COAL'S HEALTH IMPACTS IN PHOLA

A Community Health Screening Programme Related to Air Pollution from Coal Mining Activities in Mpumalanga Highveld

September 2024

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A Community Health Screening Programme Related to Air Pollution from Coal Mining Activities in Mpumalanga Highveld

Final Report

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BACKGROUND

The Mpumalanga Highveld in South Africa is known for having high levels of a variety of criteria pollutants which exceed the National Ambient Air Quality Standards of South Africa and the WHO Air Quality Guidelines (Department of Environmental Affairs, 2022; Mcdaid, 2014; Hallowes & Munnik, 2017; Holland & Spadaro, 2019; Shikwambana et al., 2020; Mpumalanga Health Strategic Plan, 2020–2025). The area is home to coal-fired power stations that emit 1,051,895 tonnes of NOx (73%), 2,300,554 tonnes of SO2 (82%) and 108,448 tonnes of PM10 (12%) per year into the environment of Mpumalanga Highveld (Holland, 2017; Gray et al., 2019). Children and adults living in the area suffer severe, direct health effects due to long-term exposure to pollutants (SO2, NO, CO) and other effects of coal mining.

Eskom, as the local power utility, must keep an undisrupted electricity supply with minimal environmental negative impacts, moving about 118Mt of coal in 2018/19, making coal mining unavoidable. Air pollution from coal mining activities adversely impacts the social, economic, and environmental wellbeing of the affected communities, with minimal effects on the polluter (Euripidou et al, 2022). Phase 1 and 2 of Ermelo and Carolina has revealed the plight of communities within the coal mining areas who are exposed to poor air quality with elevated levels of toxic elements. In order to continue advocating, creating a positive, transformative and sustainable change in communities of Mpumalanga highveld, this project details a community health screening activity related to air pollution from coal mining activities in Phola.

The specific objectives of this project were:

- To get a comprehensive picture of the community's current health status, needs, and issues related to air pollution from coal mining activities in Phola.
- To recommend strategies for mitigating the health impacts of air pollution from coal mining activities and improving community health for Mpumalanga highveld.

METHODOLOGY

The methodology is based on the community-based participatory research (CBPR) paradigm, an innovative research paradigm that combines knowledge and action to improve community health and reduce health disparities (Minkler & Wallerstein, 2011; Collins et al, 2018). Utilising this framework involves community members, researchers and other stakeholders in the research process, recognising and maximizing the importance of their diverse contributions. A community based descriptive survey was employed to assess a comprehensive picture of the community's current health status, needs, and issues related to air pollution from coal mining activities in Phola.

Geographical setting

The community-based survey was done in Phola, a place in the Emalahleni Local Municipality, Nkangala District Municipality in the Mpumalanga Province of South Africa. Phola is one of the areas affected by air pollution from coal mining.

Figure 1: Geographical setting of Phola

Population, sample and sampling

The target population were adult respondents of at least 16 years of age living in Phola, conversant with the subject matter, confirmed to be appropriate to take part in the survey. StatsSA (2012) indicates Phola had a population of 31,885 inhabiting 8,913 household at that time. Census 2022 population figures increased by 1.8% to 32 459, and 23.4% increase in households 9122. Therefore, a minimum sample size @ 95% CI, and 5% margin of error, will give us 369 households with additional 31 to cater for attrition thus making a total of 400 to be approached for the survey. The study used convenience sampling to select households in the Phola community. Upon agreeing to participate in the survey, one adult is randomly selected from the household to complete the interview. This approach was most suitable for community pH, sensitive to the participation dynamics when other members become aware.

Data collection tool

A structured interview guide with open-ended questions was utilised to collect data. Information on demographic variables, General health and wellness in the community, including perception of air pollution on health were collected. A face to face method of data collection was done. Quantitative data was analysed using descriptive and inferential statistics where necessary. Open-ended questions were analysed using content analysis and then coded descriptively.

Ethical considerations

To achieve the right to self-determination, participants were informed of the details of the and were required to provide written, signed consent to participate. This is a research ethics requirement, among others. They were informed of their right to withdraw from the study at any time without any adverse consequences. Confidentiality of the collected data was maintained by removing all identifiable information, such as names on the transcribed data. Furthermore, the data was kept safely in a computer file with password protection. The participants signed an attendance register and an informed consent form before participating in the study.

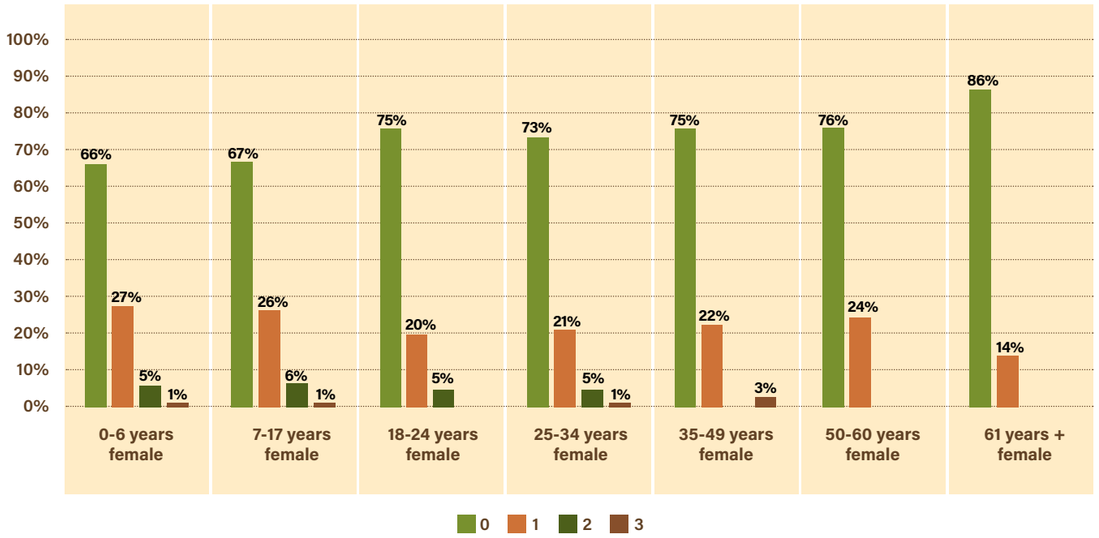
FINDINGS OF SOCIODEMOGRAPHIC CHARACTERISTICS

Proportion of female members in Phola households by age

The chart illustrates the distribution of female members in Phola households by age group, with each color representing a different number of female members: blue for households with no female members, red for one female member, purple for three female members, and black for four female members in each age group (Figure 2). In the 0-6 years age group, 66% of households report having no female members. Conversely, 27% have one female member, and small percentages (5%; 1%) report having three and four female members in this younger age group, respectively. For the 7-17 years age group, 67% of households also have no female members, which is similar to the youngest age group. However, a slightly lower percentage (26%) report having one female member, with minimal representation (6% and 1%) for households with three and four female members in this age group. In the 18-24 years age group, 75% of households have no female members. About 20% of households have one female member, and 5% have three female members, with no households reporting four female members in this age group.

