Article

Community Health Risk Awareness and Knowledge of Air Pollution in Annadale, Polokwane Local Municipality, Lim-popo Province, South Africa

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Community Health Risk Awareness and Knowledge of Air Pollution in Annadale, Polokwane Local Municipality, Limpopo Province, South Africa

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Abstract: Exposure to air pollution have detrimental effects on the elderly, women, people with pre-existing medical conditions, people living in poverty and children. The aim of the study was to investigate the extent of community awareness and knowledge on the health risks associated with exposure to air pollution. A cross-sectional study design was used for the study, using self-administered questionnaires. A simple random sampling technique was used to select 376 respondents. Systematic sampling method was applied to select the households. SPSS version 26 was used to analyze data. Of 376 respondents, 221 were males and 154 females. 113 were aged between 23-47years and 353 were aware that if they don't protect themselves against polluted air, they may get sick, with age and educational status associated with their awareness ($p < 0.05$). About 361 knew what air pollution is and 188 think the air they breathe in Annadale is moderate. A total number of 278 said they feel sick/uncomfortable when the quality of air is bad. About 293 knew that people are exposed to air pollution by breathing contaminated air and 237 identified sewage smell as the main cause of air pollution. Respondents who identified internet and television as the main source of information were 199 and 177 respectively. Those who were not aware of actions implemented to reduce air pollution were 180. Based on the results of the study, respondents are aware of the dangers of exposure to polluted air, and it is necessary that air pollution risk communication strategies be implemented to empower residents.

Keywords: community; health risk; awareness; knowledge; air pollution

1. Introduction

Air pollution happens when different particles and gases emanating from various sources are released in the atmosphere mix [1]. Air pollution also takes place when gaseous substances, particulate matters and radioactive materials are emitted into the atmosphere through natural and anthropogenic sources of air pollution [2]. In urban areas air pollution is caused by rapid industrialization, population growth and increase of vehicle ownership, sewage purifications plants, waste disposal sites, industrial emissions, dusty roads, and the use of solid fuels for cooking [3]. Several studies previously investigated community knowledge and awareness of the causes and effects of air pollution. The study conducted at three Chinese megacities (Shanghai, Wuhan, and Nanchang) assessed the level of knowledge on air pollution and established that more than half (57.50%) of the respondents were not aware of the causes of air pollution [1]. In 2017, investigation on public awareness on the effects of air pollution in Wuhan, China established that 65% of the respondents were not aware of the control measures implemented by government to address air pollution [4].

The study conducted in Tehran; Iran over the period of 2015-2016 evaluated knowledge and attitudes amongst the university students on the sources of air pollution [5]. The level of knowledge amongst the students was weak and the community did not receive adequate and effective education regarding air pollution [6]. In Peninsular, Malaysia (Southeast Asia), a study that explored public awareness and support for environmental protection focusing on air pollution found that female respondents had lower awareness compared to the male respondents [7].

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The European Union Directive on Air Quality 2008/50/EM recommended the guideline limits to control the pollutants that are considered detrimental to human health, infrastructure, and environment [8]. Despite the efforts made by various governments worldwide, air pollution is still a major environmental problem. In India even after the government adopted different control measures that include air pollution legislation, industries emission standards, environmental impact assessment, environmental audits, control of motor vehicle pollution, air pollution action plans for problem areas and development of environmental standards and promotion of air pollution awareness, air pollution is still a problem [9]. In South Africa, the National Environmental Management: Air Quality Act 2004 (No 39 of 2004) and Section 24 of the Constitution 1996 (108 of 1996) requires the government to take responsibility for ensuring that everyone in the country has the right to breathe air that is not harmful to their health and their wellbeing [10].

Exposure to air pollution is associated with an increase in hospital visits, worsening of asthma attacks, poor lung function, premature birth, and deaths of children with respiratory infections [11]. A study in South Africa by Shirinde, Wichmann and Voyi explored the relationship between wheeze and selected sources of air pollution in residential areas at Thembisa and Kempton Park. It was found that when gas was repeatedly used for reheating homes and when the trucks passed close to the residential area, children experienced more wheeze [11,12]. In Limpopo Province at Greater Tubatse Municipality, Tshehla and Wright assessed possible impact of the concentration of air pollution from anthropogenic sources (vehicles, industries, road dust, open burning, and combustion sources) and natural sources (wildfires and windblown dust) and discovered that particulate matters are linked to childhood pneumonia, respiratory diseases, stroke, cardiovascular and chronic obstructive pulmonary disease (COPD) [13]. In Sub-Saharan Africa, exposure to air pollution is linked to diseases such as asthma, heart disease, hypertension, COPD, and lung cancer [14]. In the city of Polokwane, children of the ages (13-14 years) from the homes that are using biomass fuel for cooking are at high risk of developing asthma [15]. UNICEF indicate that communities should be made aware of the level of air pollution they are exposed to, the effects of air pollution, how to reduce air pollution and how to protect themselves from air pollution [16].

