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ISSN: 0976-3031

International Journal of Recent Scientific Research
Vol. 6, Issue, 6, pp.4861-4865, June, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

DETERMINATION OF SERUM TSH AMONG COAL MINE WORKER AND POPULATION LIVING IN VICINITY OF CHANDRAPUR DISTRICT, MAHARASHTRA

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ARTICLE INFO

Article History:

Received 14th, May, 2015
Received in revised form 23th, May, 2015
Accepted 13th, June, 2015
Published online 28th, June, 2015

Key words:

Creatinine, Coal dust, Environmental toxicant, Heavy metals, Hormones, Thyroid Stimulating Hormone.

ABSTRACT

Environmental pollutants and Heavy metals (Hg, Al, Se, etc.) have ability to alter the function of endocrine gland in humans which leads to interrupt the synthesis and secretion of hormones in the body. It is speculated that prolonged occupational and environmental exposure of toxicants is responsible for suppression of thyroid hormones. The aim of present study is to determine serum Thyroid Stimulating Hormone level and biochemical parameters in Coal mine workers as well in residing population of Chandrapur district, Maharashtra. Total n=94 serum samples were collected from coal mine workers (n=46) and non exposed (n=48) subjects. Statistical data processing was done by using SPSS and Medcalc software. Statistically significant increased of serum TSH ($p< 0.0001$) was noted in coal miners 3.68 ± 0.99 as compared to non exposed 1.99 ± 0.57 subjects. Slightly positive Pearson's correlation was observed in serum TSH with Creatinine (r=0.196) and urea(r=0.35) but statistically insignificant. On the basis of finding, serum TSH and Creatinine may be used as potential marker for preliminary toxicity determination among coal mine workers.

INTRODUCTION

A wide range of environmental pollutants in mining were encountered into the biological systems which alters the biochemical processes in humans (Pablo *et al.*, 2012). It is well known that environmental problems have increased exponentially due to rapid growth in population and increased demand of several household materials (Attfield *et al.*, 2008). Mining operations released toxic substances like Dioxins, Cyanide, Mercury, Arsenic, Aluminium, Lead, Cadmium, Antimony etc in environment (Lyn Patrick *et al*., 2009; Chen *et. al*., 2008). These toxicants may also interfere with the hypothalamic–pituitary–thyroid regulatory axis.

Anterior pituitary releases TSH which itself is regulated by thyrotropin releasing hormone (TRH) produced by the hypothalamus. It is associated with hypothalamus and regulate TSH and reduced serum T3 (Triiodothyronine) or T4 (Tetraiodothyronine) concentration as shown in figure 1 (Guyton *et al.*, 2006). Exposure of certain extent of environmental toxicants is responsible for suppression of TSH and high T4 levels. (Guldotti *et al.*,1992). Recent research in India showed that about 42 million people suffered from thyroid dysfunction (Ambika *et al.*, 2011). It is speculated that prolonged occupational exposure to mining dust and heavy metals have the ability to alter the function of endocrine gland in humans which leads to alterations in the biochemical and hormonal regulatory processes in the body. Hormones are responsible for the maintenance of homeostasis (normal cell metabolism), reproduction, and development (Juhua Luo *et al.*, 2014). U. S. Environmental Protection Agency (U S E P A), Occupational Safety and Health Administration (O S H A), Consumer Product Safety Commission (C P S C) and Endocrine Society were reported Environmental pollutant and heavy metal (Al, Hg, Se etc) as Endocrine-Disruptors (Diamanti *et al.*, 2009; Howdeshell *et al.*, 2002).

Studies reported that an increased incidence of thyroid disease (autoimmune) has been associated with environmental toxicants but its association with exposure has not fully studied (Vusumuzi *et al.*, 2014; Desai, 1997). Therefore, these findings necessitated further research on determination of stress responsive hormone, i. e serum TSH in coal mine workers and the nearby populations in their vicinity. Its determination may help to diagnose and monitor prolonged exposure of coal dust in miners via hypothalamus pituitary axis alternation of pituitary gland function.

The present study aims to find out level of Serum TSH in coal dust exposed mine workers and non exposed population to check that whether its elevated levels may have significant effect on creatinine and urea and also is there any association between serum TSH and biochemical parameter of kidney function test or not.

