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Analysis and Perception of Health Impact of Motor Vehicle Emissions on Traffic Police in Nairobi, Kenya

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Abstract Clean air is important for human health and well-being, air pollution has increased in many parts worldwide and thus posing a significant threat people's health. In Kenya, the traffic police officers who constantly un covered stand on road junctions continuously expose themselves to motor vehicle emissions, greatly risking their health. This study collected qualitative data and quantitative data analysed police person's perceptions of the health impact of motor vehicle emissions on traffic police in Nairobi, Kenya. The respondents were sampled from among the traffic police officers who normally control traffic in Nairobi CBD. Pretested questionnaires were used to collect data. The study showed that police officers were aware of the effects that the motor vehicle air pollution could have on their health. About 98.1% of respondents indicated that they are affected by motor vehicle pollution. On average, about 30% of the police officers are off duty due to sickness while 82.2% had been greatly affected by exposure to motor vehicle pollution. 58.9% new cases of the health effects related to motor vehicle emission constant though majority did not take any measures. They obtained this knowledge and experience from their colleagues suffering from respiratory diseases; reporting frequent occurrence of health problems thought to arise acquaintance to motor vehicle emissions. The study accomplishes that there is an association between the amounts spent manning traffic and contact to high levels of pollution. The traffic officers have associated illnesses such as respiratory problems, asthma, cancer and other diseases that are pollution related to the high emissions of motor vehicle pollution in the Central business district.

Keywords: *health effects, traffic police, motor vehicle emission, respiratory diseases*

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1. Introduction

Dominant part of the present vehicles utilize inward combustion engines that consume gas or other petroleum products; and disregard to supplant worn or deteriorated segments by Motorists which result in poor engine performance, higher fuel utilization, motor harm and excess emissions [1,2]. During combustion, various vaporous materials and pollutions are produced. These ignition side-effects are discharged into the environment as fumes gasses. Among the gasses stand nitrogen oxides, carbon monoxide, sulfur dioxide, lead and particulate matters that contaminate the atmosphere. It has been affirmed that, in creating nations of the world, vehicular development has been to a great extent unchecked by natural managing bodies making large amounts of contamination [3]. One of the main worries of air contamination is the unfavorable wellbeing it has on wellbeing. Confirmation focuses to air contamination that shoots from transport as an essential supporter of ill health.

In Kenya, every person is eligible to a clean and healthy atmosphere and he or she is indebted to enhance it. The entitlement to a clean and healthy environment includes the access by persons in Kenya to the various public elements or segments of the environment for recreational, educational, health, spiritual and cultural purposes [4]. World Health Organization battles that perfect air is a fundamental necessity for human wellbeing and prosperity despite the fact that air contamination keeps on representing a noteworthy risk to wellbeing around the world. As indicated by their appraisal of the weight of ailment because of air contamination, more than two million unexpected losses happening every year can be ascribed to the impacts of urban open air and indoor air contamination caused by the consuming of petroleum products [5]. The greater part of these ailment troubles, specifically respiratory complexities, are borne by the populaces of creating nations Kenya included [5], currently urban air pollution is increasing.

The traffic police department' mandate ensure that drivers on the road comply with the traffic Act and related subsidiary legislations. A majority of the traffic police staff have to spend much of their time on the roads while on duty. In these circumstances therefore, they are exposed to particulate matter and exhaust gases emitted by the vehicles on the road. This situation is worsened during peak hours when the traffic is heavy and more pollutants are released into the ambient air. This may affect their health in a variety of ways including irritation of eyes, nose and throat [6].

Vehicular emission has long run negative health consequences for those who are continuously exposed to it. This is a rather broad group including almost all the citizens of a metropolis. However, the impact varies and it depends on the direct contact with vehicular emission. The traffic police personnel's of the city are a very vulnerable group in this regard. Standing long time in the city junctions facing the vehicles directly has a direct negative effect on them [7].

The environment conscious is very low in developing countries such as Kenya. Pollution hazard rarely come into the rational choice of the traffic men. Moreover the policemen's duty is divided between on the road and off the road periods. Obviously the former involves a far greater health hazard with direct exposure to the vehicular emissions. These duty allocations are determined by the higher authorities with little consideration of the policemen health. Given this scenario, it is only the traffic officers themselves that can mitigate their health losses by taking measures to ameliorate the detrimental effect of air pollution. It is alongside this contextual that this study required to analyze the perception of motor vehicle emissions pollution impact on the health of traffic police in Nairobi, Kenya.