The study seeks to add on existing health risk awareness and knowledge about air pollution to allow Annadale community to improve their health conditions by making informed decisions on how to prevent and protect themselves from exposure to air pollutants. The study is attempting to investigate the extent of community health risk awareness and knowledge on air pollution in Annadale, Polokwane Local Municipality in Limpopo Province, South Africa. The findings of this study will be used to suggest possible air pollution awareness intervention strategies that can be used to improve the community awareness and knowledge regarding air pollution in Annadale.

2. Materials and Methods

2.1. Study Approach and Study Design

The study used quantitative research approach to quantify collected data from selected sample to generalize the results. A cross-sectional study design was employed to obtain the overall picture of the situation.

2.2. Study Site and Population

The study was conducted at Annadale residential area locally known as Ladanna surrounded by industrial areas and is located within Polokwane Local Municipality under Capricorn District Municipality in Limpopo Province, South Africa. Statistics South Africa 2011 report estimated that there is 6 386 population consisting of 3 244 females (50.80%) and 3 142 males (49.20%) in Annadale [17]. Statistics South Africa also estimated that there are around 2 277 households in Annadale, with population groups consisting of Black Africans at 3 723 (58.30%), followed by Whites at 2 499 (39.13%) and Coloured at 116 (1.82%). The most dominating spoken languages in Annadale are Afrikaans (38.24%), followed by Sepedi (28.12%) [17]. The target population was community members between the ages of 18 to 65 years and above who have been residing in Annadale over the period of one year.

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2.3. Sampling and Sample Size

A simple random sampling technique was used to obtain a representative sample in the study. A sampling frame consisting of a list of all units in Annadale was developed and used to randomly draw the sample of 376 (n=376). A systematic sampling method was used to select the households, where every third household was selected.

Yamane (1967) Formula: $n = \frac{N}{1 + (Ne2)}$ was used to calculate the required sample,

where e: = 5% represented the margin of error, N: Population size = 6 386 and n=sample size.

$$n = \frac{6\,386}{17}$$

$$n = 376$$

To ensure representativeness of the sample, 5% margin for possible non-response was added and the study aimed to reach 376 respondents.

2.4. Data Collection and Analysis

The study used self-administered questionnaire developed by researcher to collect data from the respondents over the period of 15 February 2021 to 30 March 2021. The questionnaire was developed by reviewing literature of similar studies [1,4]. The questionnaire was translated into dominating local languages (Sepedi & Afrikaans) and was distributed to the respondents for self-completion and were collected by the researcher after completion. The questionnaire consisting of 22 questions with section A: collecting demographic information about the respondent, section B: included questions assessing the extent of knowledge and section C: asked questions assessing the extent of community awareness on the effects, causes and sources of information on air pollution. The completed questionnaires were coded and captured on the excel spreadsheet and data was imported from excel spreadsheet into the IBM Statistical Package for Scientific Solution (SPSS) version 26 to analyze it. The categorical variables were reported in the form of frequencies and percentages, whereas continuous variables were reported numerically in the form of mean and standard deviations. The student t-test was used to test for continuous variables and the Chi-Square test was used to compare the groups between the categorical variables. If the p-value was found to be less than 0.05 or does not fall within the range, the null hypothesis was rejected.

2.5. Pre-testing the Instrument

The questionnaire was pre-tested by the researcher on ten respondents at Emdo Park (Extension 29) in the City Polokwane over the period of 02 to 06 February 2021. The reason for choosing this pilot site was that it has similar characteristics as the study site (Annadale). The respondents were informed of the purpose and objectives of the study and were requested to give consent for voluntary participation. Out of ten members who participated in the pilot study, 40% where males and 60% females. Most (50%) of the respondents were employed full time, 60% were of the age between 23-47 years and 70% had tertiary qualification. All (100%) of the respondents knew what air pollution is, 100% identified sewage as the main cause of air pollution and 100% identified the lungs to be most affected by air pollution. Pre-testing of questionnaire assisted the researcher to modify and rephrase questions that were not clear to the respondents. Pre-testing also assisted in establishing if the questions asked were able to answer the research question.

