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Assessing knowledge, awareness, and perception of traffic personnel in Iligan City, Philippines on urban air pollution

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Abstract

Field traffic enforcers are the forefront in directing traffic in which they are assigned in the busy streets filled with automobiles expelling fumes and are one of the populations that are constantly exposed to air pollution via traffic exhaust. This study evaluates the knowledge, awareness, and perception on air pollution of this population who are at high risk by means of a questionnaire-guided interview. The study population consists of a total of thirty-five field traffic personnel who are natives in Iligan City and basic sociodemographic data were gathered from the study population. All of the members of the study population reported to be aware and has sufficient knowledge on air pollution. Different perceptions on air pollution were noted and a significant number of the population (82.86%) has a positive attitude towards air pollution on the local scale. Factors such as age, marital status, gender, and years of service were found to be significant in correlation (p-value 0.000 is less than α=0.05) to how they perceive air pollution. Furthermore, the attitude of the study population was found to be of significant correlation (p-value 0.000<α=0.05) to the resulting environmental actions they have done and what precautionary measures they are observing.

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Introduction

Air pollution, both outdoor and indoor, has always been a national and international concern and it is globally recognized that the health risks it imposes are extremely serious (Tao *et al*., 2014; Urman and Hosgood, 2015; Ni *et al*., 2015). Recent studies have shown that the disease burden attributable to air pollution, which is a risk factor, is substantial (Burnett *et al*., 2014). The World Health Organization reported that ambient air pollution was globally responsible for 3 million deaths in 2012 with Western Pacific and Southeast Asia bearing most of the burden with 1.1 million and 799,000 deaths, respectively.

Perception is a vital component in bringing about change in behavior and has a key role in public response and dialogue towards critical environmental exposures. It would be safe to assume that by increasing the public's perception, knowledge, and awareness, we are promoting behavior that would intervene and protect from various environmental exposures. Sjöberg *et al*. (2004) defined perception as an assessment which is subjective of levels of exposure to any environmental hazard and the concern for the consequences it could bring. Several researches on environmental risk assessment have established a link between exposure and the risks that it may impose upon one's health.

Despite the adverse health effects and increasing mortality rate caused by exceeding levels of particulate matter, very few studies regarding air quality in the Philippines had been published. Philippines, as a developing country, is industrializing rapidly and the growth of motor vehicles is also rapidly increasing. Thus, air quality is adversely affected by the emissions from motor vehicles. Based from the records of the Land Transportation Office (2014), it was recorded that on 2013, there were a total of 7,690,038 motor vehicles that are registered and only a total of 13,793 motor vehicles were apprehended in violation of the Republic Act No. 8749 or Philippine Clean Air Act of 1999, in which 65.72% of the cases remain unresolved. Although there are laws such as the Republic Act No. 8749 which addresses these problems, there are still not enough resources to establish monitoring stations or proper measures to properly achieve and maintain air quality that meets the National Ambient Air Quality Standards required by the Clean Air Act.

The aim of this study is to assess the knowledge, awareness, and perception of the traffic personnel based in Iligan City that have been constantly exposed to traffic-related air pollution. The output of this study could be used in leading awareness of government officials especially the local government or leaders with power to advocate and create policies or ordinances specific to air or traffic-related pollution.

Materials and methods

Study area and population

The study was conducted within the area of Iligan City, which is located north of Lanao del Norte, Mindanao, Philippines. An initial reconnaissance of traffic-congested areas was done to survey the population which is the traffic enforcers that are being constantly exposed to traffic exhaust fumes.

Recruitment of the study population was done at the Iligan City Traffic Office and only those individuals who are working in busy intersections were recruited to be part of the study population; a minimum of two months of experience in the occupation was also required. Participating traffic enforcer personnel were asked to sign a consent form before participating in this study in order to ensure the confidentiality of their identity.

Questionnaire-guided interview

The traffic enforcer personnel that were gathered at the beginning of the study were interviewed with a questionnaire as a guide.

The interview consisted of four parts including knowledge, perception, attitude, and practices towards air pollution. Questions asked were taken from the study of De Giusti *et al.* (2012), and de Bono *et al.* (2010).

