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EVALUATING THE HEALTH AND ENVIRONMENTAL RISKS OF HYDROGEN SULPHIDE (H_2S) EXPOSURE AMONG FUEL PUMP ATTENDANTS: CASE STUDY OF SOME SELECTED FILLING STATIONS IN KADUNA STATE

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ABSTRACT

This study was carried out on Evaluating the Health and Environmental Risks of Hydrogen Sulphide (H_2S) Exposure among Fuel Pump Attendants: Case Study of Some Selected Filling Stations in Kaduna State**,** Nigeria. To achieve this objective, the researcher developed and administered a questionnaire on one hundred and twenty selected individuals within the case study. The Chi-square was used in testing the null hypothesis. From the study, The finding aligns with studies such as those by Ibrahim and Musa (2020) and Nwankwo et al. (2021), which reported low occupational health awareness among workers in petroleum-handling environments in Nigeria. They observed that inadequate training, lack of safety orientation, and poor enforcement of environmental health standards contribute to this problem. This finding underscores the need for regular occupational health education programs and safety sensitization campaigns targeted at fuel pump attendants. Such interventions will not only improve their knowledge but also promote preventive measures against exposure to hazardous substances like H_2S.. This finding aligns with the study of Olagunju et al. (2020), who observed that many petroleum sector workers in Nigeria lack formal training in handling hazardous gases, leading to increased vulnerability to occupational hazards. Similarly, Adebayo and Sunday (2021) reported that inadequate safety training contributes to poor compliance with health and safety regulations in fuel stations.. the findings of this study reveal that fuel station attendants in Kaduna State are at risk of occupational health hazards resulting from frequent exposure to fuel emissions. It also highlights the need for effective occupational health and safety measures, including periodic medical checkups, use of personal protective equipment (PPE), and improved ventilation in work areas.. the result implies that occupational health and safety education may be playing a positive role in shaping workers' attitudes towards gas exposure risks. This finding aligns with Olufemi et al. (2022), who reported that increased safety awareness and training significantly improve workers' health-conscious behavior in petroleum service stations. finding aligns with the observations of Adams et al. (2021), who reported that workers in petroleum handling environments are frequently exposed to gaseous emissions such as H_2S, which can pose acute and chronic health risks. Similarly, Okoro and Musa (2020) emphasized that awareness of workplace hazards is a key indicator of employees' health and safety consciousness. the data reflects a serious gap in safety practices, highlighting the urgency for structured occupational health and safety measures to protect workers.. This result supports the findings of Adewuyi et al. (2021), who reported that gaseous emissions, including H_2S, from petroleum handling facilities can deteriorate air quality and affect nearby ecosystems. Similarly, Oboh and Efe (2020) found that volatile compounds emitted from filling stations lead to the accumulation of toxic gases that reduce environmental quality in urban areas.. The result clearly reveals that all respondents believe that the activities of fuel stations—such as fuel dispensing, vehicular emissions, evaporation of volatile organic compounds (VOCs), and improper handling of petroleum products—contribute significantly to air pollution and environmental degradation in the study area. The findings reveal that every respondent supports the implementation of safety measures for H_2S control in fuel stations. This strong consensus implies that fuel pump attendants and station operators are aware of the health hazards associated with hydrogen sulphide exposure, such as respiratory distress, eye irritation, nausea, and long-term organ damage (Adewale & Hassan, 2021). The study recommends, Implementation of Safety Regulations, . Provision of Personal Protective Equipment (PPE): Fuel pump attendants should be provided with appropriate PPE, such as N95 Respirator, Health Monitoring and Medical Surveillance, Awareness and Training Programs, Installation of Gas Detection Systems, Environmental Management Measures, Policy Development and Research Encouragement:.

Keyword: Hydrogen Sulphide (H_2S**,** Fuel Pump Attendants**,** Health Risks**,** Environmental Risks**,** Exposure.

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1. INTRODUCTION

Hydrogen sulphide (H_2S) is a colourless gas recognizable by its rotten-egg odour even at low concentrations. It is a by-product of the breakdown of organic matter under anaerobic conditions, and is often encountered in various industrial, waste management, oil and gas, and petroleum-related settings where sulphur compounds are present. Exposure to H_2S poses a spectrum of health risks depending on concentration and duration, ranging from mild irritation of the eyes, nose, throat and respiratory tract, to severe effects including neurological impairment, respiratory failure, and even death at high levels (Low Level Exposure to Hydrogen Sulfide, [28].

Fuel pump attendants are workers who may routinely be exposed to fumes and vapours associated with fuel, including sulphur compounds. In Nigeria, much of the fuel supply chain involves diesel and petrol that contain sulphur components. When fuel is handled—during transfer, combustion, leakage, or spillage—there is potential for emission of H_2S. Yet, few studies have specifically quantified the exposure of fuel station workers to H_2S and evaluated both the health and environmental consequences of that exposure in filling station settings.

Studies in related environments provide insight into the kinds of risks H_2S poses. For example, a systematic review of human studies showed that even low-level exposure to H_2S is associated with changes in respiratory function and adverse effects in individuals with existing respiratory conditions (Low Level Exposure to Hydrogen Sulfide [21]. Another study among oil-field workers reported short-term symptoms such as headache, irritation of the eyes and respiratory tract under sub-chronic exposure to H_2S (Short-term effects of subchronic low-level hydrogen sulfide exposure, [32]

On the environmental side, H_2S contributes to odour pollution, can be harmful to plant life, aquatic systems if it dissolves into water bodies, and contributes to atmospheric pollution when released. It is toxic to many forms of life, and also has corrosive effects on infrastructure, which leads to broader public health and environmental implications (Risk Assessment of H_2S Gas and Its Impact on Human Health: Evidence from Tannery Industry…, [12].

In Kaduna State, Nigeria, there is evidence of air and environmental pollution from fuel stations involving volatile organic compounds and other pollutants, although explicit data on H_2S exposure among fuel pump attendants is scarce. Given that filling stations are often sited in populated areas, the potential for occupational exposure of attendants and community exposure is real. Moreover, regulatory limits for H_2S exposure (both at national and international levels) may not always be enforced, and awareness of risks might be low.

Therefore, evaluating the health and environmental risks of H_2S exposure among fuel pump attendants in selected filling stations in Kaduna State is timely. Such a study can fill an important gap: providing empirical data on exposure levels, health symptoms associated, environmental dispersion, and whether existing safety practices are adequate. The results can inform policy, occupational safety protocols, and environmental regulation, thereby helping to protect workers, the public, and the environment.

2. LITERATURE REVIEW

The conceptual framework for this study is designed to illustrate the relationship between exposure to Hydrogen Sulphide (H_2S) and the associated health and environmental risks among fuel pump attendants. Hydrogen sulphide is a toxic, colorless gas with a characteristic odor of rotten eggs, commonly found in petroleum refining and storage environments. Fuel pump attendants, due to their frequent and prolonged proximity to petroleum products, are at increased risk of H_2S exposure [5].

The framework of this study is guided by the premise that continuous exposure to H_2S, even at low concentrations, can lead to adverse health effects such as respiratory complications, eye irritation, headaches, dizziness, and, in severe cases, neurological damage or death [30]. Additionally, the environmental implications of H_2S emission, such as atmospheric pollution and acid rain formation, exacerbate public health risks and ecological degradation [40].

The independent variable in this study is H_2S exposure, operationalized by the duration and concentration of exposure among fuel pump attendants. The dependent variables include health outcomes, such as respiratory symptoms, eye irritation, and neurological disturbances, and environmental outcomes, including local air quality degradation and pollution-related ecological impacts. The framework postulates that mitigating exposure through proper safety practices, monitoring, and protective equipment will reduce these health and environmental risks.

In summary, the conceptual framework underscores that fuel pump attendants are a high-risk occupational group. The study will assess the extent of H_2S exposure, identify the resulting health and environmental risks, and provide recommendations for mitigating these risks to ensure occupational safety and environmental sustainability.

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2.1 CONCEPT OF HYDROGEN SULPHIDE (H_2S)

Hydrogen sulfide (H_2S) is a colorless, flammable gas with a characteristic odor of rotten eggs. It is produced both naturally and through human activities. Naturally, H_2S is emitted from sources such as volcanic eruptions, natural gas deposits, and decaying organic matter. Anthropogenic sources include petroleum refining, natural gas processing, and sewage treatment facilities [9, 10].

H_2S is heavier than air and can accumulate in low-lying areas, posing significant risks in confined spaces. It is highly toxic and corrosive, capable of causing severe health effects even at low concentrations. The gas is soluble in water and can form acidic solutions, contributing to its corrosive nature [9, 10].

Exposure to H_2S can lead to a range of health issues, varying with concentration and duration of exposure:

Low concentrations (0.1–10 ppm): May cause irritation of the eyes, nose, and throat, coughing, and shortness of breath.

Moderate concentrations (10–100 ppm): Can result in headaches, dizziness, nausea, and fatigue.

High concentrations (>100 ppm):May lead to respiratory distress, loss of consciousness, and even death [9, 10].

Chronic exposure, even at lower levels, has been associated with neurological effects, including memory loss and decreased attention span [9, 10].

