

Awareness of Air Pollution Effects on Cardiopulmonary Health among Students at University of Sunderland.

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Abstract

Introduction: as air pollution continues to be a major source of concern across the global community, epidemiological evidence of its effects on the cardiopulmonary health also continue to rise. It's then crucial that the proper awareness of its effect on the cardiopulmonary health be extensively studied as this will play a crucial role to alleviate the menace of air pollution while at the same time, improve how the global study aim: this study aimed to investigate the awareness of air pollution effect on cardiopulmonary health among student at university of sunderland.

Methods: a total of 488 participants completed the questionnaire. Descriptive and pearson correlation coefficient analysis was performed using spss mention the version used.

Results: the data analysis revealed a high level of awareness regarding the effects of air pollution on cardiopulmonary health. When examining the correlation between ethnicity and awareness, participants from white and black backgrounds demonstrated a strong positive relationship. In contrast, there was a weak negative correlation between awareness and participants from asian and mixed backgrounds.

Conclusion: the knowledge gained from this study will support the global community in developing comprehensive policies and measures to tackle air pollution on a wider scope, rather than in isolated efforts. Additionally, since perspectives on air pollution vary due to socio-economic and cultural differences, this study will contribute to a more unified awareness. This, in turn, will help shape a global policy or strategy to effectively combat air pollution.

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I. Introduction

Recent studies have identified air pollution as one of the leading environmental health(DeVries, Kriebel& Sama, 2017; Sofianopoulou, et al., 2019; Ihedike et al., 2024} concerns and statistically, it's considered to have led to 6.4 million deaths in 2015 (Landrigan, 2016), 4.2 million premature deaths due to outdoor air pollutant (WHO, 2018), 3.1 million deaths as a result of gaseous air pollutants (Robert and Gokhan, 2018), annual financial loss tuning to \$1-3 trillion, 3.1% lost in disability-adjusted life years (DALY) (WHO, 2018) and a major contributor to reduced cognitive ability, depression, increased anxiety, cardiovascular and pulmonary diseases (Tzivian et al., 2015). Air pollution is also said to have led to 60-80% cardiovascular related death (Burroughs and Rollins, 2017). In addition, it has harmful effects on pregnancy and lead to long-term consequences that can increase vulnerability to illness in adulthood (Anenberg et al., 2013)

With these few statistical studies of the detrimental effects of air pollution on health, and the growing interest in the study of air pollution (Agbokey et al., 2019; Ihedike et al., 2024), one would expect that the level of awareness of this non-communicable epidemic ought to have reached the global community and its effects on health should have depreciated. However, several studies have shown that the negative impact of air pollution on general well-being is still increasing at a sporadic rate (Agbokey et al., 2019; Amegah and Agyei-Mensah, 2017; Amegah and Jaakkola, 2016). Hence, it's crucial to understand the reasons behind pollution in the atmosphere and also properly raise the awareness of air pollution. To corroborate this, a study by Noel et al., (2021) on public health risk perceptions on ambient air pollution claimed that the public definition and knowledge of air pollution is far different from the scientist community explanation, and this might have majorly contributed to the losing battle in defeating this menace. (Noel et al., 2021).

II. Method

Study Design

A cross-sectional descriptive study design was used to assess the awareness of air pollution effect on cardiopulmonary health among students at the University of Sunderland. A descriptive and Pearson correlation coefficient statistic was also used to present the findings of the various variables used to determine the level of awareness of student on the effects of air pollution. A validated questionnaire was employed to evaluate the

level of awareness of air pollution on cardiopulmonary health among students at the University of Sunderland (Kettler, 2019).

Study Sample

This study was conducted at the University of Sunderland, England located in Sunderland in the Northeast of England at Latitude: 54° 54' 16.56" N and Longitude: -1° 23' 29.40" W (Johnson and Potts, 2013). The study participants included registered students at the University of Sunderland. A questionnaire was used for data collection. The age, background, and study level of participants were also considered in this study. A study population of greater than 500 students across various departments was projected for this study.

Sample Size:

This study required an estimated sample size of at least 500 bona fide students from the University of Sunderland. However, questionnaires were distributed to 680 students, with 488 responding. As many projected study participants were on summer break, the final sample size was 488. Assuming a 95% confidence level, a $\pm 5\%$ margin of error, and a standard deviation of 0.5, the analysis was conducted accordingly.

