

Cytogenetic study of traffic policemen occupationally exposed to vehicle Exhaust in Erbil City/ Iraqi Kurdistan Region

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Abstract:

Police personnel play a pivotal role in any society by ensuring security and stability. They constitute a special occupational group with exposure to violence at their work, which directly and indirectly affects their health. The first aim of this study was to assess the cytogenetic effects of urban air pollution by analyzing the chromosomal aberration frequencies and mitotic index in peripheral blood lymphocytes of traffic policemen in Erbil city. The present study was carried out on 40 traffic policemen who were worked in different streets in Erbil city included four main streets (30, 40, 60 and 100) Meter streets so many factors were studied included smoking habit and duration of work (less than five years and more than five years) and 20 controls at different age groups range between (22-50) years. The second objective of the present study is to know the common health problems among traffic policemen in Erbil city. The results suggest that there were a significant increase in the chromosomal aberrations included (Dicentric chromosome, chromatid gap, centromeric break and centromeric gap) in traffic policemen when compared to the controls but significant decreases in mitotic index were shown. The highest value of chromosomal aberrations was centromeric gap and lowest value of mitotic index were both founded in traffic policemen who were worked at 100 Meter street with duration of exposure for more than five years and who were smoker. Also the results suggested different health problems among traffic policemen included (respiratory, skin, eye, neurologic and infertility problems). Most policemen with health problems are suffering from respiratory, eye and neurologic problems while fewer of them are suffering from infertility problems.

Keywords: Chromosome aberrations, traffic policemen, Mitotic index, Smokers, air pollution, Erbil streets.

Introduction:

Traffic policemen often spend a lot of hours directing traffic in crowded areas. These activities may result in exposure to carcinogenic, airborne pollutants derived from motor vehicle exhaust, such as benzene, polycyclic aromatic hydrocarbons (PAHs), and persistent organic pollutants, (1). Benzene exposure is of particular concern because recent research indicates that it can result in chronic toxicity, with an increased risk of carcinogenesis (2)

Urban air contains a diversity of chemical compounds, some of which are genotoxins. The most important source of genotoxins in air pollution is incomplete combustion of fossil fuels, e.g., automobile exhaust, residential heating and industrial emissions (3). The composition of automobile exhaust is complex and generally contains carbon monoxide, nitrogen

oxides, particulates and polycyclic aromatic hydrocarbons (PAHs), nitroaromatics, benzene, 1,3-butadiene, sulfur dioxide and lead (4). Different biomarkers have been used to assess exposure to genotoxic compounds in general and occupational environment, ranging from the presence of mutagenic activity in urine to the induction of chromosomal damage in target and surrogate tissues (5). The hazardous traffic fumes contain a variety of pollutants which can cause respiratory problems and other systemic diseases including cancer (6). Traffic policemen exposed to vehicular emissions, work in noisy and polluted environment. Standing for long hours in a static position makes them vulnerable to ergonomic problems. Traffic police exhibited higher respiratory signs and symptoms such as cough, phlegm and rhinitis. A lower lung function was associated with non-use of protective masks among traffic policemen (7).

A number of studies among traffic policemen have investigated genotoxicity resulting from environmental exposure to lead, benzene, polycyclic aromatic hydrocarbons (PAH) and inducing cytogenetic effects. The majority of the

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studies found increased chromosomal aberration (CA), chromosomal breakage, DNA damage frequencies in lymphocytes, frequencies of micronuclei (MN) and sister-chromatid exchanges in the peripheral blood lymphocytes (8,9,10). There are both exogenous physical agents and endogenous chemical genotoxic agents, both of which cause DNA damage including double strand and single strand breaks, such DNA defects can cause mutation or chromosomal aberrations leading to genomic instability (11). The common damages on chromosomes are breaks, gaps, translocations and acentric fragments (12). Genomic instability is recognized as a major stimulating force of tumorigenesis (13).