3. Results and Discussion

3.1. Demographic Profile of the Respondents

Figure 1 presents gender of the respondents. A total of 376 respondents participated in the study and the results show that majority of the respondents were males (59%) and females (41%). Despite data from Statistics South Africa 2011 census report indicating that Annadale community consist of 50.80% females and 49.20% males, more males responded to the questionnaire in the study [17]. This

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finding might be as a result of COVID 19 lockdown regulations that allowed more males to be working from home as part of remote working arrangements.

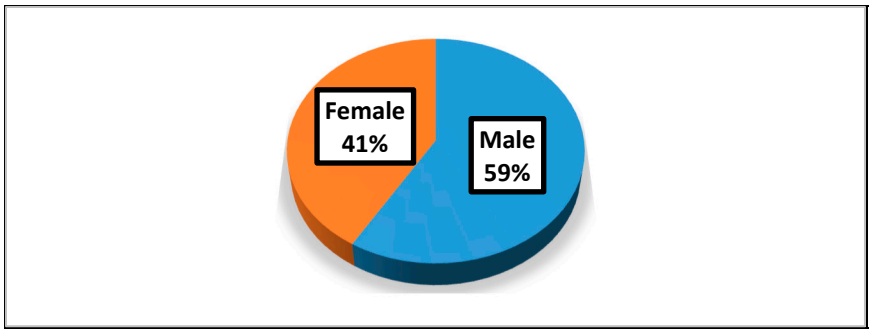

Figure 1. Gender of the respondents.

Figure 2 below indicates that majority (70%) of the respondents were aged between 23-47 years, followed by 14-22 years (13%). This shows that most of the residents in Annadale are active working age group of 23-47 years old, compared to other age groups.

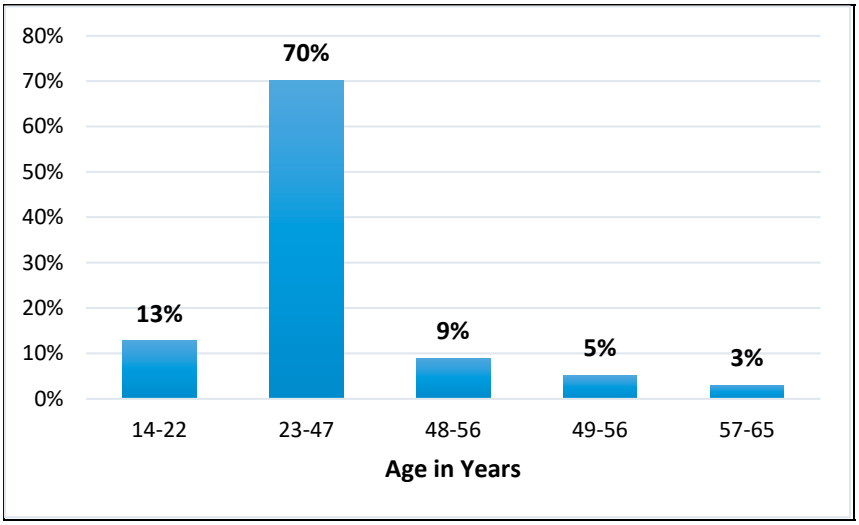

Figure 2. Age distribution in years.

Figure 3 indicates that most of the respondents in this study were Africans (93%), followed by Whites (4%), Coloureds (2%) and Indians (1%).

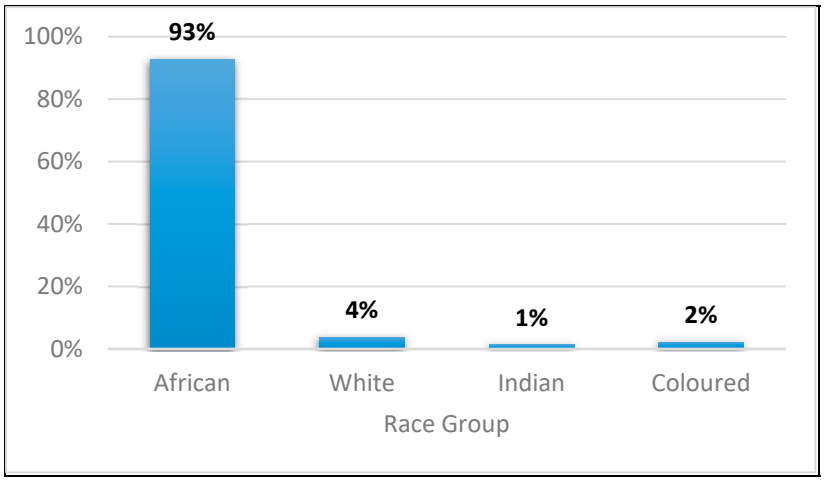

Figure 3. Race of the respondents.

