Research Article

Assessment of Liver Enzymes among Gold Mining Workers in Al-abedia Souk, Nile River, Sudan

Yassin Saad[1], Hisham Abdelhamid[1], Mona Abdelhamid[2], Awatif Khidir[3], Mosab Nouraldein Mohammed Hamad[1]

[1] Department Medical Laboratory Science, Faculty of Health Sciences, Elsheikh Abdallah Elbadri University, Sudan.
[2] Department of Chemistry, Faculty of Science, Elsheikh Abdallah Elbadri University, Sudan.
[3] Assistant professor, Faculty of Graduate studies, Elsheikh Abdallah Elbadri University, Sudan.

Corresponding author:

Mosab Nouraldein Mohammed Hamad
Head of Parasitology Department, Faculty of Health Sciences, Elsheikh Abdallah Elbadri University, Sudan.

Corresponding Email: musab.noor13@gmail.com

***Abstract*:**

This study aims to measure the liver enzymes among gold mining workers and compare them with a group of healthy subjects as a control sample. This cross-sectional study was conducted Alabedia market, Nile River, Sudan. The study included 70 people, the gold prospectors by mercury as a test group (50 people) and healthy (20 people) as a control group. The venous blood samples were collected from the two groups to measure the rates of Hg liver enzymes. Statistical analysis of the results reviled that, there was a significant increase in serum level of ALP in the test group (82.8 IU/L) when compared with the control group (70.25.1IU/L) with a *P. value* of 0.013, and an increase in serum level of ALT in the test group was (21.18 IU/L) when compared with a control group of (26.96.1IU/L) with *P. value* of 0.003. Statistical analysis of the results reviled that, there was no significant increase in serum level of AST when compared with a control group with a P-value of 0.071. The mean level of serum mercury in the test group was (62.17) and in the control group was (0.72) with *P. value* of <0.001. This study established that there is a significant increase in the levels of serum mercury compared to the control group. The new workers are more exposed to mercury than the older workers because the new workers have no experience in contact with gold mining extraction.

Keywords: Mercury, Liver Enzymes, *Evaluation*, Gold Mining.

Background:

The liver is an organ only found in vertebrates, detoxifies, various metabolites synthesizes proteins, and produces biochemical's necessary for digestion **[1,2,3]**. In humans, it is located in the right upper quadrant of the abdomen, below the diaphragm. Its other roles in metabolism include the regulation of glycogen storage, decomposition of red blood cells, and the production of hormones **[3]**.

The liver is an accessory digestive gland that produces bile, an alkaline compound that helps the breakdown of fat. Bile acids in digestion via the emulsification of lipids. The gallbladder, a small pouch that sits just under the liver, stores bile produced by the liver **[4].**The liver's highly specialized tissue consisting of mostly hepatocytes regulates a wide variety of high-volume biochemical reactions, including the synthesis and breakdown of small and complex molecules, many of which are necessary for normal vital functions**[5]**. Estimates regarding the organ's total number of functions vary, but textbooks generally cite it being around 500**[6].**

Terminology related to the liver often starts in heat- from ἡπατο-, the Greek word for liver **[7].**

Mercury (Hg) exists naturally as elemental Hg, in inorganic mercurous and mercuric compounds, and organic Hg compounds. These 3 types of Hg are known to have different toxicity and health effects **[8,9]**. Elemental and inorganic forms of Hg are predominantly absorbed through the respiratory tract, while organic Hg is mainly absorbed and bioaccumulated through the gastrointestinal tract because of its highly lipophilic nature **[8]**. Hg is removed from the human body through urine or feces, and the half-life of total Hg in the blood was found to be 57 days on average in a Japanese study **[10].** The toxicity of high-level Hg exposure is well known from Minamata disease in Japan outbreaks of which occurred in 1956 and 1965 due to the consumption of Hg-contaminated seafood, and in Iraq **[11,12].**

In addition to neurological toxicity, high levels of Hg exposure affect various human organs, including the cardiovascular, endocrine, reproductive, and immune systems **[13].** The mechanisms of its toxicity have been suggested to involve degeneration, oxidative stress, and changes in the energy metabolism of the cell, but are not fully understood **[14].**

Materials and methods:

Study design:

A descriptive cross-sectional analytical study was carried out in the local River Nile state in Alabedia market during the period from August 2017 to September 2018 to evaluate the effect of mercury exposure on liver enzymes.

Study area:

This study was conducted in Alabedia market of gold extraction, River Nile State, Northern Sudan.

Study population:

Gold mining workers of different ages and duration of exposure to mercury.

Sample size:

There were50 gold mining workers selected randomly as the test group, and 20 healthy non-exposed volunteers were selected randomly as a control group.

Sampling:

Three ml of venous blood samples were collected by the standard procedure in vaccinated plain blood container, serum was separated and tested.

Data collection tools:

An interview questionnaire was applied and filled out, which contain a name, age, duration of mercury exposure, history of liver disease, and investigations liver enzymes.