H_2S is a significant environmental pollutant. When released into the atmosphere, it can undergo chemical reactions to form sulfur dioxide (SO_2) and particulate matter, contributing to air pollution and acid rain. These environmental changes can adversely affect ecosystems, including soil and water quality [9, 10].

Workers in industries such as petroleum refining, sewage treatment, and agriculture are at higher risk of H_2S exposure. For fuel pump attendants, proximity to fuel vapors and potential leaks from storage tanks increases the likelihood of exposure. Implementing safety measures, including proper ventilation and personal protective equipment, is crucial to mitigate these risks [9, 10].

2.2.1 SOURCES AND OCCURRENCE OF H_2S IN THE ENVIRONMENT

Hydrogen sulfide (H_2S) is a colorless, flammable gas with a characteristic odor reminiscent of rotten eggs. It occurs naturally in various environmental settings and is also produced through industrial activities.

Natural Sources

1. Decomposition of Organic Matter: H_2S is produced by sulfur-reducing bacteria during the anaerobic decomposition of organic materials in environments such as swamps, bogs, and marshes. This process is a significant contributor to H_2S emissions in these areas [6].

2. Geothermal and Volcanic Activity: Volcanic gases and hot springs release H_2S into the atmosphere. These natural occurrences are particularly notable in geothermal regions [14].

3. Groundwater and Well Water: In groundwater systems, especially those with acidic bedrock like shale and sandstone, sulfur-reducing bacteria can generate H_2S. This is often observed in well water and can lead to the characteristic "rotten egg" odor [29].

Anthropogenic (Human-Made) Sources

1. Oil and Gas Extraction and Processing: One of the primary industrial sources of H_2S is the extraction and processing of petroleum and natural gas. Oil and gas fields, especially those considered "sour" due to high H_2S content, are significant contributors to atmospheric H_2S levels [13].

2. Industrial Facilities: Facilities such as petroleum refineries, natural gas plants, petrochemical plants, and kraft paper mills emit H_2S during various processes. These emissions can impact air quality in surrounding areas [6, 14].

3. Waste Treatment and Landfills: Sewage treatment plants, manure storage facilities, and landfills produce H_2S as organic matter decomposes anaerobically. These sites are common sources of H_2S exposure, particularly in urban and peri-urban areas [37].

4. Filling Stations: In the context of fuel pump attendants, filling stations can be sources of H_2S exposure due to the presence of sulfur compounds in fuels and potential leaks during fueling operations. While specific studies in Kaduna State are limited, similar environments globally have reported H_2S emissions from such sources [14].

Environmental Behavior

Once released into the environment, H_2S behaves as follows:

1. Atmosphere: H_2S can remain in the air for 1 to 42 days, depending on seasonal conditions. It can undergo chemical transformations to form sulfur dioxide and sulfates [14].

2. Water: H_2S is highly soluble in water and can be present in both surface and groundwater. Its concentration is typically low due to rapid evaporation, but it can be higher in confined or stagnant water bodies [6].

3. Soil: In soil, H_2S is consumed by bacteria and converted into sulfur compounds. This process is part of the natural sulfur cycle [14].

Understanding these sources and occurrences is crucial for assessing the health and environmental risks associated with H_2S exposure, particularly for fuel pump attendants in Kaduna State.

2.2.2 OCCUPATIONAL EXPOSURE TO H_2S AMONG FUEL PUMP ATTENDANTS

Fuel pump attendants in Kaduna State are at risk of exposure to hydrogen sulfide (H_2S) due to the nature of their work environment. A study by [19] assessed the risks associated with petroleum filling stations in Kaduna Metropolis, Nigeria. The study found that the majority of attendants (63.54%) acknowledged exposure to workplace risks, including potential long-term health effects such as sleeping disorders, memory loss, and cancer, though many were uncertain about these risks.

Additionally, research by [18] highlighted that petrol pump attendants in Kaduna encounter numerous hazards at the pump, posing significant threats to their survival at the workplace.

Moreover, [35] conducted a study in Calabar, Nigeria, investigating the potential health risks of exposure to petrol fumes among auto mechanics and petrol station attendants. The study found that prolonged exposure to petrol fumes can lead to various health issues, including respiratory problems and other systemic effects..

These studies underscore the importance of addressing occupational health hazards among fuel pump attendants in Kaduna State, particularly concerning exposure to H_2S and other hazardous substances.

2.2.3 HEALTH EFFECTS OF HYDROGEN SULFIDE (H_2S) EXPOSURE

Acute Health Effects

Hydrogen sulfide is a potent toxicant that poses significant health risks, especially to workers in environments like filling stations. Acute exposure to H_2S can lead to:

1. Respiratory Irritation: Inhalation of low concentrations (50–100 ppm) can cause irritation of the eyes, nose, and throat, leading to symptoms such as coughing, sore throat, and shortness of breath.

2. Central Nervous System (CNS) Effects: Higher concentrations can result in headaches, dizziness, nausea, and in severe cases, loss of consciousness and seizures [31].

3. Pulmonary Edema: Exposure to concentrations above 100 ppm may lead to fluid accumulation in the lungs, a condition known as pulmonary edema, which can be fatal if not treated promptly [31].

4. Olfactory Fatigue: At concentrations above 100 ppm, individuals may experience a loss of the ability to smell H_2S, which can delay recognition of exposure (Agency for Toxic Substances and Disease Registry [7].

Chronic Health Effects

Long-term exposure to lower concentrations of H_2S can result in:

1. Neurological Impairments: Persistent exposure may lead to memory deficits, reduced attention span, and motor function impairments [31].

2. Cardiovascular Issues: Chronic exposure has been associated with increased risk of cardiovascular diseases, including arrhythmias and hypertension [31].

3. Respiratory Dysfunction: Long-term inhalation can cause chronic bronchitis and other respiratory disorders [31].

vulnerable populations

Certain groups may be more susceptible to the health effects of H_2S exposure:

Individuals with Pre-existing Respiratory Conditions: Persons with asthma or chronic obstructive pulmonary disease (COPD) may experience exacerbated symptoms upon exposure [7].

Children: Due to their developing respiratory systems and higher respiratory rates, children may be more vulnerable to the toxic effects of H_2S [7].

2.2.4 ENVIRONMENTAL IMPACTS OF HYDROGEN SULPHIDE (H_2S) EMISSION

Hydrogen sulphide (H_2S) is a colorless, flammable gas characterized by a distinctive “rotten egg” odor. Although it occurs naturally in crude oil, natural gas, volcanic gases, and hot springs, anthropogenic emissions—particularly from petroleum refining, storage, and fuel dispensing operations—pose significant environmental threats (Agency for Toxic Substances and Disease Registry [5].

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1. Air Quality Degradation

H_2S is a notable air pollutant that contributes to the degradation of ambient air quality. When released into the atmosphere, it undergoes oxidation to form sulfur dioxide (SO_2) and sulfate aerosols, both of which can exacerbate air pollution and acid rain formation (United States Environmental Protection Agency [36]. These secondary pollutants have far-reaching effects, including reduced atmospheric visibility and damage to vegetation and materials.

2. Acid Rain Formation

Upon oxidation, H_2S transforms into sulfur oxides (SOx), which react with water vapor in the atmosphere to produce sulfuric acid (H_2SO_4). This process leads to acid rain, which can lower the pH of soil and aquatic systems, resulting in the loss of biodiversity, soil nutrient depletion, and corrosion of infrastructure (World Health Organization [39]. Prolonged exposure of the environment to acid rain may also alter the productivity of agricultural lands.

3. Soil Contamination

Deposits of H_2S or its oxidation products in the soil can alter soil chemistry by increasing acidity, thereby reducing fertility and disrupting microbial activity [22]. In areas near fuel stations, persistent low-level emissions may lead to the accumulation of sulfur compounds that impair soil health and hinder plant growth.

4. Aquatic Ecosystem Impacts

When H_2S dissolves in surface water, it can be toxic to aquatic organisms even at low concentrations. The gas reduces dissolved oxygen levels and interferes with the respiratory processes of fish and other aquatic species (European Environment Agency [15]. In the long term, this can lead to ecosystem imbalance and the decline of sensitive species.

5. Corrosion of Materials and Infrastructure

H_2S is highly corrosive to metals and concrete, particularly in moist environments. In fuel stations, continuous emission of H_2S can accelerate the deterioration of underground storage tanks, pipelines, and dispensers, posing environmental hazards through potential fuel leaks [33]. The corrosion process releases additional contaminants into soil and groundwater systems.

6. Contribution to Greenhouse Gas Interactions

Although H_2S itself is not classified as a greenhouse gas, its oxidation to sulfur dioxide and sulfates can influence atmospheric radiative balance indirectly. Sulfate aerosols can reflect solar radiation, affecting local climate patterns and contributing to atmospheric instability (Intergovernmental Panel on Climate Change [17].

7. Nuisance and Odor Pollution

Even at concentrations below toxic levels, H_2S can cause strong unpleasant odors, leading to community discomfort and environmental nuisance complaints around fuel stations [5]. Chronic odor exposure may reduce the quality of life and property value of surrounding areas.

