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Impact Assessment of Traffic Emission on the Respiratory System of Non-Smoking Traffic Policemen in Palestine

W A Madhoun[1,2,*], E Salem[3], A Eljedi[3], H A Isiyaka[4], and F C Ros[2]

[1]Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor, Malaysia
[2]Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia Kuala Lumpur, 54100 Kuala Lumpur, Malaysia
[3]The Islamic University of Gaza, Gaza, Palestine
[4]Kano University of Science and Technology, Wudil, Nigeria

*Email: wsah79@gmail.com

Abstract. This study was carried out to investigate the effects of prolonged exposure of non-smoking traffic police men to vehicular emission within the northern Gaza Governorate-Palestine. Samples of atmospheric pollutants such as PM_{10}, CO and CO_2 were collected alongside respiratory data involving lung function, chest and respiratory status and direct physical examination. This was done in order to understand the level of association between respiratory status such as effect on breathing, upper respiratory tract irritation, frequent cough and eye irritation. Chi-square statistical techniques and descriptive statistics were applied in the datasets. The result shows that there is a strong association between air pollution and respiratory disease with a p-value 0.027 at significance of alfa 0.05. The statistical result shows that about 20 non-smoking traffic policemen have upper respiratory tract infection, 15 with frequent cough symptom, 6 with shortness of breathing and 25 with eye irritation. This study is an indication that vehicular emission within the study area is a primary source of pollution that possesses a risk in exposing non-smoking policemen to series of respiratory diseases. Government agencies and other stakeholders should provide preventive measures in either reducing the number, concentration and sizes of pollutants emitted or provide protective measures to reduce the level of exposure of traffic policemen and other habitants.

1. Introduction

Quality human health is very paramount in any societal development. This is because the physical and mental stability of individuals and their ability to discharge their duties in any organization can be retarded when exposed to poor air quality condition. Air pollution is a well- recognized public health problem associated with a range of adverse health outcomes, ranging from premature mortality to sub clinical respiratory symptoms [1]. According to WHO [2] an estimate of 2.4 million people dies each year from causes directly attributed to air pollution. The USA for instance, spends over $ 200 million annually on routine ambient air monitoring programs [3]. The most dangerous atmospheric air pollutant is PM_{10} that negatively affects human health because it can easily diffuse into the gas-exchange region of the lung when inhaled. This can cause lung cancer, asthma as well as respiratory and cardiovascular diseases [4]. CO reduces the body's ability to deliver oxygen to the organs and tissue because it bonds with haemoglobin more easily compared with oxygen [4].

However, pregnant women and infants are more affected by CO. This is because CO affects the amount of oxygen fed to the foetus through the mother as well as affects infants negatively before and

after birth [5]. Ozone is formed when Nitrogen Oxide and Volatile Organic Compounds in heat and sunlight react. O_3 is an extremely reactive compound that reduce the functionality of the lung, damage tissues, accelerates the level of decay and discoloration of material's [1]. Ozone is a greenhouse gas that causes global warming by trapping infrared radiation emitted by the earth surface [6].

Air pollutants found in urban area represent a mixture of primary particles emitted from various sources and secondary particles from aerosols formed by chemical reactions [7]. Air Quality is a measure of the concentrations of gaseous pollutants and sizes or number of Particulate Matter emitted by human-induced activities or natural processes [2]. Air is polluted when particulate toxic elements emitted by natural or anthropogenic sources exceed the normal threshold required for a normal life [8]. Air pollution can also be seen as an excess in the concentration of atmospheric gasses and aerosol particles induced by anthropogenic activities sufficiently high to damage plants, animals other life forms, ecosystem structures or works of art [9].

According to [10] air is polluted mostly by anthropogenic induced pollutants and non-point source pollutant in the environment. These non-point sources pollutants are mainly generated from sources that cannot be easily spotted out which affects the environment directly or indirectly. This has directly and indirectly accelerated the rate of morbidity, mortality and environmental degradation in both short and long-term exposures [11]. Despite the effort put in place by government and other stakeholders to set an emission standard and technically improve the emission control pattern, the expanding industrialization, urbanization and increase traffic volumes especially in places along the Gaza-strip have increased the level of air pollution.

