SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA, LEGON

SMOKE EXPOSURE AND RESPIRATORY SYMPTOMS AMONG SLUM DWELLERS IN THE GA EAST MUNICIPAL ASSEMBLY, ACCRA

BY

SALIFU HADARA

(10703284)

THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT FOR THE AWARD OF MASTER OF SCIENCE IN OCCUPATIONAL HEALTH DEGREE

DECEMBER, 2019

DECLARATION

I declare that this dissertation submitted is my own work under supervision of my supervisor. All information used in this dissertation has been duly acknowledged by appropriate referencing and this dissertation either in whole or in part has not been presented elsewhere for another degree.

23/12/2019

…….…….. ……

Salifu Hadara **Date**

(Student)

…… 14/12/2019

Dr, Reginald Quansah **Date**

(Supervisor)

DEDICATION

I dedicate this work to Allah, who provides me with knowledge, understanding and strength. I also dedicate this work to my mother, wife, son and daughter for their prayers, support and understanding. Thank you all.

ACKNOWLEDGEMENT

I wish to express my sincere appreciation and gratitude to my academic supervisor, Dr. Reginald Quansah who provided me with the best of guidance and direction to complete this work.

My profound gratitude also goes to all staff and lecturers of the School of Public Health, especially Department of Biological, Environmental and Occupational Health Sciences. I am most grateful to you all.

I am very grateful to the respondents, residents and stakeholders who voluntarily consented to be part of this study. May Allah bless you all.

I thank you Allah for everything you have done in my life and continue to provide, Glory be to You. I cannot stop thanking You, Allah.

A special heartfelt gratitude goes to my beloved mother, Nabla Ayishetu, my lovely wife, Bugdow Sawuda, son, Abdul-Muhaimin and daughter, Hafsat for your consistent prayers, support and understanding. I appreciate your sacrifices and efforts. I thank all colleagues and friends for your wonderful contributions and assistance.

Finally, I say thank you to all those who have contributed in diverse ways to the success of this project.

ABSTRACT

Background: In Ghana, air pollution from indoor sources is the single leading contributor to adverse health outcomes such as cardiovascular and respiratory morbidities and mortalities. Indoor air pollution is associated with estimated 15,000 deaths yearly in Ghana and 3,000 deaths of children under five years. It is also a significant risk factor for non-communicable diseases in Ghana and possibly the biggest risk factor for women in rural areas.

Objective: The study sort to provide understanding of the sources of smoke exposure and the relationship between smoke exposure and respiratory symptoms among slum dwellers in the Ga East Municipal Assembly (GEMA).

Methods: A population-based cross-sectional study involving 200 randomly selected households living in slums in the GEMA. Four communities located 1 km of the Abokobi dumpsite which includes Ablor Adjei, Evangelical Presbyterian (EP) area, Paraku Estates and Pantang were selected for the study. The data were collected on the following; socio-demographic characteristics, any exposure to smoke at home, exposure to smoke from cigarette smoking (active and passive smoking), backyard garbage burning, dumpsite, biomass fuel use and symptoms related to respiratory system. A questionnaire loaded in a Research Electronic Data Capture (REDCap) application was employed to collect the data. The data were analyzed using SAS v9.4 and presented in tables and chart. Chi-square test was used to determine the associations between the exposure and outcome variables. The level of significance was set at $p<0.05$.

Results: Many of the participants (28.50%) were in an age group of 41-50 years. The prevalence of respiratory symptoms among the study population were chronic cough

(20%), phlegm production (17%), wheezing (17%) and shortness of breath or breathlessness (14%). The sources of exposure to smoke among the communities were biomass fuel use (47%), dumpsite smoke (53%), backyard garbage burning (97.5%) and cigarette smoking (active or passive smoking) (41.5%) There was association between exposure to smoke from the dumpsite, biomass fuel use, cigarette smoking and chronic cough. The study also showed association between almost daily exposures to smoke from backyard garbage burning and chronic cough, phlegm production and breathlessness.