Sampling Method:

A simple random sampling method was used to ensure a diverse selection of participants across various courses and departments, online questionnaires were distributed to randomly selected students at the University of Sunderland. This approach aimed to achieve an efficient and unbiased sample. The study included participants of any sex and ethnicity, aged 18 years or older. However, all participants were required to be registered students at the University of Sunderland, studying at either of its two campuses in Sunderland.

Instrument

❖ This study aimed at investigating the level of awareness of students at the University of Sunderland on air pollution effects on cardiopulmonary health. Instrument used was questionnaire through a Qualtrics survey. A link was generated by Qualtrics and sent to potential participants through various social media groups such as WhatsApp, Facebook, and X. The bar-code to the online questionnaire was also printed out and shared to potential study participants in classes and libraries. Data from the filled questionnaire was extracted using a Microsoft Excel Package. The code was shared among student at various departments (undergraduate, and postgraduate). The questionnaire consists of the following constructs of the study participants: gender, age, academic status, ethnicity, view on the effect of air pollution on general health, awareness of air pollution ability to cause or exacerbate respiratory disease awareness of the link between air pollution and lung cancer, awareness of children vulnerability to the effects of air pollution on their lung's development, awareness of the positive link between air pollution and increase respiratory infection, awareness of the environmental factors (air pollutants) they are exposed to..

All questions excluding those on demographic characteristics of the study participants were formatted on a five-point scale ranging from 1 = strongly agree to 5= strongly disagree. To also examine respondent consistency in answering questions, some questions scale ranges from five-point scale from 1 = Definitely Yes to 5= Definitely No.

A validated questionnaire was employed in this study.

Analytical Approach

The responses from the online questionnaire from the Qualtrics survey were first exported into an Excel file and uncompleted and or inconsistent responses were deleted. The data were analysed using SPSS version 28 (IBM SPSS Statistics)

Descriptive statistics (Frequency, percent, bar chart, and cumulative percent) was used to describe the level of awareness of air pollutant effect on cardiopulmonary health. Also, Pearson's correlation coefficient was conducted to examine the inter-correlation among ethnicity and the awareness of air pollution effects on cardiovascular health and pulmonary health. All statistical tests were two-tailed and alpha of 0.05 or less was considered statistically significant.

III. Result

Demographic Data

Demographic information (Figure 1) from the data analysis includes participant's age and gender; 61% of the participants between the ages of 26 and 35 years, 18.1% of the participants between the ages of 36 and 45 years, 15.7% of the participants between the ages of 25 years and below, and 61% of the participants between

the ages of 45 years and above. However, 55.2% of the participating students were women, whereas only 44.8% are men.

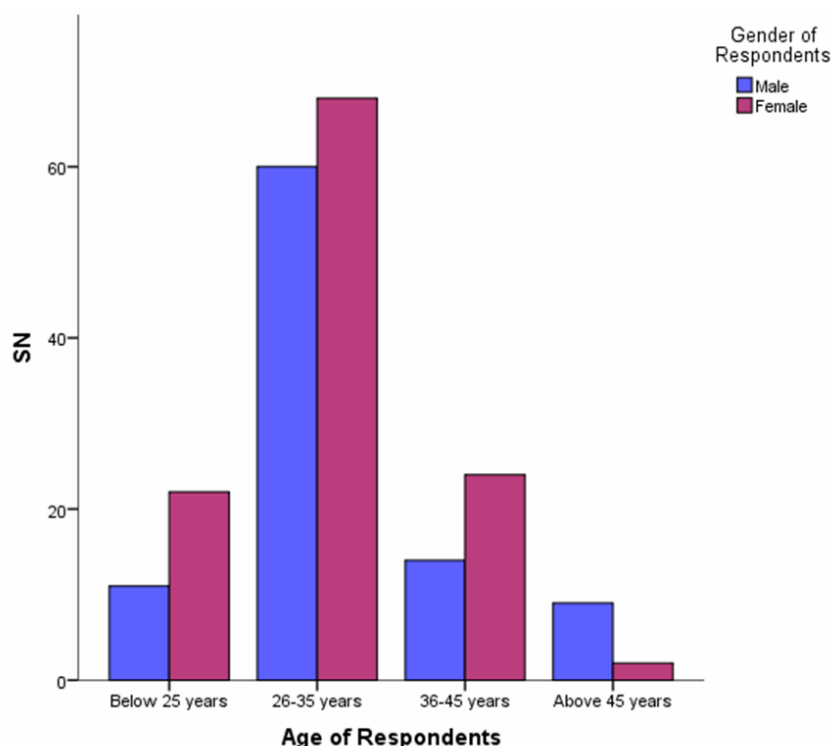


Figure 1: Display of response by Age.

