Health Risk Carcinogenic and Non-Carcinogenic Evaluation of BTEXs in Urban Workers in Klang Valley, Malaysia

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Introduction

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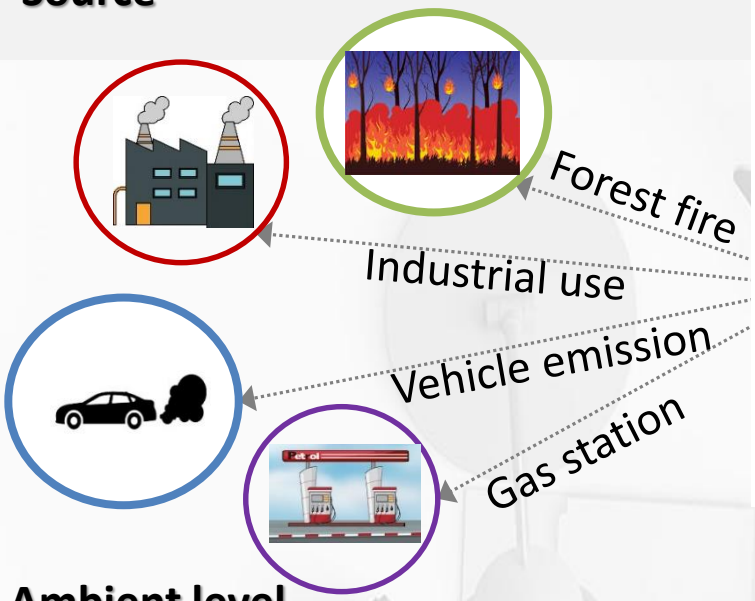
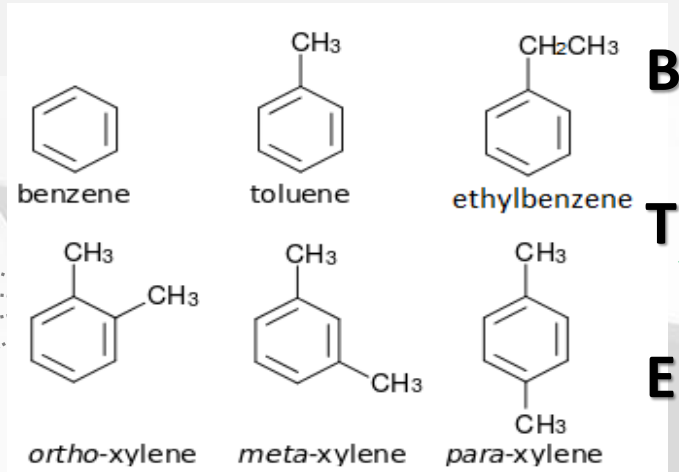
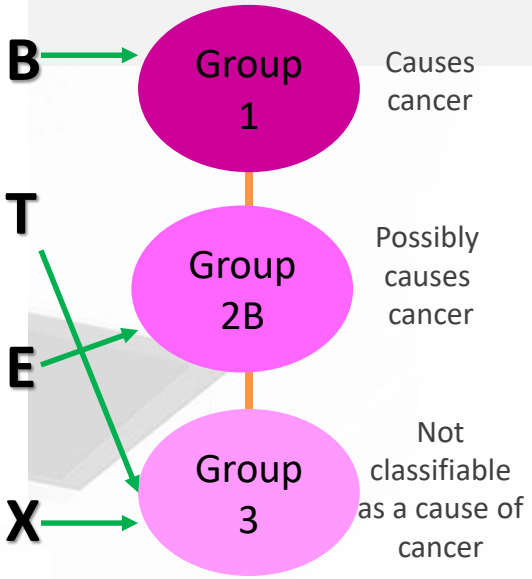