The interview aimed to gauge the knowledge of the traffic enforcer personnel on the basics of air pollution, perception, attitude, and practices in relation to air pollution

Data analysis

The data gathered from the questionnaire-guided interviews were compiled on to Excel 2007 for data management. Basic statistical tools such as the mean, median, mode as well as Multivariate Test of Association and Binomial Proportion Test for *p*-value determination were then used to analyze and make inferences from the gathered data.

Results and discussion

Respondents

Thirty five (35) traffic enforcers operating in Iligan City agreed to be the subjects of this study. The study population consisted of twenty-nine (29) males and six (6) females with ages varying from twenty-one (21) years old to sixty-four (64) years old, with more than 60% (24 respondents) reported to be married. More than half of the group (62.86%) has been in the occupation of traffic enforcement for several years. The demographic summary of the recruited respondents is shown in Table 1.

Table 1. Sociodemographic data of the study population.

Variables	Count (%)	Variables	Count (%)	Mean ± SD
Gender		Years of service		
Male	29 (82.86)	Below 1 year	13 (37.14)	7.06±8.74
Female	6 (17.14)	1-5	10 (28.57)	7.06±8.74
Alcohol Consumer		6-10	1 (2.86)	7.06±8.74
Consumer	18 (51.43)	10<	11 (31.43)	7.06±8.74
Non-consumer	14 (40.00)	Age (in years)		
No Data	3 (8.57)	20-29	8 (22.86)	42.40±12.08
Marital status		30-39	4 (11.43)	42.40±12.08
Single	10 (28.57)	40-49	11 (28.57)	42.40±12.08
Married	24 (68.57)	50-59	10 (28.57)	42.40±12.08
Widowed	1 (2.86)	Above 59	2 (5.71)	42.40±12.08
Smoking Habit		Body mass index		
Smoker	12 (34.29)	Underweight	0 (0.00)	25.37±3.68
1-5 sticks	4/12 (33.33)	Normal	17 (48.57)	25.37±3.68
6-10 sticks	2/12 (16.67)	Overweight	14 (40)	25.37±3.68
>10 sticks	4/12 (33.33)	Obese	4 (11.43)	25.37±3.68
No Data	2/12 (16.67)			
Non-smoker	18 (51.43)			
No Data	5 (14.29)			

Knowledge, awareness, and perception about general pollution

Based from the data gathered, all of the respondents claimed to have awareness about pollution in general and also believes that pollution is harmful to both the environment and to one's personal health. The study population was grouped into two categories namely: the unaware group and the aware group based on their responses from the survey. Based on the results of the Binomial Proportion Test conducted with the aware and unaware respondents, all criteria in the knowledge about general population is significant at *p*-value less than the 95% CI (p-value < α=0.05). This implies that the proportion of the study population is significantly aware what pollution is all about and believes that it is harmful to the environment and the

people's health. Moreover, the mean proportion of the respondents about awareness of the different types of pollution is significant at *p*-value (0.000 < 0.05).

Table 2. Perceptions of the study population regarding air pollution.

Perceptions of air pollution:	Frequencies (%)	
	Yes	No
It is a contamination in the air.	26 (74.29)	9 (25.71)
It is harmful to our health and environment.	32 (91.43)	3 (8.57)
Introduction into the air of a substance which has harmful effects.	16 (45.71)	19 (54.29)
When air contains gases, dust, fumes in harmful amounts.		
It is a contamination of the bodies of water.	24 (68.57)	11 (31.43)
It produces harmful or annoying levels of noise.		
It destroys the soil and water ecosystem.	15 (42.86)	20 (57.14)
	11 (31.43)	24 (68.57)
	18 (51.43)	17 (48.57)

Five categories were given for the respondents to choose from about how they perceive general pollution. Eleven (31.43%) of the total thirty-five respondents have claimed that general pollution is the process of making land, water, and air dirty and not suitable to use while ten (28.57%) of the respondents have claimed that it is the action of poisoning especially by the environmental contamination with man-made waste and it has several types which are harmful to the environment and to humans. The least percentage (11.43%), with a number of four individuals, was obtained from those respondents who have claimed that they are not sure what pollution is.

Table 3. Correlation between sociodemographic factors and perception of air pollution.

