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Epidemiological Study: Effect Of Trace Elements In Diabetes Mellitus Through Drinking Water Near Tannery Areas, Vellore, South India

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Abstract: ***Ecological humiliation and unethical human intervention in the natural structure has enlarged the fear for the healthy life. The polluting of water bodies is general in the developing countries. The present paper shows the trace elements (Ni, Zn, Fe, Pb, Cd, Co, Cu and Mn) concentrations in the intake water of places in around Vellore city and their possible effect on the health of the inhabitants. The higher concentration of some elements in the intake water and the poor health of inhabitants are correlated. It was believed that trace metals have many adverse health impacts. Some of the poisonous metals have also been revealed to be elevated in biological samples of diabetes mellitus patients. In the present work, we review the important roles of trace metals in islet function and diabetes development in which the in vitro, in vivo or human suggestions are related with disclosure to Pb, Fe, Cu, Cd, Zn and Ni. Concluded this investigation, we abridge the proof which suggests that some trace metals could play significant role in diabetes mellitus as ecological danger aspects.***
Keywords: Tannery, Trace metal, intake Water, Vellore

I. INTRODUCTION

Heavy metals are among the most persistent of pollutants in the aquatic ecosystem because of their resistance to decomposition in natural conditions [1]. High concentrations of these metals can be released into the aquatic environment as a result of leaching from bedrocks, atmospheric deposition, water drainage, runoff from riverbanks, and discharge of urban and industrial wastewaters [2-3]. The elemental anomaly in the groundwater regime once created through natural processes or by unintended or unethical human intervention, often goes unabated. The toxicity of an element depends on the dose, the chemical form, route of exposure, bio–availability, and distribution in the body, storage and excretion parameters. In recent years, considerable interest has been focused on assessing the human health risk posed by metals, metalloids, and trace elements in the environment. It has long been recognized that large areas of the globe contain human populations characterized by having trace element deficiency, or excess including chronic poisoning [4-6].

Many current examples of environmental health problems are the result of long – term, low-level exposure to heavy metals. One notable example is the widespread poisoning caused by high arsenic levels in well waters in Bangladesh and West Bengal. During the past several decades, studies in a number of other locations have demonstrated widespread occurrence of trace elements in water at concentration significantly higher than the permissible limits. It is clear that metal enters the aquatic system from diverse sources, both point and non – point and can be readily transported from abiotic to biotic system. Places in Vellore District Tamilnadu, is famous for its leather industries. The population may be at risk because of mobilization of metals from the several chemical processes used by these industries. It has been reported that at some places the effluents from the local industry has been pumped into the bore wells that joins the groundwater used for drinking purposes. It has long been believed that heavy metals possess many adverse health effects. Uncontrolled industrialization has released heavy metal pollution in the world. Heavy metal pollutants damage organ functions and disrupt physiological homeostasis. Diabetes mellitus is growing in prevalence worldwide[7].

Several studies have indicated that the deficiency and efficiency of some essential trace metals may play a role in the islet function and development of diabetes mellitus. Some toxic metals have also been shown to be elevated in biological samples of diabetes mellitus patients. In the present work, we review the important roles of trace metals in islet function and diabetes development in which the in vitro, in vivo or human evidences are associated with exposure to Zinc, Arsenic, Chromium, Cadmium, Copper, Manganese, Lead and Nickel. Through this work, we summarize the evidence which suggests that some heavy metals may play an

important role in diabetes mellitus as environmental risk factors. Toassess the mobilization of metals from these activities five groundwatersamples were collected and analyzed for their trace element contents.

II. MATERIALS AND METHODS

A. Study Area

The research area lies between latitude 12°15' to 13°15' north latitudes and 78°20 to 78°50 east longitudes in Tamilnadu State. The total geographical area of the district is 6,077sq.km.
(5, 92,018hect).The Vellore District is one of the most vital and vibrant Districts in terms of industrial development in the State. The Vellore District has a dominant presence in the Leather and leather based industries. Vellore District accounts for more than 37% of the county's export leather and leather related products such as finished leather, shoe uppers, shoes, garments, gloves etc.