The pattern is similar for the 25-34 years age group, where 73% of households report no female members, 21% have one female member, and 5% have three female members. The proportion of households with four female members remains low at 1%. In the 35-49 years age group, 75% of households again report no female members, 22% have one female member, and 3% have three female members. For the 50-60 years age group, 76% of households have no female members, with 24% reporting one female member and no households reporting three or four female members. Finally, the 61+ years age group reveals 86% of households reporting no female members. 14% have one female member, and none have three or four female members (See Figure 2).

Figure 2: Household females by age



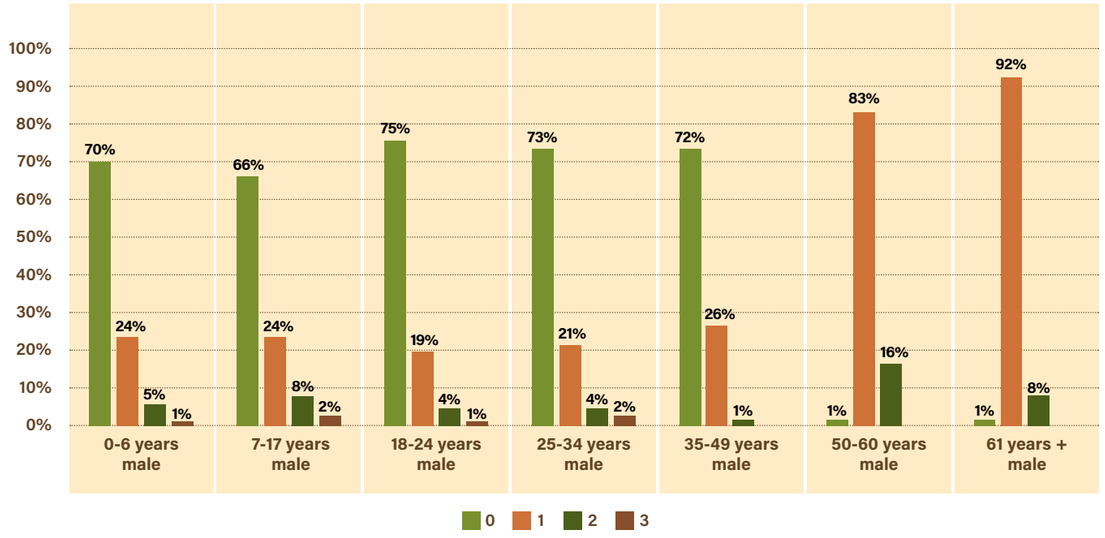
Proportion of male members in Phola households by age

The chart illustrates the proportion of male members in Phola households, categorised by age groups, based on survey data (Figure 3 below). In the 0-6 years age group, 70% of households report having no male members. Conversely, 24% of households have one male member, while 5% have two male members. Households with three male members were minimal, standing at 1%, and no households reported having four male members in this age group. For the 7-17 years age group, 66% of households have no male members. About 24% of households have one male member, and 8% report having two male members which is an increase from the 0-6 years age group. The proportion of households with three or four male members remain very low, at 1% and 0%, respectively. In the 18-24 years age group, the majority of households (75%) report having no male members. The proportion of households with one male member drops slightly to 19%, with only 4% of households having two male members, and 1% reporting three with none reporting four male members.

The 25-34 years age group shows 73% of households with no male members. About 21% of households have one male member, while 4% have two male members, and 1% have three male members. Almost similar to the younger age groups, larger households with multiple male members are rare. In the 35-49 years age group, 77% of households report having no male members, with 26% having one male member. The percentage of households with two male members is relatively low at 1%, and none having three male members which is a slight decrease from the previous mature age group 25-34 years.

For the 50-60 years age group, there is a noticeable increase in households with male members, where only 1% of households report having no male members. The majority, 83%, have one male member, and 16% have two male members, showing that men in this age group are more likely to be present in households. There are no households with three or four male members in this age group. In the 61+ years age group, 92% of households report having one male member. The remaining 8% of households have two male members, 1% reporting zero members with no households reporting three or four male members (Figure 3).

Figure 3: Household males by age



Demographic characteristics of the respondents

Table 1 reveals the results of demographics for respondents. The gender distribution among respondents indicates a higher percentage of females (63.5%) compared to males (36%). The age distribution of respondents reveals that the largest age group is 35-49 years, comprising 33.5% of the sample. This is followed by the 25-34 years age group at 20.8% and the 50-60 years age group at 20.5%. The data on educational attainment shows that a significant proportion of respondents have completed high school (60.3%), while 18.8% have primary education and 15.5% have tertiary education. The ethnic composition of the community is overwhelmingly Black/African (98.5%), with very small percentages of respondents identifying as Indian/Asian, Colored, or White. The survey results indicate that a substantial portion of households rely on social grants (56.3%) as a primary source of income, with unemployment affecting 42.5% of the population. Only 36.4% of respondents reported being employed by a company or organisation. While approximately 12% of the population had disabilities, the majority (81%) had no form of medical aid. The majority of the population (63.4%) used clinics when they get ill (See Table 1).

> **“The gender distribution among respondents indicates a higher percentage of females (63.5%) compared to males (36%). The age distribution of respondents reveals that the largest age group is 35-49 years, comprising 33.5% of the sample.**

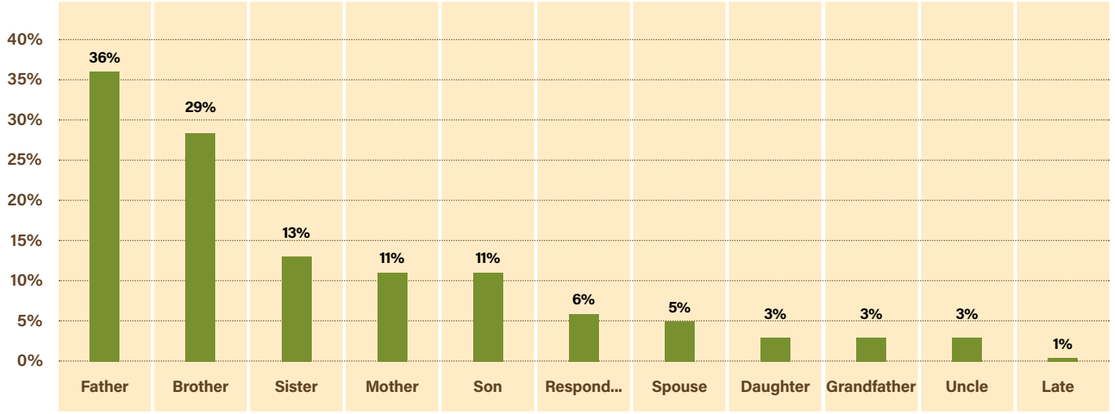
Table 1: Demographic variables of the respondents

