EVALUATIONS OF TOXIC HEAVY METALS LEAD AND MERCURY IN REGULAR HEMODIALYSIS SMOKER AND NON-SMOKER PATIENTS BY COMPARISON WITH OTHER NORMAL POPULATION IN EGYPTIAN POPULATION

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ABSTRACT

Around the population, worldwide, 10% are affected by chronic kidney disease (CKD); hemodialysis is the common choice of renal replacement therapy. Cigarette smokers have a high Lead level than the non-smoker population, as Tobacco leaf grew on polluted soil, and it is proven that Mercury poisoning depends on the dose and duration of exposure. The study aimed to determine two crucial toxic heavy metals elements Lead and Mercury concentrations in pre hemodialysis. Methodology: blood samples were collected from CKD patients on maintenance hemodialysis for more than six months divided into non-smoker and smoker to be compared with samples from a control group non-CKD, non-smoker persons. Our study was conducted in September 2019 in Al Mokattam insurance hospital – Cairo and involved 60 persons of both sexes. They were divided into three groups: CKD stage 5 patients on hemodialysis 40 patients and sub-divided into two groups; (smoker) 20 patients and (non-smoker) 20 patients and the history of eating fish and seafood was taken. The third group was a control group, including 20 healthy non-smoker participants. Lead and Mercury were analyzed by electrothermal atomic absorption spectrophotometer in Al Borg central Laboratory. The complete blood count (CBC), kidney function tests, and Iron parameters were also detected. Results: prolonged duration on hemodialysis did not raise Lead or Mercury level in the blood, while smoking raises the Lead level in the blood, and eating fish and seafood more than once per week increased Mercury level in the blood. There was a relation between raised Lead level and anemia in hemodialysis patients. Conclusion: Lead and Mercury measurement is essential in hemodialysis patients with possible symptoms of heavy metal toxicity. Lead level monitoring is recommended in resistant anemia in hemodialysis patients.

Keywords: Hemodialysis, Lead, Mercury, Toxicity, Smokers, Eating fish.

INTRODUCTION

Chronic kidney disease prevalence worldwide is about 10.4% among men and 11.8% among women (Wang et al., 2010).

Also, 10.5 million people require dialysis or transplantation all over the world; many people die all over the world as they do not receive the treatment. (Liyanage, 2015) (Murray et al., 2016).

Hemodialysis, mostly outpatient and inpatient therapy, provides the extracorporeal removal of waste products such as urea, creatinine, and free water from the blood in renal failure (Geoffrey, 2011).

Hemodialysis provides rapid and excellent clearance of solutes, so it is the first choice of renal replacement therapy in cases who need dialysis acutely and as maintenance therapy in end-stage renal disease (ESRD) patients (Daugirdas et al., 2007).

An increase of toxic trace elements or a deficiency of essential trace elements can affect health, as trace element levels are
essential for survival (Tonelli et al., 2009).

There is a state of oxidative stress and antioxidant depletion in ESRD patients (Miura et al., 2002).

The exposure to environmental pollution contains Lead (Pb) replaces copper by competition with binding sites; it is proven that exposure to Pb is toxic if exceed standard level (Buchet et al., 1990) (Mueller et al., 1998).

Accumulation of Pb in the liver, kidneys, and bone is found mainly in chronic environmental exposure to Lead (Satarug et al., 2002).

The primary sources of Lead exposure in normal populations are tobacco and diet (from contaminated water and crops are grown on contaminated soil) (Chiba and Masironi, 1992).

According to WHO, every 10 s, another person dies because of tobacco use; the Tobacco leaf grown on polluted soil is the source of Al, Cd, and Pb in cigarettes (Adamu et al., 1989).

The body more easily takes up Lead inhaled through cigarette smoke than in food or water (Sisman et al., 2003).

Irreversible renal tubular damage caused by Lead (Jarup et al., 1997).

Smokers have more than twice as high concentration as non-smokers. (Stohs et al., 1997).