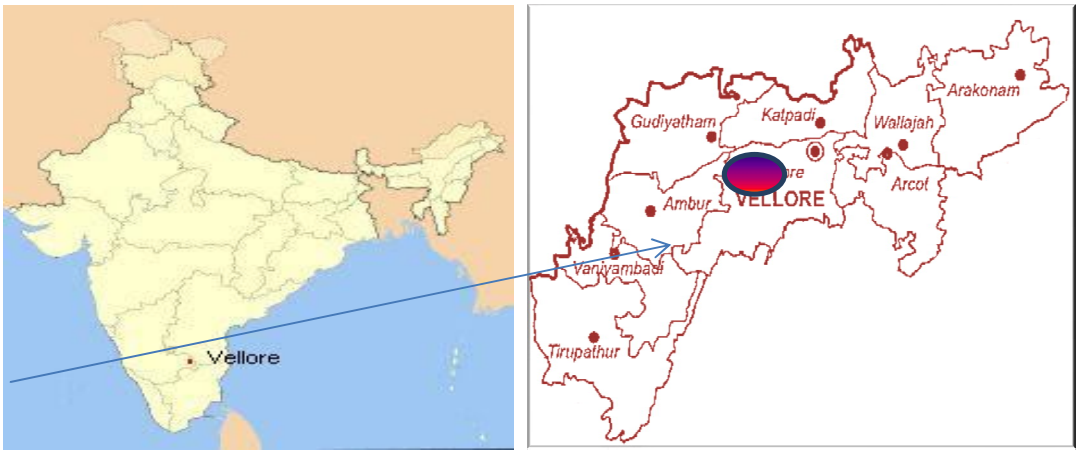

Fig.1 Map of Vellore district (Study area) - Sample region

The District provide enough scope for the development and growth of industries engaged in Chemicals, Food processing, Sugar and Jiggery manufacturing, man-made Fibers, Fertilizers manufacturing, Textiles Garments, Steel castings and Auto bearing manufacturing. The existing units are facing two major problems viz., poor marketing and financial problems. Cloth mills and rice mills, leather and leather based products belong more to the traditional type.

B. Study subjects

The present research of diabetes mellitus (T2) and diagnosis was carried out in department of pathology, ESI hospitals in Vaniyambadi, Ambur, Pernambut, Vellore and Ranipet of Vellore district. The blood samples were taken from the tannery workers and tenants (outdoor patients as well as admitted patients), who have been advised by clinicians for blood sugar investigations. Workers have been advised for blood sugar investigations on the basis of symptoms and signs. The study covered a sizable number of tannery workers (including office workers) in Vellore district (i.e.) 200 subjects which includes 114 males and 86 females and 15 of healthy controls (non-diabetes) of age between 25 - 65 years. These subjects are residing in several villages of five taluk of Vellore district (Vaniyambadi, Ambur, Pernambut, Vellore and Ranipet) and survey covered a distance of approximately 80 Km (on road). ESI Hospital admission survey has been carried out to collect the data with a standard questionnaire during the period of January 2015 to December 2016. Before enrolling the clinical study, all the patients were validated properly by pre-clinical screening which includes signs a symptom of diabetes mellitus and laboratory investigation for diabetic screening and any complications of diabetes or other involvements such as cardiovascular, renal diseases. Standard methods are used for the various anthropometric measurements (blood grouping, blood glucose, blood cholesterol etc. [8].

C. Data collection and classification

Around 200 data's were collected in the survey for the proposed work. The inputs designed for the system are age, gender, family background, period of working, taking medication for high blood pressure, found to have high blood glucose in a health examination during illness, smoking or using tobacco products, amount of vegetable and fruit intake, physical activity (30 minutes daily), body mass index, waist hip ratio, increased urination, hunger, thirst, poor wound healing, life style (labor class, sedentary work, retired persons and house wife's), gestational diabetes, frequent intake of non-vegetarian food, and itching all over the body.

D. Medical history

All five of thebeneficiary have no any other compliant apart from diabetic mellitus.

E. Sample Collection and Processing

About 10 mL of blood sample were collected from the antecubital vein of subjects using disposable needle and syringe. Samples were collected between 7.00-10.00 a.m. Each sample was taken in 5 mL plain specimen bottles and 5 mL fluoride-oxalate bottles after 10 - 12 hours overnight fast for analysis. The sample was centrifuged at 2000 rpm and the serum was separated and stored at -15˚C until analysis.

F. Biochemical analysis

Determination of Pb, Fe, Cu, Cd, Zn and Ni levels in serum were measured by using Flame Atomic Absorption Spectrometer – Model Varian Spectra A240, (Sample volume – 10 mL per min. Burner – Air/Acetylene, N_2O/Acetylene burner/ Gases hallow cathode – Acetylene and nitrous oxide) at Technology Business incubator Lab, Department of Science and Technology, VIT, Vellore, Tamilnadu.