Aspartate amino transferees (AST/GOT):
Aspartate aminotranseferase:9(AST OR GOT) catalyzes the transferees of the of (Astor Got)
catalyzes the transferees of the amino group from aspartate to 2 oxoglutarates forming oxaloacetate and glutamate. the catalytic concentration is determined by the rate of decrease of NADH, measured at 340 nm using the malate dehydrogenase (MDH)coupled reaction. Aspartate +2 - 0x0glutarate Oxaloacetate +Glutamate Oxaloacetate +NADH+ MALATE.

Alanine amino transferase (ALT or GPT):
Catalyzes the transfer of amino group from alanine to 2 oxoglutarates, forming pyruvate and glutamate, the catalytic concentration is determined from the rate decrease of NADH measured at 340 nm, using the lactate dehydrogenase (LDH)coupled reaction Alanine +2-Oxoglutrate Pyruvate +glutamate Pyruvate + NADH + Lactate.

Alkaline phosphatase:
Alkaline phosphate (ALP) catalyzes in the alkaline medium the transfer of the phosphate group from 4-nitrophenyl phosphate to 2-amino2 methyl-1-propanol (AMP) liberating 4 nitrophenols. the catalytic concentration is determined from the rate of 4 nitrophenol formation. measured at 405 nm. 4 – Nitrophenyl phosphate +AMPAMP- phosphate +4-Nitro phenol.

Mercury:
A small amount of the coal or fly ash sample (0.05-1.00 gms, depending on the mercury content) is weighed into a sample boat (typically nickel). The boat is heated in an oxygen-rich furnace, to release all the decomposition products, including mercury. These products are then carried in a stream of oxygen to a catalytic section of the furnace. Any halogens or oxides of nitrogen and sulfur in the sample are trapped on the catalyst. The remaining vapor is then carried to an amalgamation cell that selectively traps mercury. After the system is flushed with oxygen to remove any remaining gases or decomposition products, the amalgamation cell is rapidly heated, releasing mercury vapor. Flowing oxygen carries the mercury vapor through an absorbance cell positioned in the light path of a single wavelength atomic absorption spectrophotometer. Absorbance is measured at the 253.7 nm wavelength as a function of the mercury concentration in the sample. A detection limit of 0.005 ng (nanogram) of mercury is achievable with a 25 cm path length cell, while a 2 cm cell allows a maximum concentration of 20 µg (microgram) of mercury.

Data analysis technique:
The collected data was analyzed with the SPSS software computer program, to obtain a correlation; coefficient. Also paired t-test was used for calculating the degree of variation, *P. value*<0.05 was considered to be significant.

Ethical clearance
Informed consent was attached to each questionnaire to be obtained from the patient. There was full commitment to precaution sample taken and privacy and confidentiality.

Results:
This descriptive cross-sectional analytical study aimed to evaluate Liver enzymes among gold mining workers in the local River Nile state in the Alabedia market, in the period from Aug 2017 to Sept 2018.

Table-1: Show comparison of mean (SD) and mean difference of mercury, AST, ALT and ALP levels between case (n= 50) and normal control (n=20)

Test	*Case group* Mean (SD)	*Control group* Mean (SD)	MD (95% CI)	*P-value*
AST	20.83 (6.26)	24.02 (7.28)	-3.18 (-6.96, 0.60)	0.071
ALT	21.18 (7.09)	26.96 (6.93)	-5.78 (-9.49, -2.06)	0.003
ALP	82.82(19.33)	70.25 (16.88)	12.57 (2.71, 22.43)	0.013
Mercury	62.17(104.53)	0.72 (0.62)	61.45 (31.74, 91.16)	<0.001

Figure -1: Comparison of means of AST, ALT and ALP levels between case (n= 50) and normal control (n=20).

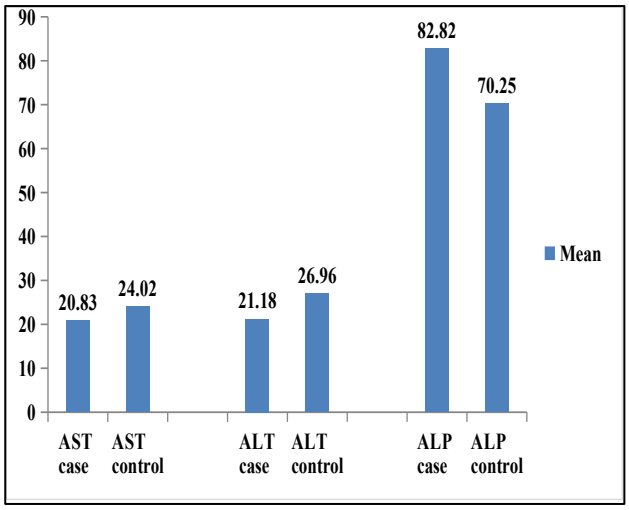
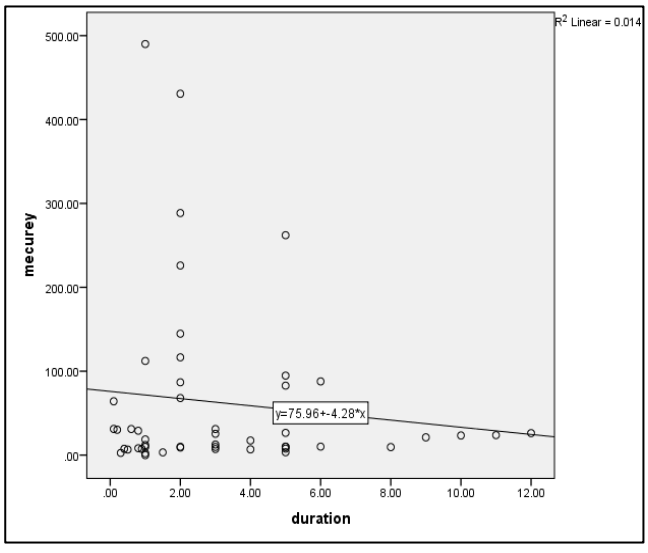


