Public Perception of Air Pollution in Malaysia Before and After Movement Control Order: A Case Study

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Abstract

Air pollution is an environmental risk assessment method conducted in this journal review. Air pollution data review before the implementation of the Movement Control Order (MCO) and after was answered by respondents. These respondents were collected randomly without selection of demographic ranges from non-university students in Malaysia within a period of 47 days. The data was then interpreted based on their demographic range, reviews, knowledge and awareness. It was to find out that there was no significant difference between demographic changes such as occupation, gender and race. Generally, it is to find that the air pollution (K et al., 2018) problem decreases after MCO where respondents have more positive opinions. Respondents also act neutrally when facing economic importance in environmental problems. However, respondents are active and positive in helping the environment personally or individually rather than collaborating with the country's efforts in terms of financial contribution. The study is important to study the effect of air pollution in Malaysia, especially Selangor and KL as a city, to assess the pollution index and reduce ecological toxicology effects on affected areas. More studies need to be discovered for risk assessment of organisms in these involved areas as well. The primary objective of this study is to assess public perceptions of air pollution in Malaysia before and after the MCO (Turrentine & Mackenzie). The research also examines how demographic factors such as age, occupation, and race influence these perceptions.

Keywords:

Introduction

Our survey is purposely for collecting information and data on Malaysian society's perceptions about our air condition before and after the Movement Control Order (MCO) due to COVID-19. Before the COVID-19 phenomenon, Malaysia experienced bad hazardous air pollution due to haze. Generally, a haze occurred as caused by widespread forest fires in Indonesia. The hazardous haze had contributed to the increasing number of cases of heart and lung diseases such as asthma, shortness of breath and fatigue (Saini et al., 2020; John et al., 2022). Other than that, the rapid development of industries in Malaysia also added to the bad quality of the air, where these industrial activities emitted harmful or poisonous gaseous to the environment through the smoke funnels (Orru et al., 2018). For instance, the emission of sulfur and nitrogen, lead particles, and chlorofluorocarbons have polluted our air conditions. These harmful gases usually lead people nearby to suffer from respiratory tract disorder as it interferes with the human respiratory system (Mackenzie et al., 2022; Kaveripakam 2021; Kelishadi & Poursafa, 2010; Hosseinzadeh et al., 2018). The primary aim of this research is to assess public perception of air pollution before and after the Movement Control Order (MCO). Factors such as demographics and public opinion are considered secondary aspects, supporting the main objective of understanding air pollution perceptions (Shakir et al., 2024).

Ever since the COVID-19 outbreak started in Malaysia, and was widely spread across the country, Malaysia's government had declared a pandemic in order to restrain the spread of the COVID-19 virus. The implementation of the lockdown in the society of Malaysia had contributed to our air pollutant level in a positive way. This study's conclusion that air pollution decreased after the MCO is corroborated by external data, such as the significant drop in the Air Pollutant Index in key urban areas like Cheras, Kuala Lumpur. According to Zahid (Zahid et al., 2022), they added that the air quality of Malaysia had an improvement after several lockdown implementations in Malaysia, in which our country's Air Pollutant Index (API) in urban has recorded an API of 36.3-61.5% while suburban areas are API 46.5-48.6%. The data that was collected showed that Malaysia's air quality had improved from moderate to good in 3 urban areas; Bandaraya Melaka, Cheras, and Alor Setar and 3 suburban areas; Seri Manjung, Kangar, and Kuantan. The Air Quality Index (AQI) of Cheras, Kuala Lumpur on 14th October 2019 recorded AQI 62 which is higher than AQI on 14th October 2020, AQI 34 (Abdullah *et al.*, 2020). Based on the Malaysia Ministry of Health, it was reported that Recovery Movement Control Order Phase 2 was implemented from 1st September until 31st December 2020 which concluded that AQI of Cheras had an improvement during MCO (Rahman *et al.* 2021). This showed that the air quality had improved over time in a year. This happened due to less visibility of motor vehicles on the road, and the halting of industries that aid in conserving our environment (Zhu et al., 2024).

Studies of public perception, awareness, and attitudes towards air pollution are rare in Malaysia. As a result, the purpose of this research is to learn more about the public's perceptions of present air pollution, environmental awareness, and attitudes toward environmental preservation (Rajalakshmi et al. 2024; Saravanan et al., 2022). A common thought of overall or large data reviews helps for better interpretation and analysis of current air quality reviews from time to time. The reason for doing this research is that no programme or law can be implemented successfully without public knowledge and support for environmental preservation. To put it another way, only citizens who are fully aware of the issue and committed to their right to a healthy environment would be able to push viable environmental protection actions (Escobedo et al., 2024). More thorough findings from this sort of research can aid in framing and designing the best policy solutions. For instance, Saleem (Saleem et al., 2022) suggested that air pollution can be solved by the problem of nanomaterials remediation. It would be an effective modern bioremediation solution for air pollution.