In the table below, in terms of the educational status and ethnicity of the respondents, 24.8% were undergraduates and 75.2% postgraduates (Table 2). Also, 4.3% of the respondents were white, 1.9% of the respondents were Mixed and Multiple ethnic groups, 2.9% of the respondents were Asian or Asian British, and 91.0% of the respondents were Black, African, Caribbean, Black British, or other black ethnic groups (Table 3).

Table 1: Educational status

	Frequency	Percent	Valid Percent
Undergraduate	121	24.8	24.8
Postgraduate	367	75.2	75.2
Total	488	100.0	100.0

Table 2: Ethnicity

	Frequency	Percent	Valid Percent	Cumulative Percent
White	61	4.3	4.3	4.3
Mixed and Multiple ethnic group	57	1.9	1.9	6.2
Asian/Asian British	75	2.9	2.9	9.0
Black/African/Caribbean/Black British, Others	295	91.0	91.0	100.0
Total	488	100.0	100.0	

Table 3 presents respondents' perceptions of the impact of air pollution on their health. A significant majority (75.7%) believe air pollution has affected their health, with 259 (53.3%) responding "definitely" and 109 (22.4%) stating "probably." This indicates a strong perceived link between pollution and health issues. A smaller group, 40 (8.1%), expressed uncertainty, suggesting a lack of clear correlation. The variations in confidence and skepticism likely stem from personal experiences and local pollution levels, highlighting widespread awareness of air pollution's potential health impact.

The same table also reveals respondents' views on whether air pollution has affected the health of their family or friends. A substantial 69.5% acknowledge an impact, with 214 (43.8%) saying "definitely" and 126 (25.7%) "probably." However, 59 (11.9%) were uncertain, reflecting ambiguity in their perception of the connection.

Table 3:

Item	Definitely Yes	Probably Yes	Might or might not	Probably not	Definitely not
In your view, has air pollution ever affected your health	259 (53%)	109 (22.4%)	40 (8.1%)	65 (13.3%)	15 (2.9%)
Has air pollution ever affected the health of any of your family or friends	214 (43.8%)	126 (25.7%)	59 (11.9%)	63 (12.9%)	59 (5.7%)

Table 4 below indicates respondents' awareness of specific respiratory conditions that can be worsened or caused by air pollution. A significant majority of 421 (86.2%) are aware of such conditions, while a smaller portion of 67 (13.8%) expresses uncertainty (maybe).

The result also reveals respondents' familiarity with the association between air pollution and lung cancer. A majority 299 (61.4%) are aware of this link, indicating notable recognition of the connection. About 82 (16.7%) respond with uncertainty (maybe), while 100 (20.5%) are not aware, and a small portion 7 (1.4%) cannot provide a definitive answer.

Also, from table below, result indicates respondents' awareness of the heightened vulnerability of children to the effects of air pollution on their lung development. A significant majority of 384(78.6%) are aware of this susceptibility, demonstrating a notable recognition of the potential risks. Approximately 39 (8.1%) respond with uncertainty (maybe), 56 (11.4%) are not aware, and a small proportion of 9(1.9%) cannot provide a definite answer. This distribution underscores the awareness among respondents about the specific vulnerability of children to air pollution's impact on lung development, suggesting an understanding of the importance of safeguarding children's health from environmental pollutants. However, the presence of uncertainty and a lack of awareness highlight opportunities for further education on this topic.

Lastly, the result also reflects respondents' understanding of whether air pollution can exacerbate symptoms for individuals with allergies or respiratory infections. A significant majority of 432 (88.6%) acknowledge this connection, suggesting widespread recognition of the impact of air pollution on these health conditions. About 42 (8.6%) respond with uncertainty (maybe), while only 5(1.0%) believes there is no such effect, and 9 (1.9%) are unable to provide a definite answer. The results emphasize a clear awareness among respondents that air pollution can indeed worsen symptoms for those with allergies or respiratory infections.