Figure -2: The relationship between mercury and duration among mining workers (n = 50).



Discussion:

The present study was carried out to investigate liver enzymes and serum mercury in gold mining in Alabedia market, River Nile state in Sudan during the period from august 2017 to Sept 2018. 70 blood samples were collected, 50 of these samples were collected from gold mining as a test group, and 20 samples were collected from the healthy individual as a control group. Statistical analysis of the results reviled that, there was a significant increase in serum level of ALP in the test group (82.8 IU/L) when compared with the control group (70.25.1IU/L) with a P. value of 0.013, and an increase in serum level of ALT in the test group was (21.18 IU/L) when compared with a control group of (26.96.1IU/L) with *P. value* of 0.003. Statistical analysis of the results reviled that, there was no significant increase in serum level of AST when compared with a control group with a P-value of 0.071. The mean level of serum mercury in the test group was (62.17) and in the control group was (0.72) with *P. value* of <0.001.

Conclusion:

This study established that there is a significant increase in the levels of serum mercury compared to the control group. The new workers are more exposed to mercury than the older workers because the new workers have no experience in contact with gold mining extraction.

Recommendations:

1\ Gold workers should wear a protective suit

2\ The method of extracting gold is rudimentary and random. Therefore, it is recommended that companies extract gold in modern, scientific, and distant ways from workers and citizens.

3\ Further studies should be done with increasing sample size is recommended and adding of another parameter to clarify the effect of mercury.

Conflict of Interest:

The author has declared that no competing interests exist.

References:

[1] Elias, H.; Bengelsdorf, H. "The Structure of the Liver in Vertebrates". Cells Tissues Organs. (1952). 14 (4): 297–337. doi:10.1159/000140715

[2] Abdel-Misih, Sherif R. Z.; Bloomston, Mark "Liver Anatomy". Surgical Clinics of North America. (2010). 90 (4): 643–53. doi:10.1016/j.suc.2010
. PMC 4038911 .PMID 20637938.

[3] "Anatomy and physiology of the liver – Canadian Cancer Society". Cancer.ca. Retrieved 2015.

[4] Ortora, Gerard J.; Derrickson, Bryan H. Principles of Anatomy and Physiology (12th ed.). John Wiley & Sons. (2008). p. 945. ISBN 978-0-470-08471-7.

[5] Maton, Anthea; Jean Hopkins; Charles William McLaughlin; Susan Johnson; MaryannaQuon Warner; David LaHart; Jill D. Wright. Human Biology and Health. Englewood Cliffs, New Jersey, USA: Prentice Hall. (1993). ISBN 0-13-981176-1. OCLC 32308337.

[6] Zakim, David; Boyer, Thomas D. Hepatology: A Textbook of Liver Disease (4th
ed.). (2002). ISBN 9780721690513.)

[7] "Etymology online hepatic". Retrieved December 12, 2013.

[8] Genchi G, Sinicropi MS, Carocci A, Lauria G, Catalano A. Mercury exposure and heart diseases. Int J Environ Res Public Health. 2017;14(1):E74.

[9] World Health Organization. Exposure to mercury: a major public health concern, preventing disease through healthy environment. Geneva: World Health Organization; 2007. p. 1.

[10] Yaginuma-Sakurai K, Murata K, Iwai-Shimada M, Nakai K, Kurokawa N, Tatsuta N, et al. Hair-to-blood ratio and biological half-life of mercury: experimental study of methylmercury exposure through fish consumption in humans. J Toxicol Sci. 2012;37(1):123–130.

[11] Harada M. Minamatadisease: methylmercury poisoning in Japan caused by environmental pollution. Crit Rev Toxicol. 1995;25(1):1–24.

[12] T. W. Clarkson, L. Magos, and C. Cox, "Tests of efficacy of antidotes for removal of methylmercury in human poisoning during the Iraq outbreak," Journal of Pharmacology and Experimental Therapeutics, vol. 218, no. 1, pp. 74–83, 1981. View at Google Scholar

[13] Mahaffey KR. Mercury exposures: medical and public health issues. Trans Am ClinClimatol Assoc. 2005;116:127–154.

[14] FernandesAzevedo B, Barros Furieri L, Peçanha FM, Wiggers GA, FrizeraVassallo P, RonacherSimões M, et al. Toxic effects of mercury on the cardiovascular and central nervous systems. J Biomed Biotechnol. 2012;2012:949048.