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Figure 4 presents the educational status of the respondents. Half (50%) of the respondents had tertiary education, followed by secondary education (45%), post-graduate (4%) and primary education (2%).

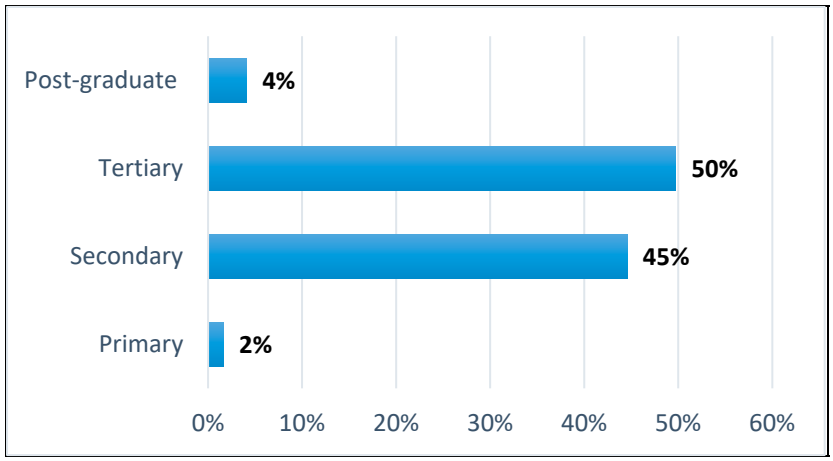

Figure 4. Educational level of the respondents.

Figure 5 indicates that majority of the respondents in this community were full-time employees (53%), students (15%), part-time employees (14%), unemployed (11%) and self-employed (7%).

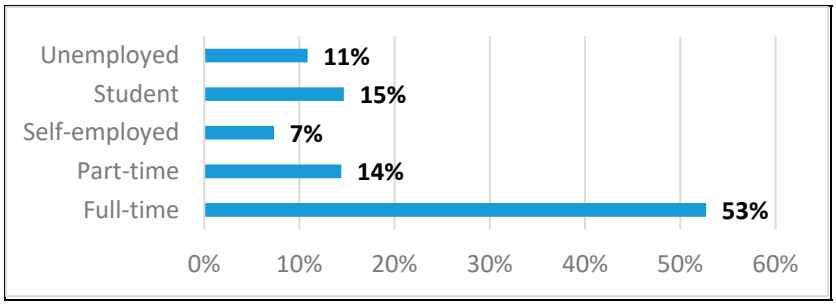

Figure 5. Employment status of the respondents.

Figure 6 presents the number of vehicles owned by respondents. The results of the study indicate that most households owned single vehicle (40%), followed by two vehicles (12%), three vehicles (7%) and more than three vehicles (6%). The study also revealed that 35% of the households in Annadale did not own a vehicle.

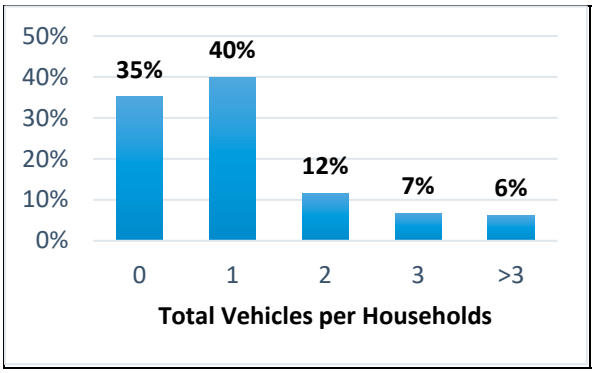

Figure 6. Vehicle ownership per household.

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Figure 7 presents the type of fuel used on vehicles owned by households in Annadale community. The findings revealed that majority (73%) of Annadale residents drive vehicles that are using petrol than diesel (12%).

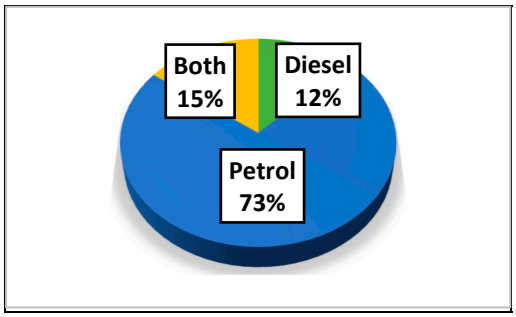

Figure 7. Type of fuel used on vehicles owned by households.