Effect		VALUE	F	*p*-value*
Age	Wilks' Lambda	0.004	173.946[b]	0.000
	Hotelling's Trace	260.919	173.946[b]	0.000
Marital Status	Wilks' Lambda	0.025	148.886[b]	0.000
	Hotelling's Trace	38.600	148.886[b]	0.000
Gender	Wilks' Lambda	0.023	164.655[b]	0.000
	Hotelling's Trace	42.688	164.655[b]	0.000
Years of	Wilks' Lambda	0.004	1141.850[b]	0.000
Service	Hotelling's Trace	263.504	1141.850[b]	0.000

**p*-value used is Multivariate Test with confidence interval of 95%.

The predominant perception on pollution in this study is the action or process of making land, water, and air dirty and not safe or suitable to use which is stated by eleven (31.43%) respondents. The respondents' subsequent perception on pollution is closely followed by the action of poisoning especially by environmental contamination with man-made waste and that pollution has several types and is harmful to the environment and to humans. Both perceptions were stated by ten (28.57%) respondents each. Several studies have also assessed public perception on knowledge of the several types of pollution and findings indicate that the highest perceived pollution is air pollution followed by water, radioactive, noise, soil pollutions along with other several types of pollution in varying orders from different studies (Obafemi *et al.*, 2012; He *et al.*, 2013; Cankurt *et al.*, 2016).

The respondents were then asked if they have knowledge on the different types of pollution and thirty-two (91.43%) claimed they have sufficient knowledge. The thirty-two respondents were then further asked to rate identified pollution types according to their knowledge on what type of pollution has the most significant impact on them or on the environment. According to the respondents, air pollution has the most significant impact (28/87.50%), followed by water pollution (26/81.25%), radioactive pollution (23/71.88%), noise pollution (22/68.75%), soil pollution (21/65.63%), light pollution (21/65.63%), visual pollution (21/65.63%), personal pollution (21/65.63%), and thermal pollution (19/59.38%), as shown in Fig. 1. Several references classify air pollution, water pollution, and radioactive pollution as the most significant types of pollution (Willett, 2011; Obafemi *et al*., 2012; He *et al*., 2013; Cankurt *et al*., 2016).

Table 4. Knowledge of the study population on the causes of air pollution in Iligan City.

Causes	N=35	%		*p*-value*
Industrial sources	24	68.57	0.041	Significant at p<0.05
Motor vehicles	29	82.86	0.000	Significant at p<0.05
Population growth	11	31.43	0.041	Significant at p<0.05
Waste disposal	25	71.43	0.017	Significant at p<0.05
Burning of waste	27	77.14	0.002	Significant at p<0.05

**p*-value used is Binomial Proportion Test with confidence interval of 95%.

Knowledge, awareness, and perception of air pollution

All of the respondents (100%) stated that they are aware of air pollution, and only one (2.86%) does not have any knowledge on air pollution. Thirty-three (94.29%) respondents also claim that they believe air pollution can cause health risks. A study conducted by Qian *et al*. (2016) reported that the awareness rate of their respondents was 64.59% which varied significantly with age, levels of education, and occupation. Due to the nature of the respondents' occupation of this study, it would be safe to assume that they would be aware of air pollution being that they are the ones who are being constantly exposed to such occupational hazard.

Table 5. Environmental actions and precautionary measures taken by respondents.

Actual practices	N=29	%
Environmental actions		
Tree planting	27	93.10
Segregation of waste	25	86.21
Usage of unleaded gasoline	8	27.59
Reduce usage of personal vehicles	6	20.69
Avoid burning of waste	20	68.97
Recycling non-biodegradable waste	14	48.28
Usage of recyclable plastics	13	44.83
Precautionary measures		
Avoid going outside	2	6.90
Wear mask	22	75.86
Use of handkerchief	11	37.93
Go on exercise	21	72.41
Avoid heavy traffic	12	41.38

Regarding the respondents' perceptions of air pollution, as shown in Table 2, the three dominant perceptions are that air pollution is harmful to health and environment (91.43%), followed by contamination in the air (74.29%), and when air contains gases, dust, and fumes in harmful amounts (68.57%). Using the definition of Chapman (2007) for contamination and its difference from pollution, in which all pollutants are contaminants but not all contaminants are pollutants, it would be logical to assume that most of the respondents of the study population are aware of air pollution and have the correct concept of air pollution being that they believe air pollution is contamination in the air and is also harmful to the immediate community at the same time. However, some of the respondents also claim that air pollution destroys the soil and water ecosystem (52.43%), is a contamination of the bodies of water (42.86%), and it produces harmful or annoying levels of noise (31.43%).

