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Lead Poisoning Effect on Human Health in a Megacity (India)

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Abstract: ***Present investigation evaluated the effects of higher concentration of Lead of vehicle exhaust on human health in relation to body fitness and cardio-respiratory responses of middle aged men (n=100) working as bus drivers in a megacity (Kolkata) and private bus driver (n=100) of a district town (Paschim Medinipur). All subjects belong to age group in between 28 years to 35 years. Anthropometric data of vertical height and body mass of the subject of both groups were measured by Anthropometer Rod, Weighing machine and compared. Body fat percent was estimated of the subjects of both groups by Siri Equation putting the value of arm skinfold thickness and iliac skinfold thickness using Harpenden SkinFold Calipers. VO_2 max was determined by treadmill exercise with direct measurement of oxygen consumption. Pulmonary minute ventilation (VE) of the subjects of both group were measured by Electronic Spirometer. Blood Pressure was measured by Sphygmomanometer and Radial Pulse rate (beats /min) was also measured. Blood haemoglobin concentration was measured by spectrophotometrical technique and compared. Erythrocyte count of the subjects of bus drivers of district town and that of the subjects of Kolkata was taken by Automatic Coulter Counter. Bus drivers working in small district town had significantly ($p<0.05$) higher lean body mass, physical efficiency and aerobic capacity than bus drivers working in megacity. People working as bus drivers in town area showed significantly ($p<0.05$) higher cardio-respiratory responses to exercise than working men (driver) in population dense megacity area. Significant ($p<0.05$) difference of blood haemoglobin concentration and erythrocyte count of drivers working in small district town have been observed in respect to bus drivers in megacity. Higher concentration of Lead of vehicles exhaust in a small area inhibits haemoglobin synthesis in blood that affect oxygenation of tissues and aerobic capacity. Continuous exposure of lead is one of the major causes of cardio respiratory disorder of people living in polluted zone of megacity. It leads hypoxia and pulmonary diseases that also one of the reasons of lower physical efficiency of people living in polluted zone of the country.***

Keywords: Cardio-respiratory, Anthropometer, Spectrophotometrical, Haemoglobin, Hypoxia.

1. Introduction

Good health shows better efficiency to combat the pollution tide in world. Health mainly depends on food nutrients. Deficiency of nutrient creates ill health. Besides that mental pleasure is also an important factor for health condition. On the other hand anxiety, stress, manmade pollutants affect the health condition of people living particularly in urban area (Goyer et al.,1973;Chamberlain et al.,1978). people living in a polluted area is affected mainly by vehicle exhaust, unburned hydrocarbons, industrial wastes, municipal sewage, nuclear waste and water pollutants which coastally increases the concentration of Lead, Chromium, Mercury, Arsenic, Fluoride, Silicon and other toxic metals in surrounding areas (Thawley et al.,1977; Pocock et al., 1989; Leggett, 1993;WHO,1996). People living in metropolitan city always facing traffic jam leads to continuous inhalation of vehicle exhaust that cause of illness include cardio vascular diseases and chronic pulmonary diseases (Charney et al.,1983).Vehicle exhausts containing unburned hydrocarbon, benzene, formaldehyde, ozone, NOx. CO_2 and fine dust particles can aggravate both heart and lung diseases. Beside that one of the major pollutants in vehicle exhaust is Lead that affects hemoglobin synthesis by inhibiting the δ-Amino Levulinic Acid Synthase enzyme and creates anaemic condition. It affects lung and arrest foetal development (Granick et al., 1973; Klein et al., 1980; Lakatta, 1993). Lead has an effect on membrane permeability of potassium ion in erythrocyte. Normally blood Pb level (25µg/100ml) increases to 70µg/100ml generally associated with above clinical symptoms. Alongside it causes fatigue condition in urban people. Toxicity developed by it damages the chromosome and process of metabolic disorder. It is mentioned that 40 µg Lead/100 mL of blood cause of damaging brain cells (National Academy of Sciences/Institute of Medicine, 2003,Dietrich et al.,1986). In a megacity environmental higher concentration of cobalt, Zn, Ni, Cu also cause different health hazards including Gastrointestinal disorders (Suttle and Mills,1966;Thawley et al., 1977). So, to protect our health condition preventive measure and pollution act on vehicles should be adopted immediately. Other factors like Age, Sex (?) and regular physical exercise may affect the body efficiency (Londeree and Moeschberger, 1982). Health is related with body fitness in terms of physical efficiency and it may be expressed as gross efficiency and net efficiency. To combat the effect of environmental toxicants Lead free fuel should be used in vehicles.