Figure 8 presents annual income for the respondents. The results of this study indicate that most (38%) of the households earn around R30 000–R49 000 annually, followed by less than R29 000 annually (37%), R50 000-R60 000 (12%) and more than R200 000 (6%). This shows that most of the households in Annadale afford vehicles with their income and those who earn more owned more than two vehicles, whereas those earning less owned one vehicle in their households. In 2016 the study by Liu found that 22.36% of respondents earned RM <2999 whereas 42.71% earned between RM3000–4999, 24.38% earned between RM5000–7999 and 10.55% earned more than RM8 000 per month [1].

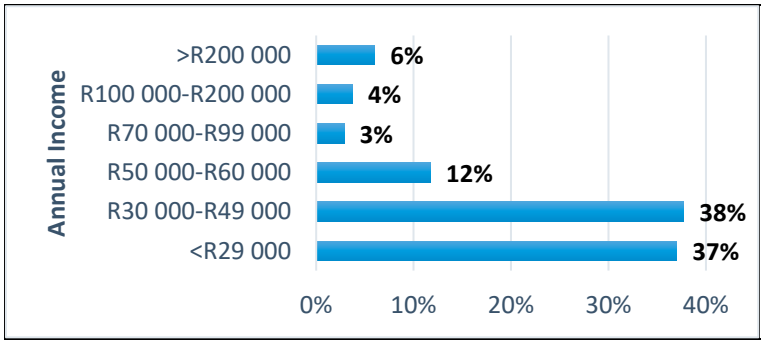

Figure 8. Annual income for the respondents.

3.2. Knowledge of Respondents on Air Pollution.

Table 1 presents and discusses the respondents' knowledge of air pollution. The findings of this study show that almost all (96%) of the respondents in Annadale have knowledge of what air pollution is. This is encouraging to see that nearly all residents of Annadale have knowledge of what air pollution is and this knowledge might have occurred because of their personal experience of regular exposure to smell from sewage, malodourous gases and particulate matters emanating from industries surrounding Annadale. The findings of the study are consistent with the study that investigated air quality in Wuhan, China and found that majority (96%) of the respondents knew what air pollution is [4]. This is in contradiction with the findings of a study in Wuhan that reported more than half of the respondents who did not know what air pollution is [1]. When the respondents were asked of what they think about the type of air they breathe in Annadale, most (50%) indicated that they think the air they breathe is moderate, whereas 27% think the air they breathe is bad and only 23% think the air is good. This means that more residents in Annadale consider the quality of air to be moderate which may put vulnerable people with chronic medical conditions at risk of being affected. The findings of this study are inconsistent with the studies which found that most of the

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respondents thought the quality of air they breathe was bad, whereas less than half thought the quality of air they breathe was moderate [4,18].

The study indicates that majority (63%) of respondents identified smell from sewage as the main cause of air pollution in Annadale. This was followed by motor vehicles (40%), industries (35%), poor waste collection (32%), cigarette smoke (26%), burning of waste (19%) whereas construction (14%) and population growth (8%) were identified by few respondents as the cause of air pollution. This means that greater number of residents in Annadale consider smell from sewage to be the main cause of air pollution, this might be because it is easy to smell sewage, compared to other types of pollutants in the air that may still be harmful in the atmosphere without being smelled. Motor vehicles, industries, poor waste collection and burning of waste respectively are also amongst other causes of air pollution in Annadale. Poor waste collection was also identified by residents amongst the causes of air pollution, because of weekly collection of waste by Polokwane Local Municipality that results in waste waiting for several days before being collected creating nuisance for the households. Similarly, a study that assessed knowledge of possible causes of air pollution and established that almost all (91.43%) of the respondents identified cigarette smoking as the major cause of air pollution [19]. The other study in contrast to this study assessed knowledge and perception of the sources contributing to air pollution found that motor vehicles, industries and constructions were identified as the main sources of air pollution [20].

Majority (78%) of the respondents in this study had knowledge that people are exposed to air pollution by breathing contaminated air. This shows that considerable number of residents in Annadale know that they are exposed to air pollution through the lungs when inhaling polluted air. The results of this study are consistent with the findings where it was found that most (77%) of the respondents knew that people are exposed to air pollution by breathing contaminated air [4]. Only 11% of the respondents in the study indicated that people are exposed to air pollution by touching contaminated soil, dust, or water and 16% did not know how people are exposed to air pollution. This is an indication that some residents in Annadale did not have knowledge of how people are exposed to polluted air because of lack of air pollution risk communication strategies by public sector, private sectors, municipalities, and NGOs to empower residents. Similarly, it was revealed that 12% of the respondents identified touching contaminated soil, food, or water, followed by 5% identifying eating contaminated food and only 4% did not know how people are exposed to air pollution [4].