Besides, it helps us in developing more advanced air soil and water pollution that is directed by air pollution. This pollution is correlated in the ecosystem cycle flow from species to individual and community (Nasrallehzadeh et al., 2023). Air pollution can cause the formation of acid rain which will leach the heavy metals in soils and cause toxicological contamination soil. Hence, risk assessment on polluted soil can be further conducted for assessing the effects of air pollution that alter the ratio of the metal in soil (Yap et al., 2019). When a particular plant absorbs these pollutants, the effect can subsequently be observed via the morphology of height or weight or capacity of absorbing heavy metals (Yap et al., 2010). In an aspect of aquatic toxicological monitors, when the risk of these pollutants is transferred to limnology sources such as ponds, lakes or rivers, the toxicants and pollutants will affect the aquatic environment such as the intertestidinal surface or coastal surfaces and seashore (Mutairi & Yap, 2021; Kılıç, 2021). This may be carcinogenic or harmful to other aquatic organisms especially seagrasses as the main producer of aquatic limnology ecosystem and other invertebrates such as *Perna viridis*, *Oreochromis* sp. and *Sepia* sp (Bujang et al., 2006). Hence, this primary study will have a positive impact on ecotoxicological reviews and studies on soil, individual, population and ecological impact.

Through the questionnaire, one of the main objectives is to find out how the public is really aware of the air pollution that is happening in surrounding areas, especially the area where the participants are living (Đurić et al., 2023) Next, our objective is to analyze how many family members have been affected by the pollution.

Other than that, from this experiment, we are also hoping to find out if the air pollution before MCO and after MCO had really changed or not. Finally, the objective of the survey is to study public opinion regarding how to tackle air pollution problem in Malaysia.

Methodology

Participants

In our study, we conducted a survey targeting non-university residents across Malaysia to capture a broad and representative sample of public perceptions on air pollution before and after the Movement Control Order (MCO). We specifically ensured that respondents came from diverse demographic backgrounds, including different ethnicities (Malay, Chinese, Indian, and others), various age ranges, and a wide geographic distribution across Malaysian states (e.g., Selangor, Wilayah Persekutuan, Terengganu, and others). Table 1 in the manuscript outlines these demographic variables. We also accounted for educational background, employment status, and income level (e.g., B40, M40, T20 categories), which are crucial in analyzing opinions on air quality and environmental awareness.

Non-University residents were targeted as survey subjects since we purposely conducted our survey for Malaysians outside Universiti Putra Malaysia (UPM hereafter) to observe public perceptions of air pollution in Malaysia before and after Movement Control Order (MCO). This survey was given to all Malaysian citizens in all states to observe their perceptions of their environment. Based on the result from the survey, Selangor residents recorded the highest percentage of answering this survey. Selangor has many metropolitan areas and is a highly urbanized town. Malaysian residents from various states, excluding those affiliated with UPM, were eligible to participate in this study. The participant pool encompassed Malaysians from the primary ethnic groups—Malay, Chinese, and Indian—residing in the designated survey areas. By deliberately focusing on Malaysians beyond the UPM community, the study aimed to attain a more uniform sample, allowing for better control over related variables. Individuals not associated with the university, such as non-residents, experience heightened exposure to air pollution due to their dwelling outside controlled university campuses. This stands in contrast to students, faculty, or staff who remain within the confines of UPM. Additionally, those residing off-campus may have developed their perspectives on air pollution based on their experiences outside of a university setting. Regarding the study's implications, pinpointing the perspectives of Malaysian citizens residing outside UPM holds particular relevance for policymakers. Malaysians are a demographic significantly impacted and regulated by government policies, plans, and incentives. Thus, focusing exclusively on Malaysians outside UPM provides a broader perspective on attitudes toward air pollution, shedding light on various factors pertaining to air pollution and the surrounding environment.

Instrumentation

Additionally, the survey instrument included specific sections that focused on demographic variables. Section A of the survey gathered comprehensive sociodemographic information such as age, gender, education level, and occupation. This allows for an analysis of how these factors may influence awareness, opinions, and behaviors concerning air pollution. Furthermore, by using chi-square tests, we demonstrated that changes in public perception of air pollution before and after the MCO are statistically significant, as shown in Table 2. The survey tool's structure was derived from a prior study we conducted in Malaysia, sharing a similar objective. Employing online research software, we administered a self-administered questionnaire for this survey. Participants were tasked with independently completing the survey without researcher guidance. The online questionnaire was exclusively designed in English, aiming to establish communication standards given its international usage. The survey questionnaire comprises three distinct sections: A, B, and C. Section A

