ASSESSMENT OF AWARENESS, ATTITUDES, AND PRACTICES OF ENVIRONMENTAL HEALTH PRACTITIONERS REGARDING AMBIENT AIR POLLUTION AND ITS ASSOCIATED HEALTH EFFECTS IN NAMIBIA

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ABSTRACT

Air pollution remains a significant global health threat, disproportionately affecting vulnerable populations, including women, children, and the elderly, across all continents. HPs are often responsible for monitoring air quality and implementing guidelines to safeguard public health. This study assessed the environmental health practitioners' awareness, attitudes, and practices regarding ambient air pollution and its associated health effects in Namibia. Using a quantitative cross-sectional analytical design, data were collected from 66 out of 76 environmental health practitioners across all 14 Regions of Namibia, yielding an 86.8% response rate. A validated online questionnaire was used. Data were analysed using SPSS version 27. The results showed that about 6.7% of participants were aware of AAP and its associated health effects. Regarding attitudes, 59% of the respondents had a negative attitude towards AAP. 9 % always participated in preventative activities regarding AAP, while 66.7% indicated that they never got involved in awareness campaigns. There was a strong negative correlation (-0.71) between the awareness and attitudes towards AAP, and a weak negative correlation (-0.20) between the awareness and practices indicating that higher awareness of AAP does not lead to greater engagement. A weak positive correlation (0.30) between attitudes and practices implies that positive attitudes may encourage greater involvement with AAP prevention strategies. Demographic factors such as age, gender, education, and experience did not significantly influence EHPs' attitudes toward ambient air pollution (AAP), highlighting the greater impact of systemic barriers like limited resources and unclear policies. Majority of EHPs did not prioritise AAP prevention strategies due to insufficient training and infrastructure. The study recommends continuous professional development and clear guidelines to better equip EHPs in addressing air pollution effectively.

Keywords: *Ambient air, ambient air pollution, attitudes, awareness, environmental health practitioner, pollution, practices*

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LIST OF ABBREVIATIONS AND ACRONYMS

AAP	Ambient Air Pollution
AHPCNA	Allied Health Professional Council of Namibia
AAP	Ambient Air Pollution
AQI	Air Quality Index
CO	Carbon Monoxide
COPD	Chronic Obstructive Pulmonary Disease
DEA	Department of Environmental Affairs
DEC	Decentralised Ethical Committee
EHPs	Environmental Health Practitioners
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
HIAs)	Health Impact Assessments
LMICs	Low- and middle-income countries
MOHSS	Ministry of Health and Social Services
NCDs	Non-Communicable Diseases
PM	Particulate Matter
PAHs	Polycyclic Aromatic Hydrocarbons
SPSS	Statistical Package for the Social Sciences
UNFCC	United Nations Framework Convention on Climate Change
UNAM	University of Namibia
VOCs	Volatile Organic Compounds
WHO	World Health Organisation

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This thesis is dedicated to my late father, Abner Ndeshipanda Itumba, who always motivated us to be the best versions of ourselves. “Vamwange tuningeni shokoo Itumba.” Tate, your words will linger in our ears forever.

To my beloved mother, Tiofilia Ndadilepo Nakapela, my inspiration and role model. Meme, thank you for your unconditional love, and for being a pillar and my strongest support system.

DECLARATIONS

I, Laudika Itumba, hereby declare that this study is my original work, which is a true reflection of my own research and that this work or any part thereof has not been submitted for a degree at any other institution.

Laudika Itumba		April2025
Name of the student	Signature	Date

CHAPTER 1: INTRODUCTION

1.1 Orientation of the study

Clean air is crucial for preserving health. Yet, air pollution has significantly increased with the swift rise in population and industrial activities in major urban areas. Air pollution continues to take a toll on the health of the most vulnerable populations, especially women, children, and the elderly across all continents around the world. According to the World Health Organisation (WHO) (1), air pollution is the deposit of substances or contaminants into the environment; hazardous enough to cause adverse effects. Ambient air pollution (AAP) is a broader term used to describe air pollution in outdoor settings, which is defined as the presence of one or more substances in the atmospheric air at concentrations and durations above natural limits (2). Poor ambient air quality occurs when these substances reach a high enough concentration to affect the environment and subsequently human health. The most pollutant substances are criteria pollutants which yielded high morbidity and mortality rates in outdoor air pollution studies (3).

These pollutants come in various forms such as gaseous, liquids or solid particulates dispensed off in the air mostly as a result of anthropogenic activities, in turn causing them cardio-pulmonary diseases with increased hospital visits associated with high infant and child mortalities (3). This study assessed environmental health practitioners' awareness, attitudes and practices regarding air pollution and its associated health effects in Namibia.

The first chapter presents the background, objectives, and problem statement.

1.2 Rationale and background of the study

Ambient air pollution (AAP) is a growing environmental and public health crisis, particularly affecting low- and middle-income countries (LMICs), where resources to combat pollution are limited. According to the World Health Organization (1), AAP is responsible for approximately 4.2 million premature deaths annually, with around 90% of these deaths occurring in vulnerable populations living in resource-limited regions (4). This staggering figure highlights the profound impact of air pollution on public health, especially in areas where health infrastructure is insufficient to mitigate the effects of pollution exposure. Air pollution is strongly linked to an array of health conditions, primarily respiratory diseases such as chronic obstructive pulmonary disease (COPD), asthma, and lung cancer, as well as cardiovascular diseases like heart attacks and strokes (2). Emerging evidence also suggests that air pollution can exacerbate neurodevelopmental disorders and negatively affect mental health (2). Such findings demonstrate that the consequences of AAP extend far beyond immediate respiratory or cardiovascular impacts, making it an urgent issue for global health practitioners to address.

According to (1), in 2019, 99% of the world's population was living in places where the WHO air quality guidelines levels were not met. The combined effects of ambient and household air pollution are associated with 6.7 million premature deaths annually. In LMICs, these levels of pollution are often due to rapid urbanisation, industrial growth, and the widespread use of biomass fuels for cooking and heating. Many of these countries experience air pollution levels that significantly exceed the WHO-recommended limits of $PM_{2.5}$ (particulate matter of 2.5 micrometres or smaller). Air quality standards in these regions are often poorly reinforced due to weak environmental regulations, lack of political will, and limited public awareness about the health risks associated with air pollution (5). In addition to the health impacts,

socioeconomic factors also play a significant role in exacerbating the effects of air pollution in lower and middle-income countries (LMICs) (6). Vulnerable populations in these regions, including the elderly, children, and those with pre-existing health conditions, are disproportionately affected due to inadequate access to healthcare and limited awareness of pollution control measures. Furthermore, the economic burden of treating diseases related to air pollution puts additional stress on the already stretched healthcare systems (4).

Air pollution is evaluated by measuring the concentration of PM and various gaseous pollutants in the air (5, 7). Particulate matter, a key indicator of air quality, refers to a mixture of solid and liquid particles suspended in the atmosphere. These particles vary in size, composition, and origin, and are typically classified into different categories based on their aerodynamic diameters, such as PM_{10} (particles with a diameter of 10 micrometres or less) and $PM_{2.5}$ (particles with a diameter of 2.5 micrometres or less) (4). $PM_{2.5}$ is of particular concern due to its ability to penetrate deep into the lungs and even enter the bloodstream, leading to severe health effects such as respiratory and cardiovascular diseases, as well as premature death (1).

Gaseous pollutants, another crucial component of air pollution, include substances such as carbon monoxide (CO), volatile organic compounds (VOCs), nitrogen oxides (NOx), and ozone (O3). Each of these pollutants has distinct sources and health impacts. For instance, carbon monoxide, a colourless and odourless gas, is primarily produced by the incomplete combustion of fossil fuels in vehicles and industrial processes. It can impair the blood's capacity to carry oxygen, posing a significant risk to cardiovascular health (8).

Volatile organic compounds (VOCs) are a diverse group of organic chemicals that can easily evaporate into the air. They are emitted from various sources, including industrial processes,

vehicle exhaust, and the use of products such as paints and solvents. VOCs contribute to the formation of ground-level ozone, a harmful pollutant, and can also have direct toxic effects on human health (9).

Nitrogen oxides (NOx), which include nitrogen dioxide (NO2), are primarily produced by vehicle emissions and industrial activities. These gases contribute to the formation of ground-level ozone and particulate matter, exacerbating respiratory conditions such as asthma and increasing the risk of lung infections (1). Ozone (O3), while beneficial in the upper atmosphere where it forms a protective layer against ultraviolet radiation, is harmful at ground level. Ground-level ozone is a major component of smog and can cause respiratory problems, reduce lung function, and aggravate chronic respiratory diseases (8).

According to (1), Global Air Quality Guidelines 2021, the annual average concentrations of $PM_{2.5}$ should not exceed 5 µg/m³ and PM_{10} not exceed 15 µg/m³. Ozone (O_3) should not exceed a peak 8-hour mean of 100 µg/m³, Nitrogen Dioxide (NO_2) annual average should not exceed 10 µg/m³, Sulphur Dioxide (SO_2) 24-hour average concentrations should not exceed 40 µg/m³, and Carbon Monoxide (CO) 8-hour average concentrations should not exceed 4 mg/m³. Outdoor air pollution originates from both natural and anthropogenic (human-made) sources. Natural sources of air pollution include wildfires, volcanic eruptions, dust storms, and biogenic emissions from plants. These sources can release significant amounts of particulate matter and gaseous pollutants into the atmosphere. However, human-made sources are the primary contributors to the rapid rise of AAP in many regions. These include the burning of fossil fuels in power plants, transportation, and industrial activities; agricultural practices that release ammonia and methane; and the use of household chemicals products (3). The impact of air

pollution is extensive, affecting not only the surrounding environment but also public health on a global scale. Understanding the sources, composition, and effects of air pollutants is essential for developing effective strategies to reduce air pollution and mitigate its health impacts.

Fuller et al (7) highlight that air pollution has a wide range of impacts, extending beyond just immediate health effects. While it is well known that air pollution can cause both short- and long-term health issues, such as respiratory infections, cardiovascular diseases, and lung cancers, the consequences of air pollution are far more reaching. These impacts reach far into the socio-economic factors of societies, leading to disruptions that affect the entire population. For instance, air pollution can lead to significant economic losses and reduced social welfare due to increased illness, strained healthcare systems, and damaged infrastructure, consequently causing decreased work productivity. Moreover, (10) noted that the burden of air pollution disproportionately affects vulnerable groups, such as children, the elderly, and those with pre-existing health conditions, thereby exacerbating social inequalities.

The World Health Organization's (3) global update in 2021 further highlights the gravity of ambient air pollution (AAP) as a major environmental health risk. AAP is largely driven by the rapid expansion of human settlements and urbanisation, particularly in developing regions. Countries like China and India, with their massive populations and rapid industrialisation, have seen some of the highest levels of air pollution. Similarly, many developing countries in Africa are experiencing rising levels of air pollution due to urbanisation, increased vehicle emissions, and industrial activities. These regions often lack the stringent environmental regulations and air quality monitoring systems that are in place in more developed countries, making them particularly vulnerable to the detrimental effects of air pollution.

The diverse effects of air pollution affect multiple aspects of life, from public health to economic stability and environmental integrity (9 10). In urban areas, high levels of air pollution can lead to a decrease in the quality of life, driving populations to relocate, which in turn can lead to overcrowded and under-resourced areas. Additionally, the environmental degradation caused by air pollution can lead to the loss of biodiversity and the disruption of ecosystems, further compounding the socio-economic challenges faced by these regions. Addressing the issue of air pollution, therefore, requires a multifaceted approach that includes not only improving air quality but also mitigating its broader socioeconomic impacts, particularly in the most affected regions of the world (7).

According to the World Bank (11) Namibia, known for its vast landscapes and low population density, faces unique challenges related to air pollution. While the country is less industrialized compared to many other regions, certain localised activities and geographical factors contribute to air quality concerns. As Namibia continues to develop, the interplay between economic growth and environmental sustainability has become increasingly significant. According to (12), air pollution in Namibia originates from both natural and anthropogenic (human-made) sources. Natural sources include dust storms, wildfires, and biogenic emissions from vegetation. The country's arid and semi-arid climate, combined with its extensive desert regions such as the Namib Desert, often leads to high levels of airborne dust, particularly during the dry and windy seasons. These dust storms can significantly affect air quality, especially in the more rural and desert areas of the country.

On the anthropogenic side, urbanisation and industrial activities are primary contributors to air pollution in Namibia. In urban centres such as Windhoek, vehicle emissions are a major source of air pollutants, including PM, nitrogen oxides (NOx) (12), and carbon monoxide (CO). The

increase in the number of vehicles, coupled with older, less efficient engines and the use of fossil fuels, has led to rising concerns about urban air quality. Additionally, industrial activities, particularly in the mining sector, contribute to localised air pollution. Namibia is rich in natural resources, and mining activities, especially for copper, uranium, diamonds, and other minerals, release dust and other pollutants into the air, affecting nearby regions.

The Ministry of Environment, Forestry and Tourism (13) reported that the health impacts of air pollution in Namibia are becoming increasingly evident. Respiratory diseases, such as asthma and chronic obstructive pulmonary disease (COPD), are on the rise, particularly in urban areas where vehicle emissions are highest. Children, the elderly, and individuals with co-morbidities are especially vulnerable to the harmful effects of air pollution. In addition to health issues, air pollution also affects Namibia's natural environment, including its wildlife and ecosystems. The deposition of pollutants can also lead to soil and water contamination, thereby affecting agriculture and biodiversity.

EHPs play a crucial role in the implementation, monitoring and evaluation of these guidelines, helping to safeguard public health. EHPs are often responsible for monitoring air quality in urban and rural settings, using data to assess whether pollution levels exceed WHO-recommended limits. They collect and analyse air quality data, particularly in regions prone to industrial pollution or high vehicular emissions, ensuring compliance with WHO thresholds for pollutants like $PM_{2.5}$ and PM_{10} (1). By doing so, EHPs help to provide real-time assessments of air quality, enabling early intervention where necessary.

(6). One of the key responsibilities of EHPs is conducting health impact assessments (HIAs) in response to exposure to air pollutants. By aligning these assessments with WHO air quality guidelines, they can better evaluate the health risks posed by exceeding pollutant limits. These assessments are critical for understanding the broader public health implications of air pollution, especially among vulnerable populations such as children, the elderly, and individuals with pre-existing health conditions (5). A pivotal role of EHPs is to educate the public about the risks associated with poor air quality and the importance of reducing exposure. This includes communicating the health risks outlined in the WHO guidelines and promoting behaviours that help mitigate exposure, such as staying indoors during high-pollution days, using cleaner cooking fuels, and adopting energy-efficient practices. Raising awareness about the dangers of air pollutants like sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) can lead to better public compliance with health advisories (1, 4). EHPs are also instrumental in shaping environmental policies that regulate air quality. By advocating for stricter enforcement of air quality standards and working closely with governmental bodies, they help integrate WHO guidelines into national and local policy frameworks. This could involve drafting air quality regulations, improving industrial emissions standards, and ensuring that urban planning takes air quality into account (7). In fact, EHPs play a role in pushing for policy reforms that support sustainable practices and reduce pollution sources, such as implementing low-emission zones or promoting the use of renewable energy. In regions where air pollution spikes occur due to industrial activities or wildfires, EHPs develop emergency response plans based on WHO air quality guidelines. They advise on preventive measures for vulnerable populations and collaborate with public health authorities to issue warnings and action plans, such as advising against outdoor activities when ozone or particulate matter levels exceed safe thresholds (20).

The current lack of extensive research on the awareness, attitudes, and practices of EHPs in Namibia regarding AAP and its associated health effects highlights the need for a comprehensive assessment of this topic. The elucidation of the awareness, attitudes, and practices of EHPs will yield crucial insights that can be utilised to inform the development of policies, intervention strategies, and capacity-building initiatives aimed at effectively addressing AAP to safeguard public health in Namibia and across borders.

1.3 Statement of the problem

Air pollution is a growing concern in Namibia, driven by both natural and anthropogenic sources, including dust storms, vehicle emissions, and industrial activities such as mining. Despite the country's relatively low population density, the impacts of air pollution are significant, particularly in urban areas and regions with intensive industrial operations. According to (13), air pollution levels in some Namibian cities, such as Windhoek, have exceeded the recommended limits for particulate matter (PM_{10} and $PM_{2.5}$), raising concerns about the health and well-being of the population.

WHO (1) has identified air pollution as one of the leading environmental health risks, contributing to a range of respiratory and cardiovascular diseases. In Namibia, the Ministry of Health and Social Services (MoHSS) (14) reported a steady increase in cases of respiratory illnesses, particularly in children and the elderly, which are closely linked to poor air quality. The lack of comprehensive air quality monitoring and regulatory enforcements further exacerbates the problem, leaving many communities vulnerable to the harmful effects of air pollution.

Despite these challenges, there is limited information on the awareness, attitudes, and practices of EHPs in Namibia concerning ambient air pollution and health effects. This gap in knowledge hampers the development and implementation of effective air quality management strategies. Given the critical role that EHPs play in monitoring and mitigating environmental health risks, it is essential to assess their current level of awareness and engagement with air pollution issues. This study sought to address this gap by assessing the awareness, attitudes, and practices of environmental health practitioners in Namibia regarding ambient air pollution and its associated health effects. By incorporating statistics from environmental health reports and data on air pollution levels, this research aims to provide a comprehensive understanding of the current state of air quality management in Namibia and to identify potential areas for improvement in policy and practice.