III. RESULTS AND DISCUSSION

Analytical analysis results are given in the Table 1.Nickel is one of the most movable of the trace metals while released to water, predominantly in contaminated waters, where organic material will keep nickel soluble. Though nickel does accumulate in aquatic life, it does not become magnified along food chains. The main threat of nickel contamination comes from the industrial pollution of groundwater. Nickel generally poses no threat to humans because its absorption from food and water is very low. The long term or occupational exposure of Nickel causes the subsequent effects: reduce body weight, heart and liver damage, and skin irritation. If it goes to the respiratory tract it increases the risk of lung and nasal cavity cancer. The MCL level of Nickel in drinking water is 0.1mg/l to 0.7 mg/l [9 - 11]. The contamination of nickel in the drinking water of the Vellore District area ranges between 0.16 - 0.59 mg/l. This is above the MCL established by the USEPA and WHO (Table 1).

Zinc metal importance to human nutrition has been familiar since 1962 after overt zinc deficiency was found among village inhabitants of the Middle East [12 -14]. Everydaynecessity of Zn for angrown person of 60 kg is about 15 mg. Expected quantity of Zn in drinking water is 0.1 - 0.245 mg/L. The desirable limit of zinc established by the Indian Council of Medical Research is0.1 mg/l and the maximum permissible limit is 5 mg/l. The concentration of Zn in the groundwater samples of the area ranges from 0.38 to 2.42mg/L. The concentration of Zn in the groundwater is more than the desirable limit but less than the maximum permissible limit. The desirable and maximum permissible limit of iron in the drinking water is 0.1 to 5mg/L, respectively. The concentration of iron in the shallow groundwater of the study area ranged between 0.26 - 1.89 mg/l, which are above the desirable limit and at a fewlocality it was found to be more than theallowablelimit (Table 1).

Table 1. Trace elements concentration in the study region in mg/l.

Trace metals	Ni	Zn	Fe	Pb	Cd	Cu	Mn
WHO	0.1- 0.7l	0.1 – 5	0.1 to 1	0.01	0.003	0.05	0.05 - .0.5
Sample-1	0.23	0.89	154	0.02	0.57	0.05	0.24
Sample-1	0.59	2.6	0.38	0.03	0.02	0.05	0.18
Sample-1	0.44	1.26	1.89	0.45	0.08	0.03	0.12
Sample-1	0.16	2.42	0.26	0.31	0.72	0.04	0.36
Sample-1	0.19	0.38	1.41	0.02	0.44	0.05	0.52

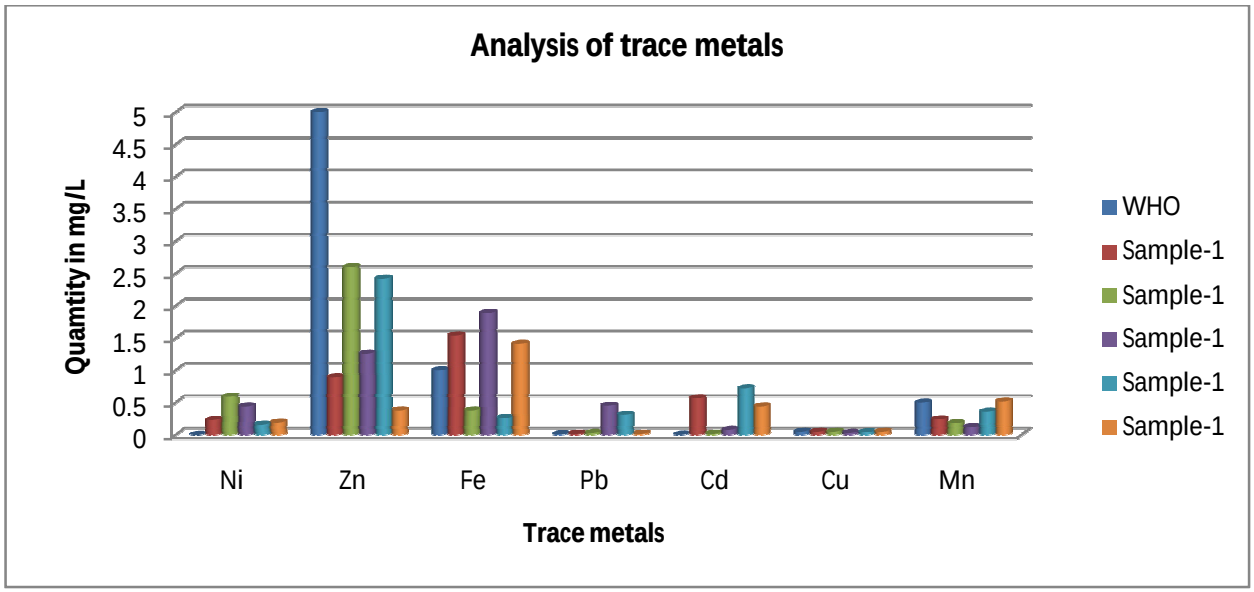

Fig.2 Graphical representation of Trace elements concentration in the study region in mg/l.