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MATERIALS AND METHODS

Study design

Coal mine workers and population living in the vicinity of mining area of Chandrapur district, Maharashtra were selected (n=94) for the present study. The age and sex matched, coal miners (n= 46) and population living in the vicinity of mining area were considered as non exposed (n= 48) subjects who were not directly exposed to mining coal dust. The age of selected subjects were ranged from (15-80) years.

A standard questionnaire was used to record information on base line characteristics such as age, sex, height, weight and etc. Height and weight were recorded for calculation of Body Mass Index (BMI). Informed consent was obtained from all study subjects. Inclusion and exclusion criteria were fixed before selection of study subjects. Workers having exposure period of 10 years were included in this study and those who were occupationally exposed to any known chemical agents, taking antacids, history of chronic diseases such as neurological disorders, diabetes, cardiovascular diseases, anemia etc and female workers were excluded from the study. All selected subjects for this study were male with a mean age of coal Miners (40.95 ± 16.0) and non exposed (38.10 ± 13.5).

Blood collection

Blood samples were collected in a medical room from subjects before the start of the shift. Approximately 5 ml of venous blood was aspirated from each subject. Blood samples were collected into plain test tubes. Collected blood samples were centrifuged at 3000 rpm for 10 minutes. Aliquots of serum samples were allowed to freeze immediately and stored at -40ºC in accordance with accepted procedures. Serum was used for determination of serum TSH, Creatinine and urea.

Determination of Thyroid Stimulating Hormone (TSH) by ELISA

Measurement of TSH is one step immunoassay, based on principle of sandwich-enzyme Linked Immunoassay (Cat. No.TH-351, DS-EIA-Thyroid-TSH). In Brief, 50µl calibrator, control and sample were added into antibody coated microwell ELISA separately. 50µl of monoclonal anti-TSH antibodies conjugated added into the well. After 120 minutes of incubation at room temperature, the wells were washed with washing solution to remove unbound labeled antibodies. A solution of TMB substrate was added and incubated for 20 minutes. The developed colour reaction was stopped using stopping solution. The concentration of TSH is directly proportional to the colour intensity of the test sample. Absorbance is measured by ELISA reader at 450 nm. Each sample was tested in duplicate.

Determination of serum Urea and Creatinine

The serum urea and creatinine levels were determined by Urea Berthelot and alkaline Picrate method by using commercially available kit (Kit-Beacon and Precision Biotech) respectively. The absorbance was measured in between 510- 600 nm. Each sample was tested in duplicate.

Statistical analysis

Mean and standard deviation was calculated by using statistical software

(SPSS software). Pearson's correlation of respective data was calculated using Medcalc statistical software (version 10.0.1)

RESULTS

Table 1 depicts the basic demographic characteristics of the selected study population. As regards age, there was slight difference in the mean age and standard deviation of the coal miners (40.95 ± 16.00) as compared to non exposed (37.10 ± 13.52) subjects. The mean duration of exposure of coal miners was 10.23 ± 4.38. Further, the mean BMI of coal miners (22.9±1.5) was lower than the non exposed (24.4 ± 1.8) subjects.

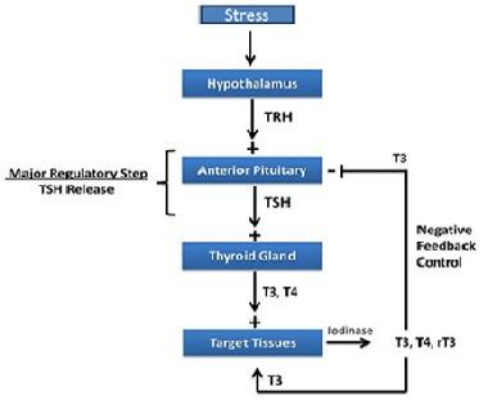

Fig: 1 Regulation of thyroid hormone secretion in human

Thyroid hormones upon stimulation due to stress secrete thyroid hormones which control its secretion through negative feedback mechanism.