Conclusion: In conclusion, our data showed associations between smoke exposure and respiratory symptoms. Smoke exposure may present a significant risk of respiratory health in the GEMA. Measures should be taken to minimize smoke exposures from exposure sources to reduce the prevalence of respiratory symptoms in the GEMA.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AAQAHS	-	Abokobi Air Quality and Health Study
COPD	-	Chronic Obstructive Pulmonary Diseases
ELC	-	Environmental Literacy Council
EP	-	Evangelical Presbyterian
GEMA	-	Ga East Municipal Assembly
GHS-ERC	-	Ghana Health Service-Ethics Review Committee
IUATLD	-	International Union against Tuberculosis and Lung Diseases
MSW	-	Municipal Solid Waste
PAHs	-	Polycyclic Aromatic Hydrocarbons
PM	-	Particulate Matter
REDCap	-	Research Electronic Data Capture
SES	-	Socioeconomic Status
SHS	-	Second Hand Smoking
SHTS	-	Second-Hand Tobacco Smoke
SOB	-	Shortness of Breath
U. S	-	United States
UNEP	-	United Nations Environmental Programme
USEPA	-	United States Environmental Protection Agency
WECF	-	Women in Europe for a Common Future
WHO	-	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

There is an urgent action required to deal with air pollution in the world's cities to improve the health and wellbeing of more than half of the population (World Health Organization (WHO), 2014). Only a small proportion of cities globally meets the WHO air quality guideline. Some cities in the world have pollution levels of two to three times higher than the guideline thresholds (WHO, 2014). For instance, the levels of particulate matter ≤ 2.5 aerodynamic diameter (PM2.5) in most countries in Africa ranges from 23.9 micrograms per cubic meter to 46.3 micrograms per cubic meter (Chasant, 2019). Meanwhile, the proposed WHO guideline for PM2.5 is 10 micrograms per cubic meter (WHO, 2005). Air pollution constitutes a significant threat to health (WHO, 2014). In Ghana, air pollution from indoor sources is the single leading contributor to adverse health outcomes such as cardiovascular and respiratory morbidities and mortalities (United Nations Environment Programme (UNEP), 2016). Indoor air pollution is associated with estimated 15,000 deaths yearly in Ghana and 3,000 deaths of children under five years (UNEP, 2016; Chasant, 2019). It is also a significant risk factor for non-communicable diseases in Ghana and possibly the biggest risk factor for women in rural areas (UNEP, 2016).

Smoke which pollutes the environment is generated from incomplete combustion of materials from various sources (Science Learning Hub, 2019). Different sources of smoke exposure in the households include biomass fuel use, garbage burning and cigarette smoking (United States Environmental Protection Agency (USEPA), 2019; Cogut, 2016; Laumbach & Kipen, 2012; & Christian, 2015). Depending on the components of the

sources of smoke the following chemicals may be found in the smoke: carbon dioxide (CO2), ammonia (NH3), methane, particulate matter, styrene, benzene, formaldehyde, acrolein, hydrogen chloride, cadmium, lead, nickel or cyanide (Cogut, 2016; Science Learning Hub, 2019; USEPA, 2019 & Christian, 2015). In addition, combustion of plastics waste generated in the home and biomass fuel use can also produce dioxin which is known to be harmful to humans (USEPA, 2017). A small amount of dioxin is also found in cigarette smoke (USEPA, 2017).

Household air pollution is vital to health because individuals spend more time at home (Perez-padilla, Schilmann & Riojas-Rodriguez, 2010). It is obvious that household air pollution has a great impact on human health and solid fuel smoke is associated with various conditions (Perez-padilla *et al.,* 2010). There are an estimated 1.6 million deaths-annually in the world that is attributed to exposure to solid fuel smoke in the developing countries (United Nations Environment Programme (UNEP), 2015). Exposure to tobacco smoke is also associated with diseases such as asthma, respiratory tract cancer and interstitial lung diseases (Perez-padilla *et al.,* 2010). Smoke from plastics burning may also lead to serious lung diseases and other health issues (Verna, Vinoda, Papireddy, & Gowda, 2015).