The present study was performed to determine some of chromosomal aberrations and mitotic index in peripheral blood lymphocytes of traffic policemen also the effects of degree of pollution in different streets in Erbil City with duration of working and smoking habit among policemen and to know the common health problems among traffic policemen in Erbil City/ Iraqi Kurdistan Region.

Materials and Methods:

The subjects were consist of 40 traffic policemen at different streets in Erbil City named (30, 40,60. and 100 Meter streets) , who work for different period of time (less than five years and more than five years) their age groups range from (22-50) years, and 20 controls (non- workers/ non – smokers), A special questionnaire was used in order to record direct response of them through several visits to streets. Each traffic policemen was provided with a questionnaire form, which includes some fields of information to be filled about the workers that are (Name, Address, Age, smoking habit, duration of service , total working hours/day and health status) were filled

in through direct interviews with them.

Blood sampling and culture

The present study was carried out at Research Center /Salahaddin University. Cytogenetic analysis was performed by using the protocol of Iraqi center for cancer and medical genetic research (ICCMGR). (14). About two ml of blood were collected from each policemen, 6 – 7 drops of heparinized blood were cultures. Cell cultures were cultivated for 72 h at 37°C in RPMI 1640 with 0.5 cc of PBS and 1% phytohemagglutinin. After 71 h we added 0.2 ml Colcemid to each tube and then after 1 h incubation both cultures were harvested using a classic technique that include centrifugation, treatment with hypotonic solution of KCL for 20 min followed by repeated fixation with methanol/acetic acid(3/1) .(14).

Microscopic analysis

After processing the cultures and preparation of slides, the slides were stained by Giemsa stain solution. The slides were examined with light microscope.

Mitotic index assay

It is proportion between number of dividing cells in different stages to the total number of cells (1000 cells) .Mitotic index can be calculated by using this formula(15) :-

$$\text{Mitotic index (MI)} = \frac{\text{Number of mitosis (metaphase cell)} \times 100}{\text{Total number of cells}}$$

Results and Discussion:

Table (1) shows the characteristics of population represent number of traffic policemen in each street represent(30,40,60 and 100 Meter street) in Erbil city , with their age groups range from (22-50) years. In each streets we study only (10) policemen. The results show that most of them were non smoker and work for more than 5 years in all streets.

Table (1) Characteristic of population represent years of exposure , smoking habit and street location for traffic policemen occupationally exposed to vehicle exhaust in Erbil City.

| Erbil City .streets – Number of policemen | Years of work as a policemen | Number of police- men | Smoking habit |
|--|---------------------------------|--------------------------|---------------|
| 30 M. street- (10) policemen | < 5 yrs. | 2 | Non –smoker |
| | > 5 yrs. | 5 | Non –smoker |
| | < 5 yrs. | 1 | Smoker |
| | > 5 yrs. | 2 | Smoker |

| | | | |
|--------------------------------------|----------|---|--------------------|
| 40 M. street- (10) policemen | < 5 yrs. | 2 | Non –smoker |
| | > 5 yrs. | 6 | Non –smoker |
| | < 5 yrs. | 1 | Smoker |
| | > 5 yrs. | 1 | Smoker |
| 60 M. street- (10) policemen | < 5 yrs. | 2 | Non –smoker |
| | > 5 yrs. | 5 | Non –smoker |
| | < 5 yrs. | 1 | Smoker |
| | > 5 yrs. | 2 | Smoker |
| 100 M. street- (10) policemen | < 5 yrs. | 2 | Non –smoker |
| | > 5 yrs. | 4 | Non –smoker |
| | < 5 yrs. | 2 | Smoker |
| | > 5 yrs. | 2 | Smoker |

Figure (1) shows that there were different health problems among traffic policemen, including respiratory problems (25%), skin problems(20%), eye problems (25), neurologic problems(25%), and infertility problems(5) of traffic police-

men. Most policemen with health problems are suffering from respiratory, eye and neurologic problems (25%). While fewer of them are suffering from infertility problems represent (5%).