Traffic policemen who work in the busy traffic signal areas for years are exposed to the risk of air traffic pollution. This is because vehicles and motorcycles discharge dangerous air pollutants that can negatively impact policemen when inhaled, and expose them to serious health predicaments. According to [12] the largest contributor to PM_{10} emission in most urban centres is vehicle emission especially from gasoline and diesel fuel combustion. References [13-16] recognised traffic emission as the major contributor to air pollution that can pose a serious health challenge. Air is a major risk factor for the development of chronic lung disorders such as Chronic Obstructive Pulmonary Disease (COPD), which may enhance the risk of lung cancer and also exacerbate bronchial asthma in sensitive individuals [17]. A report by Ministry of Planning and International Cooperation, Palestine stated that there are over 70,500 motor vehicles that cluster within a short distance and are dominated with old and out-dated. More so, pollutants are discharged from coal operation power stations in Israel factories that are transported to the Gaza strip by wind. In addition, soil dust is re-suspended due to poor and haphazard road construction within the study area.

2. Materials and Methods

2.1. Study Area

Gaza Strip is a territory of historical Palestine on the eastern coast of the Mediterranean Sea that shares borders with Egypt on the southwest and occupied Palestine on the east and north [18]. It is 41 kilometres long, and from 6 to 12 kilometres wide, with a total area of 365 square kilometres. The population of Gaza Strip is about 1.7 million people with a yearly growth rate of about 3.2%. Gaza Strip has the seventh highest population growth rate in the world [18]. Gaza strip has a special regional importance in Palestine due to the fact that it constitutes the only linkage between Egypt and the Palestine [18, 19].

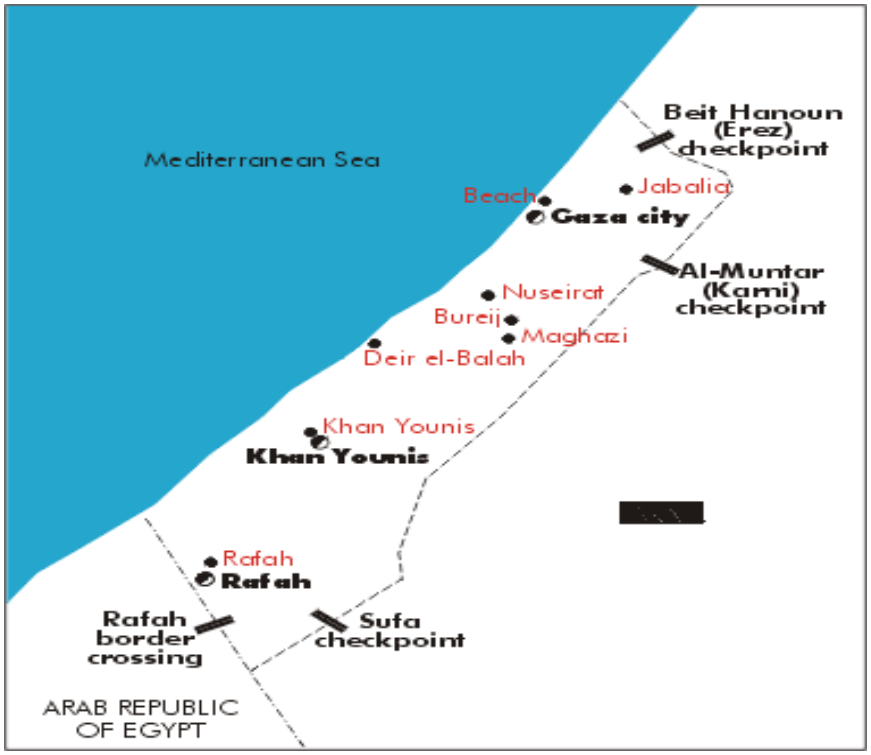

Figure 1. Map of study area showing sampling points

2.2. Sampling Data and Equipments

The sampling strategy comprises of healthy non-smoking traffic policemen within the Gaza-strip with no any history of drug abuse and other respiratory diseases. Forty-one road stationed traffic policemen assigned to control the flow of vehicles in roads and areas with high, medium and low traffic intensity in crossroads and parking areas were selected for the study.