Variable	Frequency	Percentage
Gender		
Male	144	36.0
Female	254	63.5
Other	2	0.5
Age of the respondents		
18 – 24 years	55	13.8
25 – 34 years	83	20.8
35 – 49 years	134	33.5
50 – 60 years	82	20.5
61 years +	46	11.5
Level of education		
Did not attend school	21	5.3
Primary education	75	18.8
High school education	241	60.3
Tertiary/college	62	15.5
Population ethnic group		
Black	394	98.5
Indian/Asian	2	0.5
Colored	2	0.5
White	2	0.5
Source of income		
Unemployed	169	27.8%
Self-employed	70	11.5%
Employed by company	145	23.8%
Social Grant	224	36.8%
Family member with disability		
Yes	47	11.8
No	352	88.0
Presence of medical aid		
No	322	80.6
Yes, personal	24	6.0
Yes, from the employer	54	13.5
Source of healthcare when they get ill		
Doctor’s facilities	110	22.3%
Local clinic	313	63.4%
Emergency care Centre	19	3.8%
Local hospital	5	1.0%
Pharmacist	33	6.7%
Church	7	1.4%
Traditional healers	5	1.0%
Other	2	0.4%

Specific families who have worked in the coal mining industry

A significant portion of households (50.5%) reported that no family members have worked in the coal industry while 37.3% of households have at least one family member who has worked in the coal industry. Households with two or more members working in the coal industry are in the minority, with only 12.4% of respondents falling into this category. Family members who had worked in the mining industry included close family members. The top two mentions of family members who had worked in the mining industry were male (65%), father (36%), brothers (29%), respondents’ sisters (13%), 11% were respondents’ mothers, 14% were sons or daughters, and 6% were respondents who took part in this study.

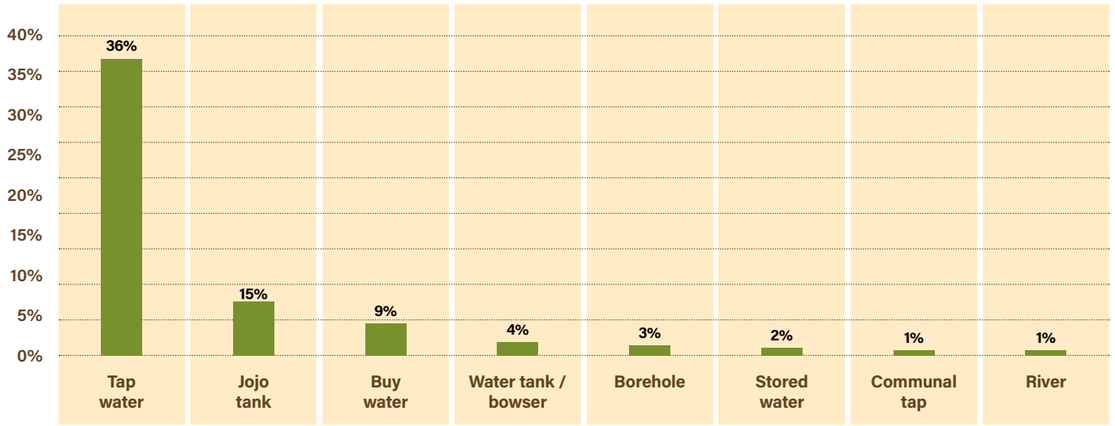
Figure 4: Nature of family members who have worked in the mining industry



Source of water for households

The study found that the Phola community had various sources of water for households, with municipal tap water being the most common (84%). While the results show that 84% of Phola residents have access to tap water, issues of water scarcity were attested to by respondents. Respondents in this study indicated that the tap water supplied by the municipality is seldom available, which leads Phola residents to buy bottled water (9%), make use of water stored in HH bulk containers or in the house in smaller containers (21%), use borehole water (3%), a communal tap (1%) or draw water from the river (1%).

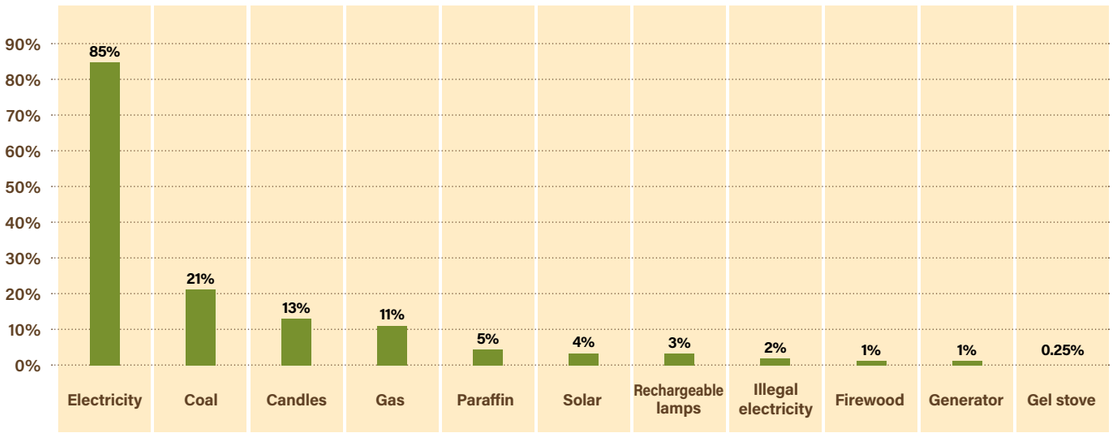
Figure 5: Source of water for households in Phola



Source of power for households

About 85% of mentions were for households that had access to electrical power, however, similar to the responses about water sources, respondents in the study indicated that they were using other sources of power, with 21% using coal, 13% candles 11% gas, 5% paraffin, 4% solar, 3% rechargeable lamps, 2% attested to utilising illegal electricity connections, while 1% of households were using firewood, or generator and a smaller percentage were using the gel technology stoves.

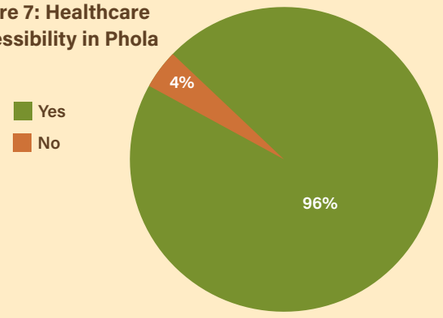
Figure 6: Power sources for Households in Phola



Healthcare accessibility

Most respondents (96%) indicated that healthcare centres were accessible in the Phola area. The 4% of respondents who stated that healthcare centres were not accessible were from Buffer, Vezi, Bhodli, Iraqi, and New Stands areas. Accessibility of healthcare facilities was described in terms of the distance respondents had to travel; thus, most respondents would confirm that the facilities were within their residential areas (Figure 7).