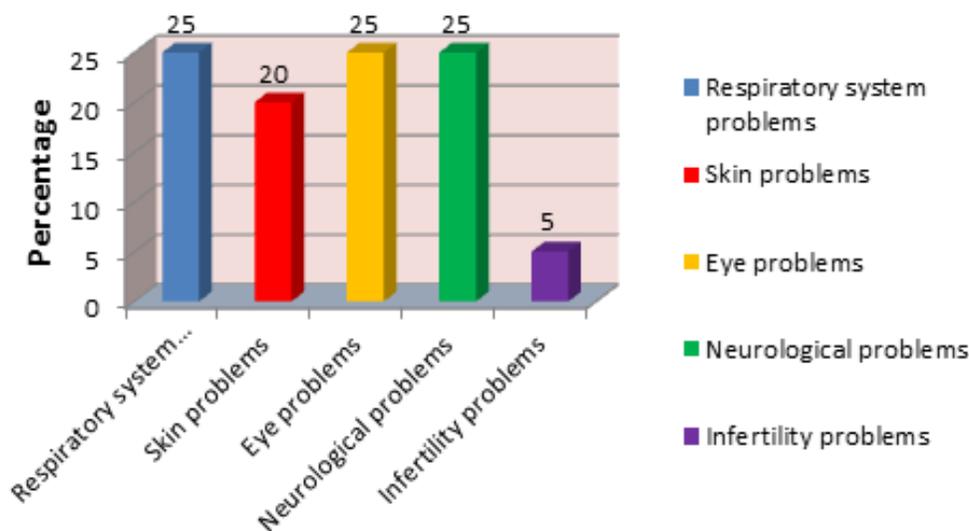


Figure (1) Common health problems among traffic policemen occupationally exposed to vehicle exhaust in Erbil City.

The results of the present study was supported by (16) who suggest that exposure to air pollutants, a major portion of which is due to emissions from the vehicles, can increase oxidant stress, decrease the levels of antioxidants and nitric oxide. This imbalance in the oxidant/antioxidant system may lead to lung damage and is likely to cause respiratory problems in individuals exposed to air pollution(17) Concluded that in the policemen the increased risk of frequent cough was related to smoking and working in heavy traffic locations. (18) Concluded that the effect of pollution by vehicular exhausts may be responsible for pulmonary function impairments.

Carbon monoxide (CO) is an important component of air pollution caused by traffic exhaust fumes. Carbon monoxide (CO)can cause chronic poisoning which shows its first symptoms as headaches, blurry vision, difficulty in concentration, and confusion.(19). Approximately half of the municipal police officers had depressive symptoms and were smokers (20). Analysis of mortality by length of service as a police officer showed that those employed 10-19 years were at

significantly increased risk of digestive cancers and cancers of the colon and lymphatic and hematopoietic tissues (21). (22) Concluded from study of impact of air pollution on fertility that there were a significant impact of air pollution on miscarriage and clinical pregnancy rates in the general population. (23) Concluded from a study of Air pollution and human fertility rates that an association between reduced fertility rates and higher traffic related air pollution levels.

Table (2) shows frequencies of chromosome aberrations which included (Dicentric chromosome, chromatid gap, centromeric break and centromeric gap), as shown in figures(2,3,4). The results have shown an increases frequency and variety of chromosomal aberration in traffic policemen compared to controls, the highest value of chromosomal aberrations was centromeric gap represent(12.0±0.0) founded in policemen with smoking habit who work for more than 5 in 100 meter street. In case of mitotic index the results shows that lowest value of mitotic index were found in smoker policemen and work for more than 5years represent(5.3±0.2) in 100 meter street.