1.4 Aim of the study

The study aimed to assess the awareness, attitudes, and practices of EHPs regarding ambient air pollution and associated health effects in Namibia.

1.5 Objectives of the study

1.5.1 To determine the awareness of EHPs about AAP and associated health effects in Namibia.

1.5.2 To determine the attitudes of EHPs towards AAP and associated health effects in Namibia.

1.5.3 To determine the practices of EHPs in the prevention of AAP and associated health effects in Namibia.

1.5.4 To evaluate the association between awareness, attitudes, and practices of EHPs towards AAP and associated health effects in Namibia.

1.6 Hypotheses of the Study

Based on the objectives of the study, the following hypotheses were developed:

a) **H_0**: There is no significant relationship between demographic variables and awareness of EHPs about AAP and associated health effects in Namibia.

   H_1: There is a significant relationship between demographic variables and awareness of EHPs about AAP and associated health effects in Namibia.

b) **H_0**: There is no significant relationship between demographic variables and attitudes of EHPs towards AAP and associated health effects in Namibia.

   H_1: There is a significant relationship between demographic variables and attitudes of EHPs towards AAP and associated health effects in Namibia.

c) **H_0**: There is no significant relationship between demographic variables and practices of EHPs related to AAP prevention and associated health effects in Namibia.

   H_1: There is a significant relationship between demographic variables and practices of EHPs related to AAP prevention and associated health effects in Namibia.

d) **H_0**: There is no significant correlation between awareness, attitudes, and practices of EHPs towards AAP and associated health effects in Namibia.

H_1: There is a significant correlation between awareness, attitudes, and practices of EHPs towards AAP and associated health effects in Namibia.

1.7 Significance of the Study

The study is of great importance to the general public, policymakers, UNAM, to the body of knowledge as well as to the researcher.

Significance to the public and policymakers

The findings of this study may have significant implications for policymakers in Namibia. A thorough understanding of the study could support policymakers in making informed decisions and developing evidence-based policies and regulations to address the negative impact of air pollution on public health. The results may offer valuable insights into specific areas requiring interventions, such as improving knowledge and implementing targeted effective measures.

Significance to the UNAM Department of Public Health

This research carries substantial significance for the Department of Public Health at the University of Namibia. The study makes a valuable contribution towards enhancing public health in Namibia through the identification and resolution of significant health concerns. The study can help the department to augment its position as a frontrunner in the realm of public

health research and education, thereby contributing to the scientific body of knowledge and possibly adding to research publications. The study's results can also be utilised to create focused interventions, curricula, and training initiatives aimed at enhancing the proficiency and conduct of environmental health practitioners, thereby promoting better environmental health outcomes for the populace of Namibia.

Significance to the University of Namibia (UNAM)

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Significance to the academic literature

This study offers significant insights into the knowledge gaps, attitudes, and practises of EHPs concerning the management thereof. The results of this study can serve as a point of reference for other scholars and relevant agents, facilitating a comparative examination aimed at reducing the gap in knowledge and population exposure burdens resulting from AAP. It has the potential

to stir heads and incite additional endeavours in the domain of environmental health in Namibia. The study can also establish a fundamental basis for forthcoming studies, thereby contributing to the development of a substantial corpus of literature about air pollution and its health effects within the Namibian context.

To the researcher

Undertaking a study on the awareness, attitudes, and practises of EHPs in Namibia with regards to AAP and its associated health effects can yield various personal and professional advantages, since this enables the researcher to investigate a pertinent and urgent matter in the field of public health, thereby augmenting the pre-existing knowledge base. This is a prominent chance to acquire significant research expertise and cultivate proficiencies in data collection and analysis. In the process, the researcher has gained more insight into the subject, which provided an opportunity to establish professional connections with experts in the field, yielding potential collaborations and career growth.

1.8 Theoretical framework

The Health Belief Model (HBM), developed in the 1950s by social psychologists Irwin Rosenstock and Godfrey Hochbaum (15), emerged as a response to the need for a robust theoretical framework to explain and predict health-related behaviours. The model was initially designed to examine why individuals often hesitate to participate in preventive health measures, such as disease screening and early detection programs. The model focuses on cognitive perceptions of health risks and benefits offering insights into the psychological

processes that influence health decision-making. It emphasises factors such as perceived susceptibility to illness, perceived severity of the health condition, perceived benefits of action, and perceived barriers to taking such action. This theoretical framework has been instrumental in shaping public health initiatives and interventions aimed at improving participation in preventive health services. Its application extends beyond individual health choices, encompassing broader efforts in health promotion and disease prevention across diverse populations.

The HBM was chosen for this study since it can offer valuable insights regarding the awareness, attitudes, and practices of environmental health practitioners in Namibia concerning ambient air pollution and its associated health effects. The subsequent analysis delves into the application of the six fundamental principles of the HBM in this study.

i) Perceived Susceptibility: Perceived susceptibility to the health effects of ambient air pollution is a crucial area of understanding for environmental health practitioners. The process entails identifying the perils and dangers linked with inadequate air quality and acknowledging one's susceptibility to those hazards. By acknowledging their vulnerability, professionals may be incentivized to undertake suitable measures to safeguard themselves and promote public health initiatives.

ii) Perceived Severity: The comprehension of the severity and outcomes of ambient air pollution on human health is a critical aspect for environmental health practitioners (15). Individuals must possess comprehensive awareness regarding the spectrum of health concerns that may result from exposure to contaminated air, including but not limited to respiratory

ailments, cardiovascular afflictions, and heightened susceptibility to cancer. Acknowledging the gravity of these health implications may enhance the dedication of environmental health practitioners toward tackling and alleviating the issue.

iii) Perceived Benefits: The recognition and communication of the advantages of adopting preventive measures and implementing interventions to mitigate ambient air pollution is imperative for environmental health practitioners. This calls for pursuing favourable strategic actions such as advancing sustainable energy alternatives, endorsing modifications in policies, establishing mechanisms for monitoring air quality, and enlightening the residents. As a result, acknowledging and effectively conveying the prospective advantages can serve as a driving force for professionals to actively participate in pre-emptive endeavours and inspire their peers to follow suit.

iv) Perceived Barriers: Perceived obstacles should be taken into consideration by practitioners to effectively address ambient air pollution. The obstacles that may impede progress include factors such as insufficient resources, inadequate infrastructure, political impediments, insufficient public awareness, or lack of inter-sectoral collaboration (21). Through the identification and restructuring of these obstacles, professionals can formulate tactics to surmount them and progress toward viable resolutions.

v) Cues to Action: EHPs must remain vigilant and responsive to the cues that trigger their proactive measures against ambient air pollution (21). The cues may encompass a range of indicators such as empirical research discoveries, official public health notifications, grievances voiced by the community, or instances of acute air pollution events. Reacting to

these signals and implementing suitable measures can assist professionals in preemptively tackling the matter and encouraging prompt interventions.

vi) Self-efficacy: Self-efficacy is a crucial factor in the ability of these professionals to effectively address ambient air pollution. Individuals must possess self-efficacy in their knowledge, competencies, and aptitudes to effectively reform, execute interventions, and exert impact on policy determinations (15). Using training, continuous education, and collaboration with other stakeholders, practitioners can enhance their self-efficacy and effectively contribute to the mitigation of ambient air pollution.

The application of the Health Belief Model to the awareness, attitudes, and practices of environmental health practitioners in Namibia can facilitate the development of interventions and strategies aimed at enhancing practitioners' level of understanding, attitudes, and practices concerning ambient air pollution and its health implications. Enhanced awareness and knowledge can result in improved efficacy and informed decision-making, which is pivotal in the execution of measures and initiatives that foster enhanced air quality for better public health safety.

1.9 Definitions of key terms

Awareness: This is the knowledge and perception of a factual situation or event acquired through shared information and lived experiences or exposure (22). This study defined awareness as the understanding of ambient air pollution and its associated effects on the health of people, and the awareness of environmental health practitioners on how pollution can be dangerous to human health.

Attitudes: Refers to an individual's evaluative stance or disposition towards a person, object, idea, or situation, which influences their thoughts, feelings, and behaviours related to that specific entity (22). This study defined attitude as a consistent way of thinking or feeling about air pollution and its health effects, the way environmental health practitioners think about pollution and how it is usually manifested in behaviour is understood as attitude in this study.

Practices: Refers to the application or implementation of knowledge, skills, and behaviours in real-world situations, allowing individuals to improve their proficiencies to achieve desired outcomes (22). This study defined practice as the customary or routine acts by environmental health practitioners in the enforcement of environmental laws.

Environmental health practitioners: Environmental health refers to the branch of public health that focuses on understanding, examining the impact and managing the interactions between people and their environment to promote and protect human health (16). EHPs professionals who specialise in the field of environmental health. In this study, EEHPs are defined as individuals in the public sector with tertiary education focusing on preventing, assessing and managing environmental risks to reduce the health impacts.

Ambient air pollution: Also called surrounding or outdoor air pollution, refers to the presence of harmful contaminants in the surrounding air, resulting from various sources such as industrial emissions, vehicle exhaust, and natural factors, which can adversely affect human health and the environment (4). Ambient air pollution in this study refers to the existence of deleterious substances or contaminants in the external atmosphere that have the potential to adversely affect both human well-being and the ecosystem.

Associated health effects: Simultaneously known as adverse health outcomes, harmful health effects, or adverse health impacts, is defined as a change in the body function or cell structure that might lead to disease or health problems, usually occurring as chronic health effects, resulting from long-term exposure or any acute health effects manifesting immediately after brief exposure to a pollutant (6). In this study, it refers to all cardiopulmonary diseases and cancers resulting from air pollution.

1.10 Thesis structure

This research is made up of 6 chapters, each chapter starting with an introduction and ending with a conclusion as summarised below

Chapter 1: Covers the introduction of the study, the background, problem statement, aim and objectives, as well as the significance of the study. The chapter also unpacks the theoretical framework of the health belief model and ends by defining key terms. It then gives a brief outline of the thesis before summarising.

Chapter 2: The chapter presents the literature review and research gaps, it details the conceptual literature on ambient air pollution, its associated health effects, the sources of air pollution, as well as the literature on the awareness, attitude and practices of environmental health practitioners is reviewed. Demographic factors of EHPs and their association to their knowledge attitudes and practices are also scrutinised.

Chapter 3: Outlines the research methodology, in terms of the research design, research population of the study, sample and sampling process, data collection instrument and procedure

as well as data analysis methods used. Lastly, this chapter presents the ethical considerations applicable to this study.

Chapter 4: Presents the study findings. Descriptive statistics were presented in the form of percentages and frequencies, tables as well as charts. Inferential statistics have also been presented in which regression analysis has been utilised, laid out, and interpreted.

Chapter 5: Discuss the study findings. The comparison and contrast of findings with the literature review was done. The chapter discusses findings about each of the four (4) research objectives.

Chapter 6: This is the last chapter, and gives the conclusions drawn from the results based on the research objectives and specific recommendations per study findings.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of the literature on the topic of ambient air pollution, offering an analysis of existing knowledge and research in this area. The review begins by providing a detailed overview of ambient air pollution, including its definition, sources, types of pollutants, and global trends in air quality. It discusses both natural and human-made contributors to air pollution, emphasising the growing concern over its impact on the environment and public health. Following the overview, the chapter examines some published studies from various countries, exploring research conducted on the awareness, attitudes, and practices of environmental health practitioners regarding ambient air pollution. These selected studies are analysed to understand how well-informed practitioners are about the causes and consequences of air pollution, their perceptions of the severity of the problem, and their engagement in practices aimed at mitigating its effects. Additionally, the review highlights the health effects of air pollution, emphasising both short- and long-term impacts on human health, such as respiratory and cardiovascular diseases, and the role environmental health practitioners play in addressing these issues.

2.2 Overview of ambient air pollution

Ambient air pollution (AAP) refers to the presence of harmful substances in the air we breathe, which can have significant impacts on both human health and the environment (17). According to WHO (1), AAP includes a variety of pollutants such as particulate matter (PM), volatile organic compounds (VOCs), gases like nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), carbon monoxide (CO), and ozone (O_3), as well as heavy metals like lead (Pb) and mercury (Hg).

These pollutants enter the atmosphere through various anthropogenic activities such as industrial emissions, vehicular exhaust, deforestation, and agricultural practices (23). In addition to human activities, natural events like wildfires, volcanic eruptions, and dust storms can also contribute significantly to air pollution (28).

The impact of AAP is not restricted to specific geographic areas, as it can affect urban, suburban, and rural environments. While pollution levels are often higher in urban and industrialized areas due to concentrated sources of emissions, rural areas are also impacted by pollutants carried through atmospheric mediums over long distances (2). The term ambient in this context refers to the surrounding environmental conditions of a specific area, whether urban or rural, where pollution is measured. The composition of pollutants in the atmosphere varies depending on several factors, including geographical location, climatic conditions, weather patterns, and the proximity to pollution sources (1). For example, particulate matter ($PM_{2.5}$ and PM_{10}) generated by vehicular emissions or industrial operations can remain suspended in the air for extended periods and travel long distances, exposing populations far from the emission source to harmful levels of pollution

(27). additionally, gases like NO_2 and SO_2, primarily produced by fossil fuel combustion, can lead to the formation of secondary pollutants, such as ozone, which further

deteriorates air quality.

The health effects of AAP are profound and multifaceted, ranging from respiratory issues like asthma and chronic obstructive pulmonary disease (COPD) to more severe conditions such as cardiovascular diseases, stroke, and lung cancer (3). Long-term exposure to AAP can even affect neurological and reproductive health, as well as cause developmental issues in children

(2). Additionally, the environmental impact of AAP includes damage to ecosystems, contributing to the depletion of soil quality, water pollution, and climate change (28). Given the complexity and the diverse sources of air pollution, mitigating AAP requires a multi-faceted approach, including stringent regulatory measures, public awareness, and the development of cleaner technologies for industrial and vehicular emissions (4).

2.3 Global trends in air quality

Globally, $PM_{2.5}$ levels remain a critical concern, particularly in developing regions. While wealthier countries have improved their air quality through regulations and cleaner technologies, many low- and middle-income countries are still grappling with high pollution levels, exacerbated by industrialisation, urbanisation, and the use of fossil fuels (11). For example, in Europe, air quality has improved due to stringent environmental regulations and the adoption of cleaner energy sources. However, several urban areas still face pollution issues, particularly from traffic emissions. Countries like Poland and

Bulgaria are frequently flagged for poor air quality due to coal-based energy production (3). In North America, air quality is generally better compared to other regions, though challenges remain in urban and industrial areas. The United States has made significant strides in reducing air pollution through the Clean Air Act, but wildfires, particularly in western states like California, have led to occasional spikes in particulate matter levels. Canada also faces seasonal pollution issues from wildfires, especially in its western provinces. China, once known for its smog-filled cities, has made significant progress through aggressive air quality policies, resulting in a notable decline in $PM_{2.5}$ concentrations since 2013. Despite these improvements, urban centres like Beijing and Shanghai still face periods of high pollution due to industrial activities and transportation (6).

According to (6), the Middle East faces unique air quality challenges, including dust storms, industrial emissions, and transportation-related pollution. Countries like Iran, Iraq, and Saudi Arabia experience high $PM_{2.5}$ levels, with sand and dust storms significantly contributing to poor air quality. In Iran, for example, pollution from vehicles and refineries further worsens air quality, leading to health issues and premature deaths. In Sub-Saharan Africa, air pollution is a growing issue as urbanisation and industrialisation increase. Outdoor air pollution is compounded by high levels of indoor pollution, largely from the use of solid fuels for cooking (37). Cities in Nigeria, South Africa, and Ghana have reported elevated levels of $PM_{2.5}$, driven by traffic, industry, and energy production. Nigeria, for instance, has one of the highest levels of pollution in the region, with poor regulatory enforcement and widespread use of diesel generators adding to the problem (29).

Air quality in Namibia is generally considered moderate to good, but there are specific concerns in areas affected by industrial activities and urban growth (13). Mining operations, particularly in Tsumeb and Rössing, contribute to sulphur dioxide (SO_2) and particulate emissions, which have raised local pollution levels. In urban centres like Windhoek, vehicular emissions are becoming a concern due to increasing traffic, though overall pollution levels remain lower compared to more industrialised nations. Dust storms originating from desert regions such as the Namib Desert also contribute to elevated PM_{10} levels, especially along the coastal regions. Despite the Environmental Management Act of 2007, there is still a need for more comprehensive air quality monitoring and enforcement to address these localised issues effectively (14).

2.4 Awareness, attitudes and practices to AAP and associated health effects

The study by Ramírez et al. (16) aimed to assess public awareness of air pollution and its health risks, while exploring how communication strategies can improve environmental health literacy. The authors sought to identify challenges and opportunities for enhancing public understanding of air pollution's impact on health and empowering communities to take preventive action. The study utilised a cross-sectional survey design to gather data on public awareness and perceptions of air pollution. The authors employed quantitative methods to analyse responses regarding the public's awareness on air pollution, perceived risks to health, and the role of communication in addressing these concerns. The study sampled a diverse population from various communities in the United States, focusing on both urban and rural regions to ensure a wide representation of public perspectives. Convenience sampling was used, targeting participants through community outreach programs, public events, and online platforms.