Table 1 Basic demographic characteristics of the study population

S. No.	Basic parameters	Coal Miners (n=46)	Non Exposed Population (n=48)
1.	**Age** (Yrs)	40.95 ± 16.0	38.10 ± 13.5
2.	**Year of exposure**	10.23 ± 4.38	-
3.	**BMI** (Kg/m^2)	22.9± 1.5	24.4 ± 1.8
	Underweight	5	-
•	Normal	41	45
	Overweight	-	3
•	Obesity	-	-

All values were expressed as mean ± SD

It was apparent from table 2 that the mean and standard deviation of different biochemical parameters according to study subjects. It was observed that serum creatinine level was statistically significant increased ($p< 0.05$) in coal miners 1.29±0.42 as compared to non exposed 0.99±0.32 subjects.

Mean and standard deviation of serum urea was also slightly increased in coal miner 16.5±7.51 as compared to non exposed 15.2±4.3 subjects but it was not statistically significant. Highly increased in TSH levels were observed in coal miners

3.68±0.99 when compared to non exposed 1.99±0.57 subjects with a p value < 0.0001 indicating statistically significant.

Table 2 Study of biochemical parameters in selected study groups

Biochemical Parameters		Total Number of subjects(n=94)		
A. Kidney Function Test		Coal Miners (n=46)	Non Exposed Population (n=48)	P value
1.	Creatinine (0.6- 1.2 mg/dl)	1.29 ± 0.42	0.99 ± 0.32	0.002 *
2.	Urea (10-45 mg/dl)	16.5 ± 7.51	15.2 ± 4.3	0.30
B.	Serum TSH (0.4- 4.0 µIU/ml)	**3.68 ± 0.99**	1.99 ± 0.57	0.0001**

All values were expressed as mean ± SD, P>0.05: non significant, P<0.05: significant, P<0.0001: Highly significant

Percent wise distribution of study groups was depicted in table 3. Elevated level of Creatinine was observed in 21 (46%) coal miners and 12 (25%) non exposed subjects, which was found to be above the normal range. No changes were noted in urea level in both the groups. High level of serum TSH was noticed in 17(37%) coal miners and 8(16%) non exposed subjects, which was found to be above the normal range.

Table 3 Percentage wise distribution of study groups of coal mine workers and non exposed subjects

Biochemical parameters (%)	Coal Miners (n=46)		Non Exposed Population (n=48)	
	Normal (%)	Elevated (%)	Normal (%)	Elevated (%)
Creatinine	25 (54)	21 (46)*	36 (75)	12 (25)*
Urea	45 (97.8)	1(2.2)	48 (100)	0
TSH	29 (63)	17 (37)*	40 (84)	8 (16)*

Note: n= Data are presented as n=number of cases, (*)= Percentage for categorical data

Table 4 showed that statistically significant increased (p<0.05) serum Creatinine 1.5±0.32 levels were observed in coal miners as compared to non exposed subjects 0.9 ± 0.42.

Table 4 Study of creatinine and urea level in subject having elevated level of serum TSH

	Coal Miners (n=17)	Non Exposed Population (n=8)	P value
Serum Creatinine	1.5 ± 0.32	0.9 ± 0.42	0.0006
Serum Urea	17.42 ± 11.62	16.09 ± 4.34	0.758

Note: All values were expressed as mean ± SD, P>0.05: non significant, P<0.05: significant
*TSH Normal Range 0.4- 4.0 µIU/ml

Table 5 Correlation of TSH with creatinine and urea among subjects having elevated level of serum TSH

Biochemical parameters	Coal Miners (n=17)	
	r-value	p-value
Serum TSH- Creatinine	0.196	0.44
Serum TSH- Urea	0.35	0.167

Note: All values were expressed as correlation, P>0.05: non significant, P<0.05: significant

On the other hand, the level of urea was slightly increased in coal miners 17.42±11.62 as compared to non exposed subjects 16.09±4.34 but it was statistically insignificant. The above observations were noted in subjects having elevated levels of serum TSH.

Table 5 provided slightly positive correlation (r=0.196) with serum TSH and Creatinine but statistically insignificant. When same correlation were applied between TSH and urea, it was noted slight positive correlation (r=0.35) but statistically insignificant. The above observations were noted in subjects having elevated levels of serum TSH.