focuses on background and demographic details, encompassing 12 questions aimed at gathering sociodemographic information from the respondents. On the other hand, section B focuses on raising awareness about air pollution. This segment encompasses 6 questions utilizing multiple-choice options that gauge respondents' perceptions of pollution levels in their respective living areas. Additionally, there are 9 true or false questions aimed at assessing public awareness of air pollution and its correlation with health, economic implications, and government pollution management strategies. Lastly, section C centers on environmental protection attitudes, presenting a set of 19 statements on a 5-point Likert scale. These statements, drawn from researchers as well as adapted from the International Social Survey Program and World Value Survey (https://issp.org; World Values Survey Association), aim to probe attitudes comprehensively. The scale's design facilitates the exploration of attitudes in three core dimensions: cognitive, affective, and behavioral. The objective here is to evaluate overall support for environmental protection and willingness to invest in environmental preservation concerning air pollution.

Data Collection

In our study, data was collected using a self-administered online survey. The survey took place over a span of 47 days, starting from April 15, 2022, and concluding on June 1, 2022. Before the official data collection began, two pilot studies were conducted involving 20 individuals (Sahak et al., 2022). The aim was to ensure that all questions could be accurately responded to and comprehended in a reasonable manner (Siti Zuhairah Abdul Rahman et al., 2021). Following the pilot studies, the survey was disseminated via Whatsapp, employing shortened links accessible across all platforms. In total, we gathered 95 responses. On average, respondents took approximately 15 to 20 minutes to complete the survey, with variations based on individual response times.

Data Treatment and Analysis

The Survey was Structured into Three Sections

For Section A, it recorded the demographic profile of respondents which included surveys about the highest level of education completed, background education, age range, gender, ethnicity, place currently living, employment status, family economic status of respondents and four questions about respiratory diseases.

For Section B, it focuses more on the awareness of current atmospheric conditions based on their place as well as some true or false questions. The respondents were asked to rate the atmospheric conditions of the surroundings, and also include a section where respondents can give ideas on how to raise awareness about the polluted air in society in Malaysia. Some responses were through social media, continuous campaigns, sharing transport, using public transport, good use of education in school and more (Dijana et al., 2023).

In Section C, this part is more focused on attitudes toward environmental protection where respondents need to answer on a scale from 1 to 5 on their opinions about some following statements. A higher score basically indicates a more positive attitude. The required response in turn involves a study of general support for environmental protection and a willingness to pay for environmental protection related to air pollution.

The changes in air pollution were measured through respondents' self-reported perceptions of air quality before and after the Movement Control Order (MCO), as detailed in Section B of the survey. Respondents were asked to rate the air pollution in their living areas based on their experiences. While we did not directly measure air quality through technical tools such as air sensors, we relied on subjective public perception to understand how people perceived the changes in air pollution during the MCO period.

For awareness of air pollution, we used a series of true/false questions and multiple-choice questions to assess respondents' knowledge about air pollution sources, health impacts, and governmental policies (as outlined in Table 3). These questions were designed to gauge general and specific knowledge about air quality, drawing from established public perception and environmental awareness surveys.

Results

Characteristics of Respondents

Table 1 shows all the demographic statistics from the study sites and the percentage data of the whole sample. Most of the respondents' age range was between 21-55 (80.0%.) Out of all the respondent information collected, 45.3% had the highest educational level of a bachelor's degree in tertiary education. In each educational background collected, slightly more than half or 55.8% of respondents were involved in a science-based educational level. Non-university students (47.4%) and full-time time workers (37.9%) are the ones that most take part among the 95 respondents. In terms of household income per month or monthly paid, it is discovered that the B40 population got the highest percentage with a number of 47.4%. The numbers of Malay, Indian and Chinese respondents are 54, 19 and 14. Nevertheless, other minority ethnicities are also involved in responding to the results and pollution overviews such as Nepalese, Bangladeshi and Iban. Based on the respondents' results, over 50 % of the respondents currently live in Selangor, and this may contribute a significant result. Among the retired workers, there are around 60% are currently employed in non-environmental sectors which influenced the attitudes towards air pollution in Malaysia before and after the lockdown period. The difference between the male and female ratio is not significant with only a 0.5% difference. Chi-square tests were conducted to assess whether demographic factors like gender, occupation, and race significantly influenced perceptions of air pollution. As shown in Table 2, the results indicate no significant differences between demographic groups, supporting the claim that these factors do not substantially affect public perceptions ($p > 0.05$).