Figure 7: Healthcare accessibility in Phola

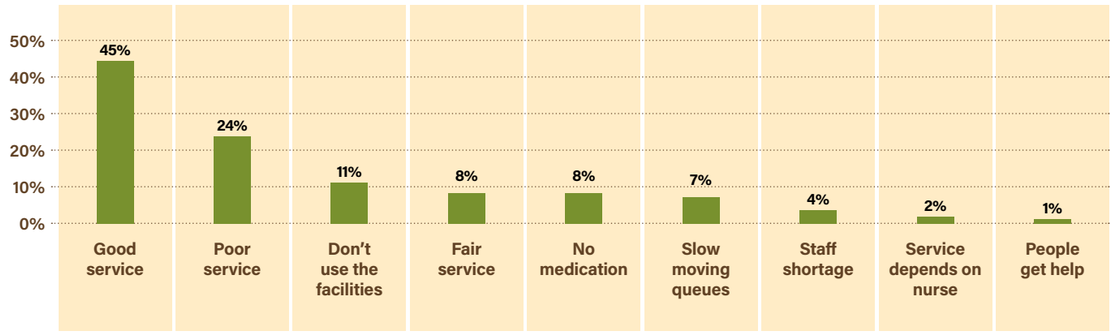


Satisfaction with the health services provided

This study found that while healthcare facilities were in place in Phola, residents were more concerned with the quality of service received. These elements were explored more in order to understand the reasons why respondents were not satisfied with the services received. Less than half of respondents (45%) indicated that the service they received at the healthcare centre was good. Close to a quarter (24%), stated that the service was below standard (poor service, 24%), 11% were not using the public healthcare facilities, either because they had other options or had not had health challenges that required healthcare facilities. Respondents indicated that while they could get to the healthcare facility in their area, utilisation of the facility was not fully realised. Eight percent of respondents indicated that the services were just fair, 8% stated there was no medication at the healthcare facilities, 7% complained about long queues and the time taken to get served, 4% mentioned that healthcare facilities did not have adequate staff to serve the Phola community. A smaller percentage (2%) indicated that the quality of service received was not consistent, rather it differed per healthcare nurse who attended to patients. One percent of respondents had positive sentiments that healthcare facilities in Phola were serving communities, offering help to those who needed healthcare services (Figure 8).

> **“This study found that while healthcare facilities were in place in Phola, residents were more concerned with the quality of service received.**

Figure 8: Satisfaction with the health services provided



FINDINGS ON GENERAL HEALTH AND WELLNESS IN THE COMMUNITY

Chronic conditions in Phola community

Chronic conditions such as high blood pressure (13.7%), skin problems (16.1%), eye problems (19.3%), angina (12.4%), arthritis (9.5%) and COPD (6.9%) were frequently reported in the past year. However, it is important to note that a wide range of respiratory diseases exist within the Phola community which includes bronchitis and asthma (Table 2).

Table 2: Confirmed chronic conditions in Phola community

Variable	Frequency	Percentage
Perceived general health		
Don't know/not sure	19	4.8
Poor	67	16.8
Fair	39	9.8
Good	57	14.3
Very Good	162	40.5
Excellent	56	14.0
Indications of chronic conditions in Phola community		
Coronary heart disease	12	3.2%
Angina (sharp pain in the chest)	47	12.4%
Stroke	5	1.3%
High blood pressure	52	13.7%
Asthma	17	4.5%
Bronchitis	8	2.1%
Arthritis (joint pains)	36	9.5%
Chronic Obstructive Pulmonary Disease	26	6.9%
Skin problems in the past 12 months	61	16.1%
Diabetes	15	4.0%
Tuberculosis	2	0.5%
Eye problems	73	19.3%
Diarrhea or stomach problems	24	6.3%
Cancer	1	0.3%

Other health issues in the Phola community

The results in Table 3 reveal a significant concern across a range of health issues, with mental health problems (93%), HIV/AIDS (92%), and suicide (90%) being the most recognised concerns, indicating a widespread awareness of these critical issues. In comparison, aging problems (88%) and homicide (83%) are also highly prevalent, reflecting the community's recognition of both physical health challenges and safety concerns. Vehicle accident-related injuries (79%) and infant deaths (67%), despite not being as prevalent as the aforementioned, are also notable, highlighting the risks associated with transportation and maternal-child health. Dental problems (62%) and obesity (56%) are less frequently identified but still represent significant health concerns, suggesting varying levels of perceived severity or impact within the community (See Table 3).

Table 3: Perceived other health issues in the Phola community (n=400)

Health issues	Yes	No
Aging problems (e.g., arthritis, hearing or sight loss)	348 (88%)	52 (12%)
Dental problems	247 (62%)	153 (38%)
Vehicle accident-related injuries	315 (79%)	85 (21%)
Obesity (childhood & adult)	221 (56%)	179 (44%)
HIV / AIDS	366 (92%)	34 (8%)
Homicide	327 (83%)	73 (17%)
Suicide	356 (89%)	44 (11%)
Infant deaths	266 (67%)	133 (33%)
Mental health problems	370 (93%)	30 (7%)

Respiratory symptoms in Phola community

The most common symptom reported is shortness of breath, with 51% of respondents experiencing it in the past 12 months, reflecting a significant concern. Irritation to the eyes (53%), throat (52%), and nose (58%) also affected a large proportion of respondents, indicating widespread respiratory discomfort, likely linked to environmental factors or chronic respiratory conditions. In contrast, more specific symptoms such as daily phlegm production (30%), wheezing or whistling sounds during breathing (32% and 31%), and skin problems (18%) were less prevalent, though still notable. The use of inhalers was the least reported (16%) (Table 4).

Table 4: Respiratory symptoms in Phola community

Respiratory symptoms	Yes	No
Coughed phlegm daily for more than 2 months in the past 12 months	121 (30%)	279(70%)
An attack of whistling or noisy sound in the chest when breathing	128 (32%)	182(68%)
An attack of whistling or noisy sound in the chest when breathing	124 (31%)	276 (69%)
Shortness of breath in the past 12 months	203 (51%)	49% (197)
Used an inhaler to relieve shortness of breath, wheezing, coughing	63 (16%)	337(84%)
Difficulty in breathing in the past 12 months	213 (53%)	187(47%)
Irritation to eyes in the past 12 months	207 (52%)	193(48%)
Irritation to throat in the past 12 months	152(38%)	248 (62%)
Irritation in the nose in the past 12 months	208 (52%)	192(48%)

Lifestyle habit of smoking in Phola community

Cigarette smoking remains a prevalent habit in Phola community as perceived by nearly 95% of the population. A significant proportion (99 out of 400) smokes cigarettes regularly. Among these, a significant number of respondents began smoking regularly at an early age, respondents starting before age eight. Another notable group of respondents started smoking during late adolescence, with 41 respondents starting between ages eight and 17. The highest age group reported 18 to 30 years, with 49 respondents starting to smoke at this age. A minority of respondents began smoking at age 50 or older, with scattered reports up to age 61 (Table 5).