2. Research Methodology

For present study hundred (100) bus drivers working at Midnapore town area under Midnapore Municipality in Paschim Medinipur district and hundred (100) bus drivers working at Chowringee more in Kolkata megacity were selected. Some physiological parameters were taken on

those subjects participating in exercise including Harvard Step test and Trade mill test. The subjects were randomly chosen and belong to middle age group (age between 35 -45 years).

Physiological parameters of such subjects were noted from anthropometric measurement i.e. height and weight using Standard laboratory techniques (Maiti et al., 2011). Arm circumference, chest circumference during inspiration and expiration were also measured by standard laboratory methods (Singh and Bishnoi, 2005). Skin fold thickness of subjects of both group were measured by Harpenden Skin fold Callipers (Jason and David, 2010). And the experimental data collected from drivers of town and city area has been shown in **Table 1.**

Blood pressure (systolic and diastolic) at normal state and after exercise of the subjects of both groups was measured by sphygmomanometer and radial pulse rate of both groups were also recorded. Measured data has been shown in **Table2.**

Resting and exercised heart rate of both the groups were measured from carotid pulsation, maximal oxygen uptake of both groups was measured during continuous Treadmill exercise, blood haemoglobin concentration of the subjects of both groups driver working in small town and bus driver working in Kolkata megacity was determined by Spectrophotometrical technique. Breathe rate and pulmonary minute ventilation (VE) of the subjects of both groups were measured by Electronic Spirometer followed by erythrocyte count using Automatic Coulter Counter and measured data of the above experiments has been shown in **Table 3**.

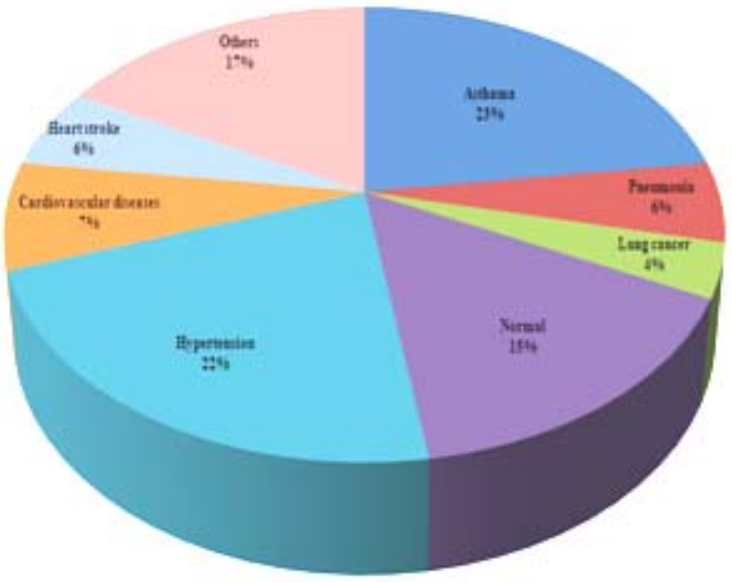
Percentage of incidence of pulmonary diseases and cardiac disorder of the subjects of both the groups were recorded that has been shown in **Fig- 1&2**.

Table 1: Measured anthropometric data of bus drivers of town area (adult men) and bus drivers (adult men) of polluted zone in megacity (Kolkata, India). In each vertical column data are expressed as Mean ± SEM.

