Work’s Environment Effect on Metal and Male Reproductive Hormones Levels: Circulating Testosterone, LH, and FSH are Positively Associated with Cadmium, Lead, and Molybdenum

Jamela Jouda¹, Enas Abdul Kareem Jabbar², Afrah Abid Maktoof², Farha A. Ali Shafi¹, Rana T. Al-Muswie², Alia Essam Mahmood Alubadi¹

¹Department of Biology, College of Science, Al-Mustansiriyah University.
²Department of Biology, College of Science, Thi-Qar university.

Abstract

Objectives: The present study was carried out to investigate the concentration cadmium (Cd.), lead (Pb.), and molybdenum (Mo.) in blood samples of petrol stations workers and its relationships with the male reproductive hormones levels such as follicle-stimulating hormone (FSH), luteinizing hormone (LH), and Testosterone. Methods: This study included 31 workers in 4 petrol station in different sites of Thi-Qar city/ Iraq, who were working since more than 5 year in the petrol station and spend more than 12h work time, and ten healthy in different sites of the same city. Both groups age were ranged from 23 to 45 years old. Heavy material (Pb, Mo, and Cd) were determined by atomic absorption method using Shimadzu AA-7000 Dual Atomizer system. Hormones level (FSH, LH, and testosterone) were determined by enzyme linked fluorescent assay (ELFA) using the Bio Merieux VIDAS Automated Immunoassay System. Results: Our results found significantly higher Cd, Mo, and Pb levels in Petrol workers compared to control (p<0.05). While no significantly differences were detected between FSH levels in control and Petrol workers groups, significantly higher testosterone level was found in Petrol workers compared to control (p<0.05). Conversely, significantly lower LH level in Petrol workers group than it in control group (p<0.05). Conclusion: the petrol station workers exposure to Cd, Pb, and Mo which lead to increase its levels in their blood due to neglect the occupational safety instructions. Thus associated positively with the testosterone level and negatively with the LH level in their blood.

Introduction

General population is exposed to low metals concentrations, either through supplementation or by eating contaminated food, water, or direct contact with contaminated soil, dust, or air.

The type of work also play role in increase blood metals concentration like in petrol station workers which are in contact with benzene and gasoline during their daily lives. Heavy metals in the workplace come from emissions in the form of fine particles that are inhaled and absorbed through the lungs, digestion, or dermal exposure [1]. Some metals, such as cadmium and lead are known to be harmful to human health [2, 3], but others, such as molybdenum which necessary for human health may be harmful above certain levels [4, 5]. A number of studies have reported that heavy metals may have negative effects on male reproductive health [5-8], even at relatively low exposure level [9]. Heavy metals can negatively affect on the male reproductive system, either by causing disruption of the hypothalamic-pituitary axis, or directly by affecting on spermatogenesis, resulting in reduced the quality of semen [10]. Many metals, mainly lead (Pb) and cadmium (Cd), are considered toxic substances for reproductive and/ or vehicles suspected endocrine disorders [11]. Studies of exposure to other metals than cadmium or lead and its effects on male reproductive system are more limited [5].

The male reproductive system depends upon the action of many different hormones or chemicals, produced by various body glands and enter systemic circulation. Gonadotropin-Releasing Hormone (GnRH) is
a tropic hormone produced by hypothalamus and stimulate the anterior part of pituitary gland to produce the follicle-stimulating hormone (FSH), which stimulate the production of sperm in the testes of men, and luteinizing hormone (LH), which causes the interstitial cells of the testes to produce the hormone testosterone. Testosterone enters systemic circulation in relatively constant concentrations in a healthy, reproductive-age male.

This hormone produces and maintains the secondary sexual characteristics of the male and responsible for the sex drive and works with FSH to stimulate the production of sperm. If sperm levels are high, making nutrients for the developing sperm scarce, the testes release inhibin. The inhibin travels through the bloodstream to the brain, where it prevents the secretion of GnRH. In the absence of GnRH, FSH and LH levels fall and sperm production slows. This is one of the major mechanisms whereby male hormones are maintained at relatively constant concentration [12].

While low testosterone levels contribute to loss of sex drive and some secondary sexual characteristics, elevated levels of testosterone cause risky behaviors in a number of different contexts [13].

This work aim to study the concentration of different heavy metals (Cd., Pb., and Mo.) in blood of petrol stations workers and its relationships with the male reproductive hormones levels (FSH, LH, and Testosterone).

Material and Method

This study included 31 workers in 4 petrol station in different sites of Thi-Qar city/Iraq, who were working since more than 5 year in the petrol station and spend more than 12h work time, as well as, ten healthy in different sites of a same city. Both groups age was ranged from 23 to 45 years old.