Blood lead generally reflects current exposure (Jarup et al., 1998)

Chronic exposure to Lead produces hematological, cardiovascular,

Neurological and nephrotoxicity in the form of progressive tubulointerstitial nephropathy that can progress to kidney failure (Skerfving et al., 1998).

Lead nephropathy is difficultly diagnosed as blood or urinary biomarkers to detect its toxicity not widely available (Elrich et al., 1998) (Fels et al., 1998).

Many modern techniques are used to detect common trace elements in biological samples (Pohaska et al., 2000).

Wet acid digestion with concentrated acids with microwave energy or conventional heating is the standard mineralization methods most frequently employed to analyze biological samples (Memon et al., 2007) (Afridi et al., 2006).

Mercury poisoning is metal toxicity depending on the dose, type, duration, and exposure method. (Bernhoft, 2012).

Mercury toxicity includes muscle weakness, skin rashes, anxiety, memory problems, numbness in the hands and feet, and troubles in hearing, speaking, and seeing (Goldman and Shannon 2001).

Due to high Methyl Mercury exposure in children, Minamata disease shows acrodynia with pink and peeled skin. Long-term exposure leads to decreased intelligence and kidney problems (Bose-O’Reilly et al., 2010). Long-term low-dose exposure to Methylmercury effects is unclear (Kosnett, 2013).

**AIM OF THE WORK**

It was to determine two crucial toxic heavy metals elements; Lead and Mercury, concentrations in the blood of patients with chronic renal failure (CRF) stage 5 on maintenance hemodialysis who were on regular hemodialysis for at least six months. Also, the study compared between smokers and non-smokers patients concerning some blood parameters.

**METHODOLOGY**

**Apparatus:**

Lead and Mercury were analyzed by electrothermal atomic absorption spectrophotometer before microwave-induced acid digestion. The accuracy of the total Lead and Mercury levels were tested by analyzing certified reference materials, which were done in Al Borg central lab Cairo, Egypt.

The analysis of elements was carried out using a double beam Perkin-Elmer atomic absorption spectrometer model 700 (Norwalk, Connecticut, USA) equipped with a graphite furnace HGA-400, pyro coated graphite tube with an integrated platform, an autosampler AS-800, and deuterium lamp as background correction system.

A domestic microwave oven (Pel
PMO23, Japan) programmable for time and with a microwave power of 100–900 W, was used to digestion the samples.

Acid-washed plastic (polypropylene) vessels were used for preparing and storing solution.

**Reagents and Glassware**

Analytical grade chemicals and ultrapure water obtained from the ELGA Lab water System (Bucks, UK) were measurement conditions for electrothermal atomization AAS.

**Thermo elemental detection limit:**

- Lead (Pb) = 50 ppb
- Mercury (Hg) = 5 ppb

**Sample Collection and study participants:**

Our study was conducted in Al Mokattam insurance hospital in Cairo. This study involved 60 persons divided into three groups of both sex with no racial exclusion criteria:

1- control group randomly selected 20 healthy subjects with normal kidney function tests and non-smoker.

2- 20 chronic renal failure (CRF) stage 5 patients (smoker) with a history of eating fish and seafood involved both genders, with an age range of 25–55 years.

All patients were undergoing maintenance hemodialysis for the previous six months or more.

3- 20 chronic renal failure (CRF) stage 5 patients (non-smoker) with a history of eating fish and seafood involved both genders, aged 25 to 55.

All patients were undergoing maintenance hemodialysis for the previous six months or more.

**Samples:**

Venous blood samples (5 mL) were drained using metal-free Safety Vacutainer blood collecting heparinized tubes from patients and participants of the control group.

N.B. The written consent was obtained from every person participating in this study according to the acceptance of the ethical committee in Al Mokattam insurance hospital in Cairo.

Blood samples for Lead and Mercury were taken before hemodialysis sessions, the blood samples for Complete Blood Count (CBC) including MCV (Mean Corpuscular Volume), kidney function test including urea and creatinine, Iron study including serum iron, ferritin, and Transferrin Saturation (TSAT) were also taken from the patients.