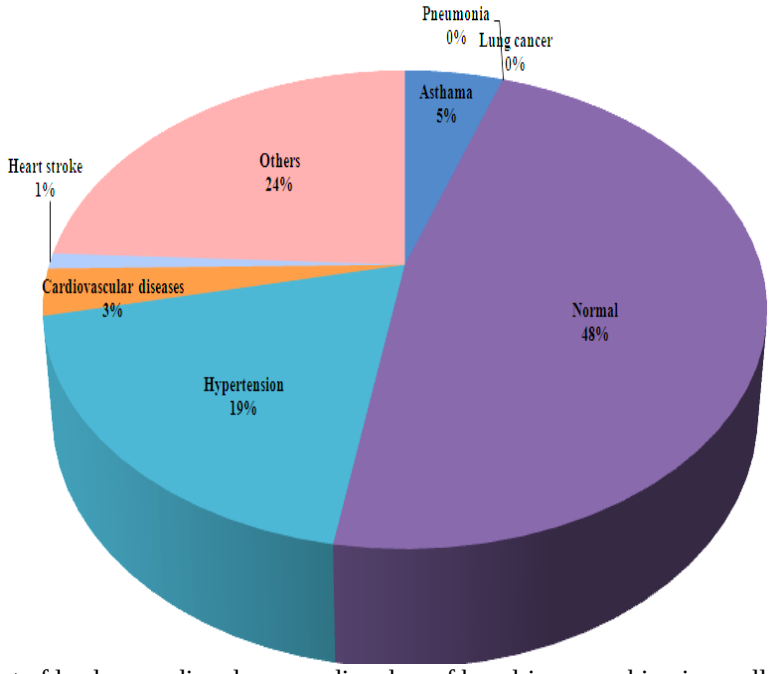
Variables	Driver working in small town (n=100)	Driver working in megacity (n=100)
Age (years)	40±0.46	40±0.32
Height (cm)	166 ±0.07	169.±0.46
Weight (Kg)	62.20±1.94	65.29±0.89
Arm Circumference(cm)	30.58±0.60	32.12 ± 0.38
Head Circumference (cm)	51.09±0.93	52.24±0.30
Chest Circumference (cm)		
• Inspiration	80 +1.02	76±2.21
• Expiration	76±0.88	74±0.78
Total Skin fold Thickness (mm)		
• Illiac	23±0.02	27±0.23
• Arm	11.0±0.05	13.0±0.02
% of Body Fat	14.0±0.02	21.0±0.03
Body density = 1.0764-(0.3081) X illiac Skin fold -0.3088 X Arm Skin Fold		
Percent of body fat ={(4.570/BD)-4.142}X 100		
Total Fat (Kg)= (Body weight (Kg) X Percent of fat)/ 100		

Table 2: Measured data of heart and lung responses of bus drivers (adult men) of small town area) & bus drivers (adult men) of polluted zone in Kolkata (India). In vertical columns data are expressed as Mean ± SEM.

Variables		**Driver working in small town (n=100)**		**Driver working in megacity (n=100)**		**Level of Significance**
Blood Pressure (mm of Hg)	Systolic	Before Exercise	After Exercise	Before Exercise	After Exercise	
		130±1.31	168±2.01	136±3.32	190±1.02	P<0.05
	Diastolic	80.92±2.30	80±2.01	80.12±1.99	80±1.22	p>0.05
Pulse Rate (beats /min)		72.0±3.10	156.0±2.74	74.26 ±2.39	178.0±3.16	p>0.05
Breathing rate breaths/min)		18 ±0.29	30.0± 1.20	21± 0.26	36.0± 1.02	P<0.05



Effect of lead on cardiopulmonary disorders of bus drivers working in megacity



Effect of lead on cardiopulmonary disorders of bus drivers working in small town

Figure 1: Pie diagrams showing the effect of high and very low concentration of lead on human health in megacity and small town in country.