After taking consent, 5 ml of venous blood was collected from antecubital vein of all subjects and control by disposable syringe in a dry sterile test tube containing EDTA anticoagulant. The plasma was separated from blood by centrifugation at (1000 xg) for 15 minute.

The plasma was used in heavy material determination (Pb, Mo, and Cd) by atomic absorption method using Shimadzu AA-7000 Dual Atomizer system, and hormones level determination (FSH, LH, and testosterone) by enzyme linked fluorescent assay (ELFA) using the Bio Mérieux VIDAS Automated Immunoassay System (Biomérieux® S.A., Marcy-l’Etoile, France).

Statistical analysis: Results are expressed as mean ± standard error (M±SE). Data were analyzed by one-way analysis of variance ANOVA followed by Fisher's test for multiple comparisons, using Stat view version 5.0. Differences were considered significant when p<0.05. Regression analysis was performed by analysis of covariance (ANCOVA) also using Stat view version 5.0.

Results

The heavy materials levels were determined in the plasma of control and Petrol workers groups, significantly higher Cd, Mo, and Pb levels in Petrol workers compared to control (p<0.05). (Figure-1) While no significantly differences were detected between FSH levels in control and Petrol workers groups, significantly higher testosterone level was found in Petrol workers compared to control (p<0.05). Conversely, significantly lower LH level in Petrol workers group than it in control group (p<0.05). (Figure-2) While no correlation were detected between FSH levels and all heavy materials type (Pb., Mo., Cd.) levels (R²=0.001, 0.005, and 0.003, respectively), significantly positive correlation (p<0.05) was found between testosterone level and all heavy materials types (Pb., Mo., Cd.) levels (R²= 0.433, 0.204, and 0.183, respectively). Conversely, significantly negative correlation were detected between LH level and all heavy materials type (Pb., Mo., Cd.) levels (p<0.05) (R²= 0.154, 0.172, and 0.164, respectively). (Figure-3)

Discussion

It is well established that the petrol industry and pump is accompanied by the emission of heavy metals such as lead [1], cadmium [14], and molybdenum. This poses a danger to workers in such places.

The results obtained show that values of blood lead, cadmium, and molybdenum levels in petrol station workers were higher than...
Two scenarios could have been operating in the study workers which may have resulted in elevated blood such heavy metals levels. Firstly, petrol workers don't use facemasks, protective cloths, and gloves during work. Secondly, they don't wash their body after work. Thus significantly increases blood heavy metals levels due to the inhalation or due to dermal absorption [15]. This finding is consistent with the other studies in Baghdad, Beirut, and Al-Najaf which found that the lead and other heavy metals blood level elevated among fuel stations workers [1, 14, 16, 17]. In another study in Basrah, the blood lead level was in normal limits among petrol station workers, who were instable of work in their job for long time which may explain this reduction in blood lead level in those workers [18].

The present study is one of the evaluations studies to the relationships between metal exposure and reproductive hormones levels in the petrol stations workers blood, and we reported a number of statistically significant or suggestive associations.

In this study, while no significantly differences were detected between FSH levels, significantly higher testosterone level and lower LH level were found in Petrol workers compared to control. Interestingly, there was no correlation between FSH levels and all studied heavy materials type levels, while significantly positive correlation between testosterone level and all studied heavy materials type levels and significantly negative correlation between LH level and all studied heavy materials type were detected. Which means that the petrol stations workers exposure to lead, cadmium, and Molybdenum lead to increase testosterone level and decrease LH level, but don’t affect on FSH level in their blood.

These results are in line with the findings of other studies which found that the cadmium and lead affect positively on testosterone and negatively on LH but don’t effect on FSH [9, 19-21]. Conversely, these results don’t match with the only study that we found it which suggested negative association between molybdenum and testosterone level [5]. In our study, testosterone levels were determined in the petrol station workers who exposure to the many heavy metals in the same time. Pb, Cd, and Mol together have appositive effect on the testosterone level. May be that can explain the differences between our study results and the other.

In conclusion, the petrol station workers exposure to Cd, Pb, and Mol which lead to increase its levels in their blood due to neglect the occupational safety instructions. Thus associated positively with the testosterone level and negatively with the LH level in their blood.
Figure 2: the level of male reproductive hormones in plasma of Petrol workers and control. A: testosterone level, B: LH level, and C: FSH level. * significantly differences of male reproductive hormones levels in subject vs. control.

Figure 3: the correlation between male reproductive hormones and heavy materials levels. (column A) testosterone level, (column B) LH level, and (column C) FSH level. (Row 1) Cd level, (Row 2) Mol level, and (Row 3) Pb level.
References


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