**The obtained information, including:**

Demographic data; occupational and environmental data; a history of smoking in the present or in the past, how long and how many cigarettes smoked per day, history of diseases; hypertension; diabetes, and renal problem duration.

**Exclusion criteria:** Patients with hepatitis B, C, acute medical events, or occupational exposure were excluded from this study.

N.B. All patients and healthy participants in the control group were frequency-matched by age, socioeconomic status, and occupations.

We did not evaluate hemodialysis patients’ relationship with medications, as all patients were matched on drug use and treated with the same dialysate solution.

The dialysis unit had suitable water treatment devices applying the international standard for the water cycle station.

**Statistical analysis:**

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (S.D.). Qualitative data were expressed as frequency and percentage.

The following statistical tests were done:

- Independent-samples t-test of significance was used when comparing two means.
- A one-way analysis of variance (ANOVA) when comparing more than two means.
- Post Hoc test: Least Significant Difference (LSD) was used for multiple
comparisons between different variables.

- Chi-square ($\chi^2$) test of significance was used in order to compare proportions between qualitative parameters.
- Pearson's correlation coefficient (r) test was used to assess the degree of association between two sets of variables.
- The confidence interval was set to 95%, and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:

\[
p\text{-value} < 0.05 \text{ was considered significant. } p\text{-value} < 0.001 \text{ was considered highly significant. } p\text{-value} > 0.05 \text{ was considered insignificant.}
\]

**RESULT**

The results of the present study are demonstrated in the following tables and figures.

**Table (1):** Comparison between smoker hemodialysis patients and non-smoker hemodialysis patients according to demographic data.

| Demographic data | Smoker Hemodialysis patients | Non-Smoker Hemodialysis patients | Control | F/$\chi^2$# | p-value |
|------------------|-----------------------------|----------------------------------|---------|-------------|--------|
| Age (years)      | 52.15±13.08                 | 47.75±9.67                       | 50.15±11.30 | 1.154       | 0.148  |
| Mean ±SD         | 29-a75                      | 29-a62                           | 27-a63 | 0.000#      | 1.000  |
| Range            | 29-67                       | 29-67                            | 27-63 |             |        |
| Sex              | Male                        | 15 (75.0%)                       | 15 (75.0%) |             |        |
|                  | Female                      | 5 (25.0%)                        | 5 (25.0%) |             |        |

F-One Way Analysis of Variance; # $\chi^2$: Chi-square test, P-value>0.05 NS
*There was no statistically significant difference between groups according to age and sex. Table (1) and Figure (1), (2).

**Figure (1):** Bar chart of comparison between smoker hemodialysis patients and non-smoker hemodialysis patients according to age (years).

**Figure (2):** Bar chart of comparison between smoker hemodialysis patients and non-smoker hemodialysis patients according to sex.
Table (2): Comparison between smoker and non-smoker hemodialysis patients concerning the period of hemodialysis (year) and frequency of eating fish.

| Smoker Hemodialysis patients | Non-Smoker Hemodialysis patients | Control | F/x2# | p-value |
|-----------------------------|---------------------------------|---------|-------|---------|
| How long patient on hemodialysis (year) |  |  |  | |
| Mean ±SD | 4.61±2.15 | 5.35±1.59 | -- | 1.238 | 0.215 |
| Range | 1.5-a8.2 | 3-a8 | -- | |

Eating fish and seafood equal once per week or more

| Eating fish | 10 (50.0%) | 10 (50.0%) | -- | 0.000 | 1.000 |
|-------------|-------------|-------------|-----|-------|-------|
| Non-eating | 10 (50.0%) | 10 (50.0%) | -- | |

T-Independent Sample t-test; #x²: Chi-square test

P-value>0.05 NS

There was no statistically significant difference between groups according to how long patients on hemodialysis and eating fish and seafood equal once per week or more: Table (2) and Figure (3).

Figure (3): Bar chart of comparison between smoker hemodialysis patients and non-smoker hemodialysis patients according to how long patients on hemodialysis.