Table 1. The demographic statistics from the present study

Demographic variables	Number of respondents	Percentage of respondents (%)	Total (%)
Gender			100
Male	47	49.5	
Female	48	50.5	
Age range (years)			100
Below 18	2	2.1	
18-20	10	10.5	
21-55	76	80.0	
56-64	6	6.3	
Above 64	1	1.1	
Ethnicity			100
Malay	54	56.8	
Chinese	14	14.7	
Indian	19	20.0	
Others	8	8.5	
Highest educational level completed			100
Diploma/Foundation	27	28.4	
Degree	43	45.3	
Master	10	10.5	

Others	15	15.8	
Employment status			100
Full time	36	37.9	
Part-time	2	2.1	
Self-employed	5	5.4	
Retired	1	1.1	
Housewife	3	3.2	
Student	45	47.4	
Unemployed	3	3.2	
Current residence			100
Selangor	49	51.6	
Wilayah Persekutuan	6	6.3	
Terengganu	7	7.4	
Sabah	4	4.2	
Johor	6	6.3	
Perak	6	6.3	
Pulau Pinang	5	5.3	
Others	12	12.6	
Job sector			100
Non-environmental governmental sector	13	13.3	
Non-environmental private sector	44	46.7	
Governmental private educational institution	25	26.7	
Governmental private environmental sector	13	13.3	
Family economic status			100
B40 (Below RM 4359)	45	47.4	
M40 (RM 4360-RM9619)	38	40.0	
T20 (Above RM 9620)	12	12.6	
Respiratory disease survey			24.21
Family members suffer from respiratory disease	12	12.6	
Family members have been hospitalized due to respiratory disease	11	11.6	
Total number of family members that have been hospitalized due to respiratory disease			100
1	8	76.9	
2	2	15.4	
3	1	7.7	
More than 3	0	0.0	

Health Conditions Related to Air Pollution

95 respondents from non-university students have reported that twelve or 12.6% among them have family members that suffered from respiratory disease or health condition. Among this 12.6% of respondents, only one respondent's family member was not hospitalized. It shows that the rate of hospitalization is very high; which is 91.67%. However, the data do not show the severity and type of respiratory disease among the family members of respondents.

Perception of Current Air Quality

Most respondents rated their living atmospheric condition as "s*lightly polluted but cause on harm*", with the amount of 55 respondents or 55.8% being positive on the perception. Nevertheless, there are 31 respondents or 32.6% who rated their living place as" Somewhat *polluted and causing harm towards ecosystem and health*."

Since the analysis aims to record the data of public perceptions of air pollution in Malaysia before and after the Movement Control Order (MCO), hence, the respondents' perception of air pollution for both aspects is recorded as well in Figure 1. These findings align with Air Pollutant Index (API) data collected from urban areas like Cheras, Kuala Lumpur, where the API decreased from 62 before MCO to 34 after MCO (Abdullah et al., 2020), supporting the conclusion that air pollution levels improved post-MCO. 54.7% of respondents rated that the air pollution is" Somewhat *polluted and causing harm towards ecosystem and health*", but the number decreased to 35.8% after the MCO period. It shows a drastic decline of approximately 20% within the given period." *Somewhat polluted and causing harm towards ecosystem and health*" was rated the most before MCO. It also shows a slight decline in the atmospheric condition of *"severely polluted"*, declining from 16 before MCO to 10 respondents after MCO.

On the contrary, the rating of air pollution level of "*Slightly polluted but causes no harm*" is as much as 24.2% and increased to 42.1 % after the MCO period. It shows improvement in air quality as this increased ratio has declined the pollution severity and harm based on the data interpretation.

However, respondents' perception of current air quality conditions is flexible as they have different levels of exposure to air pollution in their own household areas. For instance, among 11 respondents that stated with hospitalized family members that suffered from respiratory diseases, most of them rated their place as severely polluted (two respondents) and somehow polluted and causing harm to the ecosystem and health (five respondents). These two respondent percentages are as high as 63.63% suggesting that air quality perception of air quality may be correlated with respiratory disease status.
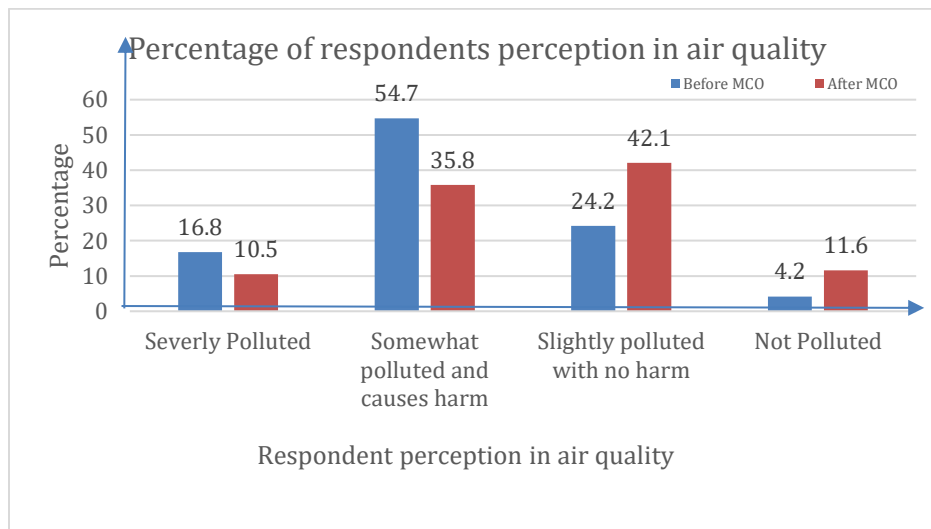

Figure 1. Comparison of respondents' perception of air quality before and after the MCO period from the present study.