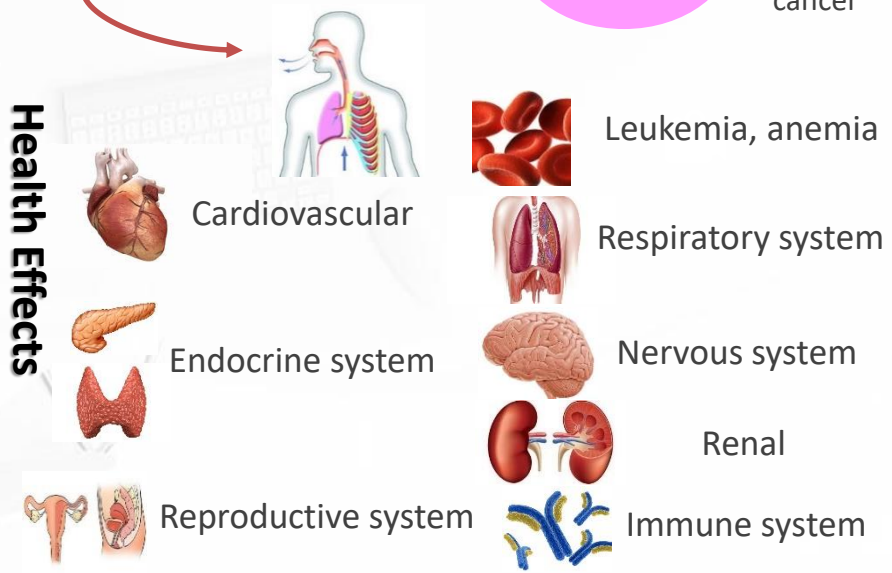




Ambient level

Benzene

WHO & USEPA: No any safe level recommended
European Union: 5 μg/m³ (annual)
Japan: 3 μg/m³ (annual)
India: 5 μg/m³ (annual)
Korea: 5 μg/m³ (annual)
Nepal: 20 μg/m³ (annual)
Thailand: 1.7 μg/m³ (annual)
Vietnam: 10 μg/m³ (annual) / 22 μg/m³ (hour)
China & Singapore: No any safe level recommended



Literature Review

Country	Benzene conc (ppb)	Health Findings	Reference
Italy	7.5±4.4	Hb, Hct, PLT, WBC, LYM, NEU	Maffei et al 2005
	5±3	↓LEU, ↓NEU, ↓LYM (correlation with blood benzene)	Casale et al 2016
	3±2	Muconic acid ↑	Berthoin et al 2004
	6.1 (4.2-9.8)	MN↑, S-PMA↑	Angelini et al 2011

Studies on traffic policemen

Occupational-based Population
Urban workers and traffic policemen

General Population
Resident / occupy who lives nearest to industrial and heavy traffic areas

Susceptible Population
Schoolchildren, pregnant women and elderly

At Ambient level

High Risk Population

Air Quality in Klang Valley

one of most polluted area with various of air pollutants (Awang et al., 2000 & Azmi et al., 2010).

heavy traffic density & emission from exhaust mobile is primary source to air pollutants (Afroz et al., 2003).

Poor wind prevailing caused pollutants constantly accumulated (DOE, 2006 & Azmi et al. , 2010)

Study's aim: to discover personal of BTEXs concentration in traffic policemen in microenvironment of Klang Valley and the potential health risk from the ambient BTEXs exposure.

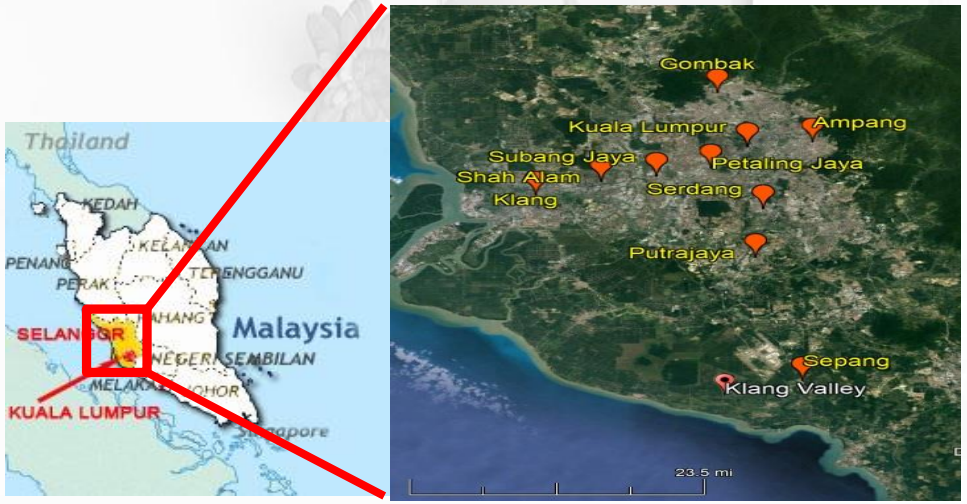
Research Methodology

STUDY DESIGN

Cross-sectional study

STUDY LOCATION

Was conducted in selected areas in Klang Valley



SAMPLING POPULATION

Traffic policemen-which has direct exposure to the traffic-related benzene emission from vehicles during controlling the traffic flows of vehicles

SAMPLING FRAME

List name of both groups are selected from Traffic Branch of Headquarters in Klang Valley region

Research Methodology

Cross-sectional study

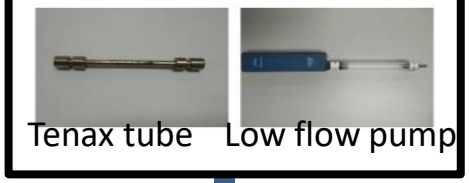
Outdoor Traffic Policemen

Inclusion criteria:
Male
Aged between 20 and 59 years old
Involve in controlling the traffic flow
No diagnosis of chronic diseases (i.e. respiratory disease, blood-related disease, cancer, kidney failure, and liver failure)