2. Material and Methods

2.1. Study Area

The study was carried out in the city of Nairobi, the capital city and the largest urban centre in Kenya and the one having the highest number of motor vehicles. The city is situated 140 kilometers south of equator and 500 kilometers west of the Indian Ocean at 1°17′S36°49′E. It occupies 696km^2 at an altitude of 1,661 meters above sea level (Nairobi county website, 2016 www.nairobi.go.ke/home/about-the-county).

2.2. Study Population

The descriptive exploratory study was targeted the traffic police working within the CBD and its outskirts. Severely congested roundabouts, within the CBD and its outskirts, were selected purposefully for the study. These are the Kamukunji, Railways terminals, University way and Uhuru Highway roundabouts manned by a population of 127 traffic police officers. Self-administered questionnaires were distributed to all the 127 participants. In addition, five (5) senior ranking officers participated in a key informant discussion. All the officers participated in the study. In respect of the proposed study, the researcher enlisted the services of traffic police leaders that is, the Base Commanders to help in the identification of the Traffic police officers according to their seniority of year of employment and work experience. It provided for equal chances of selection of individuals of similar level of experience.

2.3. Survey Instrument

The study used a self-administered English language questionnaire to collect data, all traffic police officers being sufficiently literate as evidenced by the entry qualifications.

The questionnaire was pretested with 8 traffic police officers of Kamukunji police Station who were not used in the actual study. The pretesting feedback helped establish internal consistency of the questionnaire. Before the self-administering of the questionnaires, traffic police officers were briefed on the purpose of the study. Thirty to forty five minutes were allowed for each respondent to fill in the answers in the presence of the researcher and his assistants. The questionnaires were collected immediately they were filled and validated and where necessary clarification sought from the respondent.

3. Data Analysis and Results

3.1. Working Duration and Perception on Personal Health

It was noted that on average an officer spends 10 hours manning traffic on a roundabout every week. About 98.1% of respondents indicated that they are affected by motor vehicle pollution whereas only 1.9% said that they are not affected. For those who agreed that manning the roundabout exposed them to motor vehicle air pollution, they gave the following as their reasons; The police execute their duties for extended hours along the roundabout and therefore are most of the time vulnerable to smoke from vehicles (proportions); Traffic police officers work at the roundabout without any protective gear hence making them unprotected to things like smoke and dust (proportions); During work the police are exposed to a lot of smoke from moving vehicles (proportions); The fact that there are many traffic police officers working at the roundabouts who have had respiratory problems.

On average, at any one time, about 30% of the respondents are off duty due to sickness (Figure 1) for period 1-3 days per week, which translate to about 4-12 days, were month on sick leave.

Majority of the respondents (82.2%) said that they had been greatly affected by exposure to motor vehicle pollution, 15% (moderate), 0.9% (Small) and 1.9% had not been affected (See Figure 1).

Compared to other police officers performing other core duties, the traffic officers are at a higher health risk. The findings revealed that 75.7% of the officers rated their risks as very high as compared to other officers, 23.4% (high) whereas only 0.9% rated their risks as low. See Figure 2.

Most of the respondents agreed to have known another traffic officer who have had illnesses related to motor vehicle air pollution in the past one year (58.9%) and in the past three months (40.2%). (See Table 2).

On assessment of other air pollution that could affect their health the results indicated that 12.1 % of the respondents were smokers among which 42.9% had once been advised by health professionals to quit smoking and 28.6% had been smoking first thing in the morning as an 'eye opener' and smoking an average of 6 sticks of cigarettes per day (See Table 3).

A cross tabulation was made to establish the relationship between smoking and the effects of motor vehicle pollution. Of the 39.3% people who had ever had diseases associated with motor vehicle air pollution, 16% of them did smoke. This means that 61.5% of those who smoked had ever suffered from a disease associated with motor vehicle air pollution. The 12.3% of the officers who smoke may in general look like a small number compared to those who don't smoke. However, taken on their own, and comparing them to those who have ever suffered a disease associated with Motor Vehicle air pollution, it becomes clear that smoking can be a cause for their illnesses. (See Figure 3).