Table (3): Comparison between smoker and non-smoker hemodialysis patients concerning Lead and Mercury levels in the blood.

| The lead level in blood ug/dl | Smoker Hemodialysis patients | Non-Smoker Hemodialysis patients | Control | ANOVA | P-value |
|-------------------------------|------------------------------|---------------------------------|---------|-------|---------|
| Mean ±SD                      | 13.35±2.98                   | 7.00±2.03a                      | 5.75±1.68a b | 63.045 | <0.001** |
| Range                         | 10-a20                       | 4-a10                           | 3-a9    |       |         |

| Mercury level in blood ug/dl  | Smoker Hemodialysis patients | Non-Smoker Hemodialysis patients | Control | ANOVA | P-value |
|-------------------------------|------------------------------|---------------------------------|---------|-------|---------|
| Mean ±SD                      | 0.55±0.23                    | 0.56±0.23                       | 0.34±0.09a b | 8.084 | <0.001** |
| Range                         | 0.1-a0.9                     | 0.1-a0.9                        | 0.2-a0.5 |       |         |

F-One Way Analysis of Variance

Post HOC: a: significant difference with the smoker, b: Significant difference with a non-smoker

*The Table (3) and Figure (3), (4) showing a statistically significant difference between groups according to lead level as it was higher in smoker Hemodialysis patient by comparison with non-smoker hemodialysis patients and control group in blood level and regarding mercury level in the blood, it was slightly higher (but within normal range) in hemodialysis patient both smoker and non-smoker as eating fish was shared in nearly half of both groups by comparison with a non-fish eater control group.

*The Table (3) and Figure (3), (4)
Figure (3): Bar chart of comparison between smoker hemodialysis patients and non-smoker hemodialysis patients according to lead level in blood.

Figure (4): Bar chart of comparison between smoker hemodialysis patients and non-smoker hemodialysis patients according to mercury level in blood.

Table (4): Comparison between smoker and non-smoker hemodialysis patients concerning some parameters.

| Parameter                             | Smoker Hemodialysis patients | Non-Smoker Hemodialysis patients | Control       | ANOVA  | P-value |
|---------------------------------------|-------------------------------|----------------------------------|---------------|--------|---------|
| Hb level g/dl                         | 9.48±0.61                     | 10.67±0.78a                      | 13.29±1.03ab  | 111.82 | <0.001  |
| Range                                 | 8-a10.4                       | 9.8-a12                         | 11.5-a15      | 7      | **      |
| MCV level In blood (F.L./red cell)    | 76.40±6.52                    | 83.70±4.58a                     | 88.75±2.61ab  | 32.927 | <0.001  |
| Range                                 | 65-a86                        | 76-a90                          | 85-a94        |        | **      |
| Serum iron mcg/dl normal 60-170 mcg/dl| 65.05±11.33                   | 76.60±10.08a                    | 124.95±22.36a | 82.998 | <0.001  |
| Range                                 | 47-a82                        | 60-a100                         | 89-a170       |        | **      |
| Creatinine level in blood mg/dl       | 8.59±2.31                     | 7.88±2.00                       | 0.71±0.30ab   | 120.45 | <0.001  |
| Range                                 | 5-a12.3                       | 4.9-a11                         | 0.3-a1.2      | 4      | **      |

F-One Way Analysis of Variance
Post HOC: a: significant difference with smoker, b: Significant difference with non-smoker
*p-value<0.05 S; **p-value <0.001 HS
There was a statistically significant difference between groups according to Hemoglobin level g/dl with low hemoglobin in smoker hemodialysis patient by comparison with non-smoker hemodialysis patients, MCV level in blood normal range 80-96 (F.L./red cell) is low in smoker hemodialysis by comparison with non-smoker hemodialysis patient and control group.

Serum iron mcg/dl normal 60-170 mcg/dl is all in the normal range but low in smoker hemodialysis patients, and non-smoker hemodialysis patients by comparison with the control group and Creatinine level in blood mg/dl is high in both smoker and non-smoker hemodialysis patient due to renal failure by comparison with the control group (Table:4 and Figures: 5, 6&7).

Figure (5): Bar chart of comparison between smoker hemodialysis patients and non-smoker hemodialysis patients according to H.B. level.