Questionnaire Distribution

Personal Monitoring

Analyze using GC-MS-TD



HRA

Carcinogenic

Known to cause cancer in human

Adverse health effects other than cancer and gene mutation

Non-Carcinogenic

Health Risk Assessment

Parameter	Definition	Description/source	Unit
CA	Pollutant concentration in air	Personal sampling	$\mu g/m^3$
IR	Inhalation rate	USEPA, 2011b	0.875 m^3/hour (for adults)
ET	Exposure time	Working hours	hr/day
EF	Exposure frequency	Questionnaire	days/year
ED	Exposure duration	Questionnaire	year
BW	Body weight	Questionnaire	kg
AT	Averaging time	70 years x 365 days for cancer estimation	days
CSFi	Cancer slope factor	Benzene: 2.73 x 10^{-2} (RAIS, 2010) Ethylbenzene: 3.85x10^{-3} (RAIS, 2010)	mg/kg day^{-1}
RfC	Hazard quotient	Benzene: 3x10^{-2} (ATSDR, 2005) Toluene: 5 (USEPA-IRIS, 2003) Ethylbenzene: 1 (ATSDR, 2005) Xylene: 1x-10^{-1} USEPA-IRIS,200)	mg/m^3

Health Risk Prediction:

Chronic Daily Intake, CDI=CA x IR x ET x EF x ED / BW x AT

Cancer risk = CDI x CSFi

EC = CA x ET x EF x ED / AT

HQ= EC / (RfC x 1000 µg/mg)

Findings & Discussion

Personal monitoring among 115 outdoor traffic policemen in Klang Valley
Average hour in controlling the traffic flows: 4.5 hours (range: 2.5-7.1 h)

	Benzene (µg/m³)	Toluene (µg/m³)	Ethyl-Bz (µg/m³)	*m,p*-Xylene (µg/m³)	*O*-Xylene (µg/m³)	Xylene (µg/m³)
Mean	53.40	178.79	48.94	77.03	73.17	150.21
SD	39.83	123.77	25.55	46.01	41.36	83.72
Median	37.98	153.12	45.37	69.35	61.98	131.13
Min	6.26	31.75	9.68	3.01	11.80	24.24
Max	295.46	948.20	119.61	222.92	205.41	359.82

The relative abundance for 10 studied areas of Klang Valley region were as follows: toluene > m,p-xylene > o-xylene > benzene> ethyl. This study found toluene was appeared most predominant species. In gasoline, toluene is added around 5-7% (Raysoni et al., 2017) and benzene about 3-7% by weight respectively. The greater concentration of toluene and xylene may also influenced as they widely used as solvent in industrial other than traffic sources. Klang Valley frequently reported as deteriorate ambient air quality. The major sources of VOCs particularly BTEXs in ambient air of Klang Valley primarily contributed by anthropogenic emission with total of 94% related to vehicles emission/exhaust and gasoline evaporation (Hosaini et al., 2017). It is city with rapid development in industrial and commercial activities as well as densely populated (DOS, 2010) and having heavy vehicular traffic region in Malaysia.

Findings & Discussion

BTEX inter-species ratio in Klang Valley's environment

Source from traffic emission

		T/B	E/B	m,p-X/B	0/B	m,p-X/E	o-X/E	B/T
Outdoor Traffic Policemen	Mean	3.591	1.042	1.560	1.501	1.556	1.464	0.305
	SD	1.322	0.315	0.479	0.398	0.449	0.186	0.091
	Median	3.621	0.994	1.671	1.513	1.534	1.462	0.276
	Min	1.562	0.175	0.088	0.244	0.103	0.982	0.073
	Max	13.782	2.095	2.899	2.512	2.942	1.965	0.640

Ratio T/B=indicator the toluene and benzene were originated from vehicular emission as the value > 2. This implies traffic policemen face to the air toxic of benzene Class I during they were involve in controlling the traffic flows.