On preparedness of adverse health effects it was found that majority 47.7% were not prepared for adverse health effects that could result from motor vehicle emissions, 32.7 indicated they were little prepared, 8.4% were prepared. (See Figure 4).

On preparedness on motor vehicle pollution, about 50.5% indicated that their stations were not prepared, 34.7% (a little prepared), 8.9% (prepared) while only 5.9% claimed to have been very prepared, 5.6 were well prepared while another 5.6% were unaware of any effects. (See Figure 5).

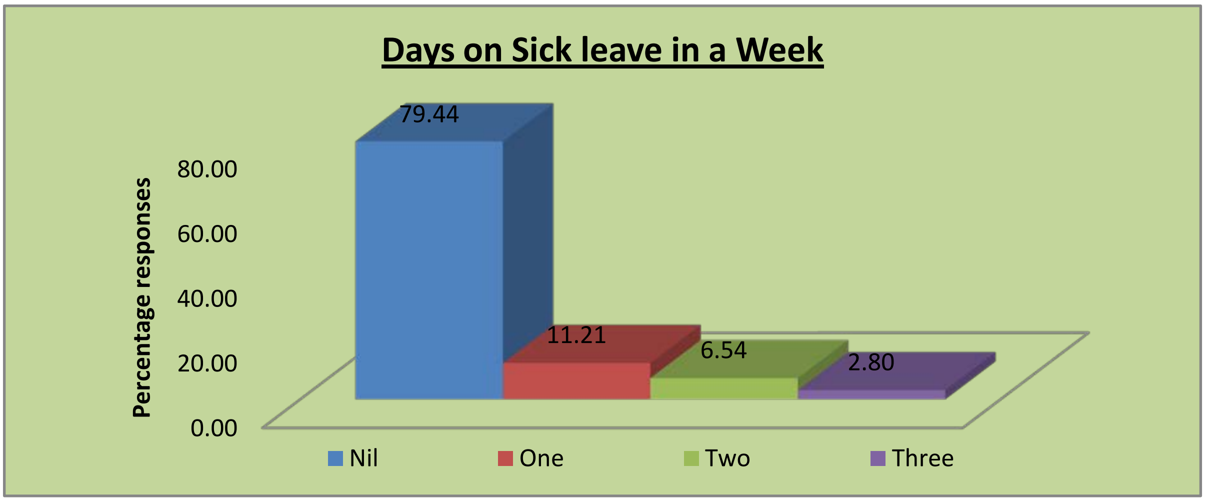

Figure 1. Days on sick leave in last one week

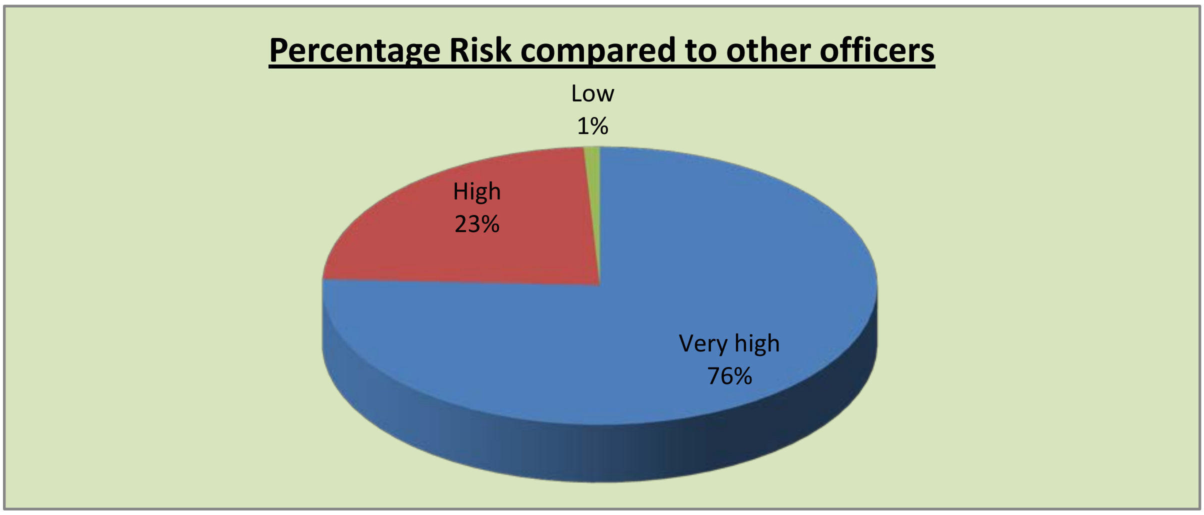

Figure 2. Risk compared to other officer

Table 1. Chances of Negative Effects

Chances of Negative Effects	Frequency	Percent
High/already affected	88	82.24
Moderate	16	14.95
Small	1	0.93
None	2	1.87
Total	107	100

Table 2. Knowledge of another officer who suffered

Knowledge of another officer who suffered	Frequency	Percentage
Yes	63	58.9
No	44	41.1
Total	107	100

Table 2. Use of cigarettes and alcohol

Smoking and alcohol issues	Yes	No
Do you smoke?	12.1%	87.9%
Have you ever been advised during the past year (12 months) by a health professional to stop smoking?	42.9%	57.1%
Have you ever had a smoke first thing in the morning to steady your nerves (Eye opener)?	28.6%	71.4%