Table 4. Aawareness of specific respiratory conditions that can be worsened or caused by air pollution

Item	Yes	Maybe	No	Can't say
Are you aware of any specific respiratory conditions that can be exacerbated or caused by air pollution?	421 (86.2%)	67 (13.8%)	0	0
Have you heard about the link between air pollution and lung cancer?	299 (61.4%)	82 (16.7%)	100 (20.5%)	7 (1.4%)
Are you aware that children can be particularly vulnerable to the effects of air pollution on their lung development?	384 (78.6%)	39 (8.1%)	56 (11.4%)	9 (1.9%)
Do you know if air pollution can worsen symptoms for individuals with allergies or respiratory infections?	432 (88.6%)	42 (8.6%)	5 (1.0%)	9 (1.9%)

Table 5 below portrays respondents' exposure to dust from sources like stone, wood, and textiles. A substantial portion 296 (60.5%) confirms exposure. About 117 (23.8%) express uncertainty (might or might not), and a smaller fraction of 16 (8.1%) believe they are probably not exposed.

Also, the result presents respondents' exposure to tobacco and cigarette smoke (passive smoking) as an environmental factor. A significant portion 221 (45.2%) indicates exposure. About 146 (30%) express uncertainty (might or might not), and 51 (10.5%) believe they are probably not exposed and 70 (14.3%) definitely not.

Furthermore, the result showcases respondents' exposure to smoke from sources like fumes and soldering. The responses indicate that a considerable proportion of respondents 163 (33.3%) experience this exposure. About 144 (29.5%) express uncertainty (might or might not), and 98 (20%) believe they are probably not exposed.

The result presents respondents' exposure to exhaust gases as an environmental factor. A considerable proportion of respondents 158 (32.4%) indicate exposure. About 161 (32.9%) express uncertainty (might or might not), and 104(21.4%) believe they are probably not exposed.

Lastly, the result in also portrays respondents' exposure to gases and solvents as environmental factors. A significant portion of respondents 149 (30.5%) indicate exposure of 128 (26.2%) express uncertainty (might or might not), and 125 (25.7%) believe they are probably not exposed.

Table 5 Analysis and Interpretation of Data on Environmental Exposure

Item	Definitely Yes	Probably Yes	Might or might not	Probably not	Definitely No
What environmental factors are you regularly exposed to: Dust (Stone, wood, textile)	296 (60.5%)	117 (23.8%)	40 (8.1%)	35 (7.6%)	0
What environmental factors are you regularly exposed to: Tobacco and Cigarette Smoke (passive smoking)	221 (45.2%)	146 (30%)	51 (10.5%)	70 (14.3%)	0
What environmental factors are you regularly exposed to: Smoke (Fume, Soldering)	163 (33.3%)	144 (29.5%)	98 (20%)	83 (17.1%)	0
What environmental factors are you regularly exposed to: Exhaust gases	158 (32.4%)	161 (32.9%)	104 (21.4%)	65 (13.3%)	0
What environmental factors are you regularly exposed to: Gases and Solvent	128 (26.2%)	149 (30.5%)	125 (25.7%)	86 (17.6%)	0

Table 6 provides insights into the daily walking distances of respondents. A significant portion of respondents 446 (91.4%) walk distances ranging from under 5 kilometers to 25 kilometers. A smaller portion, 26 (5.2%), walks between 26 and 35 kilometers, while an even smaller proportion, 16 (3.3%), walks distances above 35 kilometers. These results reflect a varied range of daily walking habits among the respondents.

Table 6: How many distances do you walk in a day?

	Frequency	Percent	Valid Percent
Under 5km	216	44.3	44.3
5Km - 25km,	230	47.1	47.1
26Km - 35km	26	5.2	5.2
Above 35km	16	3.3	3.3
Total	488	100.0	100.0

The result in the table 7 below reflects respondents' experiences of encountering air pollution during road walks. A substantial portion 71.0% of respondents agree with this statement. About 15.7% neither agreed nor disagreed, suggesting some uncertainty or variation in respondents' experiences. A smaller percentage of 10.0% somewhat disagreed, indicating a milder level of agreement, and 2.4% strongly disagreed. The results show that a large and variable percentage of people regularly encounter air pollution when strolling along roads.