The study found that while many respondents were aware of air pollution as a health threat, there were significant gaps in environmental health literacy, particularly in understanding the specific health impacts of different pollutants. Additionally, participants from lower socioeconomic backgrounds and rural areas were less informed about air quality issues. Trust in information sources varied, with health professionals being the most trusted but underutilised, and social media often spreading misinformation. The authors concluded that there are substantial opportunities to improve public awareness and health literacy regarding air pollution. They suggested that targeted communication strategies, particularly those that involve health professionals and use trusted local channels, could enhance public understanding and motivate behavioural change. The study highlighted the need for improved

risk communication and communitybased education to empower populations to act on air quality issues.

Quityne and Kelly's study (23) sought to assess the knowledge, perceptions, and attitudes of individuals in Ireland regarding poor air quality, with the overarching goal of informing policymakers and stakeholders about how to craft effective communication strategies for air pollution management. The research utilised a quantitative cross-sectional design, where data were collected from a sample of 1,005 individuals, randomly selected from various regions across Ireland. This diverse sample allowed the study to capture national level as well as localised perceptions of air quality.

In terms of key findings, the study showed that 66% of participants at the national level were aware of the harmful effects of air pollution on health, indicating a relatively high level of general awareness. However, when participants were asked about local air quality, only 35% of respondents displayed awareness, suggesting that individuals might not be fully aware of pollution levels in their immediate environments. This discrepancy highlights the potential gap between national discourse on air pollution and localised public awareness (n = 668 at the national level and n = 337 at the local level). The study also explored the socio-demographic factors influencing air pollution awareness, finding significant correlations between respondents' awareness levels and factors such as age, gender, socio-economic status, and geographic location. For instance, younger individuals, those with higher educational attainment, and those living in urban areas were more likely to be aware of air quality issues compared to their rural and older counterparts. In conclusion, (23) emphasised that the environmental health literacy of the population concerning air pollution was inadequate, especially at the local level. They recommended implementing public awareness campaigns

targeted at specific demographic groups, particularly in rural areas, to bridge this gap in understanding and empower communities to act on air pollution issues.

Another study conducted by (30) aimed to assess the knowledge, attitudes, and practices of Lebanese physicians regarding air pollution. This observational study utilised a descriptive cross-sectional correlational design, collecting data through a selfadministered online survey distributed to 874 members of the Lebanese Order of Physicians. Descriptive statistics and chi-square tests were employed for data analysis. The findings revealed that physicians lacked knowledge about various sources of air pollution, such as dust, perfume, candles, vacuum cleaners, air fresheners, and electronic cigarettes. While most physicians acknowledged that air pollution increases the risk of multiple health issues, only 38% regularly inquired about their patients' exposure to air pollution, though 75% felt they had a role in mitigating it. More than half of the respondents were confident in advising their patients on air pollution sources, and twothirds supported including air pollution exposure assessments in routine medical visits. The study concluded that with the rising levels of air pollution, healthcare professionals must stay informed on this issue. The results highlight the need for ongoing education for physicians about air pollution and the development of guidelines for assessing patients' exposure.

In Ghana, Odonkor and Mahani (38) conducted a study to evaluate the knowledge, attitudes, and perceptions of air pollution in Accra. Using a cross-sectional design, they collected quantitative data from 1,404 respondents, which was analysed using SPSS version 23. The study had a higher proportion of female respondents (54.1%) compared to males (45.9%). A majority (70.5%) of respondents were aware of the haze (air pollution) and its negative health impacts. However, there was a significant relationship between sociodemographic factors and awareness of air pollution ($P = 0.01$). Additionally, correlations were found between residents'

age, educational level, length of stay, marital status, and their knowledge or awareness of air pollution ($P < 0.05$). While most respondents were aware of the health risks associated with air pollution, awareness was lower among certain demographic groups, such as the elderly and those with less education. The study suggests the need for inclusive policies that educate and guide all segments of the population on air pollution and its health effects. Furthermore, most residents recognised that improving air quality is a shared responsibility, indicating that the government could leverage this sentiment to develop collaborative strategies with citizens for more effective air pollution control.

In South Africa, (17) evaluated the perceptions of environmental health practitioners (EHPs) regarding the integration of health surveillance into air quality management, with a particular focus on assessing the challenges and opportunities in linking air pollution and health risks. The study employed a cross-sectional survey design, where a questionnaire was distributed to environmental health practitioners. The questionnaire focused on perceptions, knowledge, and practical experiences regarding air quality management and the inclusion of health surveillance in their professional practices. The study found that although there was support among EHPs for integrating health outcomes into air quality management, knowledge gaps and resource constraints significantly hindered their ability to participate in health surveillance activities.

Most EHPs cited issues such as staff work overload, lack of formal training on the link between air pollution and health, as well as limited data availability at the local level. Furthermore, the majority of local municipalities did not have health surveillance systems in place, complicating efforts to track and mitigate air pollution's health impacts. The study concluded that for air quality management to be more effective, there needs to be stronger policy integration,

improved training for EHPs, and better access to health-related data. The authors recommended the development of frameworks that would facilitate the inclusion of health surveillance in municipal air quality management plans, emphasising the need for collaboration between health and environmental sectors to address air pollution more holistically.

2.5 Associated health effects of ambient air pollution

Air pollution is a significant concern in the modern world, posing serious toxicological risks to both human health and the environment. Gorhani-Azam et al (39) reviewed the effects of air pollution on human health and practical measures for prevention in Iran. The aim was to discuss the toxicology of major air pollutants, sources of emission, and their impact on human health. The review found that air pollution can cause serious environmental damage to the groundwater, soil, and air. Particle pollutants were found to be major parts of air pollutants. Long-term exposure to current ambient pollutant materials concentrations may lead to a marked reduction in life expectancy. The increase in cardiopulmonary and lung cancer mortality was found to be the main reason for the reduction in life expectancy. Reduced lung functions in children and adults lead to asthmatic bronchitis and chronic obstructive pulmonary disease (COPD). These are also serious diseases which induce lower quality of life and reduced life expectancy.

Manisalidis et al. (18) conducted a comprehensive review of the health impacts of various air pollutants, highlighting the critical role these substances play in the onset of several diseases. Particulate Matter (PM), consisting of microscopic particles, can penetrate deeply into the respiratory system when inhaled. PM exposure is strongly linked to both respiratory and cardiovascular diseases, as well as disorders of the reproductive system, central nervous

system, and even cancer. PM affects not just the lungs but can travel through the bloodstream, leading to far-reaching health impacts.

Ozone (O_3), which is beneficial in the stratosphere for shielding the Earth from harmful ultraviolet (UV) rays, becomes hazardous at ground level. When present in high concentrations, ground-level ozone can irritate and damage the respiratory tract, contributing to asthma exacerbations and COPD. Its oxidative properties are also harmful to the cardiovascular system, leading to increased hospitalizations and mortality from heart-related events. In addition, nitrogen oxides (NOx) and sulphur dioxide (SO_2), primarily produced by the combustion of fossil fuels, aggravate respiratory conditions by causing airway inflammation and worsening asthma symptoms. Volatile Organic Compounds (VOCs), such as benzene, and polycyclic aromatic hydrocarbons (PAHs), derived from both industrial processes and vehicular emissions, have been recognised as carcinogenic, causing long-term health issues, including lung cancer.

Carbon monoxide (CO), a colourless and odourless gas, binds with haemoglobin in the blood, limiting the body's ability to transport oxygen, which can result in carbon monoxide poisoning—a life-threatening condition that affects the brain and heart. Similarly, heavy metals like lead are toxic when absorbed into the body, accumulating in bones and organs, leading to both acute and chronic poisoning, which manifests as neurological disorders, cognitive impairments, and kidney dysfunction. The review also underscores the complex relationship between air pollution and climate change, noting how increased levels of greenhouse gases contribute to global warming. The warming climate, in turn, affects the spread of infectious diseases, as changing temperatures and weather patterns expand the habitats of vectors like mosquitoes, spreading diseases such as malaria and dengue fever. Furthermore, climate change

contributes to the frequency of natural disasters, which can exacerbate environmental pollution and health issues.

The body of evidence highlights the profound impact of air pollutants on human health, emphasising the importance of reducing emissions and improving air quality standards to prevent a wide array of diseases and protect public health. The study conducted by Iyanda

(40) aimed to investigate the causes, effects, and potential solutions to air pollution in Namibia. The research specifically focused on measuring the levels of fine particulate matter ($PM_{2.5}$) and identifying key pollution sources across rural and urban settings in the country. The study sought to provide insights into the health impacts of air pollution and offer recommendations for mitigating its effects. The study used a quantitative research approach, where air quality data were collected from various locations across Namibia. The study primarily focused on measuring $PM_{2.5}$ concentrations, as well as other pollutants such as carbon monoxide (CO), nitrogen oxides (NOx), sulphur dioxide (SO_2), ozone (O_3), and volatile organic compounds (VOCs). The methodology involved a

combination of field data collection from air quality monitoring stations and a review of existing air pollution reports and literature. The study included both urban and rural areas to capture the variation in air pollution sources and effects.

Major cities like Windhoek and Walvis Bay were selected to represent urban environments, where vehicular emissions were identified as a primary pollution sources.

In rural areas, sampling focused on regions near mining activities, such as Tsumeb and Rössing, to assess the impact of industrial emissions. The study used random sampling for air

quality monitoring in urban areas and purposive sampling in mining regions, where pollution levels were expected to be higher. The study revealed that Namibia's average $PM_{2.5}$ concentration is 25 µg/m³ annually, more than double the WHO's recommended limit of 10 µg/m³, indicating that air quality in the country is moderately unsafe. The major sources of pollution were identified as food processing and mining industries, vehicular emissions, and the burning of wastes. Air quality varied significantly between urban and rural areas. While industrial activities like mining and smelting in remote areas contributed to poor air quality in rural regions, vehicle emissions were the dominant source of pollution in urban centres.

The health impacts of air pollution were substantial, with both short-term symptoms such as respiratory irritation and headaches, and long-term health risks including lung cancer, cardiovascular diseases, and chronic respiratory illnesses. Vulnerable populations, particularly those with asthma and COPD, were identified as being at higher risk. The author concluded that air pollution in Namibia poses significant health risks, particularly due to elevated levels of $PM_{2.5}$ and other harmful pollutants.

The study emphasised the need for public awareness campaigns to educate the population about the dangers of air pollution and promote energy-efficient practices. Key recommendations included promoting carpooling, improving public transport, efficient infrastructure, and reducing exposure for vulnerable individuals, especially those with preexisting respiratory conditions. Additionally, it was suggested that regulations on industrial emissions should be strengthened, and urban planning should prioritise reducing vehicular emissions in densely populated areas.

2.6 Chapter Summary

This chapter provided a detailed review of the literature on ambient air pollution (AAP), drawing from a variety of scholarly articles published across different countries to offer a comprehensive understanding of the global issue. The review explored studies on AAP's causes, effects, and the level of public awareness regarding its impact on human health and the environment. It was observed that AAP is a significant environmental and public health concern globally, affecting both developed and developing nations. In the reviewed studies, the majority of participants were aware of the harmful effects of air pollution, including its role in exacerbating respiratory and cardiovascular diseases, contributing to premature mortality, and its links to climate change. However, the extent of awareness varied by region and socio-economic status, with certain populations being more informed than others, depending on factors like access to education, media coverage, and the prevalence of pollution sources in their environments. The chapter also highlighted that despite widespread awareness, there are still significant challenges in mitigating AAP due to industrial growth, urbanisation, and policy enforcement.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides a comprehensive overview of the research approach and design employed in this study, detailing the methodology used to investigate the research problem. The discussion begins by outlining the research design, and the rationale behind choosing this specific framework to address the research questions. Next, the sample and sampling techniques used in the study are described, detailing the criteria for selecting participants, the sample size, and the specific techniques employed to ensure the representativeness and reliability of the findings. It further explains how the chosen sampling method aligns with the study's objectives and ensures that the data collected is both relevant and comprehensive. The chapter also delves into the data collection procedures, outlining the instruments and methods used to gather information. It discusses the practical steps involved in the data collection process to ensure the accuracy, validity, and reliability of the data. Finally, the chapter concludes with a discussion of the ethical considerations involved in conducting the research. This includes ensuring informed consent, maintaining confidentiality, and addressing any ethical challenges that may arise, particularly when dealing with sensitive data or vulnerable populations. This section highlights the study’s commitment to upholding ethical research standards, in line with institutional and international guidelines.

3.2 Research approach

This study employed a quantitative research approach, which is well-suited for measuring variables such as awareness, attitudes, and practices among EHPs regarding air pollution. This approach's structured nature allows for standardised data collection tools, such as surveys or

questionnaires that yield numerical data (24). These numerical data are crucial for conducting statistical analyses, such as correlation and regression, to explore relationships between dependent and independent variables (25). This method enabled the researcher to analyse trends and relationships between variables to determine if there are significant associations between EHPs' awareness of air pollution and their attitudes or practices. The quantitative approach is particularly advantageous for this study, as it aims to assess whether demographic factors influence these relationships. This made it possible to statistically assess how factors like education level or geographical location impact air pollution-related practices, thus contributing to a more detailed understanding of EHPs' engagement with air quality management (26).

Quantitative research often benefits from a large sample size, which enhances the generalisability of findings (25). However, in this study, the relatively small population of EHPs in Namibia was targeted in its entirety. This comprehensive approach ensured representation of the entire population, thereby strengthening the reliability of the results. While the generalisability of the findings may be limited to contexts with similar characteristics, the study's ability to provide evidence-based recommendations remains a significant strength. These recommendations could inform policies and strategies for air pollution management in Namibia and potentially in other similar settings (26).

3.2.1 Research design

This study employed a cross-sectional analytic design, which is frequently used to examine the relationship between variables at a specific point in time within a defined population. Cross-sectional studies are designed to capture a 'snapshot' of data, collecting information from

individuals at a single time point to assess associations between variables of interest (19). This type of study is effective for determining the prevalence of certain characteristics or outcomes, such as awareness, attitudes, and practices regarding air pollution, and relating them to demographic factors like age, gender, and education level (20).

A cross-sectional design enables the identification of correlations between these variables, helping researchers to explore potential associations without manipulating the study environment. This study allowed for the evaluation of how demographic factors impact environmental health practitioners' awareness, attitudes and practices related to air pollution at a given time, thereby facilitating the analysis of relationships between these variables and helping to inform policy and intervention strategies (24). While crosssectional designs are efficient and cost-effective, they are limited by their inability to determine causality. This is because they assess data at one point in time, making it difficult to establish the direction of relationships between variables. However, they remain valuable for generating hypotheses and identifying areas for further research (25). The researcher utilised it by determining the level of awareness, attitudes, and practices of EHPs towards AAP and associated health effects in Namibia between January and April 2023.

3.3 Study population

A population is defined as the entire set of individuals sharing common characteristics that are relevant to the research question, about which the researcher aims to draw conclusions (26). In this study, the population comprised all Environmental Health Practitioners (EHPs) employed in both government and private entities in Namibia. This choice was deliberate, as these professionals are directly involved in environmental health management, making them the most appropriate group for the study’s objectives.

According to the 2020 annual report of the Allied Health Professions Council of Namibia (AHPCNA), there were 273 EHPs registered to practise in the country. This figure reflects the entire pool of professionals qualified to work in both government and private sectors. However, when focusing on district hospitals specifically, the distribution of EHPs varied significantly, with the number of EHPs at individual facilities ranging from 1 to 5. This resulted in a total target population of 76 EHPs working at government hospitals.

The relatively small target population was justified given the comprehensive nature of the sampling. By including all EHPs working in these settings, the study ensured that the findings were representative of the entire group of practitioners in district hospitals, reducing the potential for sampling bias. While the small population size limits the generalisability of the findings to broader settings, it enhances the reliability and depth of insights within the specific context of district hospitals.

3.3.1 Inclusion Criterion

All participants must be registered Environmental Health Practitioners (EHPs) working in Namibia. This ensured that respondents have relevant professional experience in environmental health, including air pollution and public health issues.

The study included individuals who were 18 years of age or older, officially registered as EHPs, and employed at government facilities in all fourteen Regions of Namibia. Other eligible criteria were proficiency in English language literacy and the provision of informed consent. These specific criteria were implemented to ensure that the participants possessed the requisite

professional qualifications, are expertise in environmental health, and had the legal capacity to participate in the study. The objective of incorporating EHPs from different regions was to encompass a broad spectrum of experiences. The process of selecting participants who possessed the ability to comprehend and communicate proficiently in the English language was to ensure optimal communication during the data collection phase. Participants must provide informed consent and be willing to complete the self-administered survey. Informed consent ensured that participants understood the purpose and nature of the research and voluntarily agreed to contribute.