Table 5: Smoking History for those who have smoked (n=99)

	Yes	No
Perceived burden of Cigarette smoking	375 (94%)	25 (6%)
Have you ever smoked cigarettes regularly?	99 (25%)	301 (75%)
How old were you when you first started smoking cigarettes regularly		
8 to 17 years	41 (41%)	
18 to 30 years	49 (49%)	
31 to 50 years	6(6%)	
More than 50 years	3(3%)	
Do you still smoke cigarettes?	79 (80%)	21 (20%)
Do you use any other inhaled tobacco or nicotine products (pipes, cigars, electronic cigarettes, e-cigarettes etc.)	31(31%)	69 (69%)

FINDINGS ON ENVIRONMENTAL PROBLEMS EXPERIENCED IN THE PHOLA

General environmental health problems

This data on the environment problems in the Phola community highlights a broad range of environmental problems present, with some issues affecting nearly the entire population (Table 6). The most prevalent problems are air pollution (97%), noise from coal mining (97%), dust from coal mining (98%), and water pollution (96%), indicating severe environmental degradation linked to the industrial activities (probably mining activities). Overpopulation is another major concern, with 96% of respondents recognising it as an issue, closely tied to the high rates of pollution and noise. In contrast, problems like drought (25%), flooding (25%), and soil erosion (49%) are less uniformly experienced, with about half or fewer of the respondents identifying them as issues. Social problems such as domestic violence (87%), drug and alcohol abuse (95%), and teenage pregnancy (93%) are also highly reported, reflecting significant social challenges within the community (Table 6).

Table 6: Environmental problems experienced in the Phola community

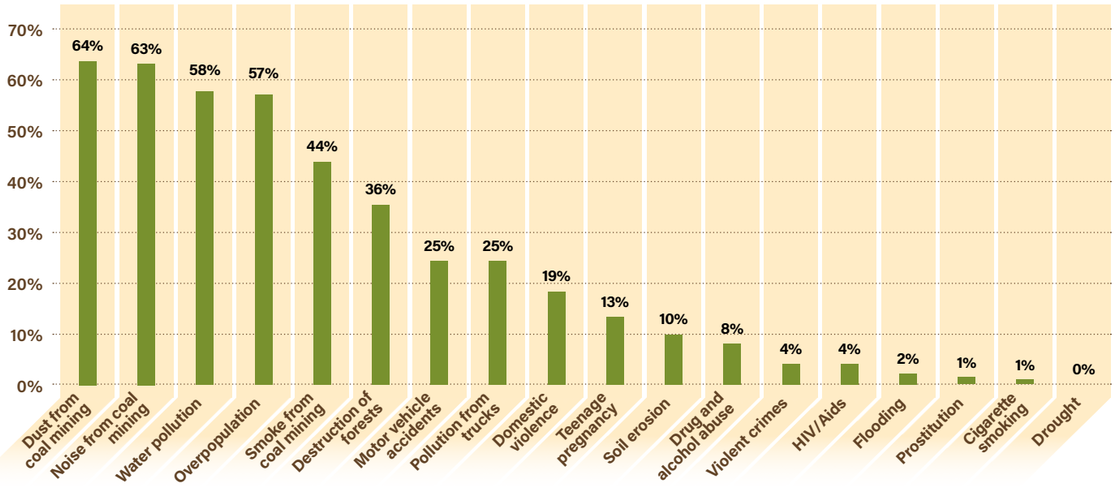
Environmental problem	Yes	No
Overpopulation	385 (96%)	15 (3%)
Destruction of forests	241 (61%)	149 (49%)
Water pollution	385 (96%)	15 (3%)
Air Pollution	392 (98%)	8 (2%)
Noise from coal mining	389 (97%)	11 (2%)
Dust from coal mining	392 (98%)	8 (2%)
Smoke from coal mining	388 (97%)	12 (3%)
Motor vehicle accidents	358 (90%)	42 (10%)
Pollution from trucks	375 (95%)	25 (5%)
Domestic violence	347 (87%)	53 (12%)
Teenage pregnancy	388 (97%)	12 (3%)
Drug and alcohol abuse	388 (97%)	12 (3%)
Violent crimes	381 (95%)	19 (5%)
Prostitution	210 (53%)	190 (47%)
Drought	119 (30%)	281 (70%)
Flooding	100 (25%)	300 (75%)
Soil erosion	196 (49%)	204 (51%)

Problems perceived to be resulting from coal mining

When respondents were asked to link the issues in Phola to mining activities, the following results were obtained. In the top 10 mentions were, air pollution (75%), dust from coal mining (64%), noise from coal mining (63%), water pollution (58%), overpopulation (57%), smoke from coal mining (44%), destruction of forests (36%), motor vehicle accidents (25%), pollution from trucks (25%), domestic violence (19%), teenage pregnancy (13%). Respondents also mentioned that soil erosion (10%), drug and alcohol abuse (8%), violent crimes (4%), HIV/AIDS (4%), flooding (2%), prostitution (1%), and cigarette smoking (1%) in the Phola community, were also a result of coal mining activities in the area (Figure 9).

> **"The most prevalent problems are air pollution (97%), noise from coal mining (97%), dust from coal mining (98%), and water pollution (96%).**

Figure 9: Problems perceived to be resulting from coal mining



Perceptions of the environment as a hazard for Phola community

The majority (96%) believe that the Phola environment exposes families to hazardous chemicals which cause coughing, feeling breathless or wheezing (95%), that the environment affects children born in the future in the community (91%) and worry of future air pollution-related health problems (90%). Despite the projected health problems from air pollution in Phola with majority willing to participate in environmental camp (59%), the government is not doing enough to address the health problems from coal mining (84%) and there are insufficient healthcare services in the Phola community to treat sick members (65%). Most respondents (42.6%) would turn to clinics or hospitals for information on air pollution, highlighting the trust placed in healthcare institutions as sources of reliable information. A significant portion (21.3%) also sees community leaders as key sources of information, reflecting their important role in disseminating information and guiding community decisions (Table 7).