A dumpsite which is located in the area of the slum dwellers (Abokobi dumpsite) is a major receptor of waste mainly from Accra Metropolis, Ga East Municipal, Ga West Municipal, Ledzorkuku Krowor Municipal, Adenta Municipal and Ga Central Municipal Assemblies (Ga East Municipal Assembly (GEMA), 2019). The dumpsite receives annually almost 100,000 tons of waste (GEMA, 2013). Some of the other open dumpsites in Accra include but not limited to Kpone, Oblogo, Achimota and Sarba (Kusi, Nyarko, Boamah &

Nyamekye, 2016) & Baah & Kharlamova, 2013). There is sporadic burning of garbage at the Abokobi dumpsite that generates smoke which spread and affect individuals in the surrounding communities. Many of the community members, especially, children have visible health problems, including irritation and red eyes, runny nose, respiratory diseases, skin infection and stunted growth (Personal Communication: Medical Officer at Pantang Hospital).

Evidence has also shown that fire and smoke from the Abokobi-Pantang dumpsite affect the livelihoods and health status of the residents living close to the dumpsite (Jeffrey, 2015).

This study seeks to provide the understanding of sources of smoke exposure and respiratory symptoms among slum dwellers in Ga East Municipal Assembly of the Greater Accra Region.

1.2 Problem Statement

Air pollution is a significant contributor to the global burden of respiratory disease and allergies, leading to a high rate of deaths annually (Laumbach & Kipen, 2012; World Health Organization (WHO), 2015). This is due to indoor and outdoor air pollution (Laumbach & Kipen, 2012; World Health Organization (WHO), 2015). Respiratory diseases and allergies associated with air pollution include asthma, chronic obstructive pulmonary disease, pneumonia and perhaps tuberculosis (Laumbach & Kipen, 2012).

There are an estimated 7 million deaths that occur globally every year due to air pollution-related diseases such as heart diseases and acute and chronic respiratory diseases (WHO, 2015). According to WHO (2015), 4.3 million deaths associated with air pollution in the

world are as a result of indoor air pollution. This is attributed to the combustion of fuel that generates black carbon (soot) which among other fuel include biomass fuel (WHO, 2015).

In Ghana, biomass fuel consumption is a little above 60% of the total energy consumption, which contributes significantly to indoor air pollution (UNEP, 2016). The prevalence of tobacco use in Ghana among males is 13.1% (Ghana Health Service, 2018). Outdoor pollution sources such as second-hand tobacco smoke is recognized predisposing factor for respiratory conditions (WHO, 2019). Also, it is estimated that about 41% of global waste is burnt openly and residential burning accounts for most of the open waste burning (Cogut, 2016). Waste management system in Ghana is probably one of the worse in the world (Chasant, 2019). Residents in Accra sometimes burn trash in the open, releasing toxic fumes into nearby homes, businesses and the environment (Chasant, 2019). A scientific survey conducted by Anaman & Nyadzi (2015) among 120 people in 120 households in Gbawe, a suburb of Accra reported that about 10.8% of the people were engaged in open waste burning.

According to a report by Ministry of Sanitation and Water Resources (2018), the following diseases in relation to smoke exposure and presence of dumpsite were found common among slum dwellers in the GEMA: skin diseases and upper respiratory tract diseases. The prevalence of respiratory tract infections among dwellers living in the GEMA was reported to be 14.6%. (Ministry of Sanitation and Water Resources, 2018). These diseases that affect the residents in the GEMA were attributed to activities among dwellers and at a dumpsite that expose residents to smoke (indoor and outdoor air polutants), fire and odour (Ministry of Sanitation and Water Resources, 2018 & Jeffrey, 2015).

There is the need to provide the understanding of various sources of exposure to smoke and respiratory symptoms among slum dwellers in the Ga East Municipal Assembly of the Greater Accra Region.