3.3.2 Exclusion criteria

The researcher set exclusion criteria to establish a focused and consistent sample for the assessment that was in line with the research goals. Individuals who were not registered EHPs or those working in other health-related fields (such as public health officers, doctors, or nurses) were excluded. This ensures the study focuses solely on the targeted professional group. The study also excluded students, interns, or trainees who were not yet fully qualified to practice or registered EHPs. These individuals may not have the necessary experience to provide informed responses about air pollution management in professional settings. Non-consenting EHPs, as well as EHPs from the private sector were also excluded from the study. This is because, EHPs in the public sector typically have different roles, responsibilities, and priorities compared to those in the private sector. Public sector EHPs are often more directly involved in community health initiatives, regulatory enforcement, and environmental monitoring, which aligns with the study's focus on public health and air pollution control measures. In contrast, private-sector EHPs focus on occupational health, safety, and environmental compliance, which might not align with the public health aspect of ambient air

pollution being studied. Excluding private-sector EHPs ensured the study focused on practitioners directly involved in public health and government-led environmental health initiatives, leading to more relevant and consistent data. According to (43), differences in work roles and environments between public and private sector workers can lead to varied experiences and perspectives, which can influence study outcomes.

3.4 Sampling and sample size

A sample is a subset of the total population which constitute the study subjects, while sampling is the process of selecting the most feasible participants for the study (20. A consecutive non-probability sampling method was used in this study. Also known as a total population or enumerative sampling, consecutive sampling is a process of including all the subjects who meet the inclusion criteria and are conveniently available (25), to be part of the study. To make it possible to carry out this research, due to time constraints, the researcher's expertise, and limited resources, the population was narrowed down to a target and accessible population from which study samples were drawn. Therefore, the sampled population comprised all EHPs who were working at government hospitals, in the respective districts of all 14 Regions of Namibia, since this was the population that is more accessible to the researcher. Given that the population was relatively small, the researcher decided to include everyone. Hence no sampling formula was used in this study. The sample size was 76 EHPs from the respective district hospitals of all 14 regions in Namibia. All EHPs who were available during the data collection period had an equal chance to participate in the study.

The researcher utilised total population sampling to collect data from all EHPs in the country's district hospitals, thereby ensuring that the results are a true representation of the entire population of interest. According to (42), if a sample is less than 100 and is manageable, total population sampling ensures representativeness, which is critical for accurate generalisation within that specific population. It also increases statistical power and ensures more reliable estimates for statistical analysis eradicating the possibility of sampling bias.

3.5 Data collection instrument

A research instrument is a tool used to collect, measure, and analyse data that is relevant to the research topic (26). In this study, a structured self-administered online questionnaire was employed as the primary data collection instrument, targeting EHPs. A questionnaire is a well-established method in social and health research that consists of a set of carefully designed questions intended to collect factual and perceptual information from individuals with knowledge of a specific phenomenon (25). This method is particularly advantageous when seeking to collect a large amount of data from a widespread or diverse population within a short period, making it a cost-effective and time-efficient approach (25).

The questionnaire in this study was composed of 25 questions—both closed and open-ended—divided into four distinct sections. Section A consisted of short questions aimed at obtaining socio-demographic information from participants, such as age, gender, years of experience, and geographic location.

Section B contained polytomous questions designed to assess participants' awareness on AAP. These questions provided respondents with multiple-choice options, allowing for a comprehensive assessment of their awareness levels.

Section C used Likert scale formatted questions to measure participants' attitudes towards AAP. The Likert scale is particularly effective in capturing the degree of agreement or disagreement with statements, offering insight into the respondents' perspectives and opinions.

Section D incorporated both Likert scale and open-ended questions to assess the practices of EHPs about the prevention and control of AAP. This section allowed for both structured responses and detailed explanations, providing more insights into how EHPs engage with air pollution mitigation efforts.

The use of a self-administered online questionnaire in this study allowed for convenient and efficient data collection, especially given the dispersed nature of the target population across Namibia. By offering both the use of closed-ended and open-ended questions, the instrument ensured meticulous collection of data and understanding of the awareness, attitudes, and practices related to air pollution among EHPs (26).

3.6 Validity and reliability

The crucial aspects to consider in research design and measurement procedures are validity and reliability. Validity means truthfulness, it is the degree to which an instrument measures what it intends to, given the context to which it is applied (37). On the other hand, reliability is the extent to which the instrument can be depended upon to consistently yield the same results when used repeatedly over time, or if used by two different investigators under comparable conditions. The study utilised face validity and content validity to ascertain the questionnaire's precision in assessing the pertinent constructs.

According to the best knowledge of the researcher, no similar studies on this topic have been conducted in Namibia before. Therefore, the instrument was meticulously crafted for this study to attain face validity, whereas content validity was established by conducting a comprehensive literature review and seeking guidance from the research supervisors. The issue of construct validity was effectively tackled by clearly defining the research objectives and utilising established concepts and theories. The notion of content validity was employed to ascertain that the questionnaire sufficiently encompassed the relevant domain of interest. The study also took criterion validity into account by conducting a comparison between the study outcomes and established norms or expert opinions. To ensure reliability, a pre-test of the research questionnaire (inter-rater reliability) was done before the commencement of data collection to test the stability of the instrument. The researcher ascertained that the research questions were clear, specific, and unambiguous.

3.6.1 Pilot test

Piloting is a small-scale trial conducted before the main study on a limited number of participants from the population at hand (44). By conducting a pilot test, a researcher orientates self and identifies possible problems with the data collection plans. It also helped with some conceptual improvement of the research design (25). The pilot test was conducted with a small sample of 10 EHPs from selected district hospitals, namely,

Grootfontein, Tsumeb, Omuthiya, Onandjokwe and Oshakati, with two EHPs per facility. These participants were not included in the main study to avoid bias in the final data collection. The reason was to test the questionnaire and verify the validity and reliability of the survey questions. Testing the instrument ensures that the questions are clear, understandable, and appropriately worded. Any confusion or misinterpretation of the questions by the pilot study

participants were refined before the full study, thereby reducing the likelihood of collecting unreliable or inconsistent data during the main study.

3.7 Data collection procedure

Burns and Grove (45), defined data collection as a precise, systematic way of gathering information relevant to the research purpose, specific objectives, questions or hypothesis.

After obtaining permission to collect data from the MoHSS, the researcher approached the human resources department and requested the email addresses of all senior EHPs in the different regions of Namibia. The researcher distributed the electronic questionnaire link to chief and senior EHPs across all fourteen regions of Namibia. These senior EHPs subsequently shared the link with their subordinates across all districts via emails, WhatsApp groups, and direct messages. A total of 76 questionnaires were tracked and confirmed as distributed, aligning with the target population. The researcher later made direct calls to individual EHPs, especially in Regions with low response rates. The utilisation of an online questionnaire format facilitated ease of distribution and retrieval of responses.

The phase of data collection extended over four months, between January and April 2023, affording a sufficient duration to procure responses from as many participants as possible. The researcher deemed informed consent to be a critical component of the data collection procedure, herein, participants who consented to participate in the study were expected to complete and submit the questionnaire online, to respond to 25 closed and open-ended questions, approximately within 25-30 minutes. The use of English as the official language in Namibia was to guarantee consistency and understanding amidst varied geographical regions.

The process of data collection was characterised by efficiency, inclusivity, and respect for the time and preferences of the participants, which was achieved using online questionnaires, consent procedures, and a meticulously designed questionnaire.

3.8 Data analysis

Data analysis involves a systematic process of examining, cleaning, transforming, and interpreting data to convert it into meaningful information that supports decision-making (44). The researcher carefully selected appropriate statistical tools aligned with the study objectives and hypotheses to ensure that the analysis directly addressed the research aims. The analyses were conducted using the Statistical Package for the Social Sciences (SPSS, version 27), chosen for its capability to produce accurate and efficient results. To minimise the risk of data entry errors, a double-entry verification method was implemented, ensuring the reliability of the dataset.

To address the study's first objective, which sought to determine the awareness of EHPs about AAP and associated health effects in Namibia, a Likert scale with "Yes," "No," and "Don't know" responses were used. Mean scores were calculated for awareness responses, and regression analysis was employed to test the relationship between awareness and demographic variables such as age, education level, and work experience. This approach ensured that the analysis linked to the objective of determining factors associated with awareness levels.

For the second objective, which focused on determining the attitudes of EHPs towards AAP and associated health effects in Namibia, a Likert scale with responses ranging from "Strongly Agree" to "Strongly Disagree" was used. Mean scores were computed to summarise

the attitudes of participants, and chi-square analysis was conducted to explore the relationship between attitudes and demographic variables. This analysis further extended to the link between attitudes and practices, providing insights into how perspectives influence professional behaviour.

The third objective to determine the practices of EHPs in the prevention of AAP and associated health effects in Namibia, practices were assessed using a Likert scale with options "Always," "Sometimes," and "Never." Logistic regression analysis was used to investigate the relationship between practices and demographic variables, enabling the identification of factors influencing practical engagement in AAP prevention.

Finally, to achieve the fourth objective which is to evaluate the association between awareness, attitudes, and practices of EHPs towards AAP and associated health effects in Namibia, a correlation matrix was constructed determine the relationships between awareness, attitudes, practices, and demographic variables. This comprehensive analysis provided insights into how these factors interact, fulfilling the study's aim to assess the awareness, attitudes, and practices of EHPs regarding ambient air pollution and associated health effects in Namibia.

Demographic data, such as participants' age, education level, gender, and work experience, were summarised using frequency distribution tables to provide a clear overview of the sample characteristics. Gender data were further visualised through graphical representations, offering an accessible and clear interpretation of participant distribution. Likert scale data for awareness, attitudes, and practices were presented using response distribution tables, ensuring a structured and transparent display of varying levels of agreement or opinion.

By explicitly linking the statistical tests to the research objectives, the analysis demonstrated a clear and logical alignment with the study's purpose, assuring readers that the chosen methods were purposeful and not arbitrary. This approach highlights the study's methodological rigour and ensures confidence in the validity of the findings.

The logistic regression model was used to predict outcomes related to awareness, attitudes, or practices towards AAP (48). Independent Variables: The independent variables (predictors) were the demographic characteristics of the respondents, such as age, gender, level of education, years of experience and source of information.

The formula for binary logistic regression was used as follows:

$$\text{Log}\left(\frac{P}{1-P}\right) = \beta 0 + \beta 1 X 1 + \beta 2 X 2 + ... + \beta k X k$$

Where: P = Probability of awareness

$\beta 0$ = Intercept

$\beta 1,2,...,\beta k$ = Coefficients of demographic variables $X 1, X 2, ..., X k$

The output of logistic regression typically includes odds ratios (OR) for each predictor variable, which indicate how a unit change in a demographic variable (for example, moving from one age group to another) affects the odds of being aware of AAP, having positive attitudes, or engaging in practices. An odds ratio greater than 1 suggests that an increase in the predictor

variable increases the odds of the outcome (for example, higher education level may increase the likelihood of awareness of AAP. An odds ratio of less than 1 indicates that an increase in the predictor variable decreases the odds of the outcome (for example, years of experience may reduce the likelihood of engaging in AAP prevention practices).

P-values and confidence intervals were used to assess the statistical significance of each predictor. A p-value measures the probability of obtaining results as extreme as the observed results, assuming that the null hypothesis is true. The null hypothesis typically states that there is no effect or no association between the variables being tested. The pvalue helps in deciding whether to reject the null hypothesis in favour of the alternative hypothesis. A p-value less than or equal to 0.05 indicates that the observed data is unlikely to have occurred under the null hypothesis. In this case, we reject the null hypothesis and conclude that there is evidence of a statistically significant relationship between the independent variable (for example, education level) and the dependent variable (for example, awareness of ambient air pollution).

3.9 Research Ethics

Research ethics are the principles, rules, and regulations that all researchers should follow and abide by while conducting research (46). A researcher is responsible for conducting a study in an ethical manner; this is because any study involving human subjects is of special concern related to the protection of the rights of the human subjects. Research ethical clearance was obtained from the University of Namibia, Oshakati Campus Decentralised Ethical Committee (DEC (***See Annex A***). While permission to conduct this study was granted by the MoHSS (***See Annex B***). Additional authorisation was given by the regional chief and senior EHPs in the respective thirty-three district hospitals. A high professional standard of conducting research implies the acceptance of responsibilities, and a researcher is responsible to fellow researchers,

to respondents, to society as a whole and, most importantly, to oneself. This study applied the three fundamental ethical principles as discussed below.

3.9.1 Principle of respect

The researcher adhered to ethical principles by ensuring that each participant's right to self-determination was respected throughout the study. Participants were fully informed of their rights and given the autonomy to decide whether they wished to participate, ensuring that their decision was made without any form of coercion or pressure. According to research ethics guidelines, voluntary participation is a fundamental requirement, allowing individuals the freedom to engage in the study based on their informed consent (25, 26). In this study, every participant was required to either accept or decline the informed consent form before proceeding (see Annex C), ensuring that they fully understood the nature of the research, its purpose, and their role in it (46).

Furthermore, participants were explicitly informed that they could withdraw at any stage of the study without facing any negative consequences. This assurance is aligned with ethical research standards, where the right to withdraw is critical to maintaining trust and autonomy in research participation (24). The researcher also made efforts to respect the rules and regulations of all involved institutions and relevant authorities, ensuring that the study complied with institutional ethical guidelines and regulatory requirements. This demonstrates a commitment to conducting the research responsibly and in accordance with professional ethical standards (46).

3.9.2 Principle of beneficence and non-maleficence

In this study, no incentives or direct rewards were offered to participants, ensuring that their decision to participate was entirely voluntary and not influenced by external motivations. This aligns with ethical research practices, which discourage the use of excessive incentives that could unduly influence participation (46). Participants were made aware that, although they would not receive individual benefits, the study's findings would contribute to the body knowledge and help address identified gaps with regards to air pollution, ultimately benefiting the public (25).

While the study did not involve any interventions or manipulation of participants, the researcher took care to avoid including sensitive or uncomfortable questions. This was done to respect participants' comfort and well-being, ensuring that the research process did not cause any emotional or psychological distress. Respecting participants' autonomy and minimising any potential harm is a core ethical principle in research (46).

To further protect participants, the researcher assured them that all data collected would be treated with strict confidentiality and anonymity. No personal identifiers, such as names, were included on the questionnaires (see Annex D), ensuring that responses could not be traced back to individual participants. This practice is essential for protecting participants' privacy, especially when dealing with sensitive topics (26). All completed questionnaires were securely stored on a password-protected computer, and only authorised personnel had access to the data. Once the study concluded, all raw data were destroyed, and only the analysed findings were retained for reporting purposes. This ensured compliance with data protection laws and ethical research standards, which require the responsible handling and destruction of sensitive information (46). By following these protocols, the researcher ensured that no harm was caused

to participants, maintaining the integrity of the research and protecting the rights of those involved.

3.9.3 Principle of justice

Participants in the study were fully informed about the nature and purpose of the research without any information being withheld. Each participant received an information sheet that clearly outlined the objectives, scope, and importance of the study. This ensured that all participants had a comprehensive understanding of what the research entailed and their role in it (46). Along with the study details, the researcher's and supervisors' contact information was shared with every participant. This measure provided an additional layer of transparency, enabling participants to reach out with questions or clarifications about any aspect of the study, ensuring they felt comfortable and well-informed before giving their consent (26).

The recruitment of participants adhered strictly to the inclusion criteria, and all individuals were given an equal opportunity to participate. The selection process was consistent, with each participant being recruited through the same standardised procedure, ensuring fairness and eliminating bias. This approach aligns with ethical guidelines that emphasise equitable treatment of participants throughout the recruitment and data collection process (25).

Participants were encouraged to ask questions and seek clarifications by using the provided contact details. This open communication ensured that they were fully informed about their participation and any concerns could be addressed promptly. After giving informed consent, participants filled the questionnaire, which was distributed in a uniform manner. Respondents were instructed to complete the questionnaire at their convenience, within the data collection period, ensuring flexibility and minimising disruption to their daily routines. This method

allowed participants to take part at their own pace, promoting thoughtful responses and maintaining the integrity of the data collection process (46).

3.10 Chapter summary

This chapter provided an in-depth discussion of the research methodology utilised in the study. The research employed a quantitative approach, which allowed for the objective measurement and analysis of data regarding the awareness, attitudes, and practices of EHPs with regards to air pollution. A cross-sectional analytical design was adopted, enabling the collection of data at a single point in time to assess the prevalence of certain variables and identify any relationships between them. This design is particularly effective for measuring associations between demographic factors and the dependent variables under investigation.

The chapter also detailed the use of total sampling as the method for participant selection. This sampling technique involves including the entire population that meets the inclusion criteria in the study, which, in this case, encompassed all EHPs relevant to the study's scope. By utilising total sampling, the study aimed to increase the statistical power and ensure a more comprehensive representation of the population, allowing for greater generalisability of the findings. Given the involvement of human subjects, the chapter highlighted the ethical considerations observed throughout the research process. These included ensuring informed consent, maintaining respect, confidentiality and anonymity, and minimising any potential harm to participants. The ethical implications of these practices were discussed in detail, illustrating the researcher's adherence to ethical standards and guidelines to protect participants' rights and welfare. This focus on ethics ensured that the study maintained its integrity while safeguarding the interests of the participants (46).