Figure (6): Bar chart of comparison between smoker hemodialysis patients and non-smoker hemodialysis patients according to MCV level in serum iron.

Figure (7): Bar chart of comparison between smoker hemodialysis patients and non-smoker hemodialysis patients according to creatinine level in blood.
Table (5): Correlation between metals and parameter levels studied in smoker hemodialysis patients.

| Parameter                              | The lead level in blood ug/dl | Mercury level in blood ug/dl |
|----------------------------------------|-------------------------------|------------------------------|
|                                        | r    | p-value | r    | p-value |
| The lead level in blood ug/dl          |      |         | -.494* | .027    |
| Mercury level in blood ug/dl           | -.494* | .027    |      |         |
| Age (years)                            | .495* | .027    | .026 | .913    |
| How long patient on hemodialysis (year)| -.125 | .600    | .102 | .668    |
| Hb level g/dl                          | -.505* | .023    | .247 | .294    |
| MCV level In blood (F.L./red cell)     | -.379 | .099    | -.009 | .969    |
| Serum iron mcg/dl normal 60-170 mcg/dl| -.050 | .833    | .160 | .502    |
| Creatinine level in blood mg/dl        | -.094 | .694    | .075 | .754    |

R-Pearson Correlation Coefficient
P-value >0.05 NS; *p-value <0.05 S; **p-value <0.001 HS

* As shown in Table (5) and figures (8), (9), (10); there was a statistically significant negative correlation between lead levels in blood with Mercury level in blood and H.B. level as increase lead level associated with anemia, but how long patient on hemodialysis has no correlation with Lead and Mercury level, so it is not involved with Lead and mercury toxicity.

There was a statistically significant positive correlation between lead levels in blood with age.

Figure (8): Scatter plot of correlation between lead level in blood and mercury level in b blood in smoker hemodialysis patients.
Figure (9): Scatter plot of correlation between lead level in blood and age in smoker hemodialysis patients.

Figure (10): Scatter plot of correlation between lead level in blood and H.B. in smoker hemodialysis patients.
Table (6): Correlation between metals and parameter levels studied in non-smoker hemodialysis patients.

| Parameter                              | Correlation in blood ug/dl | Correlation in blood ug/dl |
|----------------------------------------|----------------------------|---------------------------|
|                                        | r  | p-value | r  | p-value |
| The lead level in blood ug/dl          | .271| .248    |
| Mercury level in blood ug/dl           | .271| .248    |
| Age (years)                            | .175| .461    |
| How long patient on hemodialysis (year)| -.237| .315   |
| Hb level g/dl                          | -.080| .739    |
| MCV level in blood (Fl/red cell)       | -.227| .336    |
| Serum iron mcg/dl normal 60-170 mcg/dl| -.180| .447    |
| Creatinine level in blood mg/dl        | -.132| .578    |

R-Pearson Correlation Coefficient r, P-value >0.05 NS
*There was no statistically significant correlation between lead level in blood & any parameter levels studied in non-smoker hemodialysis patients (Table: 6).

Table (7): Correlation between lead level in the blood, the mercury level in blood with Age (years), Hb level, MCV level, Serum iron, and Creatinine level in blood.

| Parameter                              | Correlation in the blood (ug/dl) | Correlation in the blood (ug/dl) |
|----------------------------------------|-------------------------------|---------------------------------|
|                                        | r  | p-value | r  | p-value |
| The lead level in blood ug/dl          | .657**| .002    |
| Mercury level in blood ug/dl           | .657**| .002    |
| Age (years)                            | .221| .349    |
| Hb level g/dl                          | -.402| .079    |
| MCV level in blood (Fl/red cell)       | .380| .098    |
| Serum iron mcg/dl normal 60-170 mcg/dl| -.363| .116    |
| Creatinine level in blood mg/dl        | .281| .231    |

R-Pearson Correlation Coefficient r
P-value >0.05 NS; *p-value <0.05 S; **p-value <0.001 HS
*There was a statistically significant positive correlation between Mercury levels in blood with Lead levels in the blood. Also, there was a statistically significant negative correlation between mercury levels in blood with Hb level (Table: 7 and figures: 11&12).