The result indicates respondents' anticipation of air pollution's impact on their cardiovascular health during road walks. A substantial portion 68.6% agrees with this statement. About 23.3% neither agree nor disagree, suggesting some uncertainty in respondents' anticipation. A smaller percentage of 5.7% somewhat disagrees, indicating a milder level of anticipation, and 2.4% strongly disagree. This distribution shows that most respondents believe that roadside air pollution may negatively affect their cardiovascular health, though to varied degrees.

The result presents respondents' anticipation of air pollution's impact on their pulmonary health during road walks. A significant portion 72.9% agrees with this statement. About 19.5% respondents neither agreed nor disagreed, suggesting some uncertainty in respondents' anticipation. A smaller percentage of 5.2% somewhat disagrees, indicating a milder level of anticipation, and 2.4% strongly disagree. This distribution shows that most people are concerned about the effects of air pollution on their lungs while going on walks near roads, yet their levels of concern differ.

The result presents respondents' anticipation of the impact of various environmental factors on their pulmonary health. A significant portion 80.5% agrees with this statement. About 15.2% respondents neither agreed nor disagreed, indicating some uncertainty in respondents' anticipation. A smaller percentage, 2.4%, somewhat disagrees, and 1.9% strongly disagrees. According to these results, the vast majority of respondents believe that environmental variables, such as air pollution, may have an effect on their lung health; however, they express this belief with varying degrees of agreement.

The result presents respondents' anticipation of the impact of various environmental factors on their cardiovascular health. A substantial majority 76.7 % agrees with this statement. About 19.0% respondents neither agreed nor disagreed, suggesting some uncertainty in respondents' anticipation. A smaller percentage, 3.3% somewhat disagrees, and 1.0% strongly disagrees.

Table 7: Awareness of Air Pollutants Presence in the Environment and its Effects on the Cardiopulmonary health

Item	Strongly agreed	Somewhat agreed	Neither agreed nor disagreed	Somewhat disagreed	Strongly disagreed
I often encountered air pollution when I carry out road walk	200 (41.0%)	151 (31.0%)	76 (15.7%)	49 (10.0%)	12 (2.4%)
I anticipate that air pollution can impact my cardiovascular health when I carry out a road walk.	151 (31.0%)	184 (37.6%)	114 (23.3%)	27 (5.7%)	12 (2.4%)
I anticipate that air pollution can impact my pulmonary health when I carry out a road walk	156 (31.9%)	200 (41.0%)	95 (19.5%)	25 (5.2%)	12 (2.4%)
I anticipate that exposure to any environmental factors above can impact my pulmonary health	193 (39.5%)	200 (41.0%)	74 (15.2%)	12 (2.4%)	9 (1.9%)
I anticipate that exposure to any environmental factors above can impact my cardiovascular health	195 (40.0%)	179 (36.7%)	93 (19.0%)	16 (3.3%)	5 (1.0%)

The result in the table 8 below reflects respondents' familiarity with measures or strategies that promote the use of clean and renewable energy sources, such as solar or wind power, and their relationship to protecting cardiopulmonary health. A majority of 69.0% respondents are familiar with these measures, suggesting a substantial awareness of the link between clean energy and health protection. About 16.2% respond with uncertainty (maybe), and 14.8% are not familiar with such measures.

The result reveals respondents' awareness of initiatives aimed at raising public awareness about air pollution and its impacts on health. More than half of the respondents 52.9% are aware of such initiatives, indicating a notable level of recognition of efforts to educate the public. About 24.8% respond with uncertainty (maybe), while 18.6% are not aware of these initiatives, and 3.8% cannot provide a definite answer.

Table 8 Awareness of Air Pollutants Presence in the Environment and its Effects on the Cardiopulmonary health

Item	Yes	Maybe	No	Can't say
Are you familiar with any measures or strategies promoting the use of clean and renewable energy sources, such as solar or wind power and protecting cardiopulmonary health?	337 (69.0%)	79 (16.2%)	72 (14.8%)	0
Do you know if there are any initiatives aimed at raising public awareness about air pollution and its impacts on health?	258 (52.9%)	121 (24.8%)	91 (18.6%)	18 (3.8%)

Table 9 Awareness of air pollution effects on cardiopulmonary health by Ethnicity using Pearson correlation