Table 3: Measured data of cardio-respiratory responses after treadmill exercise and blood haemoglobin concentration. In vertical columns data are expressed as Mean ± SEM.

Variables	Drivers working in small town (n=100)	Drivers working in megacity (n=100)	Level of Significance
Resting Heart Rate (beats/min)	72±2.64	74.26±1.41	p>0.05
Maximum Heart Rate (beats/min)	178.0±1.02	190.0±2.43	P<0.05
Maximal Oxygen uptake (lit/min)	5.2±0.08	4.65±0.02	p<0.05
Pulmonary minute ventilation after exercise (VE) (lit/min)	15 ± 0.36	18± 0.13	p>0.05
Physical Fitness Index (%)	90.0±0.02	72.0±0.32	P<0.05
RBC Count (million/mm^3)	5.1±0.33	4.8±0.28	P<0.05
Hemoglobin Concentration (gm%)	15 ±0.84	13.8±1.02	p<0.05

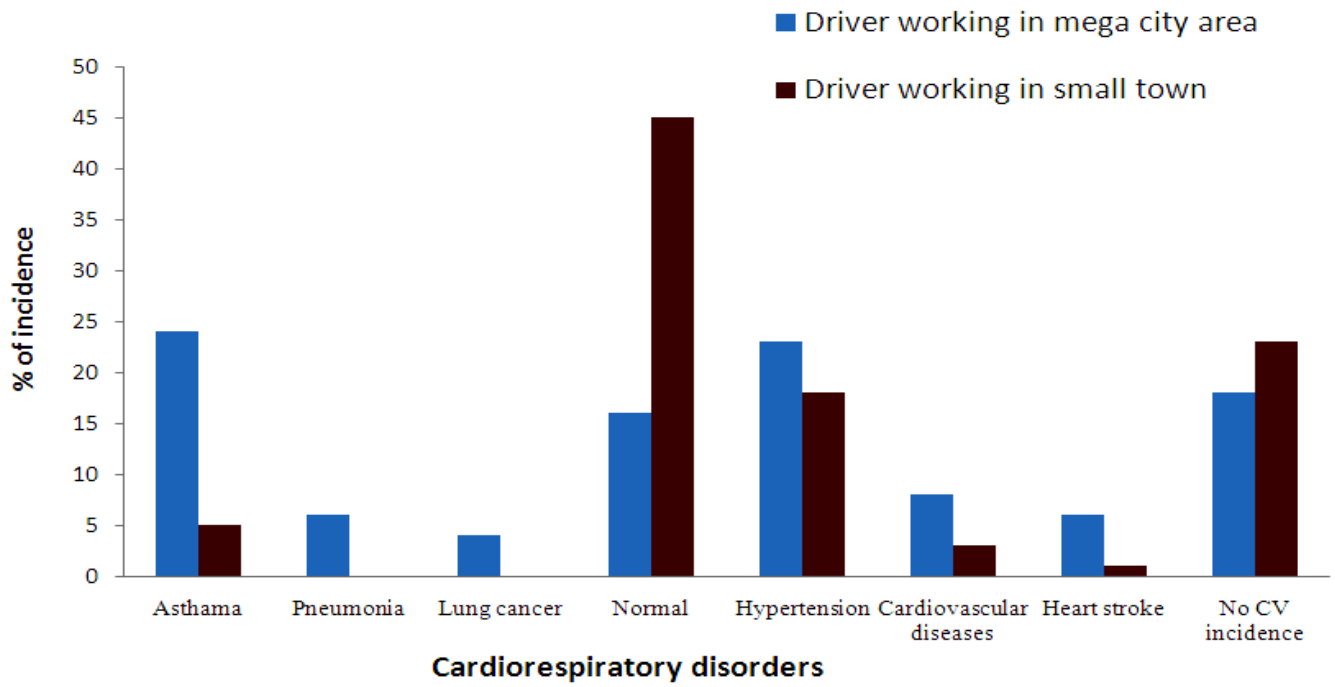


Figure 2: Bar diagram showing comparative study the effect of higher and lower concentration of lead on cardio-respiratory disorders of bus drivers working in megacity and small town respectively.