Table 7: Perceptions of the environment as a hazard for Phola community

Perceptions	Yes	No
Phola environment exposes families to hazardous chemicals	382 (96%)	18 (4%)
Phola community causes coughing, feeling breathless or wheezing	378 (95%)	22 (5%)
The Phola environment will affect children born in the future in the community	365 (91%)	35 (9%)
I worry about getting health problems in the future because of pollution from coal mining air pollution	358 (90%)	42 (10%)
The government is doing enough to address the health problems from coal mining	57 (14%)	343 (84%)
There are plenty of economic opportunities in Phola	68 (17%)	83%
My family members have actively looked for environmental pollution information	162 (41%)	59%
Some or all family members are willing to participate in environmental camp	236 (59%)	41%
There are enough healthcare services in the Phola community to treat sick members	138 (35%)	65%
Source of information on air pollution		
I don't know	61	14.4%
Doctor	72	17.0%
Clinic/hospital	170	40.1%
Community leader	85	20.0%
Schools	24	5.7%
Other	12	2.8%

Irritation to eyes and smoking (p=.019);
Irritation to the nose and smoking (p=.050);
Household members experiencing respiratory symptoms and source of income (p=.024);
health issues in Phola and source of income (p=.023).

DISCUSSION OF SOCIODEMOGRAPHIC INFORMATION

Proportion of household members in Phola households by age and gender

Interestingly, all the household indicate a high percentage of no females (ranging from 66% to 86%). The percentage of households with one female in all age groups ranged from 14% to 27%. While households with two females constitute only 1% in only three age groups (0-6 years, 7 to 17 years, 18 to 24 years, and 25 to 34 years). Households with 3 or 4 female members across all age groups are nearly non-existent in Phola community. Comparing these results, it is evident that across all age groups, the majority of households tend to have no female members, with a smaller proportion having just one female member. Households with three or four female members are rare across all age groups, suggesting that larger families with multiple female members in an age group are uncommon in this community. Furthermore, it can be noted that the younger age group demographics exhibit a higher percentage of female members (one or more) in their age groups in each household which declined in the more mature ages.

Across the same age brackets for males, similar patterns emerge with minor variations in frequency. For example, the proportion of households without males in all age groups ranges from 1% from age groups of more than 50 years to 75% in the age group of 18 to 24 years. All the age groups across households indicated one male figure with percentages ranging from 21% to 92%. Households with two females constitute 2% or less in all age groups, while those with three or four males are very minimal or nearly non-existent (Figure 2). Comparing these results with the female data, both male and female data show that the majority of households across most age groups tend to have no members of that gender. However, a significant difference emerges in the 61+ years age group. For males, 92% of households have one member, while for females in the same age group, most of the households' report having zero members (86%). This suggests that elderly males are more likely to be the sole male member in households, while elderly females are less present in these households. Overall, while the trends for younger and middle-aged groups are somewhat similar across genders, the older age groups show a divergence, with males more likely to be present as members in households compared to females.

Gender and age of the respondents

According to statistics South Africa census (2022), females constituted a higher percentage than males, thus confirming the findings of the current community health survey in Phola. A higher percentage of females indicate gender imbalance that could influence various socio-economic dynamics within the community. For instance, healthcare services, employment opportunities, and social support systems might need to be tailored more towards the needs of women, particularly in areas like maternal health, gender-based violence prevention, and economic empowerment programs for women. The relatively smaller proportions of younger adults (18-24 years) and older adults (61+ years) suggest that the community is predominantly middle-aged. This affirms the results of Cowling (2024), who indicated only 36% and 1% percent of SA population to be younger and older ones thus showing 63% to be middle-aged. This demographic structure has significant implications for local services, particularly in terms of healthcare, where there may be an increased need for services targeting chronic conditions and age-related health issues. The relatively smaller proportion of younger adults (18-24 years) could suggest either a trend of migration out of the area or a lower birth rate.

Educational profile of the respondents

According to Department of Higher Education and Training (DHET) (2024), 3.3%, of people aged 25-64 years in 2023 had certificates, 6.0% have diplomas and 7.3% have degrees as their highest level of educational attainment (HLEA), thus affirming the findings of this project.The low percentage of respondents with higher education could impact the community's economic prospects, as higher levels of education are typically associated with better employment opportunities and higher income levels as indicated by Baum et al (2013). Additionally, this educational distribution may also influence the health literacy of the community, which is crucial in managing and preventing health issues emanating from coal mining activities.

This educational profile suggests the need for initiatives aimed at improving educational outcomes and promoting further education, which could help in addressing unemployment and underemployment issues in the community. The homogeneity in ethnic background (Gann & Duignan, 2022) may contribute to a strong sense of cultural cohesion within the community, but it may also mean that public health and social interventions can be more narrowly focused on addressing the specific needs and challenges faced by this majority group. The high reliance on social grants (Cousins et al, 2020) reflects significant economic challenges within the community and suggests limited access to stable, formal employment. This economic strain might also contribute to other social issues identified in the survey, such as crime and substance abuse.

Disabilities

The relatively low percentage (11.8%) of households reporting a family member living with a disability suggests that most of the community may not be directly affected by disability issues. According to Stats SA (2022), around 3,3 million individuals (5.3% of SA population) identified as living with disabilities and this confirms the findings of this study. However, for the minority that is affected, the impact could be significant, necessitating specialised services and support. The low prevalence might also reflect the overall health status of the community, although it's important to consider whether the survey captured all forms of disability accurately. Healthcare access appears to be limited, with 80.5% of respondents indicating they do not have medical aid or health insurance. This lack of coverage suggests that most of the population may rely on public healthcare services, which could be overburdened and under-resourced, hence severely limiting access to quality healthcare and increasing the community's vulnerability to health crises.

In South Africa, the public health sector caters to approximately 84% of the population (Docrat et al, 2019) and this confirms the findings of this study. Thus, most of the disproportionately vulnerable groupings, such as the poor, elderly, immunocompromised, pregnant females, babies, and growing children that are affected by air pollution use public health sector. A smaller portion of the community (13.5%) has employer-provided health insurance, which may be linked to formal employment sectors. This could indicate that those with formal employment are better protected against healthcare costs. Only 6% of respondents have personal health insurance, suggesting that most individuals do not prioritize or cannot afford private health coverage.

Families working in coal mining

The study confirmed the dependency of the Phola community on coal mines in the area, confirming

the finding of Lewis (2019) that male community members express their masculine dominance also through getting employed in the extractive industry. Lewis (2016) and Della Bosca, and Gillespie (2018) highlight the close relationships that develop over time between communities and mining companies operating in their vicinity, the crucial contribution of mining activities at both community and family levels. Lewis (2016) narrates a story of Central Appalachia from his ethnographic study, as a community that feels a connection to the coal mining industry, supporting the industry through labour supply, similar to the case of Phola. Lewis (2016) proves that employment in coal mining is not just a job, rather, it is 'a way of life'. Li (2016) also expresses the importance of coal mining jobs on communities, and that more jobs could have a significant positive impact on well-being and a more sustainable way to plough back economic benefits into communities. This study confirms the 'attachment' the Phola community has with coal mining entities in the area, for their sustained livelihoods through employment.