Iron is richer in earth's crust but its shortage occurs all through the earth.

Iron is necessary for the action of cytochromes, peroxides and certain other hemoprotien and flavoprotien enzymes. According to the results of some experimental studies conducted on rodents, iron deficiency significantly enhances the occurrence of certain kind of tumors and multiplied sensitivity of animals to some carcinogens [15]. While administered parent rally, iron is a highly toxic element. Humans are usually well protected from oral overdose, but kids from 1 to 2 years of age are predominantly susceptible to Iron toxicity from ingestion of iron supplement that have been commercially synthesized for adults [16].

The allowable limit of lead in intake water is 0.01mg/l. The contamination of Lead in the intake water of the research region is from 0.02-0.45 mg/l that is higher than the allowable limit set by typical agencies and could cause ill effects on the health of the consumers (Table 1).The beneficial effects of lead are not known. No biological function of lead is known. Lead taken into the human body will be harmful to human health. It can also cause renal and gastrointestinal disturbances [17].

The recommended permissible limit of cadmium in drinking water is 0.003mg/l and its concentration in the study area water ranges from 0.021 - 0.723mg/l(Table.1). Cadmium is least soluble in water Cadmium is frequently used in electroplating and in pigment manufacturing industries. It is mainly retained in liver and kidney problems. The major effects in the persons occupationally exposed to cadmium are lung diseases and renal functions [18-20]. In addition, exposure to cadmium can lead to high concentrations in the blood and increased frequency of chromosomal deformity. Nervous symptoms disorder caused by cadmium toxicity include; dizziness, headache, cramps, and loss of consciousness [21]. The inhabitants were not only exposed to Cadmium through drinking water but also through the rice grown in the contaminated water. There is also evidence from animal studies that Cadmium is implicated in the etiology of hypertension [22-24].

The desired level of copper in potable water is 0.05 mg/l [17]. The concentration of Cu in the groundwater of the study area ranges between 0.03 and 0.59 mg/l(Table.1).At a normal concentration copper is a biologically important trace element; at elevated concentration it is toxic for living organisms. It is an important and indispensable element for the vital functions of humans, animals and plants. The health hazard would be much higher, if there is coincidence of exposure of ultraviolet radiation and deficiency of protecting factors [25]. Symptom of Copper deficiency may appear, even if the amount of the metal in diet is adequate, but there is excess in sulfates, which reduce the solubility of copper – containing substances in water and so its bioavailability for the living organism [26]. Copper in the body is capable of binding bacteriotoxins and increase the activity of antibiotics [27].

Condensed blood concentration of trace metal has been stated in pathological and pregnancy situations, leukemia, Anemia, and certain kind of tumors; aggressive illnesses produced by larvae are also linked with the deficiency of Copper and Iron in the body [28].The desired and allowable quantity of manganese in drinking water is 0.05 mg/l to 0.5 mg/l respectively.

The concentration of manganese in the groundwater of the area ranged from 0.12to 0.52 mg/l which is above the desired level and below the permissible limit(Table 1). The groundwater of the area thus does not appear to be a Manganese hazard.

IV. CONCLUSIONS

It is evident from the studies carried out in relation to the prevalence of diseases and metal toxicity in Vellore District that this industrial town has a poor health record. And the quality of groundwater quality is also not nice. The current revision concludes that the contamination of the trace elements *i.e.*, Pb, Fe, Cu, Cd, Zn and Niin the intake water of the study zone is advanced than the allowable limits recognized by the World Health Organization (2006). This high contamination might be producing the harmful consequence on the populations of the area that is evident from the worst health condition. The arithmetical investigation of the trace metals also indications that definite metals which are producing injuries have a progressive correlation with everyone. Hence, the growth of one component may enhance the contamination of other component in the contemporary situations.