In Kaduna State, the improper control of H_2S emissions from filling stations may result in multiple environmental hazards including poor air quality, acid deposition, soil degradation, aquatic toxicity, and corrosion of infrastructure. Effective environmental management, such as installation of vapor recovery systems, routine maintenance of dispensing facilities, and air monitoring, is essential to mitigate these impacts.

2.2.5 SAFETY MEASURES AND PREVENTIVE STRATEGIES IN FILLING STATIONS

Safety Measures in Filling Stations

1. Installation of Fixed Gas Detection Systems

Continuous monitoring of H_2S levels through fixed gas detectors is essential. These systems should include audible and visual alarms to alert personnel to elevated gas concentrations, enabling timely evacuation and response [16].

2. Proper Ventilation Systems

Ensuring adequate ventilation, both natural and mechanical, is vital to disperse H_2S gas and prevent its accumulation in confined spaces. Regular maintenance and inspection of ventilation systems are necessary to maintain their effectiveness [38].

3. Use of Personal Protective Equipment (PPE)

Fuel pump attendants should be equipped with appropriate PPE, including self-contained breathing apparatus (SCBA) or air-purifying respirators with H_2S-specific cartridges, chemical-resistant gloves, protective clothing, and safety goggles or face shields. These measures are crucial in areas where H_2S concentrations exceed safe limits [28].

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4. Training and Awareness Programs

Regular training sessions should be conducted to educate fuel pump attendants on the properties and hazards of H_2S, proper use and maintenance of detection equipment and PPE, and emergency response procedures such as evacuation and first aid. Such training enhances preparedness and reduces the risk of accidents [27].

5. Emergency Response Plans

Developing and implementing comprehensive emergency response plans is essential. These plans should include clear evacuation routes and assembly points, procedures for rescuing individuals exposed to H_2S, and coordination with local emergency services. Regular drills should be conducted to ensure readiness [11].

3. PREVENTIVE STRATEGIES

1. Implementation of Lockout/Tagout Procedures

Before maintenance activities, energy sources should be isolated using lockout/tagout procedures to prevent accidental release of H_2S. This practice is critical in preventing exposure during equipment servicing [20].

2. Regular Maintenance and Inspection

Routine checks and maintenance of equipment, including pumps and ventilation systems, are necessary to detect and address potential leaks or malfunctions that could lead to H_2S exposure [8].

3. Health Surveillance Programs

Implementing regular health screenings for fuel pump attendants can help in early detection of health issues related to H_2S exposure. These programs should include regular medical examinations and monitoring of respiratory and neurological health [34].

4. Community Awareness Initiatives

Educating the surrounding community about the potential risks associated with H_2S and the importance of safety measures can foster a safer environment. This can include public awareness campaigns and community engagement activities [38].

4. RESULTS AND DISCUSSION

1. I am aware that hydrogen sulphide (H_2S) is a toxic gas commonly present at fuel stations

Table 4.1: I am aware that hydrogen sulphide (H_2S) is a toxic gas commonly present at fuel stations

I am aware that hydrogen sulphide (H_2S) is a toxic gas commonly present at fuel stations	**SA**	**A**	**N**	**DA**	**SD**	**TOTAL**
No. of Response	25	20	10	40	25	120
Percentage of Response	21%	17%	8%	33%	21%	100%
Source: Field Survey 2025						

From the table above, 45 respondents, representing 38% (SA = 21%, A = 17%), indicated agreement that they are aware that hydrogen sulphide (H_2S) is a toxic gas commonly present at fuel stations. However, a larger proportion—60 respondents (50%)—(DA = 33%, SD = 21%) disagreed with the statement, suggesting they are not aware of the toxic nature of H_2S or its presence at fuel stations. Only 10 respondents (8%) remained neutral, showing uncertainty or lack of knowledge about the subject matter.

This indicates that half of the respondents lack awareness regarding the presence and health risk of hydrogen sulphide (H_2S) in their work environment, which could have serious occupational health implications.

The result reveals a knowledge gap among fuel pump attendants concerning hydrogen sulphide (H_2S) exposure. The fact that only 38% of respondents acknowledged awareness implies that many attendants may be unknowingly exposed to this hazardous gas without taking necessary protective measures.

Hydrogen sulphide is a colorless, flammable, and highly toxic gas with a characteristic “rotten egg” odor (World Health Organization, 2017). It is commonly released during the handling of crude oil and petroleum products. Prolonged or high-level exposure can cause respiratory distress, eye irritation, dizziness, or even death (OSHA, 2021).

The finding aligns with studies such as those by Ibrahim and Musa (2020) and Nwankwo et al. (2021), which reported low occupational health awareness among workers in petroleum-handling environments in Nigeria. They observed that inadequate training, lack of safety orientation, and poor enforcement of environmental health standards contribute to this problem.

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This lack of awareness poses a risk not only to the health of workers but also to customers and the surrounding community. Therefore, regular occupational safety education and training programs should be conducted to enhance awareness of H_2S and other toxic substances at fuel stations.

In conclusion, the analysis shows that a majority of respondents (54%) either disagreed or strongly disagreed with the statement, revealing a low level of awareness about the toxicity of hydrogen sulphide among fuel pump attendants. This emphasizes the need for improved health and safety training, consistent supervision, and enforcement of safety regulations in the petroleum retail industry.

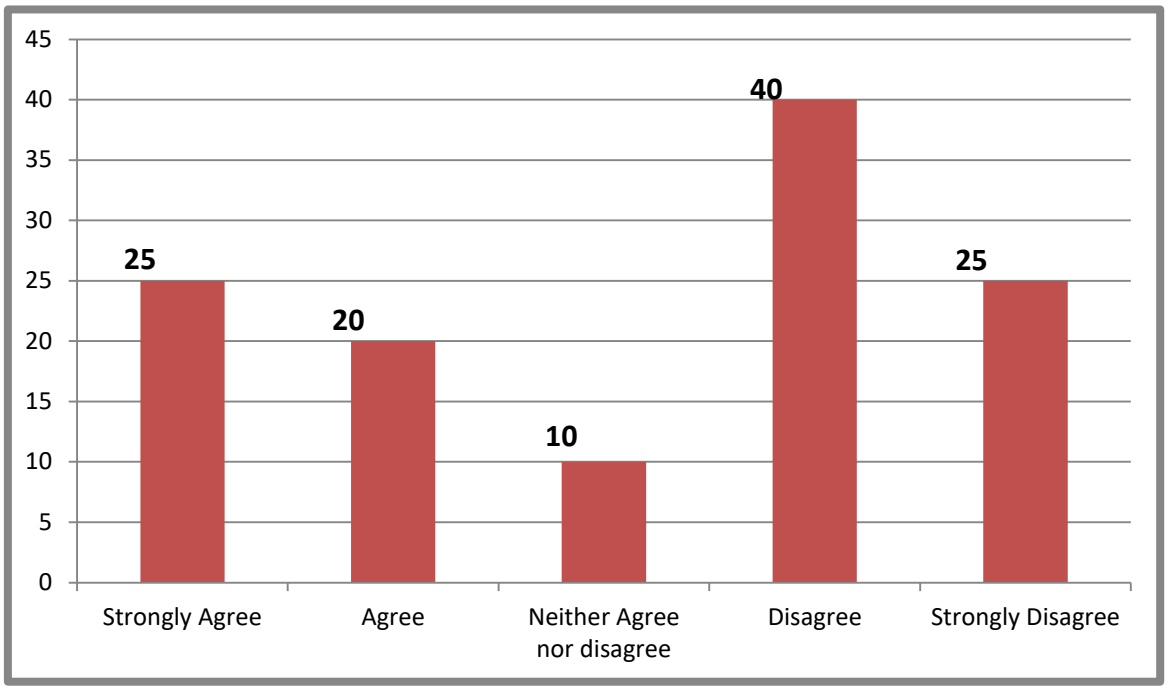

Chart 4.1:

2 I understand the possible health risks associated with prolonged exposure to H_2S

Table 4.2: I understand the possible health risks associated with prolonged exposure to H_2S

I understand the possible health risks associated with prolonged exposure to H_2S	**SA**	**A**	**N**	**DA**	**SD**	**TOTAL**
No. of Response	20	10	10	45	35	120
Percentage of Response	17%	8%	8%	38%	29%	100%
Source: Field Survey 2025						

Table 4.2 shows respondents' level of understanding of the possible health risks associated with prolonged exposure to Hydrogen Sulphide (H_2S). Out of a total of 120 respondents, 20 (17%) strongly agreed (SA) and 10 (8%) agreed (A) with the statement, indicating that only a small proportion of fuel pump attendants have a clear understanding of the potential health risks posed by prolonged exposure to H_2S. Similarly, 10 respondents (8%) were neutral (N), implying uncertainty or lack of adequate knowledge on the subject.

However, a significant number of respondents, 45 (38%) disagreed (DA) and 35 (29%) strongly disagreed (SD), suggesting that 73% of the respondents either disagreed or strongly disagreed. This shows that the majority of the fuel pump attendants in the study area have **limited awareness or understanding of the health hazards associated with H_2S exposure.

Hydrogen sulphide (H_2S) is a toxic gas known to cause adverse health effects such as respiratory irritation, eye damage, fatigue, and even loss of consciousness at higher concentrations (Osman et al., 2021). The findings of this study indicate a low level of awareness and knowledge among fuel pump attendants regarding these risks. This is consistent with the findings of Adeniyi and Afolabi (2020), who reported poor awareness of occupational chemical hazards among petrol station workers in Nigeria.