Table(2) Chromosomal aberrations and Mitotic index in traffic policemen and control groups.

| Groups | Years of exposure | Chromosomal aberrations | | | | |
|---|----------------------|-------------------------|----------------------|----------------------|----------------------|--------------------|
| | | Dicentric chromosome | Chromatid gap | Centromeric break | Centromeric gap | Mitotic index |
| Control | ---- | 0.5 ±0.2 | 0.2 ±0.2 | 0.0 ±0.0 | 0.3± 0.2 | 14± 0.0 |
| Traffic policemen Non-Smoker (30Meter street) | < 5 yrs. > 5 yrs. | 1.3 ±0.2 1.7 ±0.2 | 0.7 ±0.2 1.0± 0.0 | 0.0± 0.0 0.7± 0.2 | 0.7± 0.2 1.5± 0.1 | 12± 0.0 11 ±0.0 |

| | | | | | | |
|---|----------|----------|----------|-----------|-----------|----------|
| Traffic policemen Smoker(30M.) | < 5 yrs. | 2.7 ±0.3 | 1.7 ±0.3 | 3.7 ±0.3 | 1.7± 0.3 | 11 ±0.0 |
| | > 5 yrs. | 4.3 ±0.2 | 2.8± 0.2 | 4.7± 0.2 | 2.5± 0.2 | 10 ±0.0 |
| Traffic policemen Non-Smoker (40M.) | < 5 yrs. | 0.5± 0.2 | 0.0 ±0.0 | 1.0 ±0.0 | 0.0± 0.0 | 13± 0.0 |
| | > 5 yrs. | 1.1± 0.1 | 0.5± 0.1 | 1.0± 0.0 | 1.1± 0.1 | 12 ±0.0 |
| Traffic policemen Smoker(40M.) | < 5 yrs. | 2.3± 0.3 | 1.0± 0.0 | 0.0± 0.0 | 0.0± 0.0 | 11 ±0.0 |
| | > 5 yrs. | 2.7± 0.3 | 0.7± 0.3 | 1.3± 0.3 | 0.0± 0.0 | 11± 0.0 |
| Traffic policemen Non-Smoker(60M.) | < 5 yrs. | 1.5 ±0.2 | 1.0± 0.0 | 0.0 ± 0.0 | 1.0± 0.0 | 9.7± 0.2 |
| | > 5 yrs. | 3.0 ±0.0 | 1.5± 0.1 | 1.0± 0.0 | 3.5 ±0.1 | 9.3 ±0.1 |
| Traffic policemen Smoker(60M.) | < 5 yrs. | 4.3± 0.3 | 2.7 ±0.3 | 3.3± 0.7 | 1.0± 0.0 | 8.7 ±0.3 |
| | > 5 yrs | 5.3± 0.2 | 3.7± 0.2 | 4.7± 0.2 | 5.3 ±0.2 | 8.3± 0.2 |
| Traffic policemen Non-smoker(100M.) | < 5 yrs. | 4.8± 0.2 | 4.5± 0.2 | 7.3± 0.2 | 7.8± 0.2 | 7.8± 0.2 |
| | > 5 yrs | 5.8 ±0.1 | 6.3 ±0.2 | 6.6± 0.2 | 9.3 ±0.1 | 7.3 ±0.1 |
| Traffic policemen Smoker(100M.) | < 5 yrs. | 6.8± 0.2 | 7.5 ±0.2 | 4.5± 0.2 | 9.5 ±0.2 | 6.5± 0.2 |
| | > 5 yrs | 7.2± 0.3 | 7.5± 0.3 | 5.7± 0.2 | 12.0± 0.0 | 5.3± 0.2 |

Sree et al., (2009) Concluded from study of cytogenetic evaluation of traffic policemen occupationally exposed to vehicular exhaust that traffic policemen are more exposed to poly cyclic aromatic hydrocarbon PAHs, lead and benzene, this cause of increased chromosomal aberrations. also shown higher chromosomal aberrations in traffic policemen working more than 10 years as compared to those working less than 10 years, and chromosomal aberrations are increasing with increasing duration of service. (25) Concluded from study of Cytogenetic effects in a group of traffic policemen in Cairo ,Egyptian traffic policemen showed an increased frequency of chromosomal aberrations and SCEs in their peripheral lymphocytes ..