Table 2 presents Chi-Square results to test whether there is significant association between perception of air quality before and after the MCO period from the present study.

Table 2: Perception of air quality before and after the MCO period from the present study

Perception	Before MCO	After MCO	Total	Expected Frequency
Severely polluted	16.8	10.5	27.3	13.61
Somewhat polluted	54.7	35.8	90.5	45.33
Slightly polluted	24.2	42.1	66.3	32.29
Not polluted	4.2	11.6	15.8	8.77
Total	100.00	100.00	200.0	100.00

Based on a chi-square distribution table for a degree of freedom (df) of 3 and a significance level (α) of 0.05, it was determined that the critical chi-square value is approximately 7.815. This critical value serves as the threshold beyond which we would reject the null hypothesis. Upon calculating our chi-square value to be 8.589, it surpassed the critical chi-square value of 7.815 for the specified α and df. Consequently, we reject the null hypothesis. This outcome, obtained through the chi-square test at a 0.05 significance level with 3 degrees of freedom, signifies a notable association between the perceived air quality before and after the MCO. The substantial difference in perception is unlikely due to random chance, suggesting a discernible impact of the MCO on how respondents perceive air quality.

Perception of Air Pollution Factors

In order to interpret and perceive the air quality environment in respondents' household area, respondents ought to rank which factor they believe to contribute the most or least to their residential area. Respondents can choose more than one factor to determine the exact factor of air pollution in their respective household areas. The results of Figure 2 showed that most of the respondents believed that air quality in their household areas is mainly due to motor vehicle and industrial emissions. 54 of the respondents considered that motor vehicle emissions had the highest impact on air quality, while 49 respondents had the same thought for industrial emissions. Since the respondent number range between two factors is not significant,it suggested that emissions are the overall main cause. The factors are subsequently followed by open-air burning and haze episodes. The figures for these aspects do not have large differences as well. The least concern of air pollution factors is classified as "other factors". However, "other factors" are unknown as it is not shown in the survey form.
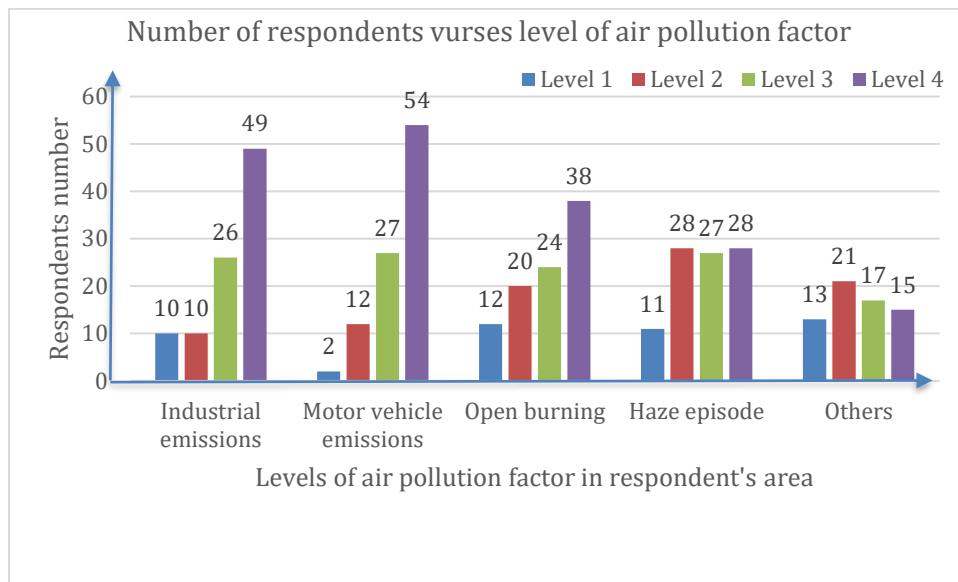

Figure 2. Shows the number of respondents with the corresponding of different air pollution factor levels

Awareness of Air Pollution-related Information

The awareness of respondents on air pollution is recorded and tested by an awareness score obtained from nine correlated questions. These questions consist of general or scientific knowledge linked with air pollution issues where as shown in Table 3. Generally, the respondents have a different awareness of air pollution information with the percentage of correct answers got by respondents ranging from 33.68%-75.79%. For instance, more than half of the respondents (56 respondents) did not give an actual answer to the first question; "*The Department of Environment (DOE) of Malaysia website updates the Air Pollution Index (API) on the official website every hour*".