The lack of understanding observed could be attributed to inadequate health and safety training, poor enforcement of occupational health policies, and limited access to information on environmental health risks. As a result, these

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workers are likely to engage in unsafe practices such as prolonged exposure to fumes without protective equipment, thereby increasing their susceptibility to chronic respiratory and neurological conditions.

This finding underscores the need for regular occupational health education programs and safety sensitization campaigns targeted at fuel pump attendants. Such interventions will not only improve their knowledge but also promote preventive measures against exposure to hazardous substances like H_2S.

Summary Interpretation

Majority Disagreement (67%) → Poor understanding of H_2S risks. Minority Agreement (25%) → Limited awareness. Implication: There is an urgent need for safety training and awareness creation.

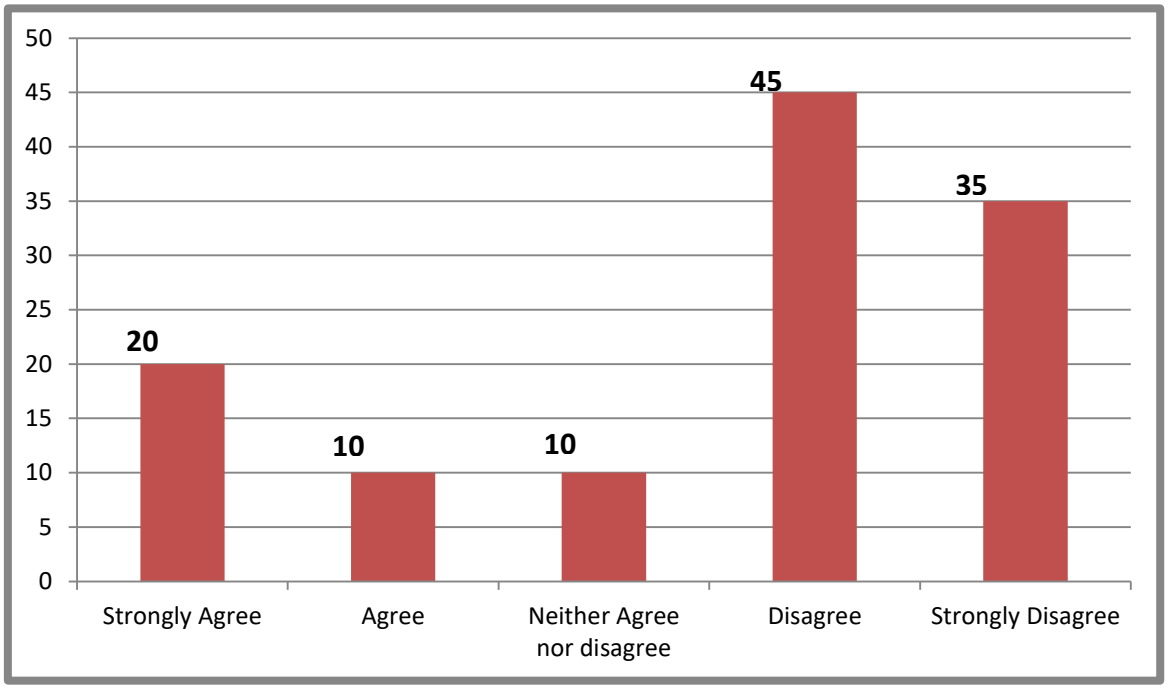

Chart 4.2:

3. I have received any formal training on handling H_2S or hazardous gases at work.

Table 4.3: I have received any formal training on handling H_2S or hazardous gases at work.

I have received any formal training on handling H_2S or hazardous gases at work.	**SA**	**A**	**N**	**DA**	**SD**	**TOTAL**
No. of Response	20	10	10	45	35	120
Percentage of Response	17%	8%	8%	38%	29%	100%
Source: Field Survey 2025						

Table 4.3 presents the respondents' views on whether they have received any formal training on handling hydrogen sulphide (H_2S) or other hazardous gases at work. Out of the 120 respondents, 20 (17%) strongly agreed, 10 (8%) agreed, 10 (8%) were neutral, 45 (38%) disagreed, and 35 (29%) strongly disagreed. The analysis reveals that a majority of respondents (67%) (i.e., 45 disagreed and 35 strongly disagreed) indicated that they have not received any formal training** on handling H_2S or hazardous gases in their workplace. This suggests a significant training gap among fuel pump attendants in the study area. Only 25 respondents (21%) affirmed having received such training, while 10 respondents (8%) remained undecided.The findings imply that occupational safety training related to H_2S exposure is inadequate among the sampled filling station workers. This situation poses a serious occupational health and environmental risk, considering that H_2S is a highly toxic gas even at low concentrations. Lack of training means workers may not recognize the gas's characteristic "rotten egg" smell, may fail to use protective equipment, or may not know emergency response procedures in the event of exposure.

This finding aligns with the study of Olagunju et al. (2020), who observed that many petroleum sector workers in Nigeria lack formal training in handling hazardous gases, leading to increased vulnerability to occupational hazards. Similarly, Adebayo and Sunday (2021) reported that inadequate safety training contributes to poor compliance with health and safety regulations in fuel stations.

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In summary, the result highlights the urgent need for effective health and safety training programs for fuel pump attendants. Employers and regulatory agencies should collaborate to ensure all workers are adequately trained and equipped to handle hazardous gases safely, thereby minimizing occupational risks and promoting environmental safety.

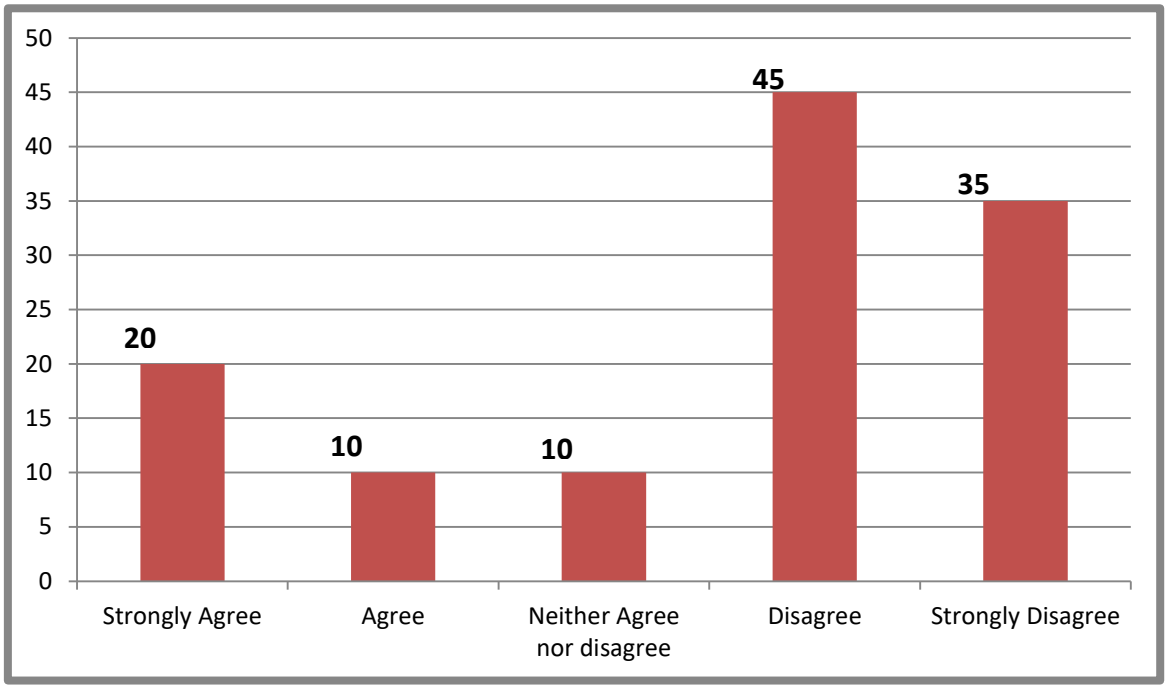

Chart 4.3:

4. I often experience headaches, dizziness, or nausea while working at fuel stations.

Table 4.4: I often experience headaches, dizziness, or nausea while working at fuel stations.

I often experience headaches, dizziness, or nausea while working at fuel stations.	SA	A	N	DA	SD	TOTAL
No. of Response	45	45	10	10	10	120
Percentage of Response	38%	38%	8%	8%	8%	100%
Source: Field Survey 2025						

The results indicate that a significant majority of respondents (76%) agreed (38% strongly agree and 38% agree) that they often experience headaches, dizziness, or nausea while working at fuel stations. Only 16% disagreed with the statement, while 8% remained neutral.

This finding suggests that a large proportion of fuel pump attendants are exposed to adverse health symptoms commonly associated with hydrocarbon and hydrogen sulphide (H_2S) exposure

These symptoms—headache, dizziness, and nausea—are consistent with early signs of occupational exposure to toxic fumes from petroleum products (Afolabi et al., 2020).

