

**Original article:**

**The effect of X-rays and toxicity lead/ cadmium on hematological and immunological cells**

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**Abstract:**

**Background:** Exposure to radiation and/or batteries containing lead/cadmium, is currently under huge investigations as they are causing many health problems. The aim of this study is to evaluate the effect of radiation and toxicity of lead and cadmium on hematological cells.

**Methods:** Forty subjects who previously exposed to lead/cadmium, twenty five radiologist and 10 healthy controls were recruited to this study. This study was conducted between January 2017 - April 2017 in Riyadh city, KSA. A questionnaire was distributed and answers were taken by the interviewer. Ten ml of whole blood in EDTA tube were collected and immediately tested by Abbott Cell Hematology Analyzer. **Results:** There was a significant difference in Hgb levels between batteries exposed people and healthy controls. Also there was a significant increase on WBCs count and lymphocytes count on battery exposed people compared to controls and radiologist. Almost 43% of battery exposed people have allergic reactions compared to controls.

**Conclusion:** Monitoring irradiation and lead/cadmium toxicity levels is suggested in patients with a high risk of immunocompromised or chronic diseases patients.

**Keywords:** Irradiation; lead; cadmium; toxicity; Saudi

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**Introduction:**

Exposure to radiation and/or batteries containing lead/cadmium is currently under huge investigations as they are causing many health problems. Exposure to X-rays on a daily basis due to a profession, accompanied by significantly deleterious effects, has been shown by numerous studies. Even, irradiation of blood and blood components is also possible at smaller doses (0.1microgray), many have unavoidable effects. International organizations and WHO, therefore, would considerably increase the safety and awareness of these professionals to take care and advise for routine screening of their blood. The effects of X-rays and toxic materials on

hematological and immunological parameters was evident for many years. However, no comprehensive study review of the effects of X-rays and toxic materials on blood products is readily available.

One of the first reports on radiation-induced haemolysis was in 1904 when Henri and Mayer<sup>1-2</sup> demonstrated that blood could be haemolysed by irradiation and X-rays. Additionally, Cadmium and Lead in batteries can cause many adverse effects on respiratory system including: asbestosis, lung cancer, chronic bronchitis, fibrosis, emphysema, and decreased oxygen supply in blood. They also have many health effects of the nervous system as well including: inability to move, loss of feeling,

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confusion, and decreased speech, sight, memory, muscle strength, or coordination. Blood analysis is one of the most important clinical tests for many medical related problems. CBC and microscopy are widely used techniques as they are cost-effective and with limited labor skills and timing

The objective of this study was to measure the effect of radiation and lead/cadmium toxicity on hematological and immunological parameters.

**Materials & methods:-**

Forty subjects who previously exposed to lead/cadmium, twenty five radiologist and 10 healthy controls were recruited to this study (as shown in Table-1).

This is a “case-control” study. This study was

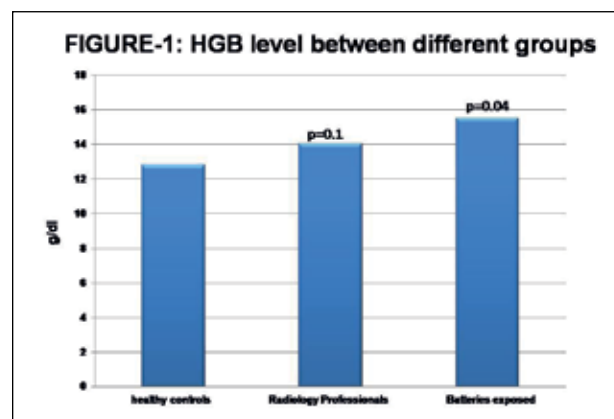
conducted between January 2017- April 2017 in Riyadh city, KSA. “A questionnaire was distributed and answers were taken by the interviewer (an example of the questionnaire is attached at the end of this booklet). Later, 10ml whole blood in EDTA tube were collected and immediately tested. CBC was measured by The Abbott Cell Hematology Analyzer. Normal reference ranges are shown in (Table-2). The lead levels were detected by spectrometry. Written informed consent was obtained in all cases. This study was approved by the ethical Committee of Prince Sattam bin Abdulaziz University (PSAU), Graphs were plotted using Cricket graph graphics package. Data comparisons were performed using ANOVA test.