To establish how respondents feel when the quality of air is bad in Annadale, a question assessing how the respondents feel was asked and it was found that majority (74%) indicated that they feel sick or uncomfortable when the quality of air is bad, compared to 17% who did not feel sick or uncomfortable when the quality of air is bad and only 9% of the respondents did not know how they feel when the quality of air is bad. This is an indication that Annadale residents are not happy with the quality of air they breathe, which put vulnerable groups at risk of experiencing adverse health effects due exposure to air pollution. Lack of knowledge by some residents of how they feel when the quality of air is bad shows that there is a need for community awareness and implementing health education measures on air pollution in Annadale. The results of this study are similar to the findings of the studies that found out that more than 50% of the respondents agreed that they feel sick or uncomfortable when the quality of air is bad in their areas [1,4,18]. When the respondents were asked to identify human organs that can be affected by air pollution, majority (82%) identified the lungs, whereas 5% identified the heart, 3% identified the nerves and 16% identified all (lungs, heart, and nerves) to be likely affected by exposure to air pollution. This means that most of the residents in Annadale know that they can be affected by air pollution mainly through the lungs when inhaling contaminated air and only few of them knew that the heart and the nerves may also be affected by air pollution. Compared to the study by Liu, almost all (98%) of the respondents identified the lungs to be likely affected by air pollution, whereas 45% identified the heart and only 36% identified the nerves [4]. Three studies indicated the effects of air pollution in communities exposed to air pollution may lead to short term and long-term effects on residents' health by reducing circulatory performance, causing lung diseases, heart diseases and increase in hospitalisation [8,21,22].

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Most (53%) of the respondents indicated that they use Internet, followed by television (47%), social media (38%), radio (33%), health care professionals (26%), newspaper (25%), magazine (8%) to access health related information on air pollution. Only 6% of the respondents indicated that they never heard health related information about air pollution on the internet, television, social media, radio, health care professionals, newspaper, and magazine. This means that Internet, television, social media, and radio are commonly used by residents in Annadale as reliable sources of information that seem to be replacing printed newspapers and magazines that were mostly used in the past. The results of this study concur with the findings of the previous studies that identified Internet, social media, newspaper, television, and radio respectively to be used by most of the people to access air pollution information [4,23,24]. Another study found out that 81.6% of the respondents' access air pollution information on television and 78.5% look outside in the sky to check the quality of air. It is further reported that 76.6% of the respondents indicate they assess air pollution by looking at the mountain to see if is clear from pollutants and 70.8% use their olfactory senses to smell if the quality of air is bad [25]. The respondents' knowledge of accessing air pollution information on the South African Air Quality Information System (SAAQIS) was assessed and majority (63%) did not know they can access air pollution information on this system, whereas only 35% know that they can access air pollution information on the system. This shows that the residents lack knowledge of accessing air pollution information on SAAQIS which denies them the opportunity to know and be aware of the quality of air they are exposed to on daily basis. UNICEF indicates that the residents should have the right to access air quality information in their areas, to allow them to take necessary actions to protect themselves against polluted air [26]. In contrast, it has revealed that most of the respondents (53.2%) knew that they could access updated air quality information on IMECA Air Quality Information System, compared to only 46.8% who did not know [27].

Table 1. Respondents knowledge on air pollution.

Survey question	**Frequency**	**Percentage%**
Do you know what air pollution is?		
Yes	356	96%
No	14	4%
Do you think the air you breathe in Annadale is good or bad?		
Good	82	23%
Bad	101	27%
Moderate	186	50%
What do you think are the main causes of air pollution in Annadale?		
Smell from Sewage	232	63%
Construction	50	14%
Motor Vehicles	149	40%
Industries	130	35%
Cigarette smoke	95	26%
Burning of waste	69	19%
Population growth	29	8%
Poor waste collection	119	32%
Do you know how people are exposed to air pollution?		
I don't know	60	16%
Breathing contaminated air	291	78%
Eating contaminated food	17	5%

