1.6 μg/L while the average UC for healthy females was 1.03 μg/L. Moreover, there was an increase in the cancer incidence in Diyala city when compared before and after the war [30]. Increased cancer incidence in Karablaa city was linked to the presence of DU contamination in the environment [31].

Birth defects

The occurrence of congenital birth defects increased by an astonishing 17-fold in the Al Basrah Maternity Hospital when compared the years 1994–1995 to 2003. The enamel portion of the deciduous tooth from a child with birth defects from Al Basrah (4.19 μg/g) had nearly three times higher lead than the whole teeth of children living in unimpacted areas. Data suggested that birth defects in the Iraqi cities of Al Basrah (in the south of Iraq) and Fallujah (in central Iraq) are mainly folate-dependent [9]. A household survey in four Iraqi governorates in 2010, collected data on more than 10,000 children and young people suggested an association between presence of potential sources of contamination in local environments from human and domestic waste, as well as war waste, in association with resident children having 'birth defects'. Children living in Basra were found to be most significantly impacted [32].

The main effected areas in Iraq

Basrah

Basrah is one of the most affected cities in Iraq. This city was heavily bombarded during the Iraqi-Iran war and later during the Gulf War in 1991 as well as in 2003. The results of measuring uranium concentration in soil samples in Basrah (16.1 ppm) show that this governorate was contaminated with DU [33]. People living close to the bombarded areas and war zones in Basrah city exhibited weak immune systems [34]. Human hair samples collected from different areas of Basrah city during 2009–2010 showed

high levels of heavy metals that are higher than international levels [35].

Baghdad

Uranium concentration was measured in the soil samples taken from the north, south, east, west and center of the city of Baghdad. The results indicate the highest concentration of uranium in the soil of the north and east of Baghdad. They were about 12.9–12.4 ppm. The lowest concentration detected was in western, central and southern Baghdad, which was about 0.60–4.6 ppm [36]. A second study confirmed the low level of contamination in the centre of Baghdad with an average of U235 below 3.99 ppm in soil and plants samples [37]. Heavily contaminated areas in Baghdad like AL-Zaifranea and AL-Sader city showed higher uranium concentration in blood samples than other areas in Baghdad that found 0.256 ppm in blood samples taken from random patients visiting the major hospitals in Baghdad [38].

Faluja

The higher rates of congenital anomalies in this city are believed to be caused by exposure to some genotoxic agent, possibly uranium [39]. People living in Faluja city, have a higher chromosomal aberration percentage than those living outside this city after the collation forces attacks in 2004 and 2007 were DU munitions were used [40].

Mosul

A study reported the presence of uranium in three damaged areas. Uranium concentration in the directly damaged areas found an average of 1.176 ppm, while its concentration in nearby areas was 50% less than the damaged ones [41]. The rate of cancer in Mosul City has increased even more since the Gulf Wars [42].

Thi-Qar

In a study to determine the DU in the bombarded old Iraqi city they found very high uranium concetration with a 1900 times increase above the allowable limits [43]. The DU concentration in soil and metal pieces near war zone in this study proved to have the highest concentration [44]. In one study [33] it was found to be 16.38 ppm.

Conclusion

The presence of a heavily contaminated environment with war related pollutants in most Iraqi cities needs great attention and huge effort to reduce the related health problems. Most of the studies done by Iraqi researchers and international collaborators confirmed the correlation between cancerous diseases and the munitions made of DU and years of wars leads to contaminate the Iraqi environment and causes a high risk to people in Iraq. Plans should include investigating the Iraqi environment from north to south especially the war zones where the DU ammunitions were used to identify the concentration of these pollutants and make plans to treat them. Treating the environmental pollutions near the war zones should be a maximum priority.

More resources should be offered to study the pollution effect on Iraqi personal health. The top priority is to increase awareness for the early detection for birth defects and congenital anomalies in the polluted areas. From a one health approach perspective, effective prevention and control of the pollution needs close collaboration between veterinarians, agriculturalist and public health professionals. A comprehensive screening for all effected animals should be done to eliminate the affected animals and food, and to avoid agriculture in the affected areas, which is particularly important, as there is no effective way to clean the soil. In addition, efforts should be made to increase the awareness of veterinarians and clinician as well as agriculture engineers along with the environmental health specialist for this environmental pollution to improve related disease prevention strategies.

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