Table -1: Subjects characteristic

	BATTERIES EXPOSED PERSONAL	RADIOLOGIST	CONTROLS
NUMBER	40	25	10
AGE	20 - 42	23 - 50	18 - 45
NATIONALITY	ALL NON SAUDI	ALL SAUDI	ALL SAUDI
EDUCATION	ELEMENRATY 10 INTERMEDIATE 8 SECONDARY 18 Bsc 4	DIPLOMA 10 Bsc 15	NA
NUMBER OF THOSE WITH HIGHER HGB	NON	NON	NON
NUMBER OF THOSE WITH HIGHER PLATELETS	NON	NON	NON
NUMBER OF THOSE WITH HIGHER RBCS	NON	NON	NON
NUMBER OF THOSE WITH ALLERGY REACTIONS (Eczema/Conjunctivitis)	17	NON	NON

Table -2: Reference ranges for blood tests

PARAMETER		
Hemoglobin (HGB) concentration	g/dL	14-18
Red blood cell count	× 10 <sup>12</sup> /L	4.2-6.2
Platelet count (Plt)	×10 <sup>9</sup> /L	150-400
White blood cell count (WBC)	×10 <sup>9</sup> /L	4-10
Neutrophils	%	40-60
Lymphocytes	%	20-40



Results:

There is a significant difference in Hgb levels between batteries exposed people and healthy controls, and the less extent with radiologist (Fig1).

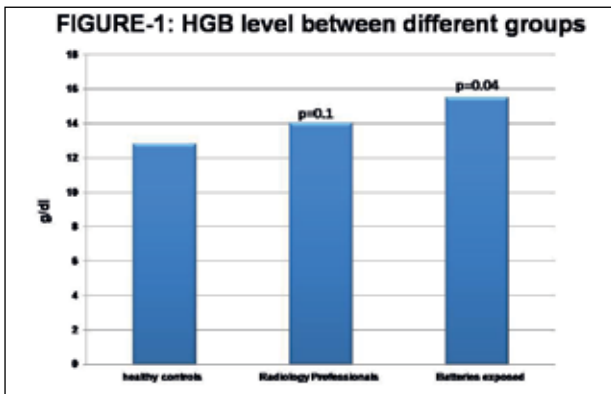
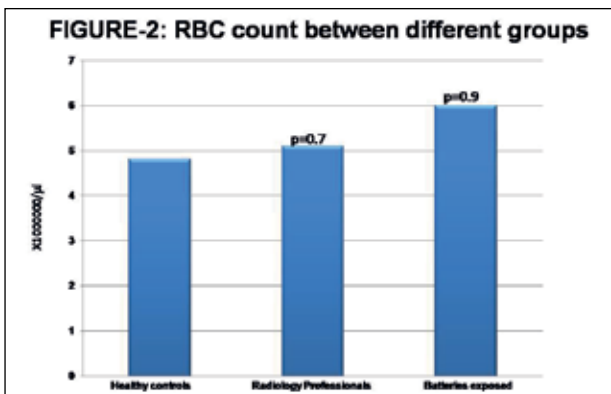
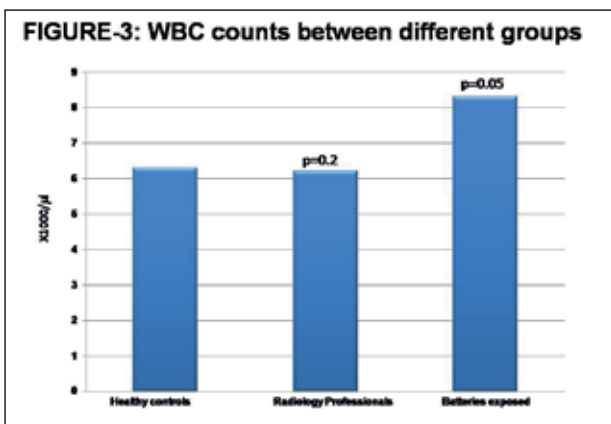


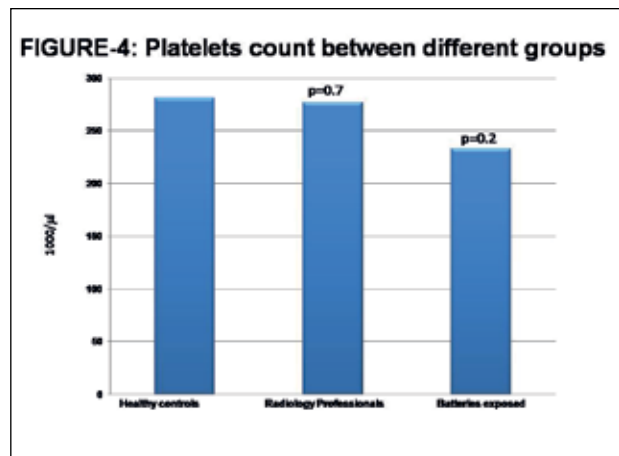
Fig 2 shows a trend on the effect of batteries exposure on RBCs count.