Survey question	Frequency	Percentage%
Touching contaminated soil, dust or water	42	11%
Do you feel sick or uncomfortable when the quality of air is bad?		
Yes	272	74%
No	62	17%
Don't Know	34	9%
Which of the following human organs can be affected by air pollution?		
Lungs	303	82%
Heart	20	5%
Nerves	11	3%
All of the above	58	16%
Which sources of information do you get health-related information on air pollution?		
Internet	197	53%
Television	173	47%
Newspaper	94	25%
Radio	122	33%
Social media	142	38%
Magazine	30	8%
Health Care Professionals	97	26%
Never heard	22	6%
Do you know that you can access air pollution information on the South African Air Quality Information System (SAAQIS)?		
Yes	131	35%
No	234	63%

3.3. Awareness of the Respondents on Air Pollution

Table 2 illustrates the respondents' awareness of air pollution in Annadale. The findings of the study revealed that majority (63%) of the respondents are aware that the air they breathe around Annadale is polluted, whereas 25% are not aware that the air they breathe is polluted and 11% did not know that the air they breathe is polluted. The high level of awareness about polluted air inhaled by residents of Annadale might be due to residents' previous experiences of continuous exposure to polluted air which played a role in increasing their awareness of the type of air they are inhaling. Similarly, a study in Mexico City is consistent with the findings of this study which reported high (53%) level of awareness on the type of air the respondents were exposed to [27]. Majority (83%) of the respondents in the study are aware that if air pollution is not controlled around Annadale, the lives of citizens will be affected. This was followed by only 10% of the respondents not being aware that if air pollution is not controlled lives of citizens will be affected. The findings show that Annadale residents are not only aware that the air they breathe is polluted, but they are also aware that if air pollution is not controlled their lives will be affected. The study findings in a study conducted in Iligan City (Philippines) agreed with the findings of this study by revealing that almost all (97.14%) of the respondents were aware of the impact of air pollution and only 2.86% of the respondents were not aware of the impact [19].

Considerable number (94%) of the respondents were aware that if they do not protect themselves against polluted air, they may get sick, compared to only 3% were not aware and 3% did not know that they may get sick if they do not protect themselves from air pollution. This means that almost all residents in Annadale are aware that they need to protect themselves from air pollution to avoid

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getting sick and they need to be informed of how to protect themselves against air pollution. A similar study found that most (64.59%) of the respondents were aware that if they do not protect themselves against polluted air, they may experience adverse health effect [18]. Old people, children, people with chronic medical conditions such as diabetes, heart diseases, lung diseases (asthma) were identified as vulnerable population that need to be aware of the precautionary measures available to protect themselves against air pollution [28]. The findings of the study revealed that majority (88%) of the respondents are aware that the sewer around Annadale should be treated to avoid odour and only 7% are not aware that sewer need to be treated to avoid unpleasant smell. These findings show that the residents of Annadale consider smell from sewage to be the main cause of air pollution that needs to be given the necessary attention. Aldosari et al. suggest that to minimise the smell from sewage there is a need to have relevant policies for management of sewage treatment plants that considers socio-economic characteristics of the population around the sewage [29].

Almost half (48%) of the respondents in the study indicated that they are not aware of actions implemented to reduce air pollution, whereas 33% are aware and 19% did not know of actions implemented to reduce air pollution. This shows that Annadale residents do not receive air pollution awareness information from government, municipality, and NGOs to allow them to take necessary actions to protect themselves. This also suggests that the right to information for Annadale residents is compromised. Previously, a study that investigated public awareness on air pollution and found that 65% of the respondents are not aware of actions implemented to address air pollution [4], whereas only 32% are aware of actions implemented to reduce air pollution. In a 2016 study, it was also reported that 45.08% of the respondents indicated that government should take responsibility to deal with air pollution, with at least 42.83% suggesting that citizens must take responsibility for air pollution [18]. When the respondents were asked if they are aware of any law regulating air pollution, the study established that 46% are not aware of air pollution related legislation, whereas 34% are aware of law regulating air pollution and 20% did not know of any law regulating air pollution. This means that most of the residents in Annadale are not aware of legislation regulating air pollution. The main legislations published to control air pollution includes Section 24 of the Constitution of South Africa 1996 (No 108 of 1996) that gives citizens the right to the environment that is safe and not harmful to their health and National Environmental Management: Air Quality Act 2004 (39 of 2004) regulating air pollution in South Africa. Lack of awareness on legislation related to air pollution in this study is consistent with the findings indicating that most (52%) of the respondents are not aware of existing air pollution and prevention law [30].

Table 2. Respondents awareness on air pollution.