Figure (11): Scatter plot of correlation between lead level in blood and mercury level in blood in the control group.
**Figure (12):** Scatter plot of correlation between lead level in blood and H.B. in the control group.

**Table (8):** Comparison between eating fish and non-eating according to Lead and Mercury levels in smoker hemodialysis patients.

| Serum                        | Eating fish | Non-eating | t-test | p-value |
|------------------------------|-------------|------------|--------|---------|
| The lead level in blood      | Mean 11.10  | 15.60      | 27.080 | <0.001**|
| ug/dl ±SD                    | 1.37        | 2.37       |        |         |
| Mercury level in blood       | Mean 0.72   | 0.37       | 30.882 | <0.001**|
| ug/dl ±SD                    | 0.13        | 0.15       |        |         |

T-Independent Sample t-test; **p-value <0.001 HS

*There was a statistically significant difference between eating fish and non-eating according to lead level and mercury level in blood in the smoker hemodialysis patients, as shown in table (8) and figure (13).

**Figure (13):** Bar chart of comparison between eating fish and non-eating according to lead level and mercury level in blood in smoker hemodialysis patients.
**Table (9):** Comparing eating and non-eating fish according to Lead and mercury levels in blood in non-smoker hemodialysis patients.

| Serum                        | Eating fish | Non-eating | t-test | p-value |
|------------------------------|-------------|------------|--------|---------|
| The lead level in blood ug/dl| Mean 7.10   | 6.13       | 1.897  | 0.176   |
| ± SD                         | 1.79        | 1.96       |        |         |
| Mercury level in blood ug/dl | Mean 0.74   | 0.35       | 82.838 | <0.001**|
| ± SD                         | 0.13        | 0.11       |        |         |

T-Independent Sample t-test, P-value >0.05 NS; *p-value <0.05 S; **p-value <0.001 HS

*There was a statistically significant difference between eating fish and non-eating according to lead level and Mercury level in blood in the non-smoker hemodialysis patients (Table: 9 and Figure: 14).

**Figure (14):** Bar chart of comparison between eating fish and non-eating according to lead level and mercury level in blood in non-smoker hemodialysis patients.

**Table (10):** Comparing male and female according to Lead and mercury levels in blood in the control group.

| Serum                        | Male | Female | t-test | p-value |
|------------------------------|------|--------|--------|---------|
| The lead level in blood ug/dl| Mean 6.0 | 5.0   | 1.350  | 0.260   |
| ± SD                         | 1.69 | 1.58   |        |         |
| Mercury level in blood ug/dl | Mean 0.34 | 0.34 | 0.002  | 0.966   |
| ± SD                         | 0.09 | 0.08   |        |         |

T-Independent Sample t-test; p-value >0.05 NS;

* In the control group, there was no statistically significant difference between males and females regarding lead and mercury levels, as shown in table (10) and Figure (15).

**Figure (15):** Bar chart of comparison between male and female according to lead level and mercury level in blood in the control group.
**Table (11):** Comparing male and female according to lead level and mercury level in blood in smoker hemodialysis patients.

| Serum                        | Male  | Female | Total | t-test | p-value |
|------------------------------|-------|--------|-------|--------|---------|
| The lead level in blood ug/dl| Mean  | 14.27  | 10.60 | 13.35  | 7.682   | 0.013*  |
| ±SD                          | 2.89  | 0.55   | 2.98  |        |         |
| Mercury level in blood ug/dl | Mean  | 0.49   | 0.72  | 0.55   | 4.802   | 0.042*  |
| ±SD                          | 0.22  | 0.13   | 0.23  |        |         |

T-Independent Sample t-test; *p-value <0.05 S

*This Table is showing a statistically significant difference between male and female according to lead level and mercury level in blood in the smoker hemodialysis patients, as male smokers were more massive than female smokers (Table:11 and figure:16).