Mitotic index used to detect the genotoxic effects of some mutagenic and carcinogenic factors (physical and chemical) on cells (26). The genotoxic effects of SO₂ exposure on workers of a fertilizer factory were investigated. Mitotic index (MI), chromosomal aberrations (CAs), sister-chromatid exchanges (SCEs) and satellite associations (SA) were observed. In SO₂-exposed workers, a lower mitotic index was recorded in comparison to controls. The MI, however, declined with duration of exposure (27) while (28,) found that cells were treated with benzene hexachloride BHC shows a significant decrease of mitotic index. (29) Showed that MI of blood lymphocytes was sig-

nificantly decreased in patients with bladder cancer.

An increased level of chromosome aberration was present in the drivers from polluted districts of Tehran compared to drivers from non-polluted areas in Lahijan.(30). The increase in the induction of micro nuclei MN and SCE among the traffic policemen and household register policemen is enhanced further by smoking(31). Knudsen et al., (1999) Suggest that long-term exposure to urban air pollution (with traffic as the main contributor) induces chromosome damage in human somatic cells. (33) Concluded that CA increased with increasing duration of exposure. This results were supported by (34) who concluded from a study of exposure of bus and taxi drivers to urban air pollutants that biomonitoring studies of human populations environmentally and/or occupationally exposed to high levels of complex mixtures of urban air pollutants reveal a genotoxic risk in humans in terms of DNA adducts .

Similar results were obtained by (35) who concluded from a study of CA levels in peripheral blood lymphocytes of traffic policemen and taxi drivers exposed to urban air pollution that chromosomal aberrations were mainly in the form of chromatid breaks and gaps. Also indicate that traffic policemen and taxi drivers have significantly greater frequencies of CAs than do controls .

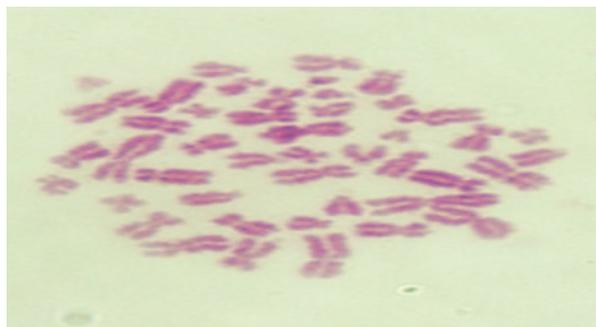


Figure (2): Normal distribution of human chromosome –male (1000 X, Giemsa stain)

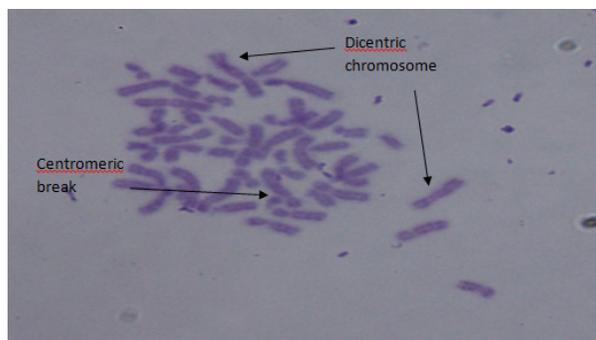


Figure (3) : Chromosome aberrations in lymphocytes of traffic policemen in Erbil City (1000 X, Giemsa stain).