CHAPTER 4: RESULTS

4.1 Introduction

This chapter gives an analysis of the study results by the research objectives. It presents the statistics on the awareness, attitudes, and practices disposed of by EHPs about ambient pollution and associated health effects in Namibia. The presentation of descriptive statistics is accomplished using tables and pie charts, which serve to visualise the frequency distributions of the respondents. The utilisation of a binary regression model was employed to ascertain the demographic variables that impacted the awareness, attitudes, and practises of EHPs about ambient air pollution. A correlation matrix was used to establish the relationship between awareness, attitudes and practices towards ambient air pollution and its associated health effects.

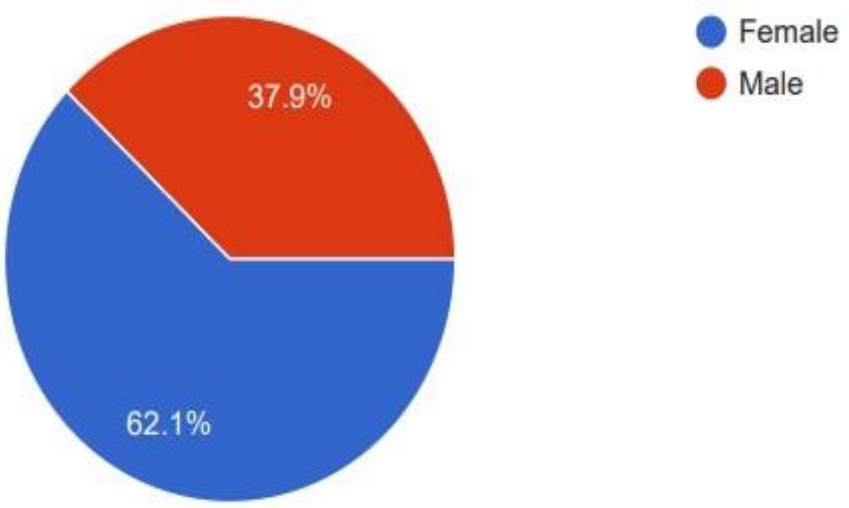
4.2 Response rate of respondents

Sixty-six valid questionnaires were received from the 76 distributed, yielding a response rate of 86.8%. Baruch and Holtom (47) stated that a response rate exceeding 70% indicates the reliability of the instrument and enhances the confidence level of the outcomes.

4.3 Demographic data of respondents

This section presents the demographic characteristics of the respondents including gender, age, highest qualification, years of experience and the region they are working.

Figure 4.1: Gender of the respondents



The above figure indicates that the female respondents comprised a majority of (n=41) 62.1%, whereas male respondents s accounted for (n=25) 37.9% of the total respondents.

Table 4.1: Age of respondents

Age group	**Frequency**	**Proportion (%)**
18 - 24 years	9	13.6%
25-34 years	40	60.6%
35-44 years	15	22.6%
45-54 years	1	1.6%
>55 years	1	1.6%
Total	**66**	**100%**

The results in table 4.1 show how the sampled population was distributed according to age. Forty (60.6%) of the respondents were between the ages of 25-34 years old. The ages 35 to 44 years made up the next-largest age group (n=15) 22.6%. While (n = 9) 13.6% of the respondents were aged 18 - 25 years. Only 1 (1.6%) respondent each belonged to the oldest age groups of 45–54 and >55.

Table 4.2: Respondents' highest level of education

Educational level	Frequency	Proportion (%)
Certificate	1	2
Diploma	4	5.5
Degree	44	66.7
Postgraduate	17	25.8
Total	**66**	**100**

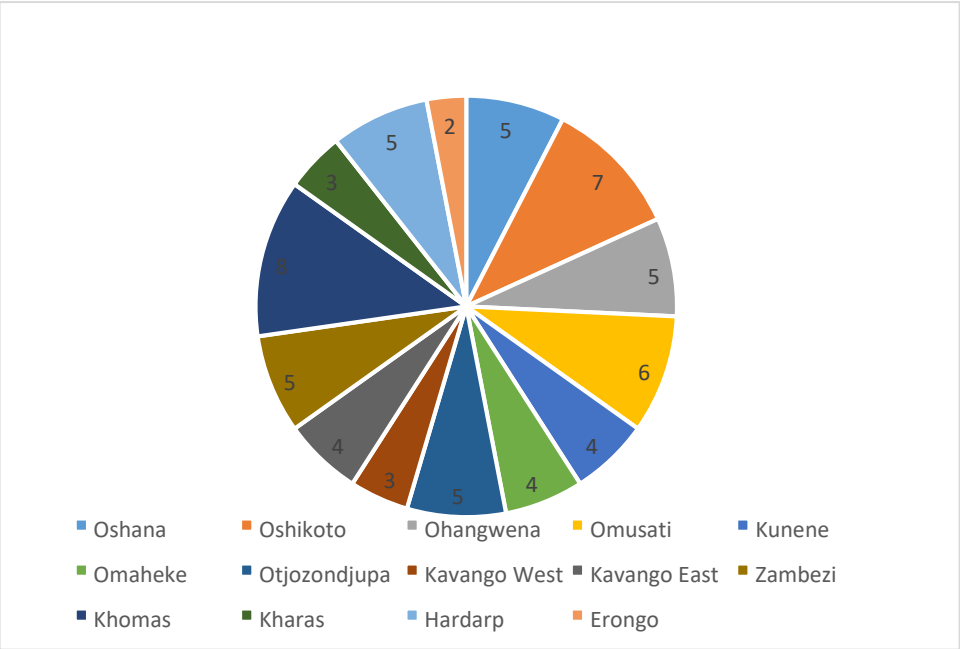
The distribution of educational backgrounds among respondents is shown in Table 4.2 above. Number of respondents (n = 66) of which certificate, diploma, degree, and postgraduate are the four categories of educational levels listed. The frequency and proportion of EHPs that fit into each category are: (n = 1) 2% of the 66 individuals possessed a certificate, and (n = 4) 5.5% had a diploma. While more than half (n = 44) 66.7% of the population had a degree. Lastly, (n = 17) 25.8% were postgraduate degree holders.

Table 4.3: Work experience

Work experience	Frequency	Proportion (%)
<5 years	33	50
5-14 years	24	36.4
15-24 years	8	12.1
25-34 years	0	0
>35 years	1	1.5
Total	**66**	**100**

Work experience is tabulated to reflect the frequency and percentage distribution of the work range by EHPs in Namibia. It is evident that (n = 33) 50% out of the total (n = 66) respondents had less than five years of work experience, which is the highest frequency and percentage. While (n = 24) 36.4% of the total respondents, are seen in the range of 5 – 14 years of work experience. Notably so, only (n = 8) 12.1% of the respondents fell into the third job experience category of 15 – 24 years).

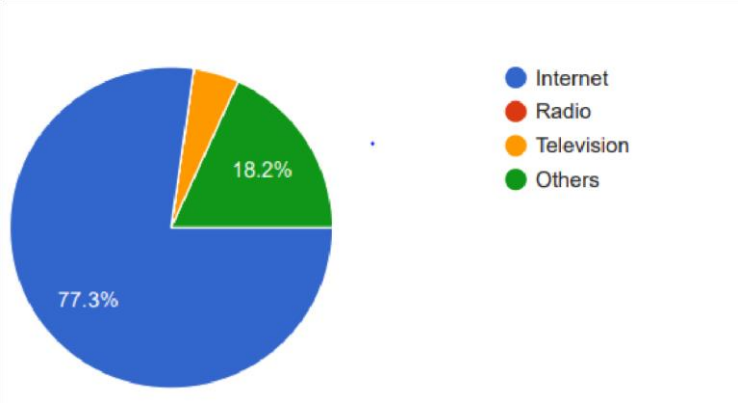
Figure 4.2: Number of respondents per Region



The pie chart illustrates the distribution of respondents across various regions, with the most number of respondents from Khomas (8), Oshikoto (7), and Omusati (6), while the least respondents are from Erongo (2), Kharas (3) and Kavango-west (3). Other regions, including Ohangwena, Oshana, Zambezi, Hardap and Otjozondjupa, have moderate frequencies, with 5 respondents each. Kavago-east, Kunene and Omaheke also have same number of respondents (4) per Region.

4.4 Sources of information regarding air pollution

Figure 4.3: Source of information relating to air pollution



The pie chart illustrates the distribution of various sources of information about air pollution prevention, with the largest portion representing the Internet as the primary source, accounting for 77.3% of the total. The 'Others' category follows with 18.2%, indicating other unspecified sources of information. Television is the least utilised medium, contributing a very small slice, while Radio is barely visible, suggesting minimal use as a source for air pollution-related information. This data highlights the overwhelming dominance of the Internet as the key medium for disseminating information on this topic.

4.5 Awareness of EHPs regarding AAP and associated health effects in Namibia

Table 4.4: Awareness of EHPs regarding AAP and associated health effects in Namibia

Statement	Yes (%)	No (%)	Don't Know (%)	Mean awareness score
Ambient air pollution is a mixture of chemicals and biological matters that react to form hazardous particles	68.2	28.8	3	**2.65**
Particulate Matter is the most common criteria air pollutant in Namibia	84.8	6	9.2	**2.75**
Ambient air pollution is a prioritised public health issue of concern in Namibia	63.6	34.4	2	**2.61**
The air quality status in Namibia is good.	39.4	47	13.6	**2.25**
Household cooking is the main cause of ambient air pollution in Namibia.	36.4	59.1	0.5	**2.27**
The short-term health effects of ambient air pollution include allergies, headaches, nausea.	84.8	12.1	3.1	**2.81**
It is solely the responsibility of the government to tackle air pollution.	19.7	80.3	0	**2.19**
Ambient air pollution is associated with long term health effects like asthma, stroke, and cancer	92.4	5	2.6	**2.89**
Air quality levels in Namibia are below WHO targets.	28.8	27.3	43.9	**1.84**
Namibia has an air quality policy.	47	33.3	19.7	**2.27**
Has air pollution ever affected your health, or the health of someone you know	60.6	30.3	9.1	**2.51**
There are ambient air pollution programs in Namibia.	21.2	30.3	48.5	**1.71**

The data in table 4.4 shows that majority of respondents recognise the harmful nature of ambient air pollution, with 68.2% understanding it as a mixture of chemicals and biological matter that forms hazardous particles, and 92.4% linking it to long-term health effects like asthma and cancer. While 84.8% acknowledge particulate matter as a major air pollutant in

Namibia, opinions are mixed on air quality, with only 39.4% agreeing that Namibia's air quality is good.

Household cooking is not widely seen as the primary cause of air pollution (36.4%), and a significant portion of respondents (43.9%) are unsure if air quality levels meet WHO targets. Government responsibility for tackling pollution is largely refuted (80.3%), and nearly half of respondents (48.5%) are unaware of existing air pollution programmes.

The overall mean awareness score is approximately 2.40 on a scale of 1 to 3, where 3 represents a high level of awareness (Yes), 2 represents a moderate level (No), and 1 represents low awareness (Don't Know). This score indicates that respondents generally have moderate to high awareness of issues related to air pollution, with the majority of responses leaning towards understanding the key concepts.

4.6 Relationships between demographic variables and awareness

Table 4.5: Relationship between demographic variables and awareness

Variable	Coefficient	p-value	95% Confidence Interval
1. Air Pollution causes sickness			
Constant	-0.9523	0.713	[-6.031, 4.126]
Gender	-1.8604	0.173	[-4.536, 0.815]
Age Group	-0.6909	0.790	[-5.787, 4.405]
Years of Experience	0.3562	0.414	[-0.498, 1.210]
Education level	0.8465	0.400	[-1.126, 2.819]
4 Particulate Matter is the Most Common Pollutant			

Constant	-31.9671	0.999	[-3.77e+06, 3.77e+06]
Gender	-0.6361	0.685	[-3.713, 2.441]
Age Group	-32.7348	0.999	[-3.77e+06, 3.77e+06]
Years of Experience	6.3641	0.999	[-7.53e+05, 7.53e+05]
Education level	1.9108	0.151	[-0.699, 4.521]
5 Air Quality in Namibia is Good			
Constant	1.6831	0.339	[-1.767, 5.133]
Gender	-0.3177	0.747	[-2.247, 1.612]
Age Group	0.6982	0.675	[-2.567, 3.964]
Years of Experience	-0.0047	0.976	[-0.305, 0.296]
Education level	-1.2465	0.201	[-3.159, 0.666]
6 Air Pollution is a Public Health Issue			
Constant	-22.4299	0.999	[-145067.6, 145022.7]
Gender	-1.5034	0.315	[-4.435, 1.428]
Age Group	1.8270	0.498	[-3.457, 7.111]
Years of Experience	-0.1332	0.547	[-0.567, 0.300]
Education level	24.4730	0.999	[-145020.7, 145069.6]

Each dependent variable was tested against the independent variables (Gender, Age Group, Years of Experience, and Qualifications) to identify the relationships. The logistic regression analyses showed no statistically significant relationships between the independent variables Gender, Age Group, Years of Experience, and Qualifications— and the various perceptions of air pollution, such as its role in causing illness, air quality, particulate matter as a common pollutant, and air pollution being a public health issue. None of the p-values for the tested

variables were below the 0.05 threshold, indicating a lack of significant relationships. Some models, particularly those involving perceptions of particulate matter and public health concerns, experienced convergence issues, suggesting potential data limitations or small sample sizes. Overall, the independent variables did not meaningfully predict perceptions about air pollution in this dataset.

4.7 Attitudes of EHPs towards AAP and associated health effects in Namibia

Table 4.6: Attitudes of EHPs towards AAP and associated health effects in Namibia

(SA – Strongly Agree, A- Agree, N- Neutral, D- Disagree, SD – Strongly Disagree)

Statements	**SA (%)**	**A (%)**	**N (%)**	**D (%)**	**SD (%)**
Using a private car over public transport contributes to more air pollution	6.1	10.7	34.8	24.2	24.2
Prioritising air quality-related activities is part of my day-to-day work	9.1	13.6	18.2	50.0	9.1
The current national legislation is effective in addressing air pollution issues in Namibia	25.8	18.2	24.2	15.1	16.7
Evidence of air pollution and its effect on health is common in Namibia	10.6	12.1	25.8	22.7	28.8
Car emissions should be checked and controlled more frequently	34.8	21.2	18.2	9.1	16.7
Human activities have no significant impact on air pollution	7.6	13.6	24.2	45.5	9.1
It is the responsibility of EHPs to make public awareness on air pollution	36.4	31.8	18.2	13.6	0.0
There is no point in me doing anything about air pollution because the government is not promoting that	16.7	9.1	21.2	19.7	33.3
The effects of air pollution are not a major concern compared to other public health issues EHPs face in the country.	19.7	33.3	21.2	16.7	9.1

Preventing and controlling ambient air pollution is not part of my responsibilities as an Environmental Health Practitioner.	4.5	16.7	51.5	21.2	6.1
Air pollution is unavoidable in today's world due to modern lifestyles and urbanisation.	30.3	18.2	24.2	4.5	22.8
If I had more knowledge on improving air quality, I would be more proactive in addressing air pollution.	42.4	21.2	18.2	12.1	6.1

The data reflects a variety of attitudes among Environmental Health Practitioners (EHPs) regarding air pollution, its causes, and their role in mitigating it. When asked about the use of private cars over public transport, a significant portion of respondents (34.8%) remained neutral, while 24.2% disagreed or strongly disagreed that it contributes to more air pollution, and only a small group (16.8%) agreed or strongly agreed. When it comes to prioritising air quality in daily work, 50% of EHPs disagreed, indicating that it is not a significant part of their day-to-day responsibilities, while only 22.7% felt it was important. Responses towards the effectiveness of current national legislation in addressing air pollution were mixed, with 25.8% strongly agreeing that the legislation is effective, while another 31.8% disagreed or strongly disagreed. There appears to be uncertainty about the evidence of air pollution's impact on health in Namibia, as 28.8% strongly disagreed with this statement, and only 22.7% agreed or strongly agreed. Interestingly, 56% of respondents supported the idea that car emissions should be checked and controlled more frequently.

However, 54.6% of EHPs disagreed or strongly disagreed with the statement that human activities have no significant impact on air pollution, with only 21.2% agreeing to some extent. Majority (68.2%) felt it was the responsibility of EHPs to raise public awareness about air pollution, with no respondents strongly disagreeing. There is a notable division in attitudes toward whether government inaction should deter personal efforts against air pollution, with

33.3% strongly disagreeing with the notion of inaction and 25.8% agreeing**.** Regarding the effects of air pollution not been major concerns compared to other public health issues, more than half (53%) of respondents agreed, while 21.2% were neutral and only 25% opposed with the statement. When asked whether controlling air pollution is part of their responsibility as EHPs, 51.5% responded neutrally, 21.2% disagreed, while 6.1% strongly disagreed and only 21.2% agreed or strongly agreed. Furthermore, 48.5% of EHPs agreed or strongly agreed that air pollution is inevitable due to modern lifestyles, although 22.8% strongly disagreed. Interestingly, 63.6% of respondents felt that they would be more proactive in addressing air pollution if they had more knowledge about how to improve air quality, showing a general willingness to take action, with only 18.2% expressing neutrality on the matter, while another 18.2 either disagreed or strongly disagreed.