The current revision had its limitations. Therefore to have more conclusive results it is suggested that: water quality evaluation with special emphasis to trace elements should be carried out on a monthly basis. The soil and the crops cultivated in the surrounding of the Vellore region which is used up by the residents ought to be assessed to find the contamination of trace metals in them. Sectors a survey is to be organized to measure the inhabitant's healthiness status at steady intervals. This questionnaire should also take feedback from the local private clinical practitioners. A more comprehensive correlation between presence of trace elements in the ingestion water and predominant illnesses shall be made to come to a last choice that it is the contaminated drinking water that is producing poor health in this area. Protection measures ought to be applied to safeguard the fitness of the residents.

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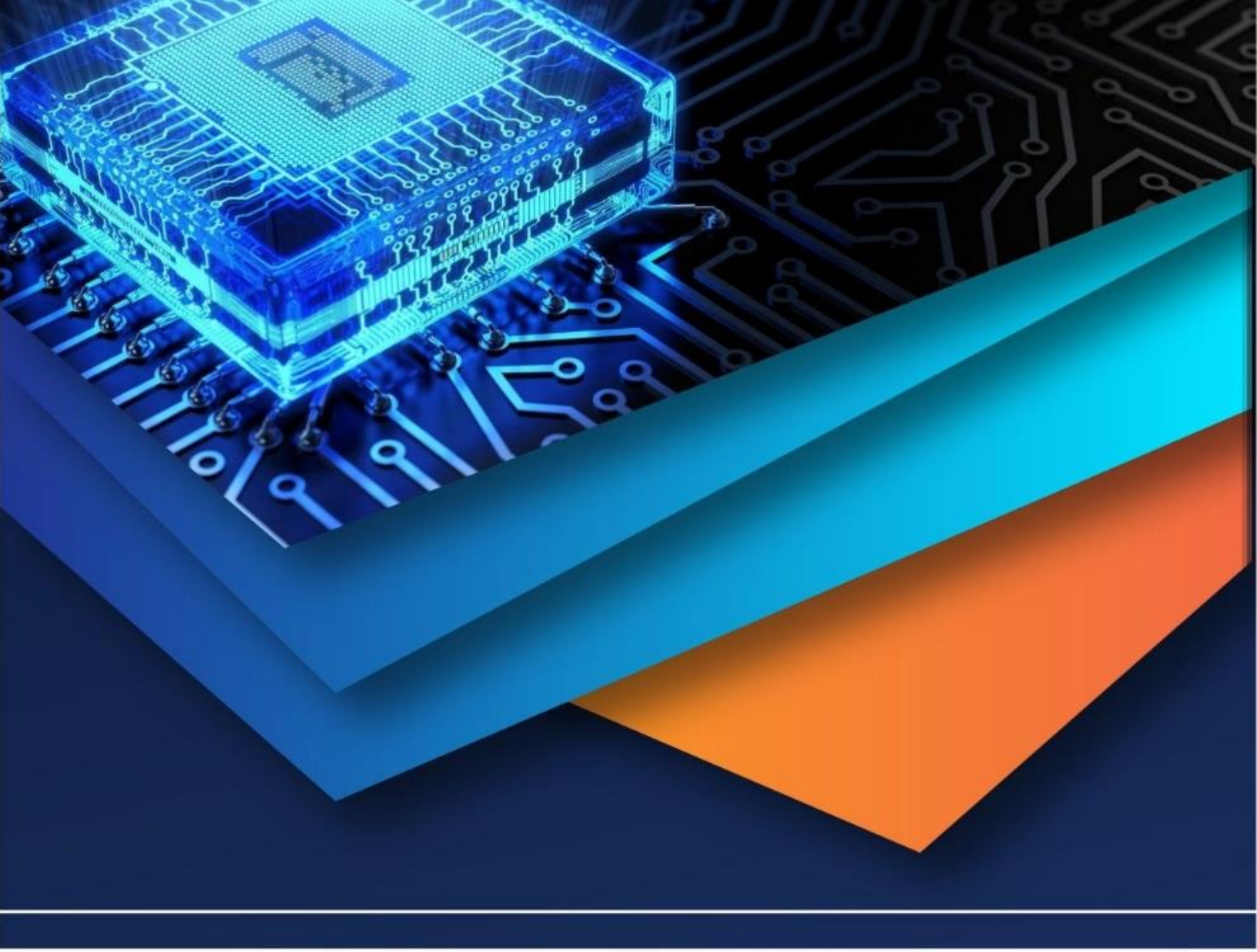

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