**Figure (16):** Bar chart of comparison between male and female according to lead level and mercury level in blood in smoker hemodialysis patients.

**Table (12):** Comparing male and female according to lead level and mercury level in blood in non-smoker hemodialysis patients.

| Serum                        | Male  | Female | t-test | p-value |
|------------------------------|-------|--------|--------|---------|
| The lead level in blood ug/dl| Mean  | 6.80   | 7.60   | 0.571   | 0.459   |
| ±SD                          | 1.97  | 2.30   |        |         |
| Mercury level in blood ug/dl | Mean  | 0.61   | 0.40   | 3.669   | 0.071   |
| ±SD                          | 0.22  | 0.19   |        |         |

T-Independent Sample t-test, P-value >0.05 NS;

* Table (12) and Figure (17) show no statistically significant difference between male and female according to lead level and mercury level in blood in the non-smoker hemodialysis patients.

**Figure (17):** Bar chart of comparison between male and female according to lead level and mercury level in blood in non-smoker hemodialysis patients.
DISCUSSION
The present study was conducted in Al Mokattam insurance hospital in Cairo and involved 60 persons of both sex with average age 25-55 years, divided into three groups:

1- control group randomly selected 20 healthy subjects with regular kidney function tests and non-smoker.
2- 20 chronic renal failure (CRF) stage 5 patients (smoker) on regular hemodialysis.
3- 20 chronic renal failure (CRF) stage 5 patients (non-smoker) on regular hemodialysis.

All patients in group 2 and 3 were undergoing maintenance hemodialysis for the previous six months or more, and blood samples pre hemodialysis for Lead and Mercury were collected before hemodialysis sessions.

Our study showed no statistically significant difference between groups according to age and sex as we select matched groups regarding age and sex in groups. At the same time, it showed a statistically significant difference between groups according to lead level as it higher in smoker Hemodialysis patients by comparison with non-smoker hemodialysis patients and control group in blood level.

Regarding Mercury, the level was not significantly higher in all hemodialysis patients than the control group.

Our study was going with Andria et, al, (2012), showing that Secondhand Tobacco Smoke leads to increase blood lead levels in U.S. children through inhalation.

Our study was also going with Richter et al. (2009), showing a high urine Lead level in smokers equaled to secondhand smoke by comparison with non-smoker in the urine. Also, Hassan et al. (2015) showed that the number of cigarettes and smoking duration increases serum Lead level and lower Copper level.

Also, there was a significant difference between males and females in the present study according to Lead and mercury levels in the smoker hemodialysis patients as male smokers were heavier smoking than female's smokers.

Concerning blood picture parameters, the present study showed a statistically significant difference between groups according to hemoglobin level g/dl with low hemoglobin in smoker hemodialysis patient by comparison with non-smoker hemodialysis patients, MCV level was low in smoker hemodialysis patients by comparison with who non-smoker and the control group.

Also, the present study showing that serum iron was low in smoker hemodialysis patients and non-smoker hemodialysis patients by comparison with control group and Creatinine level in blood mg/dl was high in both smoker and non-smoker hemodialysis patient due to renal failure by comparison with the control group.

Concerning correlation among smoker patients' parameters, there was a statistically significant correlation between Lead levels in blood with Mercury level in the blood, age (years), and H.B. level as increase Lead level associated with anemia. However, how long the patient on hemodialysis does not correlate with Lead and Mercury level denoting not involved with Lead and Mercury toxicity due to proper water cell unit in the hemodialysis unit.

Our study was against that of Johan, et al. (2013), which showed that Erythrocyte lead is associated with end-stage renal disease.

While regarding correlation among parameters of non-smoker patients, there was no statistically significant correlation between Lead level in blood & Mercury level in blood with all parameters (How long patient on hemodialysis? Hb level, MCV level in the blood, serum iron and creatinine level in blood) in non-smoker hemodialysis patients considers safe especially water cell unit in a hemodialysis unit.

The present study's result was against that of Sommar et al. (2013), which
showed that the Erythrocyte lead is associated with end-stage renal disease.