Table 4.7: Attitudes mean scores

Statement	**Attitude score**
Using a private car over public transport contributes to more air pollution	2.5
Prioritising air quality-related activities is part of my day-to-day work	2.6
The current national legislation is effective in addressing air pollution issues in Namibia	3.2
Evidence of air pollution and its effect on health is common in Namibia	2.5
Car emissions should be checked and controlled more frequently	3.4
Human activities have no significant impact on air pollution	2.7
It is the responsibility of EHPs to make public awareness on air pollution	3.9
There is no point in me doing anything about air pollution because the government is not promoting that	2.5

The effects of air pollution are not a major concern compared to other public health issues EHPs face in the country	3.4
Preventing and controlling ambient air pollution is not part of my responsibilities as an Environmental Health Practitioner.	2.9
Air pollution is unavoidable in today's world due to modern lifestyles and urbanisation	3.3
If I had more knowledge on improving air quality, I would be more proactive in addressing air pollution	3.8

The overall attitude level, based on the calculated scores, averages around 3.07 on a scale of 1 to 5. This places the overall attitude of the respondents towards air pollution prevention and related issues in a neutral to slightly positive range. Most responses neither strongly agree nor strongly disagree with the statements, indicating mixed or moderate attitudes rather than strong convictions (strongly agree). This suggests that while there is some awareness or concern about air pollution, it is not universally seen as an important issue by all respondents.

Table 4.8: Relationship between demographic variables and attitudes

Statement	**Mean Score**	**Chi-Square**	**pvalue**
Using a private car over public transport contributes to more air pollution	2.5	3.19	0.78
Prioritising air quality-related activities is part of my day-today work	2.6	7.02	0.31
The current national legislation is effective in addressing air pollution issues in Namibia	3.2	4.75	0.69
Evidence of air pollution and its effect on health is common in Namibia	2.5	4.03	0.54
Car emissions should be checked and controlled more frequently	3.4	9.45	0.09

Human activities have no significant impact on air pollution	2.7	4.56	0.47
There is no point in me doing anything about air pollution because the government is not promoting that	2.5	3.92	0.26
The effects of air pollution are not a major concern compared to other public health issues EHPs face in the country	3.4	3.63	0.45
Preventing and controlling ambient air pollution is not part of my responsibilities as an Environmental Health Practitioner.	2.9	1.77	0.77
Air pollution is unavoidable in today's world due to modern lifestyles and urbanisation	3.3	6.15	0.4
If I had more knowledge on improving air quality, I would be more proactive in addressing air pollution	3.8	6.72	0.34

The analysis indicates that attitudes toward air pollution and its management, as reflected by the mean scores, are generally neutral to moderately positive, with the strongest agreement on the responsibility of Environmental Health Practitioners (EHPs) to raise public awareness (mean score: 3.9). The Chi-Square tests reveal no significant relationships (all p-values > 0.05) between demographic variables such as gender, age, and education and the attitudes expressed in the statements. This suggests that these attitudes are consistent across demographic groups, indicating that efforts to improve awareness or engagement in air pollution issues may not need to be tailored to specific demographics but rather directed at the broader population.

4.8 Practices of EHPs in the prevention of AAP and associated health effects

Table 4.9: Practices of EHPs in the prevention of AAP and associated health effects in Namibia

Statement	Always (%)	Sometimes (%)	Never (%)
Participate in and support the implementation of legal frameworks through collective actions aimed at preventing air pollution	9.1	33.3	57.6
Organise or engage in public awareness campaigns and health education initiatives focused on air pollution.	21.2	12.1	66.7
Attend professional workshops or on-thejob training related to the prevention and control of ambient air pollution	18.2	28.8	53.0
Provide group or individual health education on the health impacts of air pollution.	25.8	30.3	43.9
Conduct industrial health and safety inspections as required to monitor air pollution levels.	19.7	50.0	30.3
Implement or maintain air monitoring systems, such as bucket brigades, at your workplace.	9.1	21.2	69.7
Conduct research or explore innovative methods to address and reduce air pollution.	27.3	24.2	48.5

The data presents respondents' participation in various activities related to air pollution prevention and control. Only 9.1% of respondents always participate and support legal frameworks aimed at preventing air pollution, and more than half (57.6%) never engage in such actions, while 33.3% do so sometimes. Public awareness campaigns and health education initiatives see low engagement, with 66.7% of respondents never participating, 12.1% sometimes, and just 21.2% always involved. Professional workshops and on-the job training on air pollution prevention are attended always by 18.2% and sometimes by

28.8%, but over half (53.0%) never participate. Health education on the impacts of air pollution is provided always by 25.8% of respondents, sometimes by 30.3%, and never by 43.9%. Industrial

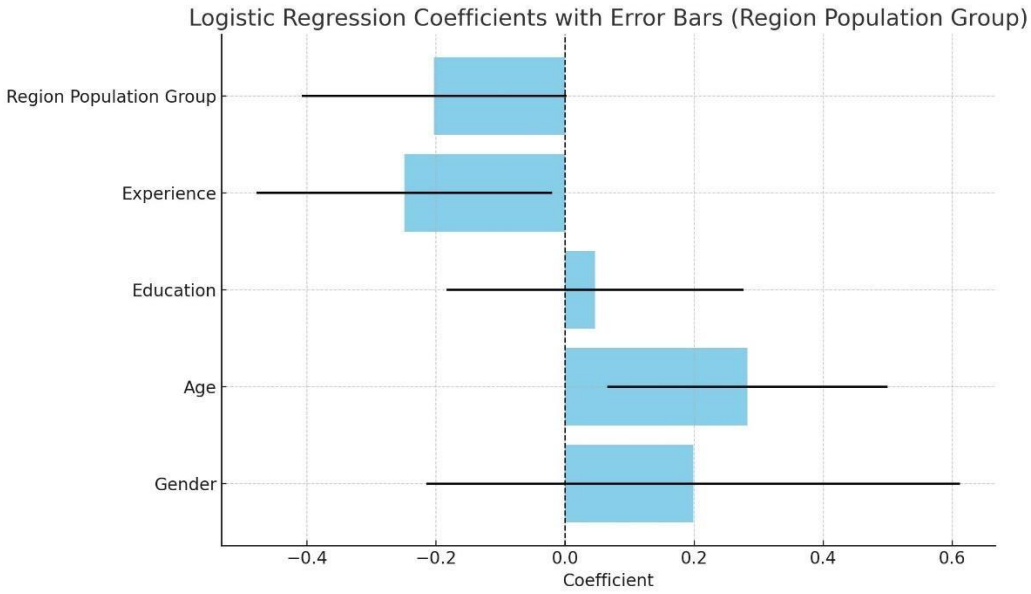
inspections for monitoring pollution levels are performed sometimes by 50% of respondents, though 30.3% never participate, and 19.7% always do. Only 9.1% always implement air monitoring systems at their workplace, 21.2% do sometimes, and 69.7% never do. Finally, 27.3% of respondents are always involved in conducting research or exploring innovative solutions to reduce air pollution, while 48.5% never engage in these activities, and 24.2% do so sometimes. These findings suggest that while some engagement exists, the majority of respondents are not consistently involved in pollution prevention activities.

Table 4.10: Practice Mean Scores

Statement	**Always**	**Sometimes**	**Never**
Participate in legal frameworks	9.1	33.3	57.6
Public awareness campaigns	21.1	12.1	66.7
Attend professional workshops	18.2	28.8	53.0
Provide health education	25.8	30.3	43.9
Conduct industrial inspections	19.7	50.0	30.3
Implement air monitoring systems	9.1	21.2	69.7
Conduct research	27.3	24.2	48.5
Mean scores	**18.6**	**28.6**	**52.8**

The average percentage of respondents who ‘Always’ engage in these practices is 18.6%, 28.6% do practice them sometimes, while 52.8% of respondents report ‘Never’ engaging in them suggesting that the overall practice regarding air pollution and its health effects levels are low.

Figure 4.4: Relationship between demographic variables and practices



The above figure presents demographic variables such as gender, ag**e,** education level, experience, and region. The participation in air pollution prevention practices was converted into a binary outcome, with 1 representing higher participation (e.g., 'Often' or 'Always'). Logistic regression showed that variables like Age (coefficient = 0.2825, p = 0.194) and Experience (coefficient = -0.2493, p = 0.276) were not statistically significant, with an overall pseudo R-squared of 0.02659, indicating that only about 2.7% of the variance in participation was explained by the model.

Table 4.11: Relationship between Awareness, Attitudes and Practices of EHPs regarding AAP and associated health effects in Namibia

	Awareness	**Attitude**	**Practice**
Awareness	1	-0.706187361	-0.204341966
Attitude	-0.706187361	1	0.300388261
Practice	-0.204341966	0.300388261	1

The above correlation matrix presents relationships between awareness, attitude, and practices of EHPs regarding air pollution and its health effects. There is a negative correlation (-0.71) between awareness and attitude, suggesting that as awareness increases, attitudes may become less positive or neutral, or vice versa. There is a weak negative correlation (-0.20) that exists between awareness and practice, indicating little to no relationship between the two. Also, there is a weak positive correlation (0.30) between attitude and practice, suggesting a slight tendency for more positive attitudes to lead to higher levels of practical engagement, though the relationship is not strong. These results indicate that while attitudes may influence practices slightly, higher awareness does not necessarily translate into more positive attitudes or increased practice.

4.9 Chapter Summary

The chapter presented the study results collected from 66 respondents who completed the questionnaire. The presentation began with an overview of the respondents' demographic characteristics, which included variables such as age, gender, educational background, years of experience as EHP, the region in which they are employed, and their primary sources of information on ambient air pollution. Subsequently, the chapter provided a detailed account of

the results concerning the awareness, attitudes, and practices of the respondents regarding ambient air pollution and its associated health impacts. These findings were organised in alignment with the study's key objectives. Specifically, the level of awareness of air pollution issues, the respondents' attitudes towards the severity and consequences of AAP, and their practical engagement in mitigating the health risks associated with air pollution were systematically analysed and presented in summary.

CHAPTER 5: DISCUSSIONS

5.1 Introduction

This chapter delves into the interpretation of the findings presented in the previous chapter, providing a more in-depth analysis of the results. Additionally, the researcher revisits the literature review to draw comparisons, highlighting both the similarities and differences between the current study and previous research conducted on similar topics in other countries. By reflecting on earlier studies, the researcher aims to contextualise the findings within a broader scope, offering insights into how this study aligns or contrasts with global trends and regional variations in the field.

5.2 Discussion on demographics of respondents

The demographic composition of Environmental Health Practitioners (EHPs) in Namibia, predominantly younger professionals with 60.6% aged 25–34 years, reflects a youthful workforce likely driven by recent recruitment initiatives and expanded environmental health programmes. This aligns with findings from the literature, such as the study by Quityne and Kelly (23), which highlighted higher awareness and engagement in environmental health issues among younger, more educated populations. Namibia's EHPs are well-qualified, with 66.7% holding degrees and 25.8% possessing postgraduate qualifications, underscoring the trend towards professionalisation in this field. However, with 50% of EHPs having less than five years of experience, the sector mirrors challenges identified by Odonkor and Mahani (38), where limited experience among professionals impacts the depth of awareness and proactive practices in addressing air pollution.

Consistent with studies like that of Ramírez et al. (16), Namibia's younger EHP demographic represents a significant opportunity for targeted training and public awareness campaigns, leveraging their education and potential to act as catalysts for improved air pollution management. Strengthening resource availability and training frameworks, as noted in studies from South Africa (17) and Lebanon (30), could further empower this workforce to address knowledge gaps and practical challenges, enhancing their capacity to integrate health surveillance and effective communication strategies in tackling air pollution issues.

5.3 Awareness of EHP with regard to AAP and associated health effects in Namibia

The findings demonstrate that (EHPs) in Namibia possess a relatively high level of awareness regarding the harmful effects of ambient air pollution (AAP), as evidenced by the fact that 92.4% of respondents recognised its long-term health consequences, including diseases such as asthma and cancer. Furthermore, 68.2% identified AAP as a hazardous mixture of chemicals and biological matter, indicating a foundational understanding of the risks associated with exposure to air pollutants. This mirrors findings by Quityne and Kelly (23), who noted similarly high levels of general awareness about air pollution’s harmful health effects in Ireland, though they also highlighted gaps in localised

understanding of air quality. Similarly, the awareness demonstrated in this study reinforces the notion that EHPs are broadly informed about the dangers of air pollution, yet discrepancies persist in their understanding of localised and specific contributors to pollution.

For example, while 84.8% of respondents identified particulate matter as a significant pollutant in Namibia, only 36.4% acknowledged household cooking as a primary contributor to AAP. This disconnect reflects findings in earlier studies, such as study by

Cai (22), which highlighted gaps in EHPs' knowledge of domestic air pollution sources like cooking practices. This lack of consensus suggests a narrow focus on industrial or vehicular emissions, potentially underestimating the impact of other critical sources, such as biomass burning, which is common in Namibia's rural areas. Addressing this gap requires targeted education programmes to improve understanding of less recognised pollution sources and their cumulative impact on air quality.

Another noteworthy finding is that only 39.4% of respondents believed that Namibia's air quality is good, despite their awareness of key pollutants. This discrepancy underscores a potential lack of trust in Namibia's air pollution management systems or a limited understanding of air quality metrics. Additionally, 43.9% of respondents were uncertain whether Namibia's air quality meets World Health Organization (WHO) standards, indicating a significant knowledge gap regarding global benchmarks. This observation aligns with the study by Iyanda (40), which stressed the need for clearer communication of air quality data and international standards to improve understanding and empower practitioners to act effectively. Uncertainty about air quality standards undermines the ability of EHPs to assess pollution risks comprehensively and advocate for necessary interventions.

The data also reveals an interesting perspective on accountability. A significant proportion of respondents (80.3%) expressed the belief that the government is not primarily responsible for addressing air pollution. This perception could stem from a lack of trust in governmental

interventions or a belief that industries or local communities should take greater responsibility. Such findings resonate with the study by Ramírez et al. (16), which noted similar concerns about the role of government in air pollution management and the importance of building trust through targeted communication strategies. The perception of government disengagement highlights an urgent need for collaborative efforts between government agencies, industries, and local communities to improve air quality.

Despite these challenges, the overall mean awareness score of 2.40 (on a scale of 1 to 3) indicates that most respondents have moderate to high awareness of air pollution-related issues. However, the finding that nearly half (48.5%) of respondents are unaware of existing air pollution initiatives highlights the need for enhanced public education and professional training to bridge this gap. This observation aligns with South African findings by Wrighty et al. (17), which emphasised that knowledge gaps among EHPs— exacerbated by limited resources and inadequate formal training—hinder effective interventions in air pollution management. Continuous professional development and training programmes could provide EHPs with the knowledge and tools necessary to lead public awareness campaigns and advocate for evidence-based policy changes.

The study's logistic regression analysis, which showed no statistically significant relationships between awareness and demographic variables such as gender, age, years of experience, and level of education, further reinforces the conclusion that awareness levels among EHPs are not significantly influenced by these factors. This finding supports the null hypothesis, as the p-values did not meet the 0.05 threshold. This result is consistent with studies like those conducted in South Africa (17) and by Odonkor and Mahani (38), which similarly found that

sociodemographic factors often do not predict awareness levels among practitioners. These findings suggest that efforts to improve awareness should target all EHPs, rather than focusing on specific demographic groups.

To address the identified gaps, studies such as (28, 30, 31) have stressed the importance of effective communication strategies to bridge the gap between public perception and the actual status of air pollution. EHPs play a pivotal role in leading these initiatives by leveraging their expertise to educate communities and promote behavioural change. The inclusion of training on specific air quality metrics, pollution sources, and health standards could enhance their capacity to address these challenges. Furthermore, as noted in (17), integrating health surveillance into air pollution management frameworks could provide EHPs with more comprehensive tools to track and mitigate pollution-related health impacts.

In conclusion, while EHPs in Namibia demonstrate moderate to high awareness of air pollution and its health risks, notable gaps persist in their understanding of specific pollution sources, air quality metrics, and the roles of various stakeholders. These gaps limit their ability to act effectively as advocates for air pollution control. Addressing these challenges through targeted education programmes, improved communication of air quality data, and stronger policy integration will be critical in empowering EHPs to manage and mitigate the impacts of air pollution more effectively.

5.4 Attitudes of EHPs regarding AAP and associated health effects in Namibia

The findings from this study concerning attitudes among Environmental Health Practitioners (EHPs) in Namibia align with and differ from previous research in meaningful ways. The neutrality and inconsistency in perceptions, such as the lack of consensus on the role of private

cars in contributing to air pollution (34.8% neutral and 24.2% disagreeing or strongly disagreeing), can be attributed to varying levels of awareness and personal experience with vehicular emissions. This mirrors findings by Quityne and Kelly (23), who noted that while general awareness of air pollution was high, there were significant gaps in localised knowledge, particularly regarding specific contributors to air quality degradation. Similarly, the uncertainty observed in this study suggests that EHPs may lack comprehensive training or data to confidently assess the role of private cars and other pollutants in Namibia, as highlighted in studies (17, 30).

The findings that 50% of EHPs disagreed with prioritising air quality in their daily responsibilities, with only 22.7% acknowledging its importance, suggest that air pollution is not perceived as a central focus of their work. This is consistent with studies by Odonkor and Mahani (38), which found that practitioners in Ghana often prioritised more immediate public health concerns over air quality issues due to competing demands. Similarly, South African research (17) highlighted that EHPs face significant challenges, such as work overload and resource constraints, which limit their ability to integrate air quality management into their daily responsibilities. These structural and contextual factors could explain why attitudes toward air pollution are inconsistent in Namibia.