3. Results and Discussion

The present study showed interesting findings that physical efficiency of bus drivers of a megacity with higher traffic density is decreasing day by day in respect to bus drivers working in a small municipality town area. As higher concentration of toxicants may affects oxygenation of myoglobin and muscular calcium metabolism that also may cause of decrement of physical efficiency in urban people(Landers et al.,1994).Our present investigation on bus drivers working in small municipal town (adult men) and bus drivers working in polluted zone of Kolkata Corporation area provides an impressive evidence that muscular efficiency cannot be restored due to vehicular toxicants ignoring the role of food nutrients and physical activity. Good nutrients have enormous role on production of sufficient energy for muscular contraction in the Physiological State of men (WHO, 1996). But higher concentration of pollutants (lead), anxiety, stress decreases oxygenation of haemoglobin in blood and aerobic respiration of tissues of human body that also one of the reasons of lowering physical efficiency of workers living in urban area (Lanphear et al.,1996;National academy of Sciences/Institute of Medicine, 2003).

Interesting findings in our investigation are that the measured data of body mass, arm circumference, iliac, chest circumference during expiration was higher in adult drivers (bus drivers) working in small town area in comparison to that data collected from bus drivers working in highly traffic dense and polluted megacity. Body fat percent (Doublen,1959) and skin fold thickness (Jason and David, 2010) of bus drivers working in polluted city is higher than that of working drivers in small municipal town (**Table-1**). Blood pressure, pulse rate and breathing rate of before and after exercise of bus drivers working in polluted area were higher than that of workers in less polluted zones in country. It revealed that bus drivers working in area with higher concentrated Lead posses weaker heart in comparison to drivers working in area with less concentrated Lead (Pirkle et al.,1985) (**Table** -2). Another finding was that myocardial strength, maximal oxygen uptake or vital capacity of bus drivers (men) working in less polluted town is higher than that of drivers working in polluted city (Kasch et al.,1966; Zeimatz et al.,1985). Pulmonary minute ventilation (VE) of working men of municipal town is lower than that of men working in a polluted city. Blood haemoglobin concentration, R.B.C. count of bus drivers of municipal town were also significantly ($p<0.05$) higher than that of the subjects working as bus drivers in polluted areas of city shown in **Table-3**. Regular physical exercise increases oxygen uptake capacity (Farrel et al., 1983; Dalsky et al., 1988), oxygenation of myoglobin and also increases oxygen consumption of muscle (Wittenberget et al.,1975; Klein et al., 1980; Leggett, 1993;Landers and Petruzzewllo, 1994). But higher concentration of Lead in traffic dense polluted city area affect oxygenation of haemoglobin, VO_2 max as well as physical efficiency of people living in polluted city (Leggett, 1993). It may inhibit the pulmonary ventilation and oxidative capacity of the ventilator muscles (Needleman et al., 1990). Different Pulmonary and heart diseases of the subjects of both groups continuous inhaling of higher and lower concentration of poisonous Lead in ambient air have been shown in **Fig-1 & 2**. It depicts an idea that Lead of vehicle exhaust is one of the causative materials for pulmonary and heart diseases of most of the bus drivers working in traffic dense polluted area. Pollution Act on vehicles should be strictly maintained to protect the human beings from health hazards in the developing countries.

4. Conclusion and Recommendations

The overall findings in this study have revealed that people living in polluted city or megacity facing continuous exposure of vehicle exhaust are not able to increase their heart rate and oxygen uptake to its maximum level as well as pulmonary ventilation due to lead toxicos is like other people living in less traffic concentrated area. Gradual detoriating the life span of urban people can be restricted either by maintaining the pollution act on vehicles or reducing the use of fuel. Rise of concentration of toxicants from vehicles may one of the major causes of muscular fatigue and detrimental effect of physical efficiency of people living in megacity or urban area.

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