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Cross-sectional study on Lipid profile and Haematological parameters among fireworks workers in West Bengal, India

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Abstract

Nowadays, components for fireworks include barium nitrate, iron dust, aluminium dust, sulphur, and polyvinyl chloride. All of these chemicals reach the bloodstream, where they are eventually stored in the liver and other body tissues after sustained exposure. Kidney, cardiovascular, neurological, and neurological problems are only a few of the negative effects of barium. Iron is necessary for haemoglobin to function. Iron poisoning is nevertheless not infrequent. The results of the haematological analysis show that the Hb, RBC, MCH, and MCHC values of the experimental group are lower than those of the control group. This study found that compared to the control group, fireworks workers had lower levels of HDL, triglycerides, cholesterol, and VLDL. While blood protein levels were lower in the experimental group than in the control group, it was found that AST, ALK, ALT, and bilirubin levels were greater in the fireworks workers when compared to the control groups.

Key words : Lipid profile, hematologic parameters, liver function, fireworks.

In India, employees in both organised and unorganised sectors are subjected to airborne particles, fumes, aerosols, fibres, gases, and vapours. By ingestion, skin absorption, and inhalation (breathing), these poisonous chemical components cause injury (eating or drinking). The nature and potential for toxic consequences, the extent and length of exposure, and the degree of danger to workers from that chemical all play a role in risk assessment.

Barium nitrate, iron dust, aluminium dust, sulphur, and polyvinyl chloride are currently used as fireworks ingredients. All of these substances enter the bloodstream and, with prolonged exposure, are deposited in the liver and other body tissues. Barium's harmful consequences include neurological and mental illnesses, and kidney, cardiovascular, and neurological diseases. Haemoglobin function depends on iron. Nonetheless, iron poisoning is not unusual. Eid R et al. has reported iron-mediated toxicity and programmed cell death. Aluminum has the potential to be neurotoxic and affect reproductive processes. Skin lesions, bone lesions in the distal phalanges of the fingers, and dramatic vascular alterations are all caused by polyvinyl chloride.

Using a hemocytometer and a hemoglobinometer, total counts of red blood cells (RBC) and white blood cells (WBC), differential counts of WBC, and percentage estimations of haemoglobin (Hb) will be determined. To determine whether the workers are anaemic or not, mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) must be determined from this data. Also, established biochemical techniques must be used to estimate blood sugar and lipid profiles (triglycerides, cholesterol, low a high-density lipoproteins) in order to access their cardiovascular risk factors.

It is necessary to ascertain the functions of specific serum enzymes that are released into the bloodstream during pathological circumstances. The enzymes would be serum alkaline phosphatase, serum glutamate-pyruvate transaminase, and serum glutamate oxalo-acetate transaminase. Any abnormalities in liver function that might develop over the course of a long history of fireworks exposure would also be assessed as part of this test. for the preparation of the manuscript relevant literature[1-21] was consulted.

Study period & working area :

The study was conducted from April 2019 to March 2022 involving the fireworks workers of the Champahati region of South 24 Parganas district of West Bengal, India.

Selection of Subjects :

Male sex workers predominate in the fireworks industry. Consequently, for this study, 100 workers who are not associated with the field of fireworks and do not work with similar chemical exposure to those of fireworks workers were chosen as the control group, while 152 male fireworks workers were chosen as the experimental group. According to age, the experimental group was split into four subgroups: A: 18–29 years, B: 30-39 years, C: 40–49 years, and D: beyond 50 years. Both groups had good mental and physical health. Other than people who resided in that region, the control group's employees belonged to other professions (police, shopkeepers, teachers, etc. who operate at different offices and places).

Inclusion and exclusion criteria :

The inclusion requirements included the workers' ages being at least 18 and their involvement in the production of pyrotechnics for at least the previous two years, with an average daily activity of 8 hours. Male employees with physical disabilities and female employees were not included in the study since, in this industry, female employees are mostly linked with the packing department rather than the manufacturing department.

Physical Parameters

A Martin anthropometer from Takei in Japan and a Crown weighing machine from Raymon Surgical in India were used to measure the height and weight of the fireworks workers and the control group, respectively. A calculation of the body surface area (BSA) was made using the study of Kuorinka I *et al.*,[12]. All of the subjects' BMIs were also calculated in accordance with Cole TJ *et al.*,[4].