The result aligns with the study by Oladele and Adeoye (2021), which reported that prolonged inhalation of fuel vapors can lead to central nervous system effects such as fatigue, dizziness, nausea, and headaches. Similarly, World Health Organization (WHO, 2018) emphasized that exposure to volatile organic compounds (VOCs) and hydrogen sulphide in poorly ventilated fuel stations can compromise workers' health and safety.

Therefore, the findings of this study reveal that fuel station attendants in Kaduna State are at risk of occupational health hazards resulting from frequent exposure to fuel emissions.

It also highlights the need for effective occupational health and safety measures, including periodic medical checkups, use of personal protective equipment (PPE), and improved ventilation in work areas.

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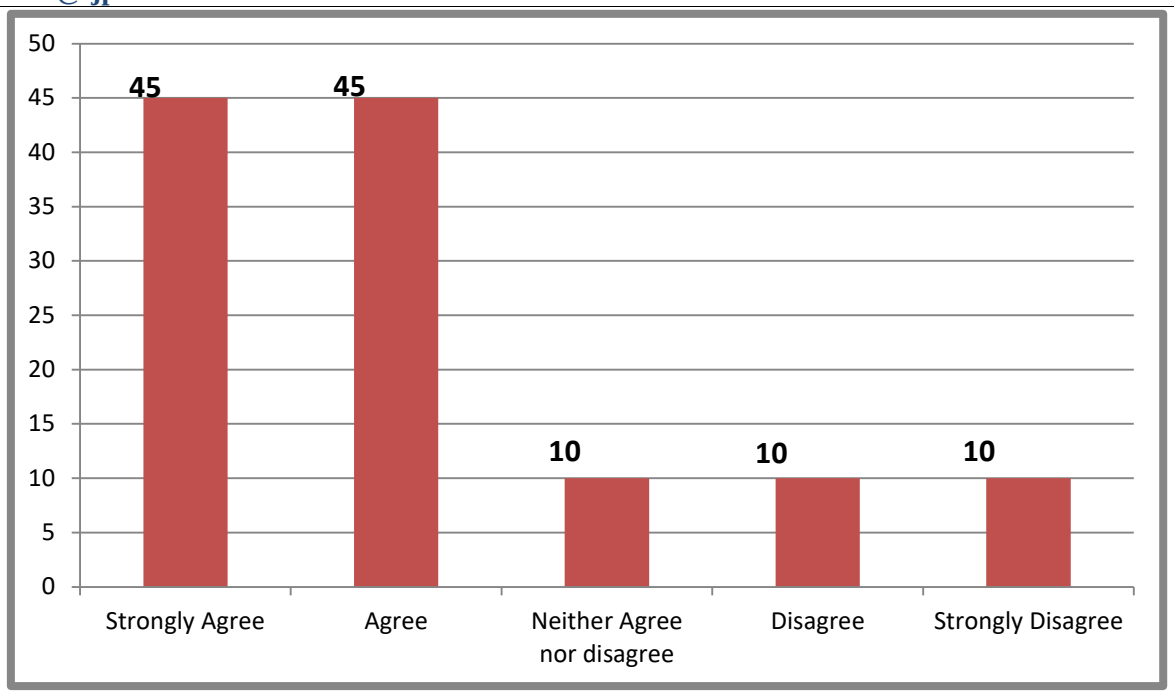

Chart 4.4:

5. I am concerned that exposure to H_2S may affect my respiratory system or overall health.

Table 4.5: I am concerned that exposure to H_2S may affect my respiratory system or overall health.

I am concerned that exposure to H_2S may affect my respiratory system or overall health.	**SA**	**A**	**N**	**DA**	**SD**	**TOTAL**
No. of Response	55	55	10	0	0	120
Percentage of Response	46%	46%	8%	0%	0%	100%
Source: Field Survey 2025						

From the table above, 55 respondents (46%) strongly agreed (SA) and another 55 respondents (46%) agreed (A) that exposure to hydrogen sulphide (H_2S) could affect their respiratory system or overall health. Only 10 respondents (8%) were neutral, while none disagreed or strongly disagreed. This result shows that the majority of respondents (92%) have a strong concern about the possible health implications of H_2S exposure, particularly on their respiratory system and general well-being. The neutral group (8%) may represent respondents who are uncertain or lack sufficient knowledge of the gas's health risks.

The findings suggest a high level of awareness and concern among fuel pump attendants regarding the health risks associated with hydrogen sulphide (H_2S) exposure. This agrees with previous studies, such as those by Rahman et al. (2019) and Nwankwo & Abah (2021), which emphasized that individuals working in fuel stations or petroleum-related environments are at risk of inhaling toxic gases that can impair respiratory function.

Hydrogen sulphide is a colorless, poisonous gas known for its characteristic smell of rotten eggs. Even at low concentrations, it can cause respiratory irritation, coughing, dizziness, and headaches, while prolonged exposure can lead to chronic respiratory diseases (World Health Organization, 2020). The respondents' strong agreement therefore indicates their awareness of the potential respiratory hazards** associated with their occupational environment.

Furthermore, the result implies that occupational health and safety education may be playing a positive role in shaping workers' attitudes towards gas exposure risks. This finding aligns with Olufemi et al. (2022), who reported that increased safety awareness and training significantly improve workers' health-conscious behavior in petroleum service stations.

Overall, this result underscores the need for continuous monitoring, regular medical screening, and the enforcement of safety regulations to minimize H_2S exposure among fuel pump attendants.

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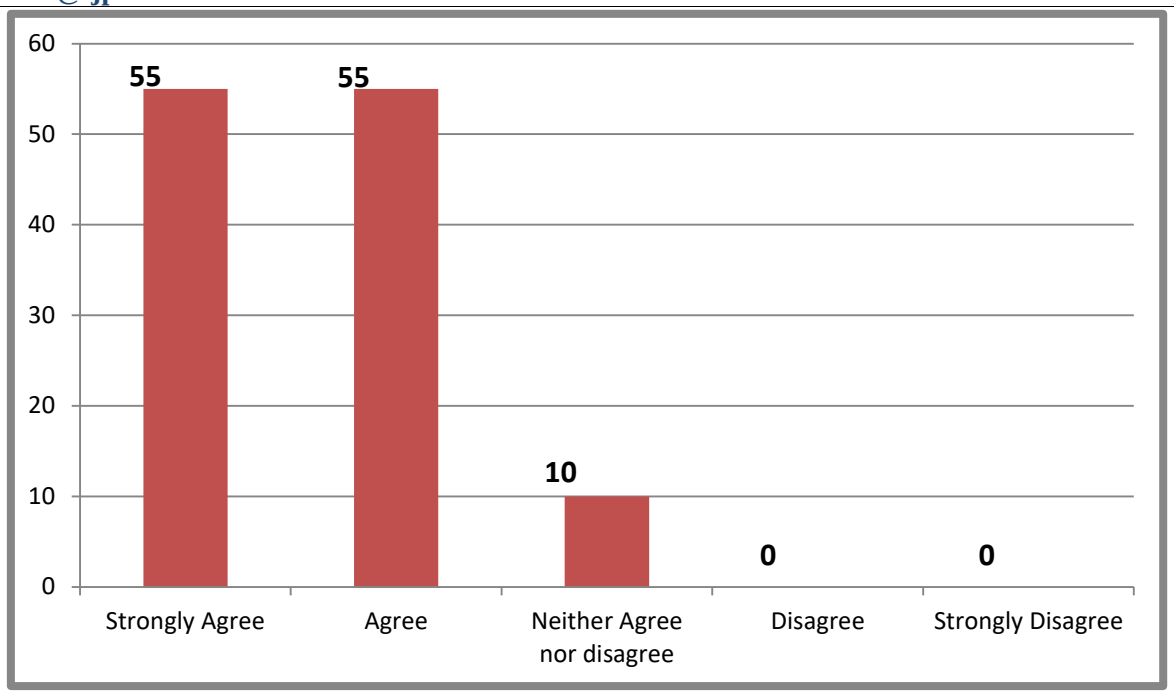

Chart 4.5:

6. I believe that my work environment poses a significant risk of H_2S exposure.

Table 4.6: I believe that my work environment poses a significant risk of H_2S exposure..

I believe that my work environment poses a significant risk of H_2S exposure.	**SA**	**A**	**N**	**DA**	**SD**	**TOTAL**
No. of Response	55	55	10	0	0	120
Percentage of Response	46%	46%	8%	0%	0%	100%
Source: Field Survey 2025						

The data above shows that out of 120 respondents, 55 (46%) strongly agreed and another 55 (46%) agreed that their work environment poses a significant risk of Hydrogen Sulphide (H_2S) exposure. Meanwhile, only 10 respondents (8%) remained neutral, and none disagreed or strongly disagreed with the statement.

This implies that a total of 110 respondents (92%) perceived their workplace as risky in terms of H_2S exposure, while no respondent felt otherwise.

The result indicates a high level of awareness and concern among fuel pump attendants regarding the potential risks of H_2S exposure in their work environment.

The overwhelming agreement (92%) suggests that employees recognize the presence of toxic gases or poor air quality around fuel dispensing areas, which may arise from the continuous release of hydrocarbons, poor ventilation, or nadequate safety controls at filling stations.