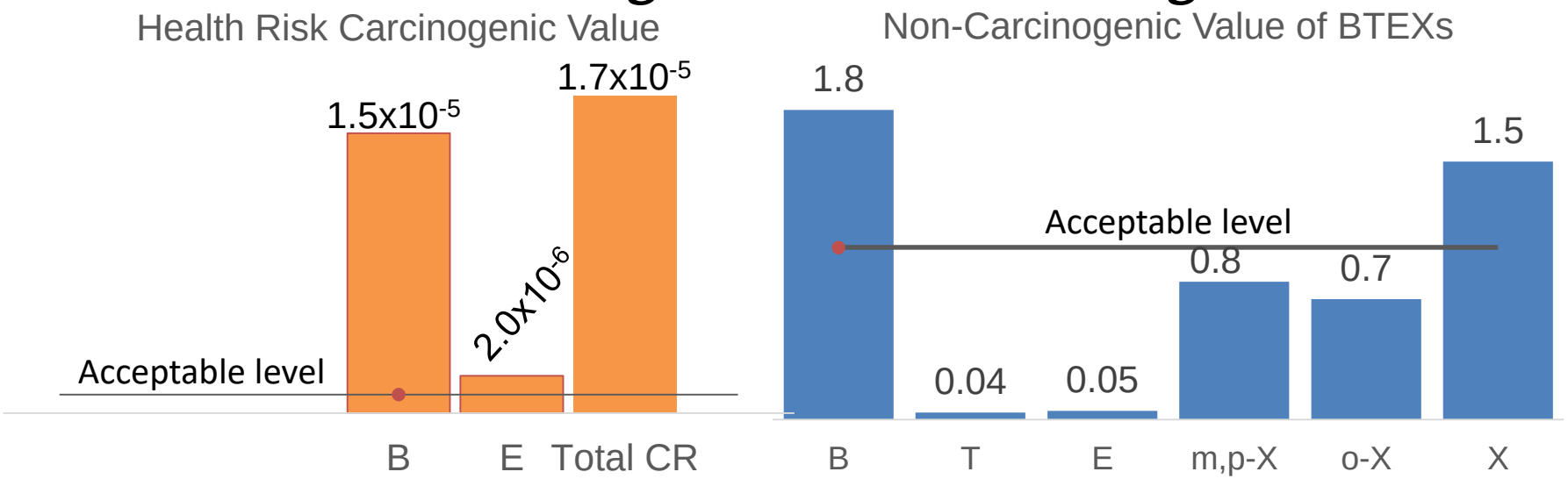
Ratio T/B & m,p-X/E= indicator for diagnostic.

Ratio m,p-X=showed the extent of photo chemical reaction in atmosphere

Ratio m,p-X/E & o-X/E=indicator for air mass transported & estimation of photochemical ages of air mass

Findings & Discussion

Health Risk Carcinogenic and Non-Carcinogenic Evaluation



The highest CR value to traffic policemen was posed by benzene (mean value: 1.5 per 10^5) and followed by ethyl-benzene (mean value: 2 per 10^5) which both greater than acceptable level of 1 per 10^6. Similarly, the CR value of B and E were found more than acceptable level in Bangkok' traffic policemen (Navaporn et al., 2017). The traffic policemen were exposed to extremely high carcinogen compounds specifically benzene. Benzene is most stable species as it is longer in atmosphere. The lifetime of B,T,E,p-X and m-X as follow: 9.4 days > 1.9 days > 1.6 days > 19.4 h > 11.8 h (Zalel & Yufat, 2008). This exhibited the traffic policemen were chronically exposed to cancer-causing agent as depletion of benzene is negligible due to slow reaction with O_3 and NO_3. The main target organ of B is bone marrow and can causes blood-related diseases. Long term exposure to ethylbenzene able affect hearing and kidney (ATSDR, 2010).

Most abundant species for non-cancer risk was benzene and followed by xylene (in unacceptable level). Toluene, ethyl-benzene, mp-X and o-X were acceptable level. Although Xylene was in non-carcinogenic group, but the longer exposure to xylene may led to eye, nose and throat irritation, shortness, deterioration in nervous and lung system (ATSDR, 2007 & McKenzie et al., 2012).

Conclusion

-Important to monitor ambient BTEXs in Malaysia as no established norms and standard for BTEXs in Malaysia unlike in Thailand, Vietnam, Japan & Korea.

STRATEGIC PREVENTION MANAGEMENT

SOURCE REDUCTION

Reduction from transport emission:

-The advance of fuels technologies with free/very less of benzene @ aromatic compound content.

--Change the conventional fuels to biofuels/cleaner fuels

-Improved emission standard/ fuel efficiency/inspection and maintenance

SOURCE REDUCTION

Reduction from industrial source:

-Regulation to restrict the location of new industries

-License of specified polluting process

SUSTAINABLE URBAN ENVIRONMENT

-Creating green areas/cities

-separating pedestrians and bicyclists from road traffic

TO WORKERS

PE & Legal:

should invariably wear scientifically devised mask

-advisable to wear plain glasses to prevent eye irritation

-Include the traffic policemen as one of criteria employees in OSH Act 1994 as number of robust adverse health found due to air traffic pollutants

TO WORKERS

Health surveillance:

-Organize special medical care and periodic follow up

-Exclude the individuals with a high sensitivity / susceptible individual to other duty away from traffic crossroads

-Medical surveillance to detect early health impairments (chest x-ray, blood analysis, physical examination

Acknowledgement

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