Our study was going with Sadeghi et al. (2014), who reported that in smoker workers, there was a significant positive correlation between the blood lead levels and Hb, Hematocrit, and TIBC, where a significant negative correlation was observed between blood lead level, iron, and TSAT%.

Our study was also going with that of Hegazy et al. (2010), showing that Lead level ≥ 10 μg/dl caused anemia and decreased iron absorption, so noticed low serum Iron and ferritin.

It was against that of Inga, s et al., (2003), which was conducted on a hundred sixty-six hemodialysis patients as blood sample was collected before and after hemodialysis sessions. The blood level of Lead, Mercury, and Cadmium levels increased after hemodialysis.

The present study showed a statistically significant correlation between mercury levels in blood with Hb level as increasing Mercury level in the blood increased anemia.

This was consistent with Weinhouse et al. (2017), who reported that Methylmercury exposure is associated with anemia, especially relevant to children.

Our study showed statistically significant differences between eating fish and non-eating fish according to Lead level and Mercury level in blood in the smoker and non-smoker hemodialysis patients.

It was against that of Taylor et al. (2016), which advised eating fish during pregnancy. Moderate Mercury levels in pregnancy were not associated with intoxication.

While it was agreed with Silbernagel et al. (2011), they reported that people eat many fish, at high risk for exposure to Methylmercury.

CONCLUSION

The prolonged duration of hemodialysis did not raise Lead and Mercury level in the blood, while smoking raises the Lead level in blood. More than once per week, eating fish and seafood increased Mercury level in the blood, and there was a significant relationship between raised Lead level and anemia in hemodialysis patients.

RECOMMENDATIONS

We advise measuring Lead and Mercury in hemodialysis patients with possible symptoms of heavy metal toxicity.

We recommend monitoring lead levels in resistant anemia in hemodialysis patients.

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تقييم سمية المعادن الثقيلة الرصاص والزئبق في مرضى الغسيل الدموي المنتظم بين المدخنين منهم وغير المدخنين بمقارنة مع الأصحاء الغير مدخنين في السكان المصريين

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إن حوالي عشره بالمائة من البشر يعانون من أمراض الكلى المزمنة، والعلاج الشائع في حالات الفشل الكلوي هو الغسيل الدموي. وقد أثبت أن نسبة الرصاص بالجسم ترتفع مع المدخنين غالبا نتيجة تلوث التربة بالرصاص. إن التسمم بالزئبق يعتمد على جرعة ومدة التعرض للزئبق خاصة في السكان المصريين.

الأهداف من البحث: دراسة نسبة الرصاص والزئبق في مرضى الغسيل الدموي المنتظمين عليه لمدة سنة أشهر في مجموعتي المرضى المدخنين وغير المدخنين.

طريقة البحث والمشاركون: عدد مرضى الفشل الكلوي كان أربعين مريضاً (ذكوراً وإناثاً) من المصريين مستشفى المقطم وقد قسمت المرضى بهذا البحث لمجموعتين بتساوي المدخنين وغير المدخنين للمقارنة بينهما ومع المجموعة الضابطة وعدوا من الأصحاء غير المدخنين. تم أخذ عينات الدم من مجموعتي المرضى قبل جلسةrolls of the kidney. تم تحديد نسبة الرصاص والزئبق وأيضاً دراسة صورة الدم وبعض مؤشرات وظائف الكلى.

النتائج: أثبتت دراسة أن التدخين يرفع نسبة الرصاص، أما الزئبق فترتفع مع من يأكلون المأكولات البحرية أكثر من مرة أسبوعياً وأن الغسيل الدموي ليس له علاقة بسمية الرصاص أو الزئبق. كما أثبتت دراستنا علاقة الرصاص بالانيميا في مرضى الفشل الكلوي المزمن.

الوصيات: وتوصي دراستنا بقياس نسبة المعادن الثقيلة خاصة الرصاص والزئبق في مرضى الغسيل الدموي عند الاشتباه في الأعراض المتعلقة بالسمية. كما توصي دراسة نسبة الرصاص في الأنيميا لعلاج مرضى الغسيل الدموي.