		I anticipate that exposure to any environmental factors above can impact my pulmonary health	I anticipate that exposure to any environmental factors above can impact my cardiovascular health
White -British			
I anticipate that exposure to any environmental factors can impact my pulmonary health	Pearson Correlation	1	.884**
	Sig. (2-tailed)		.002
	N	61	61
I anticipate that exposure to any environmental factors above can impact my cardiovascular health	Pearson Correlation	.884**	1
	Sig. (2-tailed)	.002	
	N	61	61
Mixed and Multiple ethnic group			
I anticipate that exposure to any environmental factors above can impact my pulmonary health	Pearson Correlation	1	.333
	Sig. (2-tailed)		.667
	N	57	57
I anticipate that exposure to any environmental factors above can impact my cardiovascular health	Pearson Correlation	.333	1
	Sig. (2-	.667	

	tailed)		
	N	57	57
Asian/Asian British			
I anticipate that exposure to any environmental factors above can impact my pulmonary health	Pearson Correlation	1	.274
	Sig. (2-tailed)		.599
	N	75	75
I anticipate that exposure to any environmental factors above can impact my cardiovascular health	Pearson Correlation	.274	1
	Sig. (2-tailed)	.599	
	N	75	75
Black/African/Caribbean/Black British, Others			
I anticipate that exposure to any environmental factors above can impact my pulmonary health	Pearson Correlation	1	.614**
	Sig. (2-tailed)		.000
	N	295	295
I anticipate that exposure to any environmental factors above can impact my cardiovascular health	Pearson Correlation	.614**	1
	Sig. (2-tailed)	.000	
	N	295	295

**. Correlation is significant at the 0.01 level (2-tailed).

IV. Discussion

In the result findings on the awareness of participants regarding the impact of air pollution on their health, a large proportion of people, albeit with varied degrees of confidence, seem to think that air pollution poses a health risk to them. This response shows that students are generally aware of the dangers of air pollution to human health, but with some healthy skepticism. This variations in confidence and scepticism, is likely influenced by personal experience and local pollution levels of the participants. The findings strongly agree with a nationwide English cohort study carried out by Yadav, Deora & Yadav, (2021) as the findings of this study pointed out that although it's believed that air pollution drastically affects man's health and causes high mortality rate. However, participants still have some skepticism on how much it determines the general well-being of the whole-body system (Yadav, Deora & Yadav, 2021; Abdul-Rahman,). Hence, the need to have a widespread awareness of air pollution's potential health impact. In addition, recent research carried out by Asmam et al., (2021), albeit focusing on African community, it was stated that there is already an increasing insight on how air pollution affects health across Europe, North America, South America, and Asia leaving the other continents behind. (Asmam et al., 2018).

In this study it was observed that exposure to solid pollutants showed that 84.3 percent participants which is the highest percentage are aware of being exposed to solid air pollutants which includes Although, 8.1 percent of the total population not sure if they are being exposed while 7.6 percent are oblivious of being exposed. Study carried out by Sanjoy et al., (2018) on the relationship of air quality to cardiovascular and respiratory health also stated that solid particles pollutants most especially PM_{2.5} happens to be the most reported air pollutants that affect the health in the world (Sanjoy et al., 2018). Several studies have also expressed the drastic effects of solid pollutants precisely PM_{2.5} exposure to health (Di et al., 2017; Ohlwein et al., 2019; Sofianopoulou, et al., 2019; Manisalidis et al., 2020;).

Furthermore, a significant portion signify exposure to second-hand smoking in their environment. Hence the need to raise more awareness about the effect of second-hand smoking to the cardiopulmonary health. Manisalidis et al., 2020 study also raised the awareness of secondhand smoke has been the major contributor to indoor air pollution. (Manisalidis et al., 2020). Hence, the need to raise more awareness to the global community on the detrimental effects of secondhand smoke.

In addition, significant majority of the participants are exposed to exhaust gases. These findings therefore also substantiate why much awareness of the effects of air pollution on the cardiopulmonary health needs to be carried out as exhaust gases such as NO₂, SO₂, CO, and CO₂ which are being released from vehicles and industrial machines pose a great risk to our health. Committee on the Medical Effects of Air Pollutants (2018) has also recently attributed death caused by PM_{2.5} and NO₂ in the UK annually to be between 28,000 and 36,000 respectively. Also, Thomas et al., (2017) analysed the detrimental effects to long and short-term exposure to NO₂ and SO₂ will have on the cardiovascular and pulmonary system. Hence, the need to raise more awareness of the danger of being exposed to exhaust gases most especially in urban areas where there is much infrastructural development and vehicle movement.