In contrast, studies such as (28, 37) reported that EHPs in other contexts, particularly in regions with well-developed air quality management frameworks, prioritised air pollution activities as part of their professional duties. These differences may reflect variations in institutional focus, resources, and the integration of air quality management into broader public health strategies. For instance, study (16) emphasised the importance of institutional support and clear policies

to enable practitioners to prioritise air pollution management, a factor that appears to be lacking in the Namibian context.

Moreover, the neutrality and inconsistency in attitudes may also be influenced by a lack of actionable data or training on air pollution. Studies such as (17, 30) have underscored the critical role of continuous professional education in equipping EHPs with the knowledge and confidence to address air pollution issues effectively. Without sufficient training and resources, EHPs may struggle to see air quality as a priority, focusing instead on more immediate and tangible public health challenges, such as sanitation and infectious disease control.

The divergence between these findings and those of (28, 37) can also be attributed to differing policy environments. For example, study (17) found that the lack of policy integration and health surveillance systems in South Africa hindered EHPs' ability to link air pollution to health outcomes. In Namibia, a similar lack of comprehensive frameworks may contribute to the observed inconsistencies in attitudes. In contrast, regions with established air quality management policies and dedicated resources enable EHPs to prioritise air pollution in their daily work, as noted in studies (28, 37).

The findings regarding attitudes toward air pollution legislation and its health impacts align with global and local challenges identified in the literature on Ambient Air Pollution

(AAP). The mixed responses about the effectiveness of Namibia’s air pollution legislation (25.8% strongly agreeing and 31.8% disagreeing or strongly disagreeing) could stem from regional variations in pollution sources and enforcement, as noted in studies highlighting the impact of industrial activities in mining towns like Tsumeb and Rössing, and urban vehicular emissions in Windhoek (13). This variability mirrors trends globally, where regulatory success

varies by region, such as the improved air quality in Europe through stringent regulations, contrasted with ongoing struggles in Sub-Saharan Africa due to weak enforcement mechanisms and urbanisation (11, 29). The Environmental Management Act of 2007 in Namibia, while a step forward, appears insufficient to address the specific localised challenges effectively, underscoring the need for more robust policies and enforcement (14).

The significant proportion (28.8%) of respondents who strongly disagreed that air pollution significantly impacts health in Namibia, despite growing evidence of its links to diseases such as asthma, COPD, and cardiovascular conditions (3), suggests a disconnect between awareness and the understanding of specific health impacts. This is consistent with the literature noting that long-term exposure to pollutants like PM2.5, SO_2, and NO_2 contributes not only to respiratory and cardiovascular diseases but also to neurological and developmental issues (2, 27). The localised sources of these pollutants, such as mining and industrial emissions, coupled with poor public awareness and insufficient monitoring, likely exacerbate this gap in knowledge.

Interestingly, there was stronger support (56%) for frequent checks and controls on vehicular emissions, aligning with findings that vehicular pollution is a growing concern in urban centres like Windhoek (13). However, the divided attitudes about human activities' impact on air pollution (54.6% disagreeing with the notion that human activities have no impact) suggest that while practitioners recognise certain pollution sources, there may be gaps in their understanding of the cumulative and long-term effects of humaninduced emissions. Globally, regions with high vehicular traffic and industrial activities, such as urban centres in Nigeria and South Africa, face similar challenges, where regulatory enforcement and awareness campaigns are needed to mitigate these impacts (29, 37).

The strong sense of responsibility among EHPs for raising public awareness (68.2%) reflects a promising level of commitment to addressing AAP. However, the divided perceptions on whether government inaction should deter personal efforts (33.3% strongly disagreed, 25.8% agreed) highlight a critical barrier to effective action. This finding resonates with global trends where public health professionals often feel unsupported by weak or unclear policies, as seen in Sub-Saharan Africa and the Middle East, where regulatory gaps and enforcement issues limit progress (6, 29). Similarly, Namibia's Environmental Management Act lacks comprehensive implementation frameworks, which could explain EHPs' frustration and ambiguity about their roles in managing AAP (14).

The perception that air pollution is a lesser concern compared to other public health issues (53%) is indicative of competing priorities, such as sanitation and infectious diseases, which often take precedence in resource-constrained environments like Namibia. This is consistent with findings in Sub-Saharan Africa, where indoor air pollution from solid fuel use often overshadows concerns about ambient pollution (37). Moreover, the neutrality of 51.5% regarding whether controlling air pollution is part of their responsibility reflects ambiguity in role definitions, similar to findings in South Africa, where EHPs were hindered by unclear responsibilities and insufficient training (17). Addressing these issues requires clear policy guidance and capacity building to empower EHPs to actively engage in air quality management.

The willingness of 63.6% of respondents to be more proactive with improved knowledge highlights the critical need for education and training. As noted in the literature, targeted

professional development on pollutants such as PM2.5 and SO_2, their health impacts, and effective mitigation strategies could significantly improve practitioners' confidence and ability to act (27, 28). Global examples, such as China's success in reducing PM2.5 concentrations through stringent policies and public awareness, demonstrate the potential of combining regulatory measures with practitioner education to achieve meaningful progress (6).

Finally, the lack of significant influence of demographic variables, such as gender, age, and education, on attitudes suggests that structural and systemic factors play a more significant role. As identified in studies from Namibia and South Africa, these include limited enforcement, insufficient training, and resource constraints, which collectively shape EHPs' attitudes and perceptions of their roles in managing air pollution (14, 17). This finding underscores the importance of addressing systemic barriers rather than relying on individual demographic factors to drive change.

In conclusion, the attitudes of Namibian EHPs toward air pollution legislation and health impacts reflect global and regional challenges, including gaps in knowledge, weak policy enforcement, and ambiguity in roles. These challenges align with findings from global studies, emphasising the need for comprehensive education, robust legislation, and better resource allocation to empower EHPs.

5.5 Practices of EHPs regarding AAP and associated health effects in Namibia

The results highlighting the low engagement in air pollution prevention activities among Environmental Health Practitioners (EHPs) align with broader global and regional trends, as well as the systemic challenges identified in both literature controls. For example, the finding that only 9.1% of respondents always participate in collective actions related to legal

frameworks, while 57.6% never do, mirrors trends noted by Ramírez et al. (16) and South Africa (17), where limited enforcement of environmental laws and a lack of institutional capacity hindered practitioners' ability to engage in air quality management. The perception that air pollution is primarily a governmental or industrial responsibility, rather than a shared societal concern, also aligns with Odonkor and Mahani's (38) observations, where public health professionals often prioritised immediate, tangible health threats over broader environmental risks.

The low participation in public awareness campaigns (66.7% never involved) highlights a critical gap in Namibia's outreach and education efforts. As noted by Iyanda (40) and Quityne and Kelly (23), targeted campaigns are essential to fostering community engagement and practitioner participation in addressing air pollution. However, the lack of involvement could be attributed to poor promotion of such initiatives and insufficient emphasis on their importance, similar to the findings in Sub-Saharan Africa, where weak public engagement strategies and limited resources undermined pollution control efforts (29). Strengthening public awareness campaigns and linking them to clear, actionable objectives could increase both EHPs' participation and community support for air quality initiatives.

The gap in professional development and technical engagement, evidenced by only 18.2% of respondents always attending professional workshops or training, suggests limited opportunities for skill-building. This aligns with the findings from studies in South Africa (17) and Ramírez et al. (16), which emphasised the importance of continuous professional education in equipping EHPs with the knowledge and tools necessary to address air pollution effectively. Similarly, the lack of infrastructure and technical expertise to implement air

monitoring systems, as reported by 69.7% of respondents, mirrors challenges noted in Namibia (14), where gaps in air quality monitoring infrastructure and data availability hindered local pollution control efforts. Investing in capacity-building programmes and expanding access to professional workshops and technical training could significantly improve EHPs' ability to engage in air pollution prevention activities.

Interestingly, the finding that 27.3% of respondents always engage in research or innovative approaches to reduce air pollution indicates that a segment of EHPs is actively seeking solutions, despite systemic barriers. This discrepancy between engagement in research and other activities may reflect resource inequalities, where certain practitioners have better access to funding or technical expertise. Similar trends were observed in China, where aggressive policies and investments in research and technology led to notable declines in PM2.5 concentrations, demonstrating the importance of enabling practitioners to innovate and adapt solutions to local contexts (6).

The logistic regression analysis further revealed that demographic variables, such as age, experience, education, and region, did not significantly impact participation in air pollution prevention practices. This finding is consistent with studies like those conducted in Ghana (38) and South Africa (17), where structural and systemic factors— rather than individual demographics—were found to play a more significant role in shaping engagement. The low pseudo-R-squared value of 0.02659 underscores the minimal explanatory power of these variables, suggesting that barriers such as resource availability, institutional support, and policy clarity are more critical determinants of participation. These findings support the acceptance of the hypothesis that demographic variables are not significantly related to practices in air pollution prevention.

The limited impact of demographic variables aligns with the observation that participation in prevention activities is influenced more by systemic challenges, such as insufficient resources and infrastructure, rather than individual characteristics. For example, studies by Gorhani-Azam et al. (39) and Manisalidis et al. (18) highlighted how the effectiveness of air pollution interventions relies on robust systems for monitoring and enforcing regulations, rather than individual-level factors. This systemic perspective is further reinforced by global trends in regions like Sub-Saharan Africa and the Middle East, where poor regulatory frameworks and limited capacity at local levels restrict engagement in air pollution prevention activities (6, 29).

In conclusion, the low participation in air pollution prevention activities among EHPs reflects broader systemic challenges identified in the literature, including limited resources, weak institutional support, and inadequate training opportunities. The findings highlight the need for targeted interventions, such as capacity-building programmes, improved infrastructure, and better public engagement strategies, to empower EHPs to play a more active role in mitigating air pollution.

5.6 Relationship between Awareness, Attitudes and Practices of EHPs regarding AAP and associated health effect in Namibia

The results of this study indicate a strong negative correlation (-0.71) between awareness and attitude, suggesting that as awareness of air pollution increases, attitudes become less positive or more neutral. This finding aligns with Ramírez et al. (16), who highlighted that increased awareness does not always translate into optimism or proactive behaviour. Instead, individuals who become more informed about the complexities of air pollution— such as its widespread

impact, health risks, and mitigation challenges—may adopt a more cautious stance. The study by (17) in South Africa also supports this, noting that EHPs often struggle with integrating health surveillance into air quality management due to resource constraints and knowledge gaps, which may contribute to a shift from idealistic to pragmatic attitudes. This suggests that heightened awareness might lead professionals to recognise the limitations of current strategies, making them more critical of existing air pollution policies and interventions.

Similarly, the weak negative correlation (-0.20) between awareness and practice suggests that greater awareness does not necessarily lead to increased engagement in air pollution prevention activities. This aligns with Quityne and Kelly (23), who found that although 66% of respondents in Ireland were aware of air pollution's harmful effects, only 35% had localised awareness, highlighting a disconnect between general knowledge and actionable behaviour. This disconnection can be attributed to factors such as institutional barriers, lack of resources, and a failure to translate awareness into structured interventions. The findings of (17) further reinforce this point, as EHPs in South Africa reported significant challenges in implementing air pollution control measures due to inadequate training and lack of policy integration. Additionally, Odonkor and Mahani (38) found that although 70.5% of residents in Accra were aware of air pollution's negative health impacts, awareness was lower among certain demographic groups, suggesting that knowledge alone is insufficient to drive behavioural change without systemic support.

The weak positive correlation (0.30) between attitude and practice suggests that while a more positive attitude may slightly encourage engagement in air pollution control measures, this relationship is not strong enough to drive significant behavioural changes. This is consistent

with the study by (30), which found that while Lebanese physicians acknowledged air pollution's risks, only 38% regularly inquired about patients' exposure, despite 75% believing they had a role in mitigation. This suggests that even when professionals hold positive attitudes towards addressing air pollution, actual engagement in preventive practices remains limited without clear policies, training, or institutional support. The findings of (17) also highlight the need for better integration of health surveillance into air quality management, as a lack of resources and training prevents even well-intentioned practitioners from taking action.

Overall, these findings reinforce the complexity of translating awareness and attitudes into practice. While increasing awareness is crucial, it must be accompanied by systemic changes, including policy reinforcement, resource allocation, and institutional support, to enable EHPs and other stakeholders to effectively act on their knowledge.

5.7 Chapter Summary

The chapter provided a discussion of the study's results, with a particular emphasis on the research objectives. None of the demographic variables were found to significantly influence the awareness, attitudes and practices of EHPs regarding ambient air pollution in Namibia. However, the awareness was found to lead to negative attitudes suggesting further inquiry into the relationships.

CHAPTER 6: CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

6.1 Conclusions

This study investigates the relationship between demographic variables—such as age, gender, years of experience, education level, and sources of information—and EHPs awareness, attitudes, and practices towards AAP and its associated health effects in Namibia. To achieve this, four hypotheses were formulated to examine these relationships. **6.1.1 Hypothesis a:**

H_0: There is no significant relationship between demographic variables and awareness of EHPs about AAP and associated health effects in Namibia.

H_1: There is a significant relationship between demographic variables and awareness of EHPs about AAP and associated health effects in Namibia.

The study findings support H_0, as demographic factors such as gender, age, years of experience, education level, and sources of information were not significantly related to awareness of Ambient Air Pollution (AAP) and its health effects. This lack of relationship suggests that awareness among EHPs is likely influenced by factors beyond traditional demographics, such as access to professional training, exposure to air pollution, or regional environmental conditions. For example, some EHPs may have greater exposure to air quality issues depending on their geographical location or job scope, which may shape their awareness more than demographic factors.

6.1.2 Hypothesis b:

H_0: There is no significant relationship between demographic variables and attitudes of EHPs towards AAP and associated health effects in Namibia.

H_1: There is a significant relationship between demographic variables and attitudes of EHPs towards AAP and associated health effects in Namibia.

The study findings support H_0, as no significant relationship was found between demographic variables and attitudes toward AAP and its health effects. Although respondents with higher education levels showed a slight tendency toward more positive attitudes, this effect was not statistically significant. Additionally, the mixed responses regarding the effectiveness of national legislation, personal responsibility, and the public health impact of air pollution indicate that attitudes are shaped by a range of complex factors. These may include regional enforcement of policies, personal exposure to pollution, and institutional priorities, which likely have a stronger influence on attitudes than demographic factors.

6.1.3 Hypothesis c:

H_0: There is no significant relationship between demographic variables and practices of EHPs related to AAP prevention and associated health effects in Namibia.

H_1: There is a significant relationship between demographic variables and practices of EHPs related to AAP prevention and associated health effects in Namibia.

The study findings support H_0, as demographic variables such as age, education, and years of experience did not significantly influence the practices of EHPs related to AAP prevention. Practices, such as engaging in public awareness campaigns or implementing air monitoring systems, were more likely hindered by systemic barriers, including limited resources, inadequate infrastructure, and unclear professional guidelines. These findings suggest that practices are not primarily driven by individual demographic characteristics but rather by external factors such as organisational support, policy clarity, and access to resources.

6.1.4 Hypothesis d:

H_0: There is no significant correlation between awareness, attitudes, and practices of EHPs towards AAP and associated health effects in Namibia.

H_1: There is a significant correlation between awareness, attitudes, and practices of EHPs towards AAP and associated health effects in Namibia.

The study findings partially support H_0, as significant correlations were not consistently observed between awareness, attitudes, and practices. A strong negative correlation (0.71) between awareness and attitudes suggests that increased awareness may lead to more neutral or critical attitudes, potentially reflecting the complexity and challenges of addressing air pollution. The weak negative correlation (-0.20) between awareness and practices indicates that higher awareness does not necessarily translate into practical engagement, likely due to systemic barriers. Meanwhile, the weak positive correlation (0.30) between attitudes and practices suggests that while positive attitudes may encourage action, they are insufficient without adequate resources, training, and institutional support. These findings highlight the

multifaceted nature of awareness, attitudes, and practices, with external factors playing a critical role in influencing behaviour.

6.2. Recommendations

6.2.1 To the Policymakers

The study results revealed a lack of infrastructure for air quality monitoring and limited awareness among Environmental Health Practitioners (EHPs) about pollution levels and trends in high-risk areas.

- Policymakers should prioritise the development and implementation of a comprehensive air quality monitoring system, focusing more on high-risk areas, including urban centers and industrial zones, and ensure EHPs are informed and actively engaged in its use. Real-time data collection and public reporting through regional EHPs will enhance transparency and guide evidence-based policy decisions.

- Adequate resources should be allocated for the installation, maintenance, and expansion of monitoring stations to capture accurate data on pollutants such as PM2.5, SO_2, and NO_2. This aligns with findings from Namibia (14) and Sub-Saharan Africa (29), which highlight the critical role of resource investment in improving air quality management.

- Air quality monitoring systems should be integrated into national and local public health frameworks to inform strategies addressing air pollution's health

impacts. This approach aligns with recommendations from global studies, such as Ramírez et al. (16), emphasising the need for cross-sectoral integration.