Table 3. Overall results of the public awareness of air pollution from the present study

Questions	Choices of respondents in number			Actual Answer	Percentage of actual answer
	True	False	N/A		
The Department of Environment (DOE) of Malaysia website updates the Air Pollution Index (API) on the official website every hour.	34	5	56	True	35.79
If the API value is lower than 50, hence it is considered "good" in terms of API.	45	5	45	True	47.37
Vehicles using petrol can emit carbon dioxide , methane and nitrous oxide.	72	10	13	True	75.79
Environmental Quality Act 1974 Act 127) is an act related to the prevention, abatement, control of pollution and enhancement of the environment.	52	5	38	True	54.73
Severe haze episodes over the past few years were mostly caused by the burning of underground peatland soil in Malaysia and neighbouring countries.	68	10	17	True	71.58
Malaysian Air Pollutant Index (API) standards are more strict and higher than World Health Organization (WHO) guidelines.	32	20	43	False	33.68
Air quality with API values is calculated based on the average concentration of air pollutants namely SO2, NO2, CO, O3, PM2.5 and PM10	49	5	41	True	51.58
Malaysia has the most serious air pollution in ASEAN.	26	46	21	False	48.42
Respiratory diseases were one of the top 5 leading causes of death among Malaysians.	64	9	21	True	67.38

Opinions on Environmental Protection

The opinions and attitudes of respondents on environmental protection were evaluated via nineteen questions. Some of these questions are pro-environmental that revolve around the environment as the main priority and significance. On the contrary, some of the questions are not pro-environmental that place environmental issues and protection below other importance such as economic and self-centred value. For instance, "*In order to protect the environment, Malaysia needs economic growth.*" is one of the economic and environmental argumentative questions. Table 4 clearly shows that the perceptions of individuals on environmental protection are not high. For pro-environmental protection questions, the mean range is located between "*neutral"* to *"agree"*, and some may be lower than the mean value of neutral (3). For instance, the mean value of "*The Malaysian government should reduce environmental pollution by using national assets only*" only took a value of 2.95. It could be observed that respondents are still acting neutral by choosing environmental health and economic growth. However, it shows the highest mean value in pro-environmental individual views compared with national visions. The statement that *I am always concerned about environmental pollution in daily life* obtained the highest mean value. In contrast, respondents view themselves mostly as neutral in statements of national environmental protection. The apparent discrepancy between the respondents' positive engagement in personal environmental efforts and their neutrality towards economic contributions can be attributed to socio-economic factors. A significant portion of respondents belong to the B40 income group (47.4%), representing Malaysia's lower-income segment. While individuals are willing to participate in non-financial efforts like recycling or using public transport, their ability to make financial contributions is limited by economic constraints. This highlights how economic realities influence environmental engagement, particularly in the aftermath of the COVID-19 pandemic, when financial burdens were heavier.

Table 4. Results of public perception on environmental protection from the present study

Statements	Perception scales from respondents (Number)					
	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	Min number
I am always concerned about environmental pollution in daily life.	3	3	16	46	27	3.96
In order to protect the environment Malaysia needs economic growth.	8	12	18	34	22	3.50
I am willing to share environmental facts with my friends.	5	3	17	41	28	3.85
The air quality in Malaysia is getting better as the Ministry of Environment and Water is doing more fundamental scientific research.	9	13	36	23	14	3.21
Malaysians worry too much about industrial development polluting the atmosphere and degrading human health.	8	25	25	26	11	3.07
Educating younger generations about the knowledge of environmental protection (e.g. encouraging carpooling) via school syllabus is an effective way to solve environmental pollution.	2	4	13	33	43	4.17
I do not mind an increase in taxes if the extra money is used to prevent further atmospheric pollution.	7	21	26	29	12	3.19
Protecting the environment should be given first priority always, even if it causes slower economic growth and some loss of jobs.	7	10	33	25	20	3.43
I often go carpooling to decrease environmental pollution.	10	8	32	26	17	3.27
It is meaningless to do what I can for the environment.	31	22	22	10	10	2.43
Haze is normal for economic development.	15	25	27	15	13	2.85
I do not mind paying more money to buy a hybrid car instead of a normal car for the sake of being environmentally friendly.	6	17	27	20	15	2.90
The economic growth of Malaysia is currently more important than environmental protection.	11	20	38	15	11	2.95
I am willing to be a volunteer in curbing environmental pollution.	5	7	29	35	18	3.54
Air pollution caused by cars is extremely dangerous for health	4	6	18	37	29	3.82
I have confidence that the air quality in Malaysia will improve every year with the help of individual, communities and nations	6	10	24	29	25	3.52
The Malaysian government should reduce atmospheric pollution by using national assets only.	10	13	30	26	15	3.20
Wearing a mask every day during outdoor activities could protect us from polluted air.	7	7	26	33	22	3.59