Also, the result shows that a significant portion of participants are active in road walking as 91.4% walk distances ranging from under 5 kilometers to 25 kilometers. Being an active road walker signifies that most of these participants are being exposed to air pollutants released mostly from road transportation during road walk hence the need to create more awareness on the effects of these pollutants released on the cardiopulmonary health of man. In a recent study carried out by Hsueh-Wen and Kuan-Lin, (2022) to know the awareness of people on the risk in encountering air pollution during road race, it was stated in this study that running or walking in areas that have a high degree of air pollutants is injurious to the cardiopulmonary health due to the fact that human tends to navigate easily from using their nose to breathe to using their mouth to breathe during a long walk. This, then limit the nasal function to stop air pollutants that might get into the system. Also, through the process of using the mouth to breathe, the body takes in more air than needed which also elevate the chances of taking in air pollutants. Lastly, during a long walk or heavy exercise, the ventilatory rate of the body increases which signifies that people breathe more deeply and more intermittently which could lead to the deposition of air pollutants in the lungs (Laeremans et al., 2018). All these factors are then said to lead to severe cardiopulmonary condition and eventually death (Hsueh-Wen and Kuan-Lin, 2022).

Result presented in this study also revealed that a high percentage of participants are aware of the association between air pollution and respiratory diseases. A high percentage of the participants are also aware that air pollution can indeed worsen symptoms for those with allergies or respiratory infections. This awareness highlights the importance of protecting vulnerable individuals from the adverse effects of polluted air while also suggesting the potential for further education on this topic for the minority who are unsure or not informed.

Furthermore, there is high awareness of air pollution effects on the pulmonary system which also suggests that most respondents recognize the link between air pollution and respiratory health issues. Notwithstanding the uncertainty shown by few respondents also acknowledge that some respondents might not have definitive knowledge about all the potential conditions. Likewise, the results of respondent awareness on the effects of air pollution being a causative mechanism of lung cancer and can also worsen it suggest that a significant proportion of respondents have knowledge about the relationship between air pollution and lung cancer, emphasizing the importance of public awareness campaigns to ensure accurate information reaches all segments of the population. However, there is still room for improvement in awareness, particularly among those who are unsure or unaware of the connection.

In addition, the results of this findings show a negative correlation between the awareness of air pollution effects on cardiopulmonary health and participants of Asian background although a very weak one and a strong positive relationship among participants of Europe and Africa background.

This findings aligns with the research study by Sanjoy et al., (2018), which stated that although there is a strong evidence of acute effects of air pollution on pulmonary system, however, this awareness is majorly created through studies that have been carried out in North America, Europe, and some Asian cities, while we still have limited awareness of the drastic effect of air pollution on respiratory health in most Asian countries, hence, the need to create more awareness for the general population. (Sanjoy et al., 2018).

In the result of the awareness of air pollution on cardiovascular health, it's clear from this distribution that many respondents are concerned that environmental variables, such as air pollution, may have an effect on their cardiovascular health, yet they express this concern with varied levels of certainty. The findings underline the need to recognize the hazards. associated with diverse environmental exposures, especially those that may affect cardiovascular health.

Also, there is a strong positive correlation among participants of Black and Europe background while we have a negative even though a weak correlation among participants of Asian background on the awareness of air pollution effects on the cardiovascular system. These findings align with Arku et al., (2018) research that most developed countries in the Europe have a high awareness of air pollution effects on cardiovascular system. However, the result on Africa participants differs from Arku et al., (2018) shows a negative correlation in the level of awareness of air pollution effects on man's health among participants in an Africa community (Arku et al., 2018).

These differences might however be attributed to the socioeconomic differences among participants being used for the research. While Arku et al., (2018) used participants majorly street hawkers and taxi drivers for the research, this study used participants who most probably might have a higher socioeconomic status than the former.

The result of participants in table 9, while less than one-fifth percent of the participants were not familiar with any measures or strategies that could promote the use of clean and renewable energy sources in order to tackle air pollution, one-fifth of the total participants also do not know of any initiatives aimed at raising public awareness about air pollution and its impacts on health.

Although this percentage is low, it shows the need to create more awareness for the general population on the measures that should be taken to improve the air quality. Study by (Bahino et al., 2018) also stated that irrespective of the number of government rule that is in place to tackle air pollution, monitoring and enforcing

these measures that has been enacted by the government goes beyond the capacity of the government. Hence, the need for people to be more aware of the effects of air pollution on our health and how to tackle it (Bahino et al., 2018).