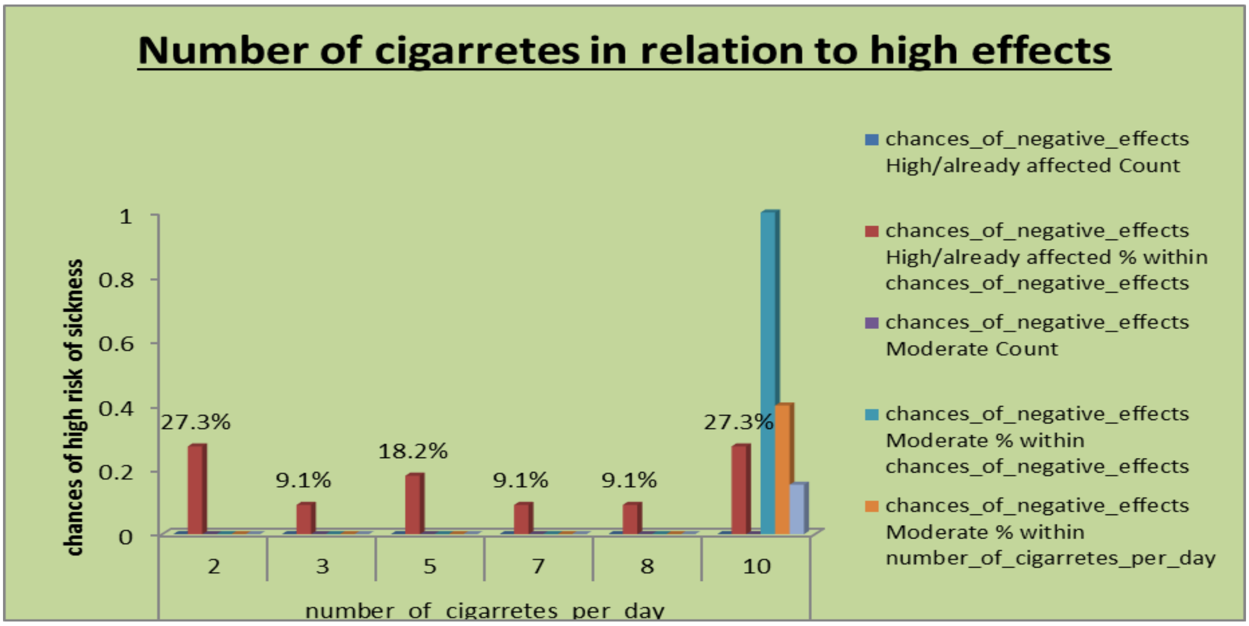

Figure 3. Number of cigarettes in relation to high effects

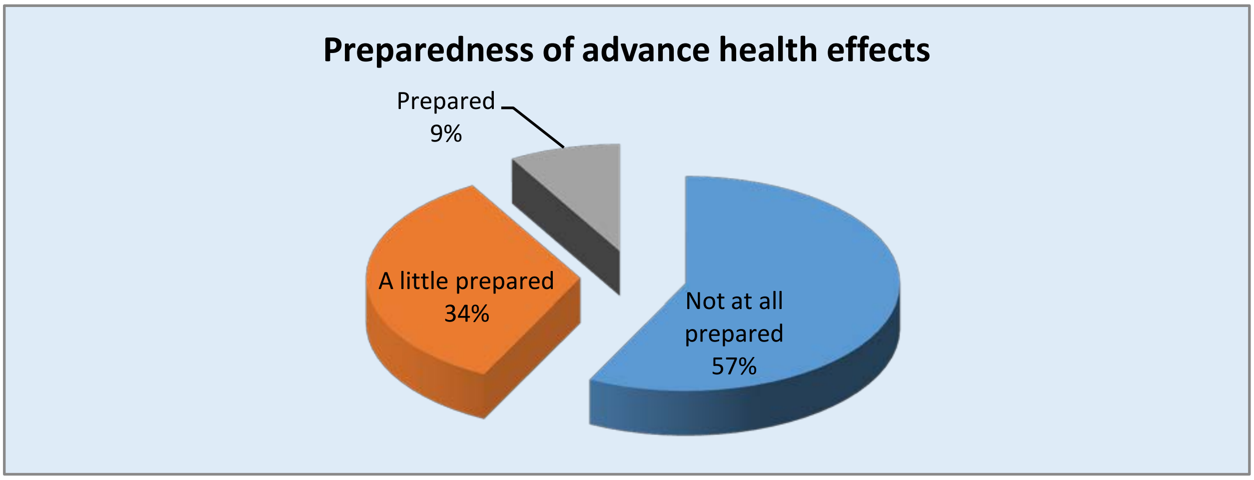

Figure 4. Preparedness of adverse effects of health

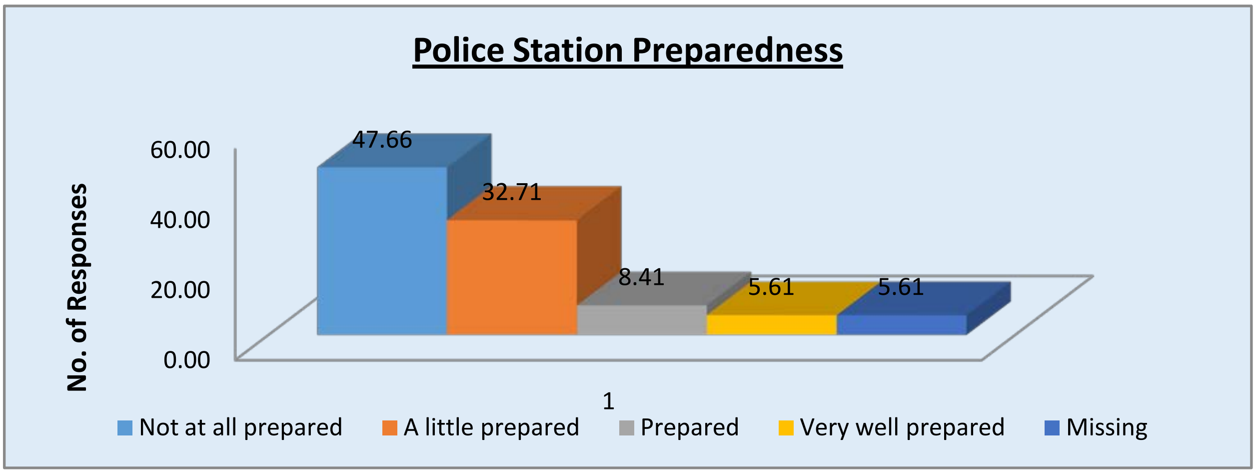

Figure 5. Police stations preparedness

The traffic department is a department within the Kenya Police Service that is charged with ensuring that drivers on the road comply with the traffic Act and related subsidiary legislations. A majority of the traffic police staff have to spend much of their time on the roads while on duty. Traffic officers spend the about eight hours or more on the road while only few spend 8 hours or less while discharging their duties. The average hours spent on the road by traffic officers is 10 hours. However, when an officer falls sick or has to leave because of other reasons, his or her duties must be taken over by other officers. Due to the limited number of officers, at times one repeats a shift. Majority of the officers interviewed stated that they spend most part of their day manning traffic.