DISCUSSION

Prolonged occupational and environmental exposure to toxic substances can pose adverse health problems in mine workers and populations living in the vicinity of mining area. (Gadge Y *et al.,* 2013) Mining dust and heavy metals have the ability to alter the function of endocrine hormone like parathyroid and stress responsive hormone (TSH) in humans. (Guyton *et al.,* 2006). Several studies indicated the adverse reproductive effects of metals can occur even at low exposure that is common for general populations worldwide. Increased incidence of thyroid disease (autoimmune) has been associated with environmental toxicant reported in human (Ambika *et al.,* 2011). Recently, National Institute of Miners' Health reported, impact of high level of aluminium on parathyroid hormone in Bauxite dust exposed mine workers (Jawade *et al*., 2014). On the basis of literature survey, scanty reports were available on significant data of occupational exposure to mining dust and their effects on serum TSH levels. No attempts made to fully understand association between serum TSH with creatinine and urea in coal dust exposed mine workers and their effects on serum TSH and kidney function test. This is the first attempts made so far to understand association between serum TSH and creatinine in coal dust exposed mine worker. Present study, pointed toward association of increased level of serum TSH as a stress responsive hormone in the coal mine workers.

The findings of this study indicated that significant increased in mean level of serum TSH and creatinine in coal miners was observed as compared to non exposed population but levels were within normal range. Table 3 showed that total (n=46), 17 number of subjects having elevated level serum TSH among coal miners. Similarly, 21 subjects in which Creatinine level were found to be elevated among coal mine workers which were above the normal range. It was also noted that those subjects having high level of TSH also have elevated levels of Creatinine. No remarkable changes were noted in serum urea level of coal miners. It indicated that increased in the TSH may have influence on increase of Creatinine level.

In consistent with our study, Zaidi *et al*, were reported increased level of serum TSH in welder suffering from hypothyroidism due to cumulative effects of welding fumes in the work environment (Zaidi *et al*., 2001; Platcow *et al.,* 3rd edition; Stern RM *et al.* 1986). Concept of this study is to correlate with above reported study as occupational exposure of toxic substances are responsible for increased serum TSH level in the both the study groups.

Other studies indicated creatinine level showed positive pearson's correlation with serum TSH and negative correlation with serum T3 and T4 levels in hypothyroid subjects (Devika *et al.,* 2009). In our study slightly positive correlation was observed in between TSH -Creatinine but it was statistically insignificant. Similarly, slightly positive correlation was observed in between TSH- urea but it was statistically insignificant. It was noted that high level of creatinine and urea in coal miners as compared to non exposed population which

may be indicated that occupational coal dust exposed miners are more prone to renal dysfunction (Saini *et al.*, 2011) In line with this, scientists reported that significant increased in serum creatinine levels in Nigerian cement factory workers (Olusegun *et al.*, 2011) as well as in hypothyroid patients observed due to occupational dust exposure. Another studies indicated closed association between increased level of TSH and creatinine may be due to thyroid hormones binding proteins (Layla *et al.*, 2010; Wang *et al.*, 2011). There were limited evidences suggested that occupational exposure to coal dust and heavy metals may affect thyroid function including inorganic arsenic, cadmium, lead, manganese, organic mercury, copper, selenium and zinc. Alterations in circulating thyroid hormone or TSH levels in relation to exposure may effect at different levels of the hypothalamus-pituitary thyroid axis or may be a result of altered thyroid hormone transport and peripheral metabolism, deactivation.

More research is needed for a better understanding of the role of creatinine and thyroid function and related health implications in coal mine workers and nearby populations of mining area.

CONCLUSION

On the basis of findings, high level of serum TSH and creatinine may be used as potential markers for preliminary toxicity determination among coal mine workers and population living nearby mine area. The study of panel of biomarkers in large number of samples for determination of significant association in stress responsive hormones is needed in future to draw solid conclusion in coal mine workers.

Acknowledgement

All Authors like to acknowledge the Director of National Institute of Miners' Health for their constant support and encouragement.

Conflict of Interest

Authors report no conflict of interest.

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How to cite this article:

Pingle SK *et al*., Determination Of Serum Tsh Among Coal Mine Worker And Population Living In Vicinity Of Chandrapur District, Maharashtra. *International Journal of Recent Scientific Research Vol. 6, Issue, 6, pp.4861-4865, June, 2015*

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