Also, the most complete standards for the awareness of air pollution that exist worldwide is the WHO air quality recommendations (WHO, 2014). which was introduced in 1987. These regulations were amended in 1997, and they were changed again in 2020 (WHO, 2018).

These standards are then converted into national legislation as every nation sees appropriate and are not legally obligatory to enforce it. A 2015–2016 review that looked at how much the WHO recommendations had been adopted into national legislation discovered that while most European countries have implemented it, many African nations had not done so and that more than 45% of African nations had no air pollution regulations at all.(Joss et al., 2017) The finest regulatory system was found in Cameroon, which implemented WHO criteria for atmospheric nitrogen dioxide (NO₂), oxygen, PM₁₀, and PM_{2.5}(Joss et al., 2017).

Considering the amount of research and awareness initiative that has then been carried out on air pollution, one should expect that the level of awareness of air pollution's detrimental effects on man's health should be high. However, statistics prove otherwise. According to estimates, more than 99% of the global population resides in regions that exceed World Health Organization (WHO) air quality standards. (WHO, 2018). It was also stated by the world health organization that should the worldwide air pollution be brought down under WHO air quality limits, it would go far to extend human life by 0.6 years (about 7 months), providing benefits comparable to those of curing lung and breast cancer. (OECD 2016; WHO 2018).

Furthermore, as stated previously, for many African towns, managing and regulating air pollution is a huge task. Although there are significant regional and worldwide attempts for improved monitoring and regulating systems, they are rarely given priority on the political agenda. The regulatory structures are typically inadequate or absent, and information transmission about the negative effects of pollutants in the atmosphere is generally subpar in most nations (Amegah and Agyei-Mensah, 2017).

Hence, with 99% of the human population under air pollution and the negative impact of this on human general well-being, it's then important to create awareness of air pollution effects on cardiopulmonary health. This paper will then help to increase the awareness of air pollution's negative effects on the cardiopulmonary system which is also in line with the European Society of Cardiology's 2015 campaign, which aims to "raise awareness of the detrimental effects that the environment can have on the heart." It will also additionally decide how much knowledge learned study participants have of how air pollution affects their cardiopulmonary health for future studies. In addition, both past and recent public health issues just like the recent COVID-19 and climatic change have also shown a strong link to air pollution and a high mortality rate (Ali and Islam, 2020). Hence, the need to urgently raise the awareness of the entire population of the detrimental effects of air pollution on man's health.

V. Strength And Limitation

One of the major strengths of this study is the first to conducted in Sunderland and in the university of study. The research added more evidence to how broad the effects of air pollution is to our cardiopulmonary health by collating literature review on the effects of air pollution to our general well-being, relationship between geographical and socioeconomic status of a participant to air pollution, epidemiological link between air pollution and cardiopulmonary health, awareness initiatives policy to tackle air pollution, and the air pollutants being caused by various environmental factors.

Also, , a correlational analysis was also carried out to analyse ethnicity of participants against the awareness of air pollution effects on cardiopulmonary health.

The potential limitation of this study includes the study was self-report so there could be some bias in reporting or misinterpretation of information. Lastly, there is no 100 percents assurance that all participants took their time to fill the survey as most of the participants were not seen face to face but via social media available for use.

Despite the limitation identified in this study, prior literature review and the result of this study have demonstrated that air pollution has a drastic effect on our cardiopulmonary health and more awareness on this menace still need to be studied to reach the global population.

One aspect that however need to be considered is how much the developing countries and the developed countries has embraced various initiatives and measures in tackling air pollution and why the developing countries haven't embraced the WHO guidelines on the control of air pollution.

Also, an extensive study on air pollutants needed to be study extensively and linked to the recent climatic change and rise in epidemic crisis.

In conclusion the findings of this study highlight the need to address air quality concerns along highways and raise awareness of the possible health hazards connected with engaging in outdoor activities in locations with high pollution levels as high percentage of the participants claimed to have experience air

pollution during road walk. Also, the study highlighted that there is much awareness among students at the University of Sunderland on the effects of air pollution on cardiopulmonary health albeit there is still some skepticism among participants on how dangerous air pollution is to man's health hence the need to raise more awareness on the effects of air pollution in the global community.

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