This study is in line with a study carried out by Bell, [8], that demonstrated that the health effects of any pollutant in an individual is directly dependent on the exposure period and toxicity of the pollutant. Nanda Kumar et al., [9], in their study among 80 TPO's in Tirupati, India observed that there was a significant statistical correlation between period of exposure and an increase in admission rate for respiratory disorders. They observed that traffic police personnel who were occupationally exposed for longer period in their life reported to have more number of admissions than traffic police with less exposure periods. (See Table 4).

Table 4. Association between type of vehicle fuel type and category of Road junction on CBD Nairobi City Kenya

Road junctions	Pollution levels			
	High pollution	Percentage	Low pollution	Percentage
Kamukunji	49.7	100	51.7	100
Railways	48.3	100	50.3	100
Uhuru highway	36.5	100	63.5	100
University way	27.9	100	72	100

The table above on cross tabulation indicates that areas with high pollution levels are railways and Kamukunji. In railways there is high concentration of *Matatu* (23) unladen (35.4%) and Large bus (45 seaters) unladen (31.2%). Kamukunji also had high concentration of *Matatu* (23) unladen (11.9%) and Large bus (45 seaters) unladen (16.5%). This is because most of this cars use diesel and Diesel tail pipe is a foremost contributor to particulate matter (PM) pollution. Additionally large bus passenger vehicles are a main pollution contributor, producing substantial amounts of nitrogen oxides, carbon monoxide, and other contamination (See Table 4).

Areas found to have low pollution were University way and Uhuru highway. University way has high concentration of Car & Taxi (46.8%) and large cars 4WD & Jeeps (25.8%). While Uhuru highway was found to have high concentration of Car & Taxi (54.6%) and large cars 4WD & Jeeps (22.7%). The vehicles in this areas use mainly fuels which has substantial volumes of nitrogen oxides, carbon monoxide, and other pollution. The emissions from cars are low.

4. Discussions

Comparable studies done demonstrated that overwhelming heavy-duty vehicles tried in Germany and Finland produced around 210mg NOx for each kilometer driven, not as much as a large portion of the 500mg/km directed out by present day diesel autos that meet the most noteworthy "Euro 6" standard. In any case, the transports and trucks have bigger motors and consume more diesel per kilometer, implying that autos deliver 10 times more NO_x for each litre of fuel.

In this study majority of the traffic police did not smoke cigarette. This is an indication that any health effects were to a great extent attributed to automobile air pollution and not to smoking. These results agree with the 2012 World Health Statistic that indicated that current daily tobacco smoking in Kenya is estimated at 9.3% [10]. These results also concur with the findings of Sharat *et al.*, [11], who had observed from his study that there was a significant decline in various parameters examined such as forced vital capacity (FVC), forced expiratory volume in one second (FEV), and peak expiratory flow rate (PEFR) on the exposed nonsmoking TPO's when compared with the controls.

On the number of years worked, the study found that on average, traffic police officers worked for 5 years in the traffic department. This therefore exposes them for long periods on daily basis to the effects of automobile air pollution. Thus traffic officers are vulnerable of being affected by the toxins with constant exposure. These results compares well with those of Braback, L., A. Breborowicz, S. Dreborg, A. knursson, H pieklik, and B. Bjorksten. [28], also reported in Switzerland, that there existed a relationship amid long-standing exposure to ambient air pollution and respiratory symptoms. Similar trends were observed by the investigator where there was more number of admissions among the traffic police personnel who were exposed for 6 years. Also Michael and Konstantinos [12] and Gauderman and others [13] all argued and demonstrated that the health effects of any pollutant is dependent on the period of exposure and the target organ affected.

The study showed a significant reduction in lung function in police workers working in the high traffic generated pollution [29]. Another study found that changes during exercise testing that included decreased gross mechanical efficiency and a decrease in the amount of keep fit period at an anaerobic threshold and highest effort compared to those whose exposure was less. In addition, those working in chronic air pollution had a higher frequency of respiratory allergies [30]. Substantial evidence and research involving combustion-related fine particulate inhalation exposure concludes that air pollution is harmful to human health. Long haul exposures have been related with cardiovascular mortality, different blood markers of cardiovascular hazard, histopathological markers of subclinical unending lung damage and subclinical atherosclerosis. Here and now exposures to particulate matter in the atmosphere have been related with cardiovascular mortality and healing facility affirmations, stroke mortality, myocardial areas of localized necrosis, confirmation of aspiratory and orderly aggravation and oxidative anxiety, modified heart autonomic capacity and blood vessel vasoconstriction [31].