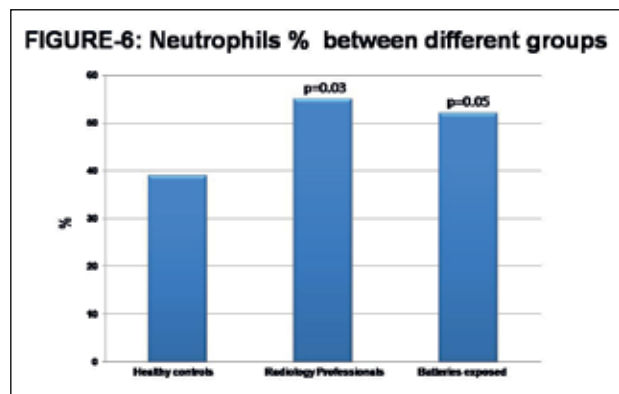
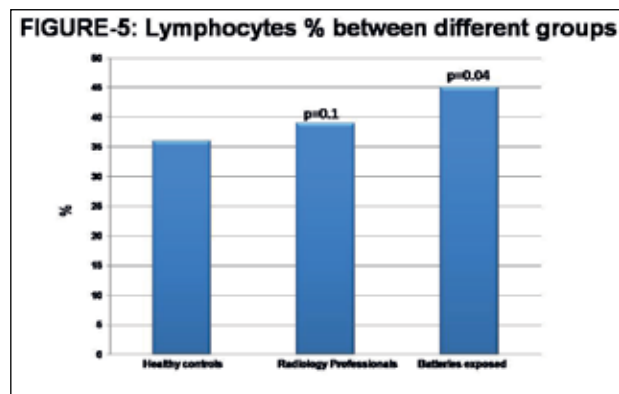
However, Fig 3 shows a significant increase on WBCs count after batteries exposure compared to healthy controls. Unexpectedly, no difference was found by x-rays on WBCs count. Platelets were resistant to battery exposure and radiation (Fig4).



A highly significant elevation of lymphocytes count was found on battery exposed people compared to controls and radiologist (Fig5).



Additionally, Fig6 shows, for neutrophils levels, there was a significant increase on battery exposed people compared to controls. Finally, there was almost 43% of battery exposed people have allergic reactions compared to controls.



### **Discussion:**

Although diagnostic X-rays are beneficial, they are contributing to developing many cancers<sup>3-4</sup>. Until recently, many studies have concentrated on the involvement of irradiation and lead/cadmium toxicity of blood cells. We assessed the impact of those two factors on the blood cells. 10ml whole blood has been utilized by our hematology analyzer. We used the reference ranges published by Alhazmi's group<sup>5</sup>. Our current results showed that both neutrophils and lymphocytes are significantly increased after exposure to both irradiation and lead/cadmium toxicity. These results are different with many publications. Sokolov<sup>6</sup> showed that X-ray at 90Gy1, cause a significant drop in neutrophils by 30%. Another study showed that a 50Gy radiation caused a 20% drop in the production of superoxides<sup>7</sup>. Holley et al<sup>8</sup> demonstrated that granulocyte function was unaffected by radiation up to 400Gy in an in vitro experiment. However, we are in agreement with a previous study which showed that B-lymphocytes are more radiosensitive than T-lymphocytes, this protection was attributed to the induction of DNA repair enzymes in the stimulated lymphocytes<sup>9</sup>. Our results also showed that no significant effect of both irradiation and lead/cadmium toxicity on RBCs and platelets. These results are in line with other studies. Mature erythrocytes were found resistant to radiation damage<sup>10-11</sup>. X-irradiation of erythrocytes at 200Gy

has no significant effect on their morphology, osmotic and mechanical fragility, or glycolytic activity<sup>12-13</sup>. Platelets aggregation, survival and release responses of were not influenced by a 50Gy radiation dose<sup>14-15</sup>. In an vitro study, Lessler<sup>16</sup> showed that even at lower dose of X-rays (1Gy) was sufficient to cause cytological abnormalities to erythrocytes. An early study in Sudan showed that lead/cadmium toxicity increased basophilia and caused many CNS indications<sup>17</sup>. Another recent study showed that lead increased reticulocytosis counts<sup>18</sup>.

The difference in nationality of the groups studied is also significant, since blood parameters even in control may differ between Saudi and Non-Saudi donors due to different life style. Future studies should expand the two groups and consider other factors such as smoking, sport and diet.

### **Conclusion**

Both irradiation and lead/cadmium toxicity often produce lymphocytosis and neutrophilia. The risk of both factors may cause many health problems even at lower doses. Monitoring irradiation and lead/cadmium toxicity levels is suggested in patients with a high risk of immunocompromised or chronic diseases patients.

### **Conflict of interest**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/ or publication of this article.

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