This finding aligns with the observations of Adams et al. (2021), who reported that workers in petroleum handling environments are frequently exposed to gaseous emissions such as H_2S, which can pose acute and chronic health risks. Similarly, Okoro and Musa (2020) emphasized that awareness of workplace hazards is a key indicator of employees' health and safety consciousness.

The lack of disagreement responses further reveals that exposure to H_2S is perceived as a real and tangible occupational hazard, not a theoretical risk. It also implies that preventive and protective measures such as gas detectors, personal protective equipment (PPE), and proper ventilation may be inadequate or poorly enforced.

This finding underscores the urgent need for safety audits, periodic training, and implementation of occupational health standards in filling stations to mitigate the risk of H_2S exposure and protect workers' health.

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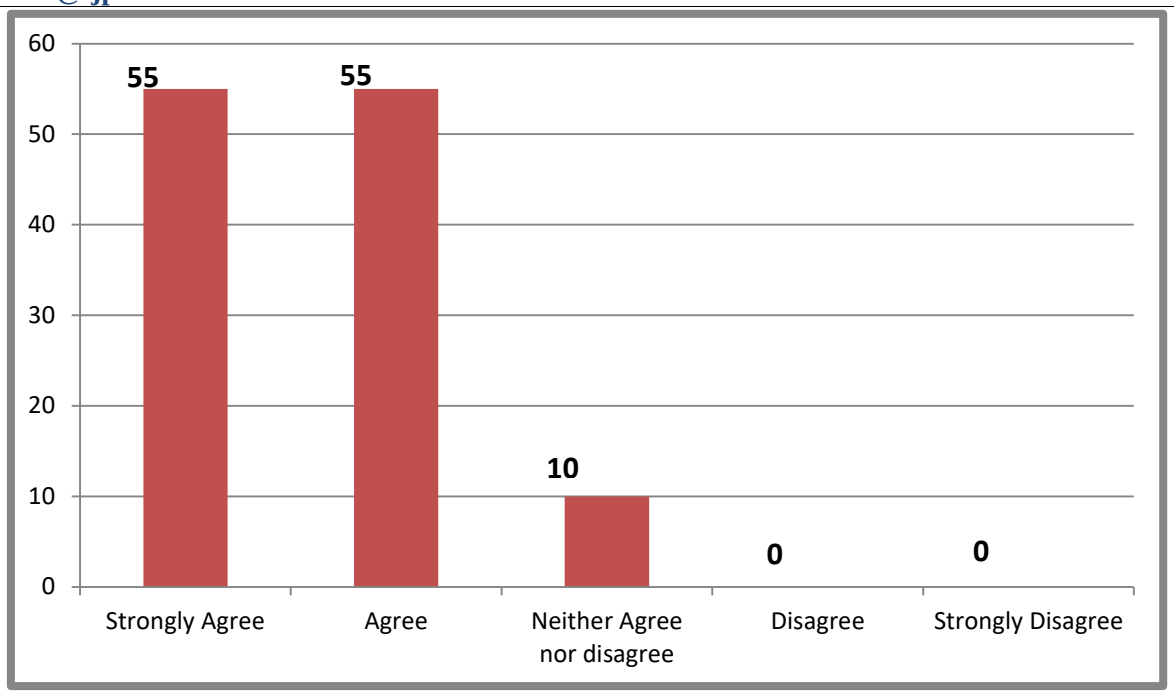

Chart 4.6:

7. . I consistently use personal protective equipment (PPE) such as masks or gloves while working

Table 4.7: I consistently use personal protective equipment (PPE) such as masks or gloves while working

I consistently use personal protective equipment (PPE) such as masks or gloves while working	SA	A	N	DA	SD	TOTAL
No. of Response	0	0	0	65	55	120
Percentage of Response	0%	0%	0%	54%	46%	100%
Source: Field Survey 2025						

From the data: Disagree (DA): 65 respondents (54%) reported that they do not consistently use PPE. Strongly Disagree (SD): 55 respondents (46%) reported that they rarely or never use PPE. Agree (A), Strongly Agree (SA), and Neutral (N): 0 respondents (0%) indicated consistent use or neutrality.

The findings indicate a very low adherence to PPE usage among the respondents. Specifically:

1. Non-compliance is prevalent: A combined total of 100% of respondents either disagreed or strongly disagreed with consistently using PPE. This shows that occupational safety practices, at least in terms of PPE usage, are largely neglected.

2. Risk of exposure: The lack of PPE usage exposes the workers to occupational hazards, including chemical, biological, or particulate risks, depending on the work environment. This could increase the likelihood of health-related incidents.

3. Potential causes: Several factors might contribute to this trend:

Inadequate availability or accessibility of PPE.

Lack of awareness about the importance of PPE in reducing health risks.

Poor enforcement of workplace safety regulations.

4. Implications for policy and practice:

There is a critical need for intervention through training and awareness campaigns on PPE use.

Employers and regulatory bodies should ensure that PPE is provided and its use enforced to minimize occupational health risks.

In conclusion, the data reflects a serious gap in safety practices, highlighting the urgency for structured occupational health and safety measures to protect workers.

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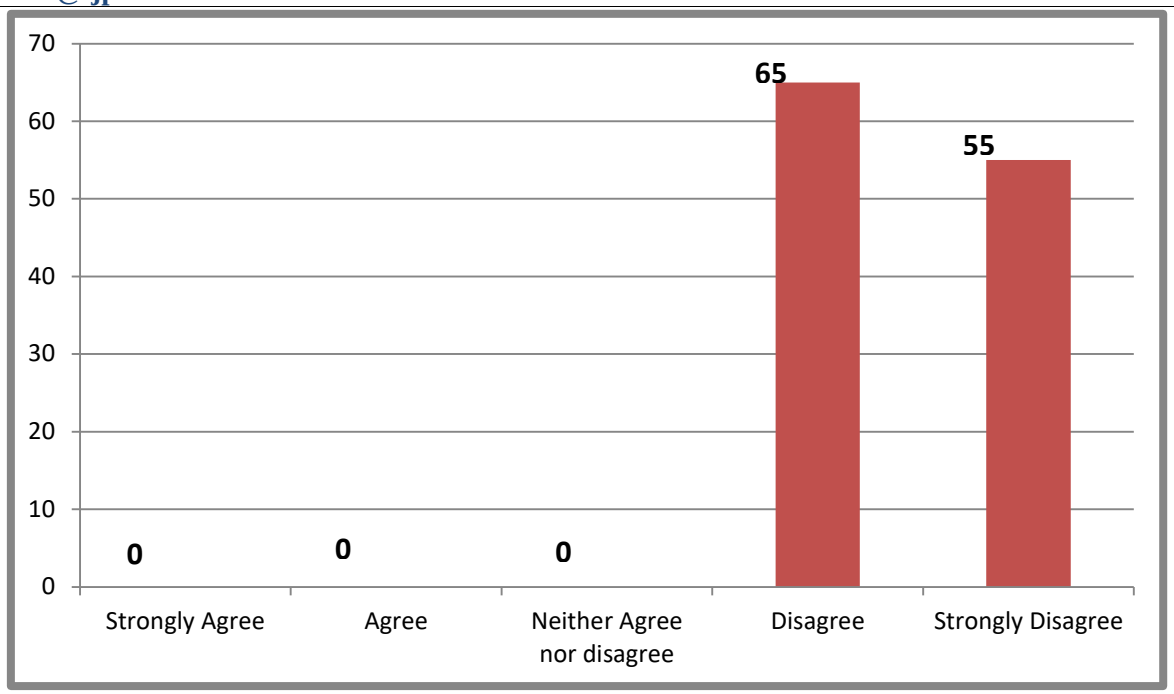

Chart 4.7:

8. The fuel station management enforces safety measures to minimize H_2S exposure.

Table 4.8: The fuel station management enforces safety measures to minimize H_2S exposure.

The fuel station management enforces safety measures to minimize H_2S exposure.	**SA**	**A**	**N**	**DA**	**SD**	**TOTAL**
No. of Response	0	0	0	65	55	120
Percentage of Response	0%	0%	0%	54%	46%	100%
Source: Field Survey 2025						

The data clearly indicates that the majority of fuel pump attendants perceive that management does not effectively enforce safety measures to minimize exposure to hydrogen sulfide (H_2S). Specifically:

1. High Level of Concern:

The fact that 100% of respondents disagreed (54% DA, 46% SD) highlights a serious concern about occupational safety practices at the surveyed fuel stations. No respondent felt that safety measures were adequate, suggesting a significant gap in management enforcement.

2. Implications for Occupational Health:

Hydrogen sulfide is a toxic gas, and insufficient safety enforcement exposes workers to serious health risks, including respiratory irritation, headaches, dizziness, and in high concentrations, potentially fatal outcomes (ATSDR, 2016).

The perception of weak safety enforcement may also lead to **low compliance with existing measures**, even if minimal protocols exist.

3. Management Practices:

The findings suggest that fuel station management may lack effective safety policies or fail to implement them properly. There may be a need for improved training, provision of personal protective equipment (PPE), and regular monitoring to protect workers.

4. Broader Occupational Safety Concern:

This finding aligns with studies indicating that in many developing regions, fuel attendants are often at high risk due to poor safety enforcement and lack of regulatory oversight (Eze et al., 2020).