Liver enzymes, Lipid profile and Haematological parameters :

Before the start of the work in the morning, 10 mL of fasting venous blood from the basilica vein was taken from the subjects. A blood sample of approximately 6 mL was taken and divided into two (3 mL for lipid profile and 3 mL for CBC). For a liver function test, 4 mL are used. For thorough clotting and clot retraction, 3 mL blood was added to SST and left to stand for 30 minutes at room temperature. Afterwards, using a Megafuge r 1.0 Heraeus centrifuge, serum was separated by centrifugation for 15 minutes at 3500 rpm (Germany, 2017). The concentrations of TC, HDL-c, and TG were measured in the serum using the Fried-Wald formula, LDL-c cholesterol was determined (LDL-c=TC-(TG/5+HDL)). Lastly, the TC/HDL-C, TG/HDL-C, and LDL-C/HDL-C serum lipid profile ratios were computed. In order to use the Beckman haematology analyzer to determine the hematologic parameters, an additional 3 mL of CBC was added to the EDTA tube (Germany, 2018). Vacuum tubes containing K3-EDTA (Greiner, Germany) and plain tubes were used to collect blood samples for the serum. The same tool and operator ran all of the tests twice.

Triglyceride (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), cholesterol, lactate dehydrogenase (LDH), aspartate transaminase (AST), alkaline phosphatase (ALK), alanine transaminase (ALT), total serum protein, bilirubin, globulin, albumin, and blood urea nitrogen (BUN) levels were measured by a semi-automated biochemistry analyzer (Roche - Hitachi MODULAR Analytics, Japan) using the Roche kits. Using the Roche Kit (Roche - Hitachi MODULAR Analytics, Japan), which is based on the Biuret method, serum total proteins (TP) were determined. The BCG method, which relies on the bonding between serum albumin and tetrabromocresol sulfonephthalein green at a pH of 4.2 and the creation of a blue-green solution, was used to test serum albumin (detected at 600 nm). Also, the serum albumin and TP values were used to estimate the serum globulins and albumin-to-globulin ratio. Using the Roche diagnostics kit, the serum ALK was tested followed by the King Armstrong method (Roche – Hitachi MODULAR Analytics, Japan). The BUN was determined using a colorimetric technique using a UV-Vis (Lambda 950. Perkin Elmer) spectrophotometer set at 520 nm.

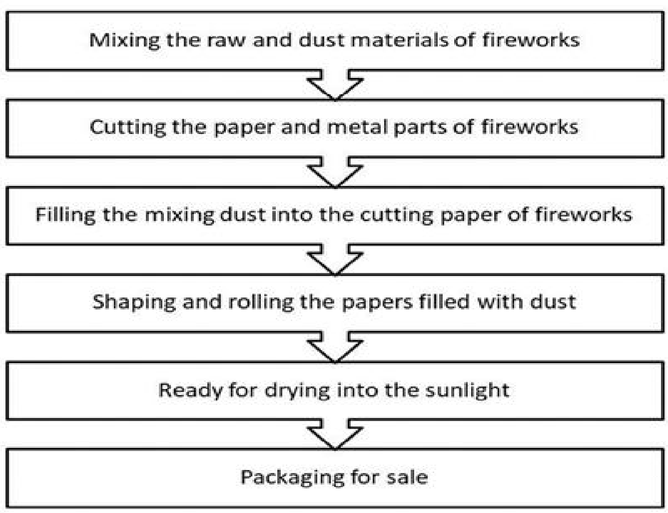
Statistical Analysis :

The definitions of sociodemographic and other variables were based on the mean and standard deviation. To determine whether there were any statistically significant differences in the demographic variables of the experimental and control groups, a Student's t test was conducted between the two groups of workers. Statistics were judged significant at p 0.05. Use of Microsoft Excel was made for the majority of the statistical analysis.

Table-1 shows the general demographic information about Fireworks employees and the control group. In terms of mean age and BMI, there was no discernible difference between the two groups. The height, weight, BSA, and year of experience, however, showed minor variations. The two groups have the same number of working days per week, daily work and rest durations, and daily work hours.

Variable	Fireworks workers (Mean±SD)n = 152	Control group (Mean±SD) n = 100	p value
Age (year)	37.43 ± 11.81	36.10 ± 11.00	> 0.05
Height (cm)	165.55 ± 8.44	168.58 ± 6.68	< 0.05
Weight (Kg)	59.74 ± 11.45	62.32 ± 10.26	< 0.05
BSA (m2)	1.65 ± 0.17	1.71 ± 0.15	< 0.05
BMI (Kg/m2)	21.80 ± 3.93	21.86 ± 2.86	> 0.05
Year of experience	16.70 ± 10.91	11.41 ± 10.58	< 0.05
Duration of work per day (Hours)	8	8	
Duration of rest per day (Hour)	1	1	
Number of working days per week	6	6	

The people who work with fireworks are poorly trained and must endure a hostile atmosphere without much comfort or protection. The manufacturing setup is likewise flawed, using too many explosives in too close proximity. All steps of manufacturing fireworks are shown in fig. 1.



Form this haematological study it was shown that Hb, RBC, MCH, MCHC of experimental group is lower than control group. Low MCHC causes anemia. WBC, Platelet higher than control group. Table-2 shown the haematological parameters of Fireworks workers and Control group.