2.2.1. Respiratory Data and Instruments. Spirometers are non-invasive diagnostic instruments for screening and basic testing of pulmonary function. Offering essential diagnostic insight into the type and extent of lung function impairment, spirometer tests can be performed fast at fairly low cost. The data comprises of chest and respiratory condition of the sampled population, physical examination by thoracist, forced vital capacity, forced expiratory volume and peak expiratory flow rate.

2.2.2. Quality Data Instruments. Kanomax Handheld IAQ Monitor Model 2211 was used to collect air quality data such as CO, CO2 PM. This instrument is very simple, flexible and can capture accurately air pollution data in a location.

3. Method of Data Analysis

Chi-Square statistical test was applied in this study to see the extent to which the observed variables are associated with the expected in a contingency table. It shows how categorically variables are related. This technique was introduced to observe if there is any association between air pollutants and respiratory disease.

Table 1 describes the result of Pearson Chi-Square Tests with a p value = 0.027 at degree of freedom of 0.05. Consequently, the general assumption here is that, if the p-value is less than the degree of freedom, and then there is a strong association between the observed and expected. In this study, it can be concluded that there is a significant relationship between the level of air pollution and the effects on respiratory system of traffic police men within the northern region of the Gaza-strip. This is an indication that traffic policemen responsible for traffic regulation in the study area are exposed to high risk of respiratory challenge.

Table 1. Result of Pearson Chi-Square test

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.917[a]	1	.027		
Continuity Correction[b]	3.867	1	.049		
Likelihood Ratio	5.014	1	.025		
Fisher's Exact Test				.044	.024
Linear-by-Linear Association	4.843	1	.028		
N of Valid Cases	41				

This result is an indication that in most urban areas, vehicular emission is predominant and significantly contributes to air quality problems [13, 15]. This is due to the traffic congestions especially during the early hours of the morning when people are rushing to work and, in the evening, when people close from work. The particles emitted from the vehicular exhaust especially are held in upper respiratory tract and accumulates in the lung and produces respiratory abnormalities. Hence, PM_{10} are of great concern in air pollution studies. The effects of air pollution include breathing and respiratory problems, aggravation of existing respiratory and cardiovascular disease, alterations in the body defence systems against foreign materials, damage to lung tissue, carcinogenesis and premature death [19]. Furthermore, Table 2 describes the physical symptoms indicating the possibilities of traffic policemen casualties within the study area.

Table 2. Physical symptoms occurrence

S/n	Symptoms	Sample	Prevalence of symptoms	
			Yes	No
1	Eyes irritation	Traffic Police	25	16
2	Frequent coughing	Traffic Police	15	26
3	Upper respiratory tract irritation	Traffic Police	20	21
4	Shortness of breathing	Traffic Police	06	35

However, the result shows that 15 traffic policemen have frequent coughs that indicate a symptom of respiratory infection while 16 have no any trace of such health predicaments. More so, 20 traffic police men have symptom of upper respiratory tract infection, while 6 have short breathing capability. 25 out of the sampled population are also exposed to frequent eye irritation.

4. Conclusion

This study was done in order to understand the level of association between respiratory status such as breathing, upper respiratory tract irritation, frequent cough and eye irritation with the level of air pollution. Chi-square statistical techniques and descriptive statistics were applied in the datasets. The result shows that there is a strong association between air pollution and respiratory disease with a p-value 0.027 at significance of alfa 0.05. The statistical result shows that about 20 non-smoking traffic policemen have upper respiratory tract infection, 15 with frequent cough symptom, 6 with shortness of breathing and 25 with eye irritation. This study is an indication that vehicular emission within the study area is a primary source of pollution that possesses a risk in exposing non-smoking policemen to series of respiratory diseases. Government agencies and other stakeholders should provide preventive measures in either reducing the number, concentration and sizes of pollutants emitted or provide protective measures to reduce the level of exposure of traffic policemen and other habitants.

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