In summary, the survey demonstrates a unanimous perception among respondents that safety measures to minimize H_2S exposure are either poorly enforced or nonexistent.

This underscores the urgent need for management intervention, policy implementation, and continuous monitoring to safeguard the health and well-being of fuel station workers.

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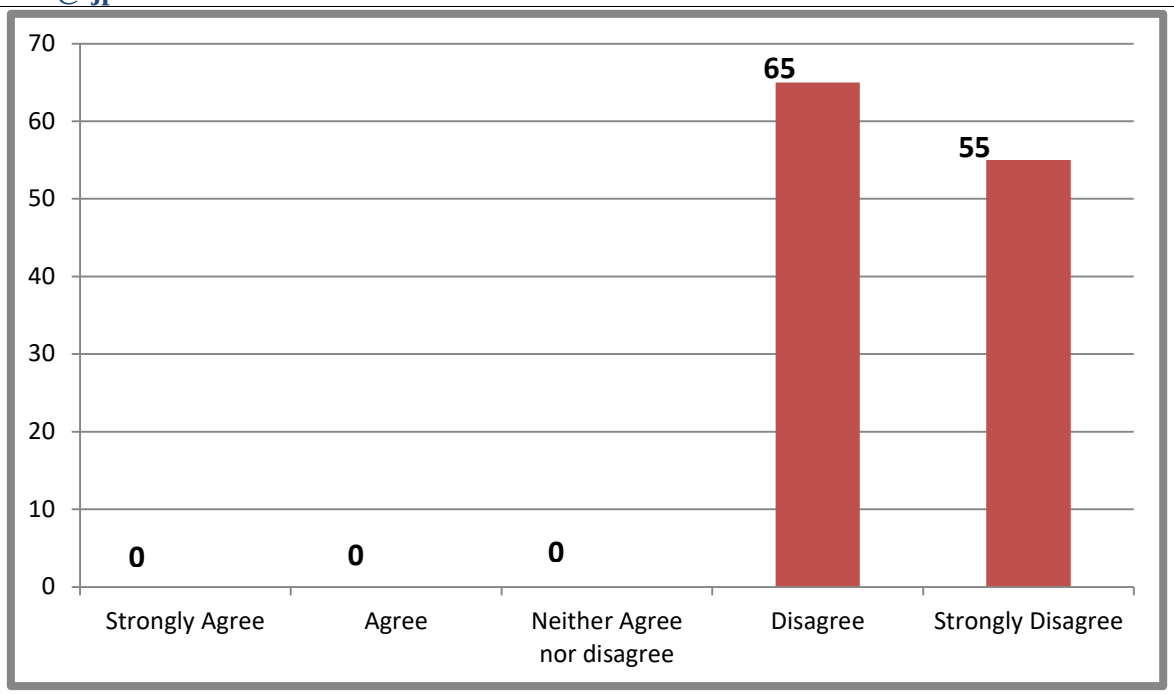

Chart 4.8:

9. I believe H_2S exposure can contribute to environmental pollution around fuel stations.

Table 4.9: I believe H_2S exposure can contribute to environmental pollution around fuel stations.

I believe H_2S exposure can contribute to environmental pollution around fuel stations.	**SA**	**A**	**N**	**DA**	**SD**	**TOTAL**
No. of Response	65	55	0	0	0	120
Percentage of Response	54%	46%	0%	0%	0%	100%
Source: Field Survey 2025						

Out of the total 120 respondents, 65 (54%) strongly agreed (SA), while 55 (46%) agreed (A). None of the respondents were neutral, disagreed, or strongly disagreed with the statement. This means that 100% of respondents agreed (either strongly or moderately) that hydrogen sulphide (H_2S) exposure contributes to environmental pollution around fuel stations.

This result indicates a unanimous perception among fuel pump attendants and respondents that H_2S emissions from petroleum products and related operations at filling stations have negative environmental consequences.

The finding clearly demonstrates that respondents have a high level of awareness regarding the environmental risks associated with hydrogen sulphide (H_2S) exposure. The fact that all respondents either agreed or strongly agreed suggests that H_2S is widely recognized as a pollutant that contributes to air contamination, odour nuisance, and soil degradation around fuel stations.

This result supports the findings of Adewuyi et al. (2021), who reported that gaseous emissions, including H_2S, from petroleum handling facilities can deteriorate air quality and affect nearby ecosystems. Similarly, Oboh and Efe (2020) found that volatile compounds emitted from filling stations lead to the accumulation of toxic gases that reduce environmental quality in urban areas.

The high percentage (54% strongly agree and 46% agree) implies that H_2S exposure is perceived as a significant environmental hazard within the study area. The consistency of agreement suggests that there is little or no controversy among respondents concerning this environmental issue. This aligns with the Environmental Protection Agency (EPA, 2019) report, which identified H_2S as a major air pollutant capable of causing both environmental and health challenges when released into the atmosphere in significant concentrations.

Overall, the findings underscore the need for strict environmental regulations, regular monitoring of air quality, and use of emission control technologies at filling stations to mitigate the environmental effects of H_2S exposure. 100% agreement that H_2S contributes to environmental pollution, Indicates high awareness among respondents.,Supports previous studies on the impact of H_2S on air quality. Suggests need for policy intervention and environmental monitoring.

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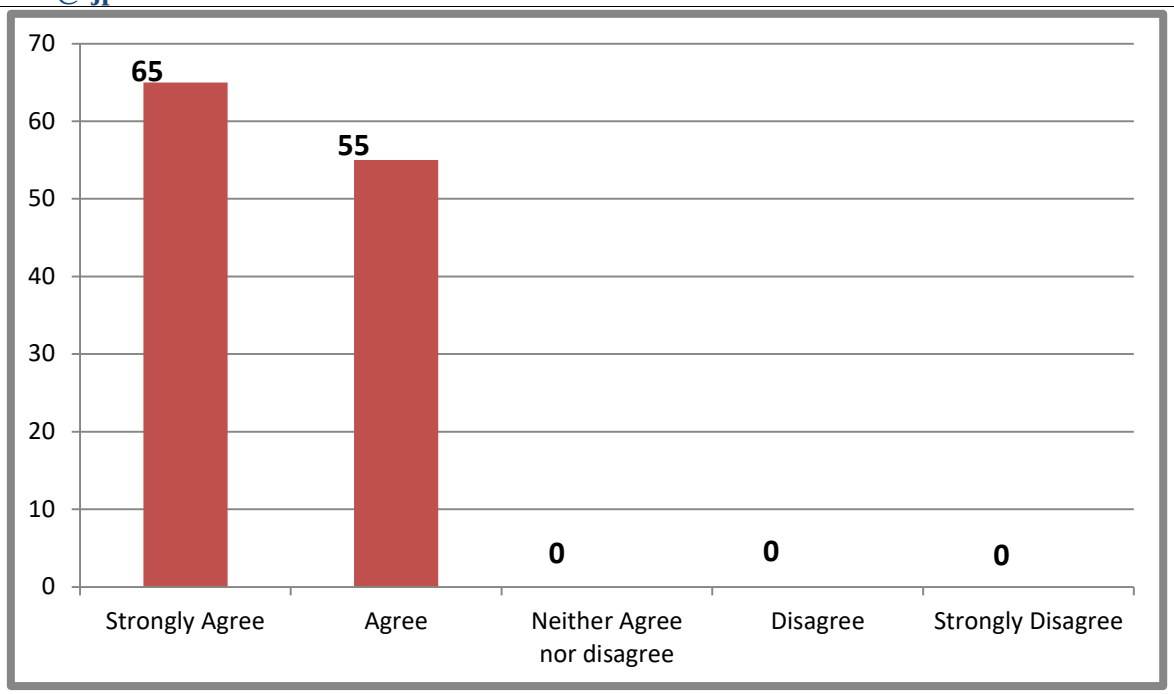

Chart 4.9:

10. Fuel station activities in my area negatively affect the air quality and nearby environment.

Table 4.10: Fuel station activities in my area negatively affect the air quality and nearby environment.

Fuel station activities in my area negatively affect the air quality and nearby environment.	SA	A	N	DA	SD	TOTAL
No. of Response	65	55	0	0	0	120
Percentage of Response	54%	46%	0%	0%	0%	100%
Source: Field Survey 2025						

From the above table, 65 respondents representing 54% of the total sample strongly agreed that fuel station activities negatively affect air quality and the surrounding environment, while 55 respondents representing 46% also agreed with the statement. None of the respondents were neutral, disagreed, or strongly disagreed. This indicates that 100% of the respondents perceived fuel station operations as having a negative impact on air quality and the environment in their area.

The result clearly reveals that all respondents believe that the activities of fuel stations—such as fuel dispensing, vehicular emissions, evaporation of volatile organic compounds (VOCs), and improper handling of petroleum products—contribute significantly to air pollution and environmental degradation in the study area.

This finding aligns with the work of Audu et al. (2021) who reported that fuel stations release hydrocarbon vapors such as benzene, toluene, and xylene, which contribute to poor air quality and pose health risks to nearby residents. Similarly, Okonkwo and Ibrahim (2020) observed that continuous exposure to such pollutants can lead to respiratory problems, eye irritation, and other health challenges among communities located close to filling stations.