Willingness to Pay for Environmental Protection

According to the survey findings, participants who had family members affected by respiratory ailments exhibited a notably greater willingness to pay (WTP) compared to those without such family health issues. However, various demographic variables like gender, age, education level, income, and parenthood did not display a notable impact on the extent of WTP. Furthermore, the survey did not identify any significant correlations between WTP and awareness levels, or between WTP and perceived air quality.

Discussions

Referring to the second section of the results; "*Health conditions related to air pollution*", there are 91.67% of respondents are hospitalized for respiratory disease treatments. It may induce that the respondent's residential area has a relatively higher air pollution index (API) or is severely polluted. These hospitalized family members were those who may have respiratory problems due to childbirth, immune weakness or environmental factors. Nevertheless, respondents who had hospitalized family members do not have a higher significant value of WTP. This is because 33 % of these particular respondents are B40 status with others are M40 financial status, so it is interpreted that they do not have full ability and source for extra financial support and payment in air pollution issue awareness (Rahman et al., 2021). These groups may also suffer from additional financial burdens due to the COVID-19 world economic crisis as suggested by (Borio, 2020). There are no T40 respondents' family members that are hospitalized. T40 individuals may have more financial sources for self-protection from air pollution that occur in residential areas and decrease their risk of respiratory problems and hospitalization.

Referring to the opinion on environmental perception, there is a lack of positive respondents in collaborating with national efforts in order to reduce air pollution in terms of finances. It may be due to the increase in daily financial credits and taxes. There is also a negative outcome in choosing a hybrid car rather than a normal-engine car. For another reason, hybrid transportation is still not popular and applicable in Malaysia as in Western countries. Hybrid cars are also higher in price (Yong et al., 2013). Malaysians are still not exposed to hybrid car accessories and facilities from the views of advertisement, promotion or exposure from national plans, this may lead to more confidence among respondents for having an engined car. Respondents are also reacting neutrally between economic importance and natural environment pollution problems. The COVID-19 pandemic may alter or influence their views on economic importance as there are economic crises that are also affected by the Russian- the Ukraine wars. They think that the economy and environment are neutrally important without acting biasedly or extremely on either side. For instance, 2.95 marks have been allocated for the "*economic growth of Malaysia is currently more important than environmental protection*". In contrast, individuals' awareness statements tend to have higher mean scores. Individuals tend to act on personal initiative rather than with groups or nations. They might think that it may be more effective in conveying the message directly to others via sharing or acts. Friends are also more likely to be influenced by individuals via socializing. Most of the individuals gave the most positive impact of pollution awareness in aspects of education. Education is important to educate youngsters and students so they to build and start good habits by concerning environmental studies via public awareness. University-specialized studies on environmental pollution such as ecotoxicology, conservation and management of limnology help to create more innovative, creative and productive environmentalists to have more awareness of air pollution issues. Education also helps in further research in environmental tragedy contaminations such as the polluted Kim Kim River (Yap & Peng, 2019).

Air pollution exerts significant adverse effects on the environment, primarily impacting essential resources such as soil and clean water. The quality of soil and water bodies is compromised by air pollution through the contamination of precipitation that interacts with these environmental elements (Manisalidis et al., 2021). The

detrimental substances present in air pollution not only pose threats to human health but also jeopardize the well-being of various other organisms, ultimately diminishing the overall environmental quality. Air pollution is intricately linked to ongoing climate changes, where pollutants like black carbon, methane, tropospheric ozone, and aerosols play a role in altering the amount of incoming sunlight, consequently elevating the Earth's temperature. This temperature rise, in turn, leads to the thawing of ice, icebergs, and glaciers. Several environmental ramifications arise from air pollution, including acid rain, haze, and climate change. Ioannis (Manisalidis et al., 2021) emphasized that global climate change stands as a critical concern associated with air pollution, recognized for its "greenhouse effect" that typically maintains the Earth's temperature stability. Unfortunately, human-driven anthropogenic activities have disrupted this crucial temperature-regulating mechanism by emitting substantial volumes of greenhouse gases.

Air pollution also has a long-term effect on our society because people that are exposed to high concentrations of air pollutants give serious issues with their health. Ioannis (Manisalidis et al., 2021) studied the long-term effect of air pollution which are neurological and psychological effects on society. For example, adults and children have been observed to have neurological effects after having extended-term exposure to air pollutants. Extended exposure to air pollutants can be a factor in psychological complications. Autism, retinopathy, fetal growth and also low birth weight.