Survey question	Aware	Don't know	Not aware
I am aware that the air we breathe around the Annadale is polluted.	233 (63%)	42 (11%)	94 (25%)
If air pollution around Annadale is not controlled the lives of citizens will be affected.	307 (83%)	25 (7%)	37 (10%)
If I do not protect myself against polluted air, I might get sick.	348 (94%)	11 (3%)	11 (3%)
The sewer around the area should be treated to avoid the odour around Annadale	326 (88%)	19 (5%)	24 (7%)
Are you aware of any actions implemented to reduce air pollution?	120 (33%)	70 (19%)	179 (48%)
Are you aware of any law that regulate air pollution?	127 (34%)	74 (20%)	169 (46%)

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3.4. Association between Air Pollution Knowledge and Awareness with Selected Variables

Table 3 presents association between air pollution knowledge/awareness and gender, age, educational status, race, employment, and income. The statistical results using the Chi-square test and P-values, show that there was a significant association of the respondents' awareness of getting sick if not protected against air pollution with age and educational status $p < 0.05$). Although almost all the respondents are aware that if they do not protect themselves against air pollution, they may get sick, age and education contributed towards their awareness. Air pollution risk communication strategies to include residents of all age groups should be implemented to increase knowledge/awareness in Annadale. Gender ($p < 0.017$) and age (0.002) were found to have significant association with the respondents' negative feelings when exposed to polluted air [1]. Regarding the respondents' awareness that the sewer around Annadale needs to be treated, a significant association with age and gender ($p < 0.05$) was observed. This shows that the respondents' awareness of the need for sewage to be treated in Annadale increased with age and gender. This suggests that air pollution information must reach all residents of different age groups and gender. In Saudi Arabia it was found out that there was a significant association between awareness of untreated sewage that leads to odour with age and educational level ($p < 0.05$) [29]. There was significant association between the respondent's awareness that if air pollution around Annadale is not controlled the lives of citizens will be affected with race ($p < 0.017$) and income ($p < 0.05$). This shows that most of the respondents' awareness that if air pollution is not controlled around Annadale the lives of residents will be affected increased with race and income. Similarly, one study found out that there was a significant association between household monthly income ($p < 0.001$) and knowledge of air pollution [1]. There was association between the respondents' awareness of any law that regulate air pollution and income ($p < 0.042$). This means that the respondents' awareness of laws regulating air pollution was associated with income. The study by Yan (2016) found that in China there was no significant association between the respondents being aware of air pollution law and income, as level of education ($p < 0.018$) was instead significant [30].

Table 3. Association between air pollution knowledge and awareness with selected variables.

Survey question	Gender	Age	Highest Educational	Race	Employment	Income
Do you know what air pollution is?	0.036	0.433	0.213	0.815	0.965	0.089
Do you know that you can access air pollution information on the South African Air Quality Information System (SAAQIS)?	0.170	0.062	0.428	0.333	0.210	0.319
I am aware that the air we breathe around the Annadale is polluted.	0.139	0.348	0.112	0.210	0.207	0.083
If air pollution around Annadale is not controlled the lives of citizens will be affected.	0.520	0.100	0.836	0.017	0.251	0.050
If I do not protect myself against polluted air, I might get sick.	0.634	0.006	<0.0001	0.361	0.937	0.978
The sewer around the area should be treated to avoid the odour around Annadale	0.039	0.002	0.681	0.726	0.634	0.699
Are you aware of any actions implemented to reduce air pollution?	0.689	0.633	0.774	0.452	0.187	0.508

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Are you aware of any law that regulate air pollution?	0.207	0.177	0.078	0.165	0.084	0.042

∗Association is significant at $p < 0.05$ level.

4. Conclusions

The purpose of the study was to investigate the extent of community awareness and knowledge on the health risks associated with exposure to air pollution in Annadale. The study concludes that most residents of Annadale have basic knowledge/awareness of air pollution and perceived the air they breathe to be moderate. Although most of the residents show that they have knowledge about air pollution, there were still some residents with lack of knowledge as it was seen when the majority of residents did not know that they can access air pollution information on SAAQIS. Furthermore, residents were not aware of actions implemented to reduce air pollution and were also not aware of air pollution legislation. This shows that there is lack of air pollution awareness strategy within Polokwane Local Municipality.

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Institutional Review Board Statement: The study was conducted following the guidelines of University of Limpopo and ethical clearance was granted by Turfloop Research Ethics Committee (TREC) Project no: TREC/440/2020: PG. Permission to conduct the study in Annadale was also requested from Polokwane Local Municipality.

Informed Consent Statement: The researcher obtained informed consent from all the respondents participated in the study.

Data Availability Statement: Data presented in this study is available on request from the corresponding author.

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