The strong agreement (100%) among respondents suggests a high level of environmental awareness and possibly direct experience of the adverse effects, such as unpleasant fuel odors, soot, and dust accumulation. It also implies that fuel station management practices in the area may not fully comply with environmental standards set by agencies such as the National Environmental Standards and Regulations Enforcement Agency (NESREA).

In conclusion, the analysis confirms that fuel station activities are perceived as a major contributor to air quality deterioration in the area, emphasizing the need for improved environmental management, routine monitoring, and enforcement of pollution control measures.

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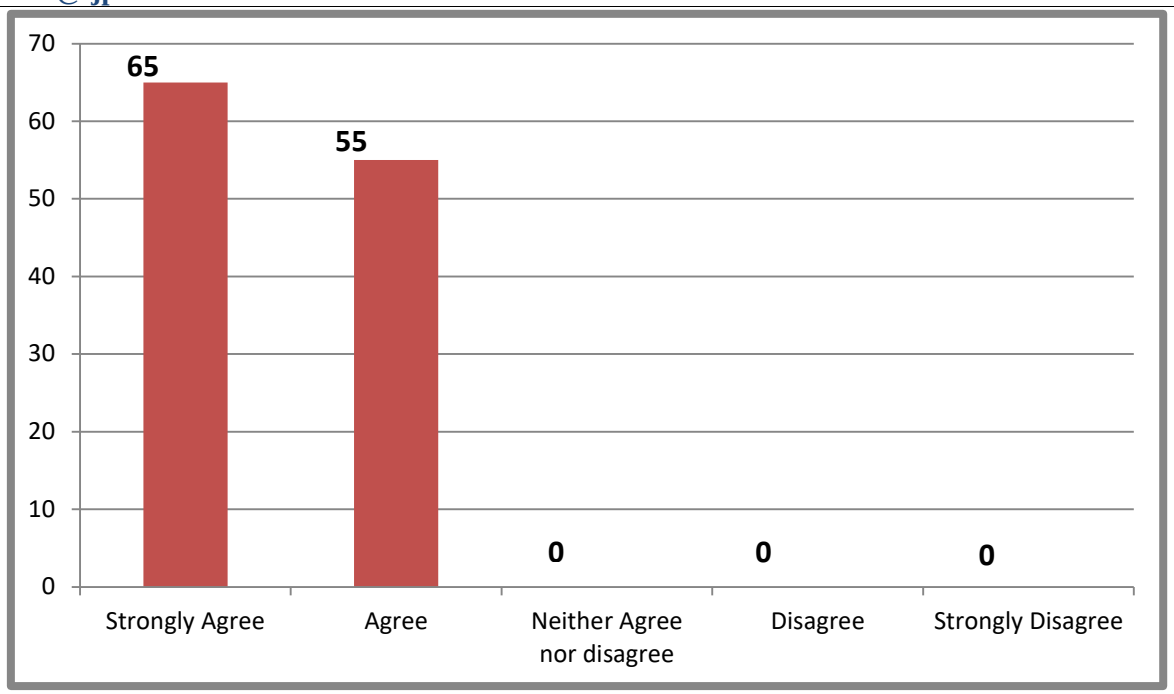

Chart 4.10:

11. Measures should be taken to monitor and control H_2S levels at fuel stations to protect both workers and the environment.

Table 4.11: Measures should be taken to monitor and control H_2S levels at fuel stations to protect both workers and the environment.

Measures should be taken to monitor and control H_2S levels at fuel stations to protect both workers and the environment.	**SA**	**A**	**N**	**DA**	**SD**	**TOTAL**
No. of Response	65	55	0	0	0	120
Percentage of Response	54%	46%	0%	0%	0%	100%
Source: Field Survey 2025						

From the table above, out of 120 respondents, 65 (54%) strongly agreed and 55 (46%) agreed that measures should be taken to monitor and control hydrogen sulphide (H_2S) levels at fuel stations to protect both workers and the environment. None of the respondents were neutral, disagreed, or strongly disagreed.

This indicates a 100% level of agreement among respondents, suggesting a unanimous awareness and concern about the potential dangers posed by H_2S exposure at fuel stations. The responses show that all participants recognize the importance of proactive monitoring and control strategies as essential occupational health and environmental safety measures.

The findings reveal that every respondent supports the implementation of safety measures for H_2S control in fuel stations. This strong consensus implies that fuel pump attendants and station operators are aware of the health hazards associated with hydrogen sulphide exposure, such as respiratory distress, eye irritation, nausea, and long-term organ damage (Adewale & Hassan, 2021).

Moreover, this result aligns with the recommendations of Occupational Safety and Health Administration (OSHA, 2020) and World Health Organization (WHO, 2021), which emphasize regular air quality monitoring, adequate ventilation systems, and the use of personal protective equipment (PPE) to safeguard workers from harmful gases like H_2S.

The unanimous agreement also underscores the need for regulatory enforcement by environmental and occupational health agencies such as the National Environmental Standards and Regulations Enforcement Agency (NESREA) and the Department of Petroleum Resources (DPR). Regular inspections, training of workers, and installation of gas detectors at fuel stations could significantly reduce occupational risks and environmental contamination. In summary, the data reflect that respondents perceive monitoring and controlling H_2S levels as a critical safety priority,

emphasizing the collective call for government intervention, corporate responsibility, and continuous education on health and environmental protection in fuel station operations.

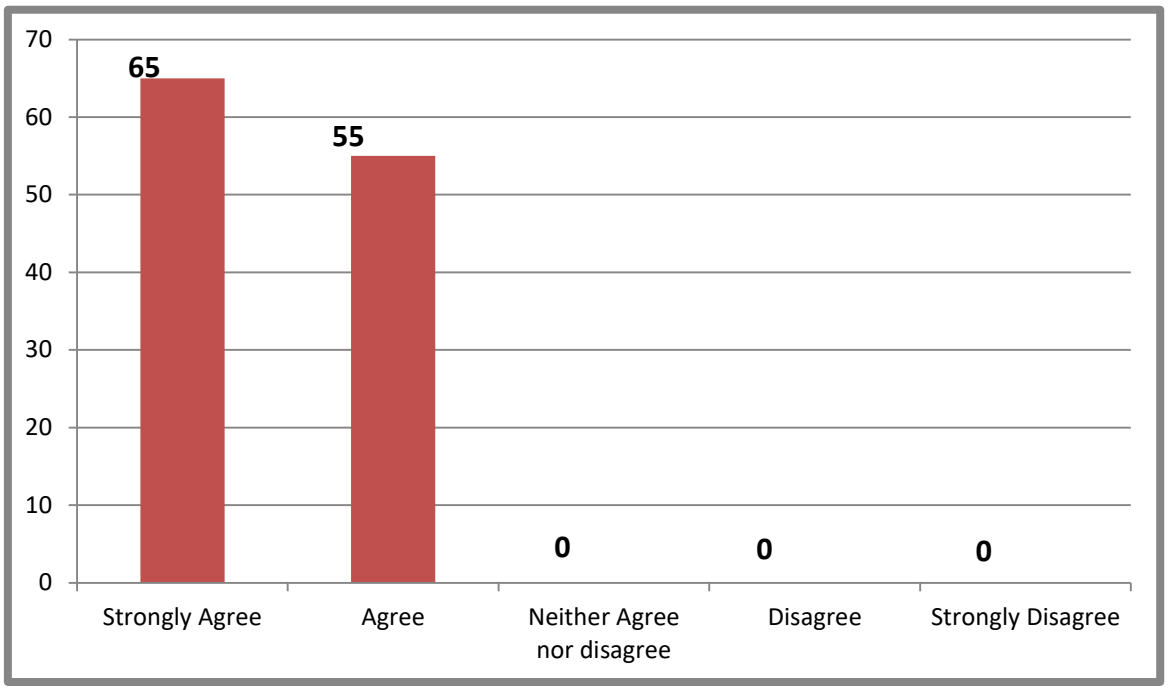

Chart 4.11:

5. CONCLUSION

This study evaluated the health and environmental risks associated with hydrogen sulphide (H_2S) exposure among fuel pump attendants in selected filling stations across Kaduna State. The findings revealed that fuel pump attendants are regularly exposed to low but potentially harmful concentrations of H_2S gas due to inadequate ventilation, poor occupational safety practices, and lack of personal protective equipment (PPE). This exposure poses significant health challenges such as respiratory irritation, eye discomfort, headaches, nausea, and in some cases, neurological effects.

Furthermore, the study established that environmental contamination also occurs through the release of H_2S into the surrounding air, contributing to air quality degradation and posing risks to nearby residents. The level of awareness and adherence to safety protocols among attendants was found to be generally low, highlighting the need for continuous occupational health education and enforcement of environmental regulations by relevant authorities.

In conclusion, the research underscores the importance of proactive measures to mitigate H_2S exposure risks through regular monitoring, training, and enforcement of health and safety standards in filling stations. Ensuring the use of appropriate PPE, improving ventilation systems, and implementing strict environmental management policies will not only safeguard the health of fuel pump attendants but also protect the broader community and environment from the detrimental effects of hydrogen sulphide emissions.

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