Table 6. Multivariate test for the environmental actions practices and precautionary measures with attitude of the study population.

Effect		Value	F	*p*-value*
Environmental	Wilks' Lambda	0.030	103.190[b]	0.000
Actions	Hotelling's Trace	32.833	103.190[b]	0.000
Precautionary	Wilks' Lambda	0.016	378.906[b]	0.000
Measures	Hotelling's Trace	60.625	378.906[b]	0.000

**p*-value used is Multivariate Test with confidence interval of 95%.

There have been studies that air pollution in the form of acid rain does pose harmful consequences to its immediate environment, to the soil, and surrounding bodies of water and is closely associated to noise pollution. In a study by Klæboe *et al.* (2000), the findings indicate that the higher air pollution levels people are exposed to the more likely they are to be annoyed by road traffic noise and by the exhaust smell of air pollution. Singh and Agrawal (2008) also conducted a study on acid rain and its ecological consequences with their findings that acid rain can acidify bodies of water, which can cause large scale negative impact on aquatic organisms, and can also lower soil pH which leaches away nutrient cations and increases availability of toxic heavy metals thus reducing soil fertility.

Test for association between sociodemographic factors and perception

Multivariate Test of Association is used to test if there is a significant relationship between the age, marital status, gender, and years of service of the respondents with how they perceive air pollution. All of the results, shown in Table 3, showed that the *p*-value 0.000 is less than α=0.05 which indicates that there is sufficient evidence to reject the null hypothesis. Therefore, there is a significant relationship between these factors: age, marital status, gender, and years of service with how they perceive air pollution. Regarding age, in a study by Kim *et al.* (2012), it was found that young people aged 20-34 years had poor perception about air pollution compared to older age groups while in another study, young respondents were more concerned about environmental issues, while older respondents were more likely to emphasize health and safety (Fischer *et al.*, 1991). Similar studies were also conducted that had a significant relationship between the age of the respondents and how they perceive air pollution (Carp and Carp, 1982; Liu *et al.*, 2016; Qian *et al.*, 2016).

There is relatively little written about the association between marital status and the perception of air pollution or any environmental issues. Though in literature, married people may be more knowledgeable and concerned about environmental pollution due to the fact that their spouses may be a

source of information on environmental issues such as air pollution and may act as an important influence on them (Brown and Macey, 1983). A study's findings indicate that exposure to environmental pollution are influenced by factors such as sex, age, and prior exposure to the pollutant (van Thriel *et al.*, 2008). Studies have shown that occupations of the respondents and the duration of stay in the community have a significant relationship with how they perceive pollution (Egondi *et al.*, 2013; Qian *et al.*, 2016).