Air pollution is linked to various respiratory system diseases, influencing asthma prevalence, onset, symptoms, and treatment response. The quality of air holds significant importance in the early development of asthma and serves as a trigger for asthma exacerbations later in life. Early-life exposure to air pollutants, particularly NO_2, heightens the risk of childhood asthma. Neidell's research (Neidell, 2004) demonstrates a notable association between carbon monoxide (CO) primarily emitted by vehicles and increased hospitalizations for asthma among children aged 1 to 18. Studies have revealed that exposure to air pollution, particularly traffic-related pollutants during infancy, is correlated with reduced lung function and persistent respiratory issues in susceptible children. Moreover, heightened exposure to outdoor air pollution is linked to more frequent usage of rescue inhalers among individuals with asthma.

The effects of air pollution extend to lung cancer, which is unsurprisingly prevalent in urban areas. Studies have demonstrated a correlation between increased road traffic and higher incidences of lung cancer. Moreover, ambient air pollution, particularly NO_2, has been linked to an elevated risk of lung cancer (Jiang et al., 2016). Consequently, the health risks posed by air pollution are substantial. Deteriorating air quality amplifies respiratory conditions like asthma and bronchitis, significantly heightens the risk of critical diseases such as cancer, and places a significant financial burden on the healthcare system.

According to the survey results, the majority of respondents identified motor vehicle and industrial emissions as major contributors to air pollution (Hong et al., 2021). Emissions from vehicles encompass pollutants such as carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxide (NO_x) in the forms of nitric oxide (NO) and nitrogen dioxide (NO_2), hydrocarbons (HC), sulfur oxides (SO_x) in the forms of sulfur dioxide (SO_2) and sulfur trioxide (SO_3), and particulate matter ($PM10$). These toxic pollutants released by vehicular emissions can significantly impact human health when individuals are exposed to them repeatedly over an extended period. The insights from this survey align with the findings of Zahid's study (Hosseinzadeh-Bandbafha et al., 2018), which indicated a decrease in the Air Pollutant Index (API) during the Movement Control Order (MCO) implementation in suburban and urban areas. This decline was attributed to various limitations on public movement, gatherings, as well as the closure of educational institutions, government offices, and commercial establishments during the MCO, except for essential services. Consequently, factors such as reduced traffic density, diminished industrial activity, and a decrease in overall social activities contributed to this improvement in air quality.

In the study made by Nurainshafika (Sahat et al., 2022), the fast increase in urbanization and industrialization has resulted in the progressive extension of suburbs into closer proximity to industrial facilities in certain locations which worsened the problem of air pollution. Industrial activities, which contribute to the level of the Air Quality Index (API), require special care. Enforcing government laws on industrial activity should monitor the Air Quality Index (API) value to ensure it stays at a healthy level.

Air pollution disproportionately impacts the health of individuals from lower socioeconomic backgrounds (Jiao *et al*. 2018). Those with higher socioeconomic status possess more resources to shield themselves from heightened exposure, such as using private transportation instead of public, working indoors rather than outdoors, residing in well-constructed homes, and potentially having access to climate control measures like indoor air filtration (Hajat et al., 2015; Abdullah et al., 2023; Sarkar et al., 2023). As one's socioeconomic status improves, so does the influence of air pollution on their health. Consequently, it is imperative for the government to implement public policies aimed at enhancing the ability of lower socioeconomic groups to mitigate air pollution and reduce the associated health hazards.

Conclusion

In conclusion, throughout this survey, we can see that most of our society is fully aware of the air quality in Malaysia and how the air condition affects human health. Public perceptions about air pollution are very important in order to raise awareness in understanding and predicting health symptoms and diseases caused by the relatively low-level annual mean of air pollution. Even at levels below government safety standards, air pollution can pose substantial health risks, especially if residents recognize and interpret it as hazardous. One significant message is that while telling individuals about the health implications of exposure, caution should be implemented since health risk perception might lead to extra health repercussions. Furthermore, although Malaysians generally express a positive attitude toward personal environmental initiatives, economic constraints often limit their willingness to invest financially in environmental protection. Future policies should take these economic factors into account when promoting sustainability efforts.

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Conflict Of Interest

The authors declare no conflict of interest.

Authorship Contribution

Conceptualization, Krishnan Kumar, Chee Kong Yap and Wan Hee Cheng; Writing—review and editing, Tze Yik Austin Hew, Muhammad Adam Roslan, Jia Ming Chew, Hideo Okamura, Yoshifumi Horie, Meng Chuan Ong, Ahmad Dwi Setyawan and. All authors have read and agreed to the published version of the manuscript.

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