

# Effects of Diesel Exhaust on Thyroid Function in Male Rats?

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**Abstract**—Studies have shown association between diesel exhaust and endocrine disorders. The aim of this study was to investigate the effects of diesel exhaust on serum levels of T3 and T4 in male rats. In this laboratory experimental study, 24 male Wistar rats were randomly divided to control group and groups exposed to 1h, 4h, 8h/day diesel exhaust of 6 rats in each group. After 10 weeks, blood samples were collected using cardiac puncture method and following serum collection, the levels of T3 and T4 were measured by radioimmunoassay. The data were statically analyzed using ANOVA. Serum T3 and T4 levels did not significantly change in rats exposed to diesel exhaust for 1h/day compared with control rats but significantly increased in groups exposed for 8h/day compared to control animals ( $P<0.05$  and  $P<0.01$ , respectively). Our findings indicate that prolonged exposure to diesel exhaust results in increased thyroid activity; according to which, exposure to diesel exhaust, particularly prolonged exposure, can be accounted as important factor associated with thyroid disorders.

**Keywords**— Diesel Exhaust, T3, T4, Testosterone, Rat.

## I. INTRODUCTION

THE thyroid gland is a vitally important hormonal gland that plays an essential role in metabolism, growth and maturation of the human body. It helps to regulate many body functions. The thyroid gland constantly releases a certain amount of hormones into the blood [1]. The thyroid hormones, triiodothyronine ( $T_3$ ) and thyroxine ( $T_4$ ), are tyrosine-based hormones produced by the thyroid gland that are primarily responsible for regulation of metabolism. Thyroid hormone regulates a wide range of genes after its activation from the prohormone, thyroxine ( $T_4$ ), to the active form, triiodothyronine ( $T_3$ ) [2]

Diesel exhaust is produced when an engine burns diesel fuel. It is a complex mixture of thousands of gases and fine particles (commonly known as soot) that contains more than 40 toxic air contaminants. These include many known or suspected cancer-causing substances, such as benzene, arsenic and formaldehyde. It also contains other harmful pollutants, including nitrogen oxides. Diesel exhaust contains significant

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levels of small particles, known as fine particulate matter. Fine particles are so small that several thousand of them could fit on the period at the end of this sentence. Fine particles from diesel engines contribute to haze which restricts our ability to see long distances. Diesel Exhaust Contains 40 Hazardous Air Pollutants, in addition, diesel exhaust contains both carbon particulates and 40 chemicals that are classified as "hazardous air pollutants" under the Clean Air Act [3]-[5]. The studies show that exposure to engine exhausts take serious deleterious effects on body function including brain [6], reproductive system [7], urinary system [8] and cardiovascular system [9]. The aim of this study was to determine the effects of diesel exhaust emission on serum levels of thyroid hormones.

## II. MATERIAL AND METHODS

### A. Animals

Adult Wistar rats weighting  $200\pm 30$ g were purchased and raised in our colony from an original stock of Pasteur institute (Tehran, Iran). The temperature was at  $23\pm 2$  °C and animals kept under a schedule of 12h light:12h darkness (light on at: 08: 00 a.m.) with free access to water and standard laboratory chow. Care was taken to examine the animals for general pathological symptoms. Food was withheld for 12-14h before death.

### B. Protocol of Study

In this laboratory experimental study, 24 male Wistar rats were randomly divided to control group and groups exposed to 1h, 4h, 8h/day diesel exhaust of 6 rats in each group. After a period of 10 weeks, blood samples were collected in appropriate tubes by cardiac puncture technique 24h after the last treatment. After collection, the blood samples left to clot at room temperature for 15 minutes and then centrifuged at 2500 r.p.m for 15 minutes. The serum layer was then separated and aliquoted into small test tubes and stored at  $-20$  °C until enzyme activity determination. Serum levels of T3 and T4 were measured by radioimmunoassay. All animal experiments were carried out in accordance with the guidelines of Institutional Animals Ethics Committee.

### C. Statistical Analysis

All values are presented as mean  $\pm$  S.E.M. Statistical significance was evaluated by one-way analysis of variance (ANOVA) using SPSS 19. Significance was measured using Fisher's least significant for the exact P values and significant differences are noted in the results. Differences with  $P<0.05$  were considered significant

### III. RESULTS

Table 1 shows serum levels of T3 and T4 in male rats. Serum T3 and T4 levels did not significantly change in rats exposed to diesel exhaust for 1h/day compared with control rats but significantly increased in groups exposed for 8h/day compared to control animals ( $P < 0.05$  and  $P < 0.01$ , respectively).

TABLE I  
SERUM CONCENTRATIONS OF T3 AND T4 IN CONTROL AND RATS EXPOSED TO DIESEL EXHAUST FOR 1, 4 AND 8H/DAY

Animals	T3 IU/L	P	T4 IU/L	P
Control	33.00±0.37	-	3.56±0.20	-
1h/day	33.17±0.54	NS	3.80±0.17	NS
4h/day	34.83±0.40	<0.05	3.92±0.38	NS
8h/day	34.83±0.83	<0.05	4.72±0.30	<0.01

The data are indicated as mean  $\pm$  SEM. P values are expressed in comparison with control group. N.S. represents non significant difference.

### IV. DISCUSSION

Our study indicated that serum T3 and T4 levels did not significantly change in rats exposed to diesel exhaust for 1h/day compared with control rats but significantly increased in groups exposed for 8h/day compared to control animals. In line with our findings, there are other studies reporting that environmental factors such as smoking [10], [11] can influence thyroid gland function. Alcohol use also has serious impact on thyroid gland function [12]. The reports indicate that exposure to diesel exhaust take serious deleterious effects on brain [6], reproductive system [7], urinary system [8] and cardiovascular system [9]. The studies also show that long term exposure to solvents and air pollutants can lead to deleterious effects on respiratory, haematological and thyroid functioning [13]. Furthermore, methyl tertiary-butyl ether in gasoline is associated with thyroid gland disorders [14]. However, contrary to our finding a cohort study has not found association between occupational exposure to engine exhaust fumes and cancer [15].

### V. CONCLUSION

Our findings indicate that prolonged exposure to diesel exhaust results in increased thyroid activity; according to which, exposure to diesel exhaust, particularly prolonged exposure, can be accounted as important factor associated with thyroid disorders.

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