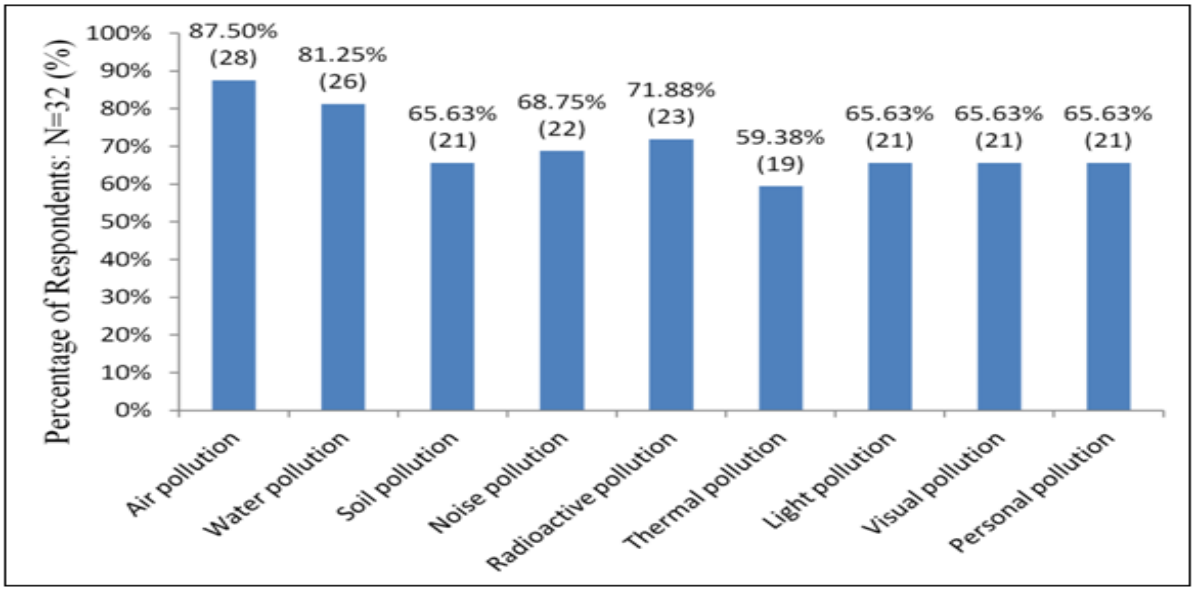

Fig. 1. Graphical representation of the knowledge of the study population to the different types of pollution according to its significance and impact.

Knowledge on the causes of air pollution

The respondents were then asked if they have knowledge on the possible causes of air pollution. Thirty-two (91.43%) respondents of this study believed that smoking of cigarettes is one of the major causes of air pollution. In a study by Egondi and colleagues (2013), their findings in Viwandani and Korogocho were of the opposite, their respondents reported cigarette smoking as the least source of air pollution at 11.6% and 18.5% respectively. Other sources of air pollution reported by the respondents of this study were industrial sources (85.71%), motor exhaust (82.86%), and burning of waste (80.00%), waste disposal (68.57%), construction (51.43%), pollution from other cities (40.00%), population growth (31.43%), household cooking (28.57%), and use of air conditioner (20.00%). These are summarized in Fig. 2. Several studies have affirmed and are closely in parallel to these findings. A study conducted by Liao *et al.* (2015), reported that their respondents claimed motor vehicles as the major source of air pollution (78.5%), followed by waste burning (56.3%), and industrial facilities (53.7%).

Another study by Li and colleagues (2016) would affirm this study's respondents' perception of the second major source of air pollution, industrial sources.

In the findings of Li *et al.* (2016), 93.2% of their respondents identify industrial facilities as the major source of air pollution. A study also conducted by Guo *et al.* (2016) interviewed respondents who reported automobiles as the major source of air pollution with 69.4%, industrial facilities with 55.7%, and construction activity with 53.3%. This is further supported by a study conducted by Dr. Smallbone (2012) in which 78% of the respondents perceive traffic exhaust as the biggest contributor to poor air quality or air pollution.

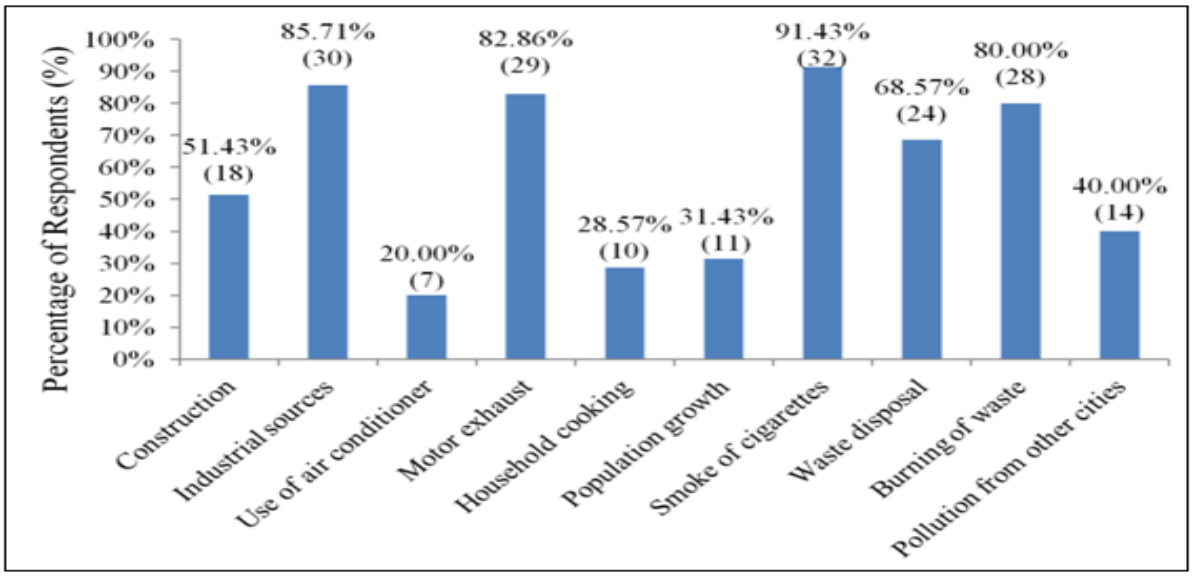

Fig. 2. Graphical representation of the knowledge of the study population on the causes of air pollution.