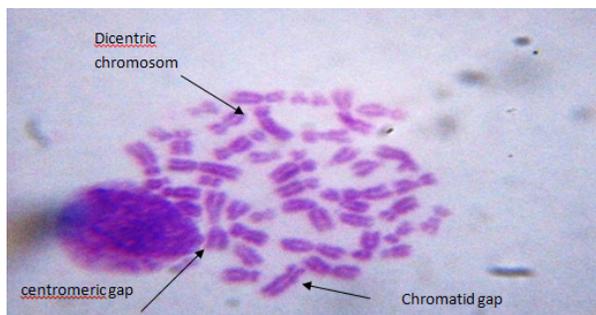


Figure (4) : Chromosome aberrations in lymphocytes of traffic policemen in Erbil City (1000 X, Giemsa stain).

Conclusions:

From the results of the present study, the following conclusions could be considered:-

1- Chromosome aberrations was occurred in policemen, included (Dicentric chromosome , centromeric gap, chromatid gap and centromeric break). The highest value of chromosomal aberrations was centromeric gap founded in policemen with smoking habit who work for more than 5 in 100 meter street.

2- In case of mitotic index the results shows that lowest value of

mitotic index were found in smoker policemen and work for more than 5years in 100 meter street.

3- Also the results shows that most of them were non smoker and work for more than 5 years in all streets

4- There were different health problems among traffic policemen, including respiratory, skin, eye , neurologic and infertility problems. Most policemen with health problems are suffering from respiratory, eye and neurologic problems.

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دراسة وراثية خلوية لرجال شرطة المرور المعرضين مهنيًا لعوادم السيارات في مدينة اربيل / اقليم كردستان العراق

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علوم الحياة، كلية التربية، جامعة صلاح الدين

الخلاصة:

ان افراد الشرطة يلعبون دورا اساسيا في اية مجتمع بضمان الامان والاستقرار. يتضمنون مجموعة مهنية خاصة وهم يتعرضون الى شدة وعنف في اعمالهم والتي بصورة مباشرة وغير مباشرة يؤثر على صحتهم. ان هواء المدن تحتوي على مركبات كيميائية كثيرة بعضها ملوثة جينيا. ان الهدف الاول من الدراسة الحالية هي معرفة التأثيرات الوراثية الخلوية لتلوث هواء المدن بواسطة تحليل التشوهات الكروموسومية وقابلية الانقسام الخلوي في الدم المحيطي لرجال شرطة المرور في شوارع مختلفة في مدينة اربيل. ان الدراسة الحالية اجريت على 40 افراد من رجال شرطة المرور في اربعة شوارع (100,60,40,30) متر. درست عدة عوامل تضمنت التدخين ومدة العمل (اقل من 5 سنوات و اكثر من 5 سنوات) وتمت دراست 20 شخص كمجموعة السيطرة في مجاميع عمرية يتراوح بين (50-22) سنة. ان الهدف الثاني لهذه الدراسة هي معرفة المشاكل الصحية الشائعة لدى رجال شرطة المرور في مدينة اربيل. ان النتائج تبين بانه توجد زيادة معنوية في التشوهات الكروموسومية تضمنت (كروموسم ثنائي السنتروميير ر، ثلم كروماتيدي، كسر كسر السنتروميير، ثلم الجزء المركزي السنترومي) لرجال شرطة المرور مقارنة بمجموعة السيطرة ولكن توجد انخفاض معنوي في قابلية انقسام الخلايا , ان اعلى نسبة للتشوهات الكروموسومية هي التشوه ثلم الجزء المركزي او السنتروميير وان اقل قابلية انقسام الخلايا لوحضت في رجال شرطة المرور شارع 100 متر وهم يعملون اكثر من خمسة سنوات في هذه المهنة وهم ايضا مدخنين. ان النتائج تبين بانه توجد مشاكل صحية عديدة بين افراد شرطي المرور يتضمن مشاكل (تنفسية، جلدية، عينية، عصبية وعقم) وان معظم افراد شرطة المرور يعانون من مشاكل (تنفسية، جلدية، عينية، عصبية) ولكن قلة منهم يعانون من مشكلة العقم.