6.2.2 To the Environmental Health Practitioners

Result**s** from the study found low levels of EHP participation in monitoring and prevention activities, including public awareness campaigns, due to a lack of training and engagement in air quality management. Hence the following recommendations:

- Incorporate air pollution prevention and control measures into routine work**.** EHPs should actively monitor, report, and address sources of air pollution, particularly in urban areas where vehicular and industrial emissions are prominent. As highlighted by Iyanda (40), proactive engagement is essential for mitigating pollution in Namibia's urban centers.

- Lead public awareness campaigns. EHPs should lead community outreach initiatives to educate the public on the health risks associated with air pollution. Drawing from South African and Ghanaian studies (17, 38), such campaigns can bridge knowledge gaps and foster community involvement in air quality improvement.

- Pursue ongoing trainings. EHPs should pursue ongoing education through workshops, seminars, and online courses focused on air pollution control technologies, health impacts, and policy developments. This aligns with global trends showing the importance of continuous professional development for practitioners in resource-constrained settings (16, 30).

6.2.3 To the Ministry of Health and Social Services

The study revealed unclear roles for EHPs in air pollution management, inadequate enforcement of existing air quality laws, and limited collaboration across sectors. The MOHSS is therefore recommended to:

- Improve legislation and reinforcement. The Ministry should review and strengthen existing air quality legislation, ensuring stricter enforcement in collaboration with stakeholders. Clear and detailed guidelines should be provided to EHPs, outlining their roles and responsibilities in air quality management, addressing gaps highlighted in the Environmental Management Act (14).

- Provide regular training programmes. Regular training initiatives should focus on the health impacts of air pollution and effective mitigation strategies, equipping EHPs with the necessary skills and knowledge to engage in prevention activities. This reflects findings by Ramírez et al. (16), where education significantly improved engagement in air pollution control.

- Foster cross-sectoral collaboration: The Ministry should facilitate partnerships between sectors such as transport, industry, and environmental agencies to comprehensively address air pollution. Joint projects on emission reduction, clean technology development, and urban air quality improvement are essential, as seen in successful global

initiatives (6, 29).

6.2.4 Recommendations for Future Studies

The following recommendations for future research are informed by the lack of clear relationships between demographic variables and awareness, attitudes, and practices related to air pollution.

1. Investigate additional influencing factors: Future studies should explore other variables, such as resource availability, organisational culture, and communitylevel engagement, which might influence awareness, attitudes, and practices toward air pollution among EHPs. This aligns with findings from Sub-Saharan Africa (29), where systemic barriers were identified as critical determinants.

2. Regional comparisons: Comparative studies on urban and rural perceptions of air pollution in Namibia should be conducted to identify regional challenges and tailor interventions accordingly. As noted by Quityne and Kelly (23), regional disparities significantly impact awareness and engagement.

3. Longitudinal studies: Tracking EHPs' knowledge, attitudes, and practices over time will help assess the impact of interventions, training programmes, and policy changes on their roles in air pollution management.

4. Systematic reviews: Conduct systematic reviews comparing Namibia’s current air pollution prevention practices with those in similar settings globally. This will identify best practices and inform strategies for improving air quality management, consistent with global examples like China’s success in reducing PM2.5 levels (6).

6.3 Limitations of the Study

This study is among the first in Namibia to utilise a quantitative, cross-sectional analytical design to explore the awareness, attitudes, and practices of EHPs toward AAP and its associated health effects. Conducted between January and April 2024, the study aimed to identify statistically significant associations between variables rather than establish causality, which is inherent to cross-sectional studies. While the findings provide valuable insights into EHPs' perspectives, it is essential to acknowledge several limitations that may have influenced the results.

Firstly, the time constraints during data collection may have restricted the depth of analysis, while the limited availability of literature on similar studies in Namibia could impact the contextualisation of the findings. Additionally, the research design, the structure of the research instrument, and the data collection procedures may introduce bias or limitations in accurately capturing the complexities of EHPs' awareness, attitudes, and practices. These factors highlight the need for cautious interpretation of the results and underscore the importance of further studies employing diverse methodologies to validate and expand upon these findings.

By transparently addressing these limitations, the study provides a foundation for future research while acknowledging the need for more robust investigations to inform evidence based decision-making and interventions in air pollution management. The study employed a consecutive sampling method to EHPs in government facilities only, thus the findings may therefore have limited relevance for EHPs in private sectors, and not be a representative of all EHPs in Namibia. Future studies should be conducted inclusively with increased sample size using other approaches, to allow generalisation of the results. Nevertheless, the researcher was persistent to collect sufficient data and analysed the data as guided by the research objectives.

In addition, an activity time log was developed for better planning, and execution. A pilot testing was also done on the research instrument for validity and reliability prior to the main study to rectify shortcomings.

6.4 Chapter Summary

The study aimed to assess the awareness, attitudes, and practices of environmental health practitioners (EHPs) on ambient air pollution and associated health effects in Namibia. In other words, the study aimed to find out what EHPs in Namibia knew, perceived, and practised with regards to AAP, taking into consideration the specific objectives. This chapter delineates the conclusions based on hypotheses, recommendations according to the study findings and finally, the limitations encountered during the study.

The study concluded that, while EHPs in Namibian have a solid awareness with regards to AAP, there is still a need for improvement in some areas like attitudes and practices, the recommendations given were thus based on the study findings, prior conclusions grounded o the hypotheses. The next section provides a list of all references cited in this study.

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LIST OF ANNEXURES

ANNEX A: Research Ethical Clearance Certificate

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: DEC OSH 0044 Date: 06/12/ 2022

This Ethical Clearance Certificate is issued by the University of Namibia Ethics Committee (REC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the ethics committee.

Title of Project: KNOWLEDGE, ATTITUDES AND PRACTICES OF ENVIRONMENTAL HEALTH PRACTITIONERS ON AMBIENT AIR POLLUTION AND

ASSOCIATED HEALTH EFFECTS IN NAMIBIA

Principal researcher: LAUDIKA ITUMBA

Staff Number/ Student Number: 201062283

Remarks: Low Risk Approved with corrections

Centre for Research Services Take note of the following:

1. Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the ethics committee. An application to make amendments may be necessary.

2. Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the ethics committee

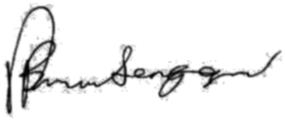
3. The Principal Researcher must report issues of ethical compliance to the ethics committee (through the Chairperson) at the end of the Project or as may be requested by the ethics committee

4. The ethics committee retains the right to:

i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the

Research Ethics Policy) have been detected or suspected, ii) Request for an ethical compliance report at any point during the course of the research.

The ethics committee wishes you the best in your research.



Prof Hans J Amukugo (Oshakati Campus Chairperson Decentralized Ethics Committee)

Prof. Davis Mumbengegwi (Head, Multidisciplinary Research)

ANNEX B: Research Permission Letter

REPUBLIC OF NAMIBIA

MINISTRY OF HEALTH AND SOCIAL SERVICES

Ministerial Building
Harvey Street
Private Bag 13198, Windhoek

OFFICE OF THE EXECUTIVE DIRECTOR

Tel: No: 061 -203 2507
Fax No: 061-222 558
Andreas.Shipanga@mhss.gov.na

Ref: Ref: 22/3/1/1
Enquiries: Mr. A. Shipanga

Date: 16 December 2022

Ms. Laudika Itumba
PO Box 792
Tsumeb

Dear Ms. Itumba

Re: Knowledge, attitudes and practices of environmental health practitioners on ambient air pollution and associated health effects in Namibia

1. Reference is made to your application to conduct the above-mentioned study.
2. The proposal has been evaluated and found to have merit.
3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**
   - 3.1 The data to be collected must only be used for academic purpose;
   - 3.2 No other data should be collected other than the data stated in the proposal;
   - 3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;
   - 3.4 A quarterly report to be submitted to the Ministry's Research Unit;
   - 3.5 Preliminary findings to be submitted upon completion of the study;
   - 3.6 Final report to be submitted upon completion of the study;
   - 3.7 Separate permission should be sought from the Ministry for the publication of the findings.
4. All the cost implications that will result from this study will be the responsibility of the applicant and **not** of the MoHSS.

Yours sincerely,

BEN NANGOMBE
EXECUTIVE DIRECTOR

ANNEX C: Participant's Information to Consent

Date: _____

Region and District Name_____

Dear participant,

I am Laudika Itumba, a postgraduate student at the University of Namibia, undertaking a research study for the fulfilment of a master's degree requirement. The study aims to assess the knowledge, attitudes and practices of environmental health practitioners on ambient air pollution and associated health effects in Namibia. The specific objectives are:

1. To determine the level of knowledge among EHPs with regards to AAP and associated health effects in Namibia.
2. To determine the attitudes of EHPs towards AAP and associated health effects in Namibia.
3. To identify practices of ambient air pollution prevention by environmental health practitioners in Namibia.
4. To determine the association between the demographic factors and the level of knowledge, attitudes and practices of EHPs with regards to ambient air pollution in Namibia.

This questionnaire is intended to collect information that will determine the knowledge, attitudes and practices of environmental health practitioners, in relation to the prevention and control of ambient air pollution, and associated health effects in Namibia. The study is conducted for academic purposes only, hence all information will just be used for this intent.

I will be grateful if you can spare 30 minutes from your busy schedule to complete the online questionnaire by following the link: https://forms.gle/J2Wg8cKrxB13KXhw6. Be assured that any information provided will be treated with confidentiality. To maintain anonymity, please do not write your name on the questionnaire.

** If any further information is required, please contact:

Researcher: Ms Laudika Itumba Cell +264 81 4257668

Email: ilaudika@gmail.com

CONSENT

Having read the information provided above, if you are willing to participate in this study, please click on the following link: https://forms.gle/J2Wg8cKrxB13KXhw6. To maintain privacy and confidentiality, no consent signature is required. Please note that by pressing "**Accept** or **Don't Accept"**, you are either consenting to complete the online questionnaire or declining to take part in the study.

ANNEX D: Online Questionnaire (template)

(https://forms.gle/J2Wg8cKrxB13KXhw6)

KAP QUESTIONAIRE

My name is LAUDIKA ITUMBA and I am conducting research about the KNOWLEDGE, ATTITUDES AND PRACTICES OF AMBIENT AIR POLLUTION AMONG ENVIRONMENTAL HEALTH PRACTITIONERS IN NAMIBIA.

I would like to invite you to take part in this survey, because you belong to the group of people I want to include in my research study. I would therefore like to invite you to complete this questionnaire.

1. The research I am conducting has been approved by the UNAM Research Ethics Committee. I will appreciate it very much if you can complete this questionnaire, and I would like to assure you of the following:

a. Filling in this questionnaire is completely voluntary.

b. You can stop filling in the questionnaire and stop participating at any time if you want to, and there will be no negative consequences for you.

c. Your participation is completely anonymous. This means that, even if I ask information that might identify you or if I know you, I am not allowed to make your identity known to anyone.

When I report on my questionnaires' data and results, I will not mention any personal information about participants that might identify them.

d. All completed questionnaires and data will be stored in a safe and secure place, and only I will have access to it. After the study, all the questionnaires and data will be permanently deleted.

2. If you have any questions about this questionnaire, or if you do not understand anything, please feel free to ask me before you start with the questionnaire, and I will be happy to explain it to you.

3. If you want to know more about the research I am doing, please feel free to ask me, and I will be happy to tell you more.

4. You can reach me on my cell phone at 081 4257668, or send an e-mail to ilaudika@gmail.com

5. It should take about 20-25 minutes for you to complete the questionnaire.

6. If you want to contact the UNAM Centre for Research Services for more information or because you have a comment or complaint about this research or about me, please call (+ 264
61) 206 4673, or write an e-mail to research@unam.na. Please provide specific information.

7. Thank you very much for your willingness to participate in this research!

* Indicates required question

*

Mark only one oval.

- Accept *Skip to question 2*
- Don't Accept

SECTION A (question 1-7):

Socio-Demographic information

1. Gender *

Mark only one oval.

- Female
- Male

2. Age (years) *

Mark only one oval.

- <25
- 25-34
- 35-44
- 45-54
- >55

3. Highest level of education? * *Mark only one oval.*

- Certificate
- Diploma
- Degree
- Postgraduate

4. What facility and department do you work in? *

_____

5. How long have you been working as an EHP? (Years) * *Mark only one oval.*

- < 5
- 5-14
- 15-24
- 25-34
- > 35

6. What is your main source of information relating to air pollution? * *Mark only one oval.*

- Internet
- Radio
- Television
- Others

7. Please indicate the name of the region and district you are working at: *

SECTION B (question 8-21):

General knowledge regarding ambient air pollution and associated health effects. (Yes= 1, No= 2, Don't Know= 0)

8. Ambient air pollution is a mixture of chemicals and biological matters that react to form hazardous particles. *

Mark only one oval.

- Yes
- No
- Don't know

9. Particulate Matter is the most common criteria air pollutant in Namibia. *

Mark only one oval.

- Yes
- No
- Don’t know

10. Air pollution contributes to cardiac illnesses, chronic cancers and * premature deaths.

Mark only one oval.

- Yes
- No
- Don't know

11. Ambient air pollution is a prioritized public health issue of concern in * Namibia.

Mark only one oval.

- Yes
- No
- Don't know

12. The air quality status in Namibia is good. * *Mark only one oval.*

- Yes
- No
- Don't know

13. Ambient air pollution affects the soil and water. *

Mark only one oval.

- Yes
- No

Don't know

14. Household cooking is the main cause of ambient air pollution in Namibia. *

Mark only one oval.

Yes

No

Don’t know

15. The short term health effects of ambient air pollution includes: allergies, * headaches, nausea.

Mark only one oval.

Yes

No

Don't know

16. It is solely the responsibility of the government to tackle air pollution. * *Mark only one oval.*

Yes

No

Don't know

17. Ambient air pollution is associated with long term health effects like * asthma, stroke, and cancer *Mark only one oval.*

Yes

No

Don't know

18. Air quality levels in Namibia are below WHO targets. * *Mark only one oval.*

Yes

No

Don’t Know

19. Namibia has an air quality policy. *

Mark only one oval.

Yes

No

Don't know

20. Has air pollution ever affected your health, or the health of someone you know? *

Mark only one oval.

Yes

No

Don’t Know

21. There are ambient air pollution programs in Namibia. *

Mark only one oval.

Yes

No

Don't know

SECTION C (question 22): Attitudes toward air pollution

22. * Please indicate how much you agree or disagree with the following statements about air pollution by choosing one box in each row. (Strongly Disagree = 1, Disagree= 2, Neither Agree/Disagree= 3, Agree= 4, and Strongly Agree= 5)

Mark only one oval per row.

---

a. . Using a private car over a public transport contributes more to air pollution.

b. Prioritizing air quality related activities is part of my day to day work.

c. The current national legislations are effective in addressing air pollution issues in Namibia.

d. Evidence of air pollution and its effect on health is common in Namibia

e. Car emissions should be checked and controlled more frequently.

f. Human activities have no significant impact on air pollution

g. We should all do our best to reduce the effects of air pollution

h. There is no point in me doing about anything about air pollution because the government is not promoting that.

i. The effects of air pollution is insignificant when compared with other problems the country is addressing.

j. Ambient air pollution prevention and control is not in my scope of practice.

k. Air pollution is inevitable in the modern world because of the way people are living

l. If I knew better how to improve air quality, I would take action.

SECTION D (question 23-25): Practices toward ambient air pollution prevention and control

23. Please indicate how often you carry out the following activities about air * pollution prevention and control, by choosing one box in each row.

(Never= 1, Rarely, =2, Sometimes = 3, Often = 4, Always= 5) *Mark only one oval per row.*

Often 4

a. Consult and support legal frameworks by taking collective action to prevent air pollution.

b. Launch public mass campaign and health awareness on air pollution

c. Attend professional workshop or on the job training regarding the prevention and control of ambient air pollution.

d. Give group/individual health education about the impacts of air pollution.

e. Do industrial health and safety inspection as required.

f. Have a “bucket brigade” or air monitoring system set up at

work.

g. Research/search on better ways to tackle air pollution

24. What other actions have you taken, or do you regularly take out of concern to help mitigate ambient air pollution or its effects?

25. Do you have any suggestions/ comments about air pollution in general?

THE END…….THANK YOU!!!

Google Forms

ANNEX E: Editor's Letter

KUKU COMMUNICATION & CONSULTANCY

For all your language editing needs

P. O. Box 21537
Windhoek
Namibia
Cell +264 810 336 206
Email: colettakandemiri173@gmail.com

PHD IN ENGLISH (UNAM), M.A. IN ENGLISH STUDIES (UNAM), BA HONOURS IN ENGLISH (UZ)

26 September 2023

To whom it may concern

LANGUAGE EDITING – LAUDIKA ITUMBA

This letter serves to confirm that the Master's thesis entitled: *A Knowledge, Attitudes, and Practices of Environmental Health Practitioners on Ambient Air Pollution and Associated Health Effects in Namibia* for Laudika Itumba, student number 201062283, was submitted to me for language editing.

The thesis was professionally edited, track changes, and suggestions were made in the document which if followed by Laudika Itumba, would result in a thesis with high-standard English.

Yours faithfully

Dr. Coletta Kandemiri
PHD IN ENGLISH (UNAM)
M.A. IN ENGLISH STUDIES (UNAM)
B.A. HONS. IN ENGLISH (UZ)

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