A significant portion of households reported that no family members have worked in the coal industry, thus indicates a shift away from coal industry employment in the community, which may reflect broader economic changes or a decline in coal industry jobs. Or possibly these community members were born and grew up in the coal mining community and are not passing the health exams due to chest related complications from polluted air. While 37.3% of households have at least one family member who has worked in the coal industry, suggesting that coal mining, while still relevant in Phola (Cock, 2022), may not be the primary source of employment for other families. Households with two or more members working in the coal industry are in the minority, with only 12.4% of respondents falling into this category. This further supports the observation that, despite the existence of coal industry employment in Phola (Cock, 20220, it may be declining or becoming more specialised within certain families, probably due to associated health complications.

Source of water in Phola community

The unavailability of water for Phola residents is seen in the various sources of water used by communities. Respondents in the study indicated that they were storing water in their houses as the water supply was erratic and or the water supplied was suspected to be not clean. Subsection 7.11.7 of the human rights case between Sibanyoni and Zakheni community vs. the Thembisile Hani Municipality, highlights the plight of Phola residents with water issues. It was mentioned that the Phola community received water from the municipality once or twice a week on Tuesdays and sometimes on Thursdays (SAHRC, 2021). Similar to this study, the case also mentions that Phola residents were using HH water storage tanks and buying water

because of the erratic water supply. The issue of clean water is also not new in the Phola community, as community protests have been witnessed, as the Phola community joined neighbouring communities in demanding clean water supply from the municipality (Mlangeni, 2021). In their plight, Phola community members linked their children's lower school performance, to the unavailability of water in the community as they spent most of their time fetching water (Mlangeni, 2021). In this study, respondents also lamented that while water taps exist in the area, water was not available daily for the Phola community.

Source of power for households

Longe et al., (201) allude to the improvements made by the South African government, increasing national electrification from 34% in 1991 to about 85% in 2021. The study also found electricity access for 85% of the Phola community, augmented by candles, coal, gas, paraffin, solar, and other sources, since the electricity supply was not reliable. Li (2016) also found that coal was affordable for communities in China, in which case it is also the second most popular (21%) in this study. The Phola community resorted to the use of various energy sources because of inconsistent electricity supply. With the worldwide quest for cleaner energy, South Africa is said to be working significantly at reducing reliance on coal, and migrating to solar and wind power (StatsSA, 2018). Only four percent of respondents in this study attested to using solar energy as an alternative to electricity. Baurzhan and Jenkins (2016) found that while global prices of solar energy usage had dropped, Sub-Saharan countries including South Africa were still subjected to higher costs of solar infrastructures, driven by unreliable techno-politico and financial risks. The Phola community energy woes may be solved by the national Free Basic Alternative Energy (FBAE) policy, which mandates municipal entities to provide means for alternative sources like coal, gas, and paraffin to poor households, but only those that are not on the grid (StatsSA, 2024).

Healthcare accessibility of satisfaction with services received

The local clinic is overwhelmingly the most frequented healthcare facility, with 78.4% of respondents indicating it as their go-to place when sick. This suggests that local clinics are the backbone of primary healthcare in this community. According to WHO (2017), public primary health care (PHC) in South Africa is provided through over 3500 clinics and community health centres to more than 90% of the population for free. Since apartheid, the government aimed to improve access to health care for the poorest and most marginalised by expanding the health care facility network and abolishing user fees for primary health care (Burger & Christian, 2020). 27.6% of cases mentioned doctor's facilities, which implies that while formal medical care is sought, accessibility or affordability issues might drive more people to local clinics. The presence of respondents using emergency care centers, pharmacists, and traditional healers indicates a reliance on varied healthcare providers, potentially due to accessibility, cultural beliefs, or cost factors. The heavy reliance on local clinics points to their importance in the community's healthcare system, suggesting a need for continued investment in these facilities.

DISCUSSION OF GENERAL HEALTH AND WELLNESS IN THE COMMUNITY

General health and indications of chronic conditions in Phola

The high prevalence of these conditions suggests significant environmental and lifestyle factors at play, possibly linked to local coal mining activities, which were noted by many respondents as contributing to air and water pollution. Respiratory conditions like asthma and chronic obstructive pulmonary disease (COPD) have been found to be aggravated by air pollution (Tran et al, 2023; Song et al., 2023). Moreover, the Phola community is exposed to long-term poor air quality with elevated levels of toxic elements which further leads to respiratory and long-term cardiovascular complications as indicated in literature (McDaid, 2014; Leonard et al, 2020; Shahriyari et al, 2021; Manisalidis et al, 2020; Konduracka & Rostoff, 2022). The data indicates a community burdened by chronic illnesses, which require ongoing management and could overwhelm local healthcare services if not adequately addressed. The continued high prevalence of chronic conditions diagnosed over a year ago underscores the ongoing challenge of managing these diseases within the community. High blood pressure and eye problems remain significant health burdens. The persistence of these conditions highlights potential gaps in healthcare follow-up and the management of chronic diseases, which may lead to complications if not adequately addressed.

There is a need for better follow-up care and chronic disease management programs to help individuals manage these conditions more effectively. The high percentages across most categories indicate that the community is grappling with a broad spectrum of health issues, with particular emphasis on mental health, chronic diseases, and violence due to their higher prevalence. The very high reporting of HIV/AIDS as a significant health issue indicates that this remains a critical public health challenge in the community, requiring continued efforts in prevention, education, and treatment. The alarming rates of mental health issues and suicide highlight a severe mental health crisis within the community, likely exacerbated by socio-economic factors, stigma, and inadequate access to mental health services. The community requires comprehensive health strategies that address not only physical health but also the significant mental health challenges facing its residents.

Short term respiratory health issues

The high percentage of respondents continually experiencing respiratory issues like coughing, phlegm and shortness of breath (especially still in the past 12 months) suggests a significant public health concern, potentially linked to environmental factors such as poor air quality which exists in Phola community. The identified symptoms are regarded as short-term exposure to air pollutants which includes cough, shortness of breath, wheezing, asthma, respiratory infections (Manisalidis et al, 2020). The widespread reporting of eye irritation could also be related to environmental air pollutants from coal mining activities. According to Lin et al (2022), the adverse effects of air pollutants (CO, NOx, PM, and O3) on human eyes include irritation and inflammation, with conjunctivitis being a frequent problem.

> **“The data indicates a community burdened by chronic illnesses, which require ongoing management and could overwhelm local healthcare services if not adequately addressed. High blood pressure and eye problems remain significant health burdens.**

Smoking lifestyle behaviors in Phola

Early initiation is often linked to higher lifetime consumption of cigarettes and greater difficulty in quitting. Young adulthood is a period where lifestyle habits, including smoking, can become entrenched. This age group's vulnerability may stem from new-found independence, stress from work or studies, and social environments where smoking is more prevalent. This continuation suggests challenges in quitting smoking, possibly due to nicotine addiction or lack of cessation support. The use of other inhaled products indicates the presence of alternative nicotine consumption habits, which may pose additional health risks. The data indicates that a significant portion of the community's smokers started at a very young age, which is a critical public health concern.