As Traffic moves slowly, slow moving vehicles emit more carbon monoxide, the problem is more surmounted in Nairobi. This co-effect is toxic to human's body. It reacts with the hemoglobin of blood and affects oxygen supply to the brain. Thus it causes death [14]. One of the major causes for road congestion and therefore, vehicular emission is the massive increase in the vehicular pollution plying in and around Nairobi city. Due to this huge vehicular pollution growth, the energy demand (both diesel and petrol) increased manifold. One of the major factors that determine vehicular emission is the speed of the vehicles. According to the eminent scientist there exists a critical speed at which the emission is less of the vehicles. If the speed is well below or well above that critical one then the emission will rise significantly. So vehicle emissions are one of the significant constituents in ambient pollution. Citing a study by NEERI [15] they found that the main concentration levels for various atmospheric pollutants have increased in all the major cities.

In Kenya, legal Notice No. 60 of 2007 [16] provides the recommended long term exposure limits as follows, 50 ppm for CO, 5000 ppm for CO_2, 3 ppm for NO_2 while short term exposure limits are given as 300 ppm for CO, 15000 ppm for CO_2 and 5 ppm for NO_2 respectively. WHO [17] also provides long term exposure limits for CO and NO_2 as 9 ppm and 0.072 ppm respectively while short term exposure limits for the same gases are given as 26 ppm for CO and 0.12 ppm for NO_2.

Other reports also indicate that cancer among the urban population in Kenya between the periods 2000 to 2002 was on an upward trend [18] and malaria was the primary source of illness followed closely by diseases of respiratory infections in the year 2005, 2006 and 2007 respectively according to Ministry of Health Kenya records 2008. Statistics in Kenya also show that about 50 Kenyans die on daily basis from various forms of cancer and about 80,000 cases of cancer are diagnosed each year in the world [19]. The reports, however, failed to give the underlying factors for cancer and respiratory ailments. This phenomenon clearly exposes gloomy situation in Kenya.

The tiny evidence accessible on automobile air pollution in Nairobi suggests great pollution emissions [20,21,22]. Similarly Mulaku and Kamau [23] demonstrated that a similar situation and condition prevailed within Nairobi. In most cases, air pollution increases in direct proportion with the increase of the number of vehicles [24] in the absence of clear policies in the management of emissions from these motor vehicles. Vehicle age and lack of regular maintenance, poor infrastructure and economic inability are factors that were found to aggravate air pollution situations in urban centres especially the Central Business District [25].

The developing countries suffer more than the developed countries from air pollution which happens from vehicle emissions. Vehicle emissions have high level of leads have led to a great environmental danger in many places in the world. For them the problem is becoming more acute as the numbers of motor vehicles are growing rapidly. Example in Delhi's, vehicular pollution is responsible for 64 percent of the pollutants thus the inhabitants inhale a lot of polluted air [26].

5. Conclusions and Recommendations

The traffic officers have associated illnesses such as respiratory problems, asthma, cancer and other diseases that are pollution related, to the high emissions of motor vehicle pollution in the CBD. The police men take long hours manning their duty stations, and due to low number, majority does not take their days off and therefore they are highly exposed.

It is recommended that structures be put in place to take care of police officers, who have suffered from the effects of motor vehicle air pollution. The study recommends that the traffic department should establish and implement a system of rotation of duties for the officer's e.g alteration of field work with office work, so as to reduce the exposure.

The study recommends that exposure can also be reduced by providing the traffic police officers with suitable personal protective devices such as masks and plain glasses to prevent lung and eye irritations. They should also be trained on their use, the type of air pollutions and associated health hazards and preventive measures required.

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Competing Interests

The author declares he has no competing interests.

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Ethical Considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/ or falsification, double publication and/ or submission, redundancy, etc) have been completely observed by the author.

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