Perceptions on the air quality of Iligan city

Almost half of the respondents (42.86%) were not satisfied with the current air quality in Iligan City. A study in Shanghai, Wuhan, and Nanchang conducted by Liu and colleagues (2016), more than half of their participants (56.69%) were not satisfied with the current air quality in the three megacities in China. They also reported that 46% of their respondents expressed anxious feelings when exposed to polluted air.

Comparison of the air quality in Iligan City for last year (2016) and this year (2017) was also asked. Almost half (42.86%) of the respondents reported that air quality this year is worse than the air quality last year. About one-fourth of the total respondents (25.71%) reported that air quality last year and this year is just the same and another one-fourth of the total respondents (34.28%) reported that the air quality last year is better.

In relation to the causes of air pollution in Iligan City, the respondents reported that the top five main causes of air pollution in Iligan City, as shown in Table 4, are motor vehicles (82.86%) followed by burning of waste (77.14%), waste disposal (71.43%), industrial sources (68.57%) and population growth, with the least respondents (31.43%).

Based from the data of the Mindanao Development Authority and Philippine Statistics Authority, the number of registered motor vehicles in Iligan City is 26,156 and the total population, as of May 2010, is 322,821 with an average annual population growth rate of 1.25. Iligan City has a land area of 813.40 square kilometers thus the population density would be 396.88; this means that for every square kilometer, there are 396 persons residing in it. Perhaps these are the reasons why the study population rated motor vehicles and population growth as some of the main causes of air pollution in Iligan City as urbanization and overpopulation is steadily increasing. Also, Filipinos especially in rural areas, tend to do a practice called "pagsisiga" or open burning of waste. In Section 48 of Republic Act No. 9003, otherwise known as Ecological Solid Waste Management Act of 2000, it prohibits this particular act (Environmental Management Bureau, n.d.).

This is because open burning of waste or garbage can cause nausea, difficulty in breathing and increases incidence of asthma, and many other diseases attributable to air pollutants. Studies have established that open burning of garbage is one of the main causes of air pollution (Afroz *et al.*, 2003; Christian *et al.*, 2010). Although this law exists, it is not strictly implemented.

Attitudes and practices of the study population against air pollution

The attitude and practices of the respondents with regards to air pollution were also included in the data gathered from the survey. All thirty-five of the respondents claimed that they care about the environment where they are working, however six (6) of the respondents think that there is nothing that can be done to tackle air pollution even mentioning that it is too late (17.14%) while the rest of the twenty-nine (29) respondents believe that there can still be something done to solve air pollution (82.86%).

The twenty-nine (29) respondents who believe that there can still be something done to tackle air pollution were then asked what regular actions or precautionary measures that they have taken against air pollution. As shown in Table 5, the most frequent environmental action claimed to be regularly done is tree planting (93.10%) with twenty-seven (27) respondents. In terms of managing waste, twenty-five (25) respondents segregate their wastes (86.21%), twenty (20) respondents avoid burning of waste (68.97%), fourteen (14) respondents recycle their non-biodegradable waste (48.28%), and thirteen (13) recycle or utilizes recyclable plastics (44.83%).

Also, in relation to motor vehicles, six (6) respondents claim to minimize utilizing their personal vehicles (20.69%), and eight (8) respondents claimed that they use unleaded gasoline in which unleaded gasoline is proven to have a better decrease in emission of carbon monoxide, hydrocarbons, and vehicle exhaust particulate matter by 60%, which is highly beneficial for the safety of the environment and of human health (Yuan *et al*., 2000).

Test for association between attitude and practices towards air pollution

To test if there is a significant relationship between the responses of the respondents whether they think there can still be something they could do about air pollution or their attitude towards air pollution with the resulting environmental actions they have done and the precautionary measures applied by the respondents, Multivariate Test of Association is used.

Based on the results provided in Table 6, using two of the Multivariate tests, the Wilks' Lambda and Hotelling's Trace, there is sufficient evidence to prove the relationship of the variables with *p*-value $0.000<\alpha=0.05$.

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