Moreover, evidence indicates that more than 50% of smokers who started smoking at a younger age are likely to develop COPD sooner or later in their lifetime (Backman et al, 2020). The fact that nearly half of the respondents began smoking before the age of 16 is concerning, as it indicates early exposure to nicotine, which can lead to long-term addiction. Undeniably, smoking is associated with asthma, decline in lung function, wheezing and COPD (Li et al, 2020; Tiotiu et al, 2021; Thomson et al, 2022). Thus, the presence of respiratory symptoms and other related complications might not be entirely due to air pollution in Phola community, smoking might be a contributing factor. There is a need for stronger smoking cessation programs in the community, including education on the risks associated with smoking and the availability of resources to help individuals quit.

DISCUSSION OF ENVIRONMENTAL PROBLEMS IN PHOLA

The survey results highlight significant environmental concerns, with air pollution and dust from coal mining being frequently cited. According to Shongwe (2018) as well as Liu and Liu (2020), emissions which include dust and coal mining activities have been found to be a source of water pollution, air pollution and land degradation with further adverse effects on aquatic life, human health livestock and crop productivity. Moreover, the environmental issues reported in this study are directly linked to the health problems reported by respondents, including respiratory issues and skin conditions. Hendryx et al (2020) indicated living near coal power plants to be associated with numerous adverse public health impacts such respiratory disease and lung cancer, cardiovascular disease and poor child health. The community's concerns about future health impacts on children due to pollution underscore the urgent need for environmental interventions and stricter regulations on mining activities to protect public health. The data indicates a high incidence of social problems as well, such as domestic violence, teenage pregnancy, and drug and alcohol abuse. These issues are often intertwined with economic instability and environmental stressors, suggesting a complex socio-economic landscape in Phola.

Unlike the Li (2019), study, where urban residents were not too concerned with impacts of coal mining, largely due to the distance, Phola community residents indicated that they live in a community marred with negative impacts of coal mining. The problems in coal mining areas, especially for residents who live within 10km of the mine, can lead to low levels of community wellness and dissatisfaction as revealed by Li (2019). In this study, the Phola community respondents were concerned with the levels of pollution from coal mining activities, dust, noise, smoke, and water quality. The negative impact of dust from coal on human health, workers, and communities within coal mining areas is well acknowledged, caused by differing sizes of dust and very small dust particles that can be deposited on alveoli, the gaseous exchange system. McIvor and Johnston (2007) and Perret et al., (2017) found the effect of coal mining dust on lungs. The noise from coal mining activities includes drilling and blasting as stated earlier and confirmed by Goswami (2015). Zhou and Srednicki (2022) dig deeper into the long-term health problems caused by prolonged exposure to extremely and very low electromagnetic noise from coal mining, which can include stress, headaches, tiredness, and anxiety (Kivrak et al., 2017). Downward effects included deforestation, prostitution, overpopulation as people migrate to seek economic opportunities, teenage pregnancy, and domestic violence.

Most respondents perceive the environment as hazardous as the majority believing it exposes families to harmful chemicals. This widespread concern highlights the severity of environmental degradation in Phola. A strong belief that the environment will negatively impact future generations reflects deep concern about long-term health consequences, which may lead to increased advocacy for environmental justice. The strong awareness of environmental hazards among residents may lead to increased demands for governmental and corporate accountability. Only a small fraction of respondents believe that the government is doing enough to address the health problems caused by coal mining, indicating widespread dissatisfaction and possibly distrust in governmental efforts. The perception of limited economic opportunities suggests that residents may feel economically marginalised, with few prospects for improving their socio-economic status. Less than half of the respondents believe there are sufficient healthcare services, indicating potential gaps in healthcare provision that could lead to unmet medical needs. A majority of respondents are willing to participate in environmental campaigns, reflecting a strong community interest in addressing environmental issues.

“Most respondents perceive the environment as hazardous as the majority believing it exposes families to harmful chemicals. This widespread concern highlights the severity of environmental degradation in Phola.

STRATEGIES FOR MITIGATING THE HEALTH IMPACTS OF AIR POLLUTION FROM COAL MINING ACTIVITIES AND IMPROVING COMMUNITY HEALTH FOR MPUMALANGA HIGHVELD

Community Strategies

- Educate the community about the health risks associated with air pollution from coal mining and how they can protect themselves. Information can be disseminated through local meetings, schools, workshops, social media, and community radio.
- Establish community-led air quality monitoring programs to collect data on pollution levels. This empowers residents to report pollution incidents and engage in advocacy. Citizens can use low-cost air quality sensors to provide real-time data on local pollution levels.
- Encourage the use of masks and indoor air purifiers, especially during high pollution days. Promote the planting of vegetation and trees around homes to act as natural air filters.
- Support the formation of local advocacy groups to pressure coal companies and government bodies to reduce emissions and comply with environmental standards.
- Educate and promote the use of cleaner energy sources such as solar power for cooking and heating to reduce reliance on coal, which can exacerbate local pollution levels.

Municipality/ Government Strategies

- Implement and enforce stricter air quality standards and emission limits for coal mining operations. Regular inspections and monitoring should be conducted to ensure compliance.
- Invest in transitioning from coal to renewable energy sources like wind, solar, and hydropower. Develop policies that support green jobs and retrain workers from the coal industry.
- Create buffer zones around coal mines where residential development is restricted. If necessary, provide relocation assistance to residents living in high-risk areas close to coal mines.
- Improve infrastructure, such as paving roads to reduce dust and building windbreaks, to mitigate the spread of particulate matter. Encourage the development of green spaces to improve air quality.
- Set up a comprehensive air quality monitoring network across the Mpumalanga Highveld, making the data publicly accessible. This increases transparency and helps communities hold polluters accountable.
- Develop and implement emergency response plans for air pollution episodes, including establishing community warning systems, distributing masks, and providing shelters with filtered air for vulnerable populations.

Healthcare Strategies

- Train local healthcare providers to recognise and treat conditions related to air pollution, such as respiratory and cardiovascular diseases. Enhance their capacity to conduct screenings and provide timely interventions.
- Establish health surveillance programs to monitor the prevalence of air pollution-related diseases. This data can help track the effectiveness of mitigation strategies and identify at-risk populations.
- Implement public health campaigns to inform the community about the risks of air pollution and preventive measures, such as reducing outdoor activities during peak pollution times.
- Deploy mobile clinics and telemedicine services to provide accessible healthcare to communities affected by air pollution, especially in remote areas. This can help diagnose and manage chronic conditions exacerbated by poor air quality.
- Ensure that healthcare facilities are equipped with air filtration systems to provide a clean environment for patients, particularly those with respiratory conditions.
- Prioritise healthcare services for vulnerable groups such as children, the elderly, and individuals with pre-existing conditions. Provide free or subsidised healthcare for air pollution-related illnesses.

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