Variable	Fireworks workers (Mean±SD)n = 152	Control group (Mean±SD) n = 100	*p* value
Hb	13.26 ± 1.53	14.28 ± 1.69	< .05
RBC	4.41 ± 0.57	4.64 ± 0.48	< .05
WBC	8.49 ± 2.55	7.64 ± 0.89	< .05
Neutrophil	55.52 ± 11.26	55.71 ± 11.22	> .05
Lymphocyte	32.81 ± 9.62	32.92 ± 7.24	> .05
Eosinophil	0.81 ± 0.24	0.77 ± 0.27	> .05
Monocyte	0.36 ± 0.12	0.39 ± 0.10	> .05
Platelets	2.70 ± 3.49	2.30 ± 0.67	> .05
MCH	30.43 ± 4.39	30.96 ± 3.54	> .05
MCHC	34.49 ± 2.36	35.24 ± 1.99	< .05

This study have shown that cholesterol, triglyceride, HDL, VLDL is lower in fireworks workers than control group. LDL is high in experimental group. Table-3 has shown Lipid profile of Fireworks workers and Control group.

Variable	Fireworks workers (Mean±SD) n = 152	Control group (Mean±SD) n = 100	*p* value
Cholesterol	195.12 ± 54.41	201.95 ± 43.59	> .05
Triglyceride	141.19 ± 63.48	146.25 ± 46.86	> .05
HDL	44.42 ± 11.58	48.11 ± 8.72	< .05
LDL	130.95 ± 29.59	121.26 ± 34.78	< .05
VLDL	33.11 ± 12.88	34.55 ± 12.64	> .05

AST, ALK, ALT, total protein, bilirubin, globulin and albumin can be used for broad assessment of the liver function. We found that the levels of serum AST, ALK, ALT, and bilirubin level increased in the fireworks workers as compared with the control groups, while serum protein in the experimental group was lower than that in the control group. Table 4 shown Liver function test of Fireworks workers and Control group.

Variable	Fireworks workers (Mean±SD) n = 152	Control group (Mean±SD) n = 100	p value
Serum total Bilirubin	0.81 ± 0.28	0.77 ± 0.27	> .05
Serum total protein	7.04 ± 0.63	7.01 ± 0.67	> .05
Albumin	4.39 ± 0.99	4.17 ± 0.74	< .05
Globulin	2.92 ± 0.37	2.88 ± 0.42	> .05
SGPT/ALT	33.61 ± 19.53	35.90 ± 14.09	> .05
SGOT/AST	29.08 ± 13.59	32.02 ± 10.47	< .05
Serum alkaline phosphatase	82.66 ± 21.37	83.61 ± 21.82	> .05

The haematological, lipid, and hepatic functions of fireworks workers were evaluated in this study. For comparison, the haematological, lipid, and hepatic functions of the control group were also evaluated. Also, it assessed how exposure to certain biochemical parameters at work had changed some of the workers' biochemical parameters.

The haematological analysis demonstrates that the experimental group's Hb, RBC, MCH, and MCHC values are lower than those of the control group. Anaemia results from low MCHC. More WBC and Platelets were found than the control group. Leucopenia, thrombocytopenia, and anaemia were caused by aluminium toxicity. These results were in line with those of, those who found that chronic exposure to aluminium citrate in humans decreased haemoglobin levels, red blood cell counts, and related markers[19].

According to this study, fireworks workers have lower cholesterol, triglycerides, HDL, and VLDL levels than the control group. In the experimental group, LDL is high. A study demonstrated that the lipid profile increased with increasing doses of aluminium sulphate[18]. The increase in triglycerides and total cholesterol levels in response to aluminium toxicity seen in the study is consistent with the researcher's observations of enhanced lipogenesis in the liver. The increase in LDH in the worker population may have been caused by skeletal or cardiovascular system deterioration[21].

For a comprehensive evaluation of liver function, test results for AST, ALK, ALT, total protein, bilirubin, globulin, and albumin can be employed. This was discovered that while blood protein levels were lower in the experimental group than they were in the control group, they were higher in the fireworks workers when compared to the control groups for AST, ALK, ALT, and bilirubin levels. Previous research has suggested that increased serum AST and ALK levels may be caused by mitochondrial degradation following liver cell apoptosis[11]. ALK is usually present in the walls of the biliary ducts. An increase in serum ALK level may indicate hepatobiliary or hepatocellular damage[6]. Liver damage can lead to impaired transport functions of the biliary tree ducts or of the hepatocytes, which ultimately increases serum ALK levels[5].

The study may be useful in learning about changes in liver function brought on by occupational exposure. The chemical concentration in workers' inhaled air should be evaluated in a future study examining the impacts of long-term occupational exposure to the fireworks industry.

Ethical considerations :

The 1964 Helsinki Declaration and its following revisions set down the ethical principles that were followed in all procedures carried out in studies involving human subjects. A documented informed consent form was signed by each participant in the study. Aliah University's Institutional Human Ethics Committee gave the approval for this project.

Conflict of interest :

The authors declare that there is no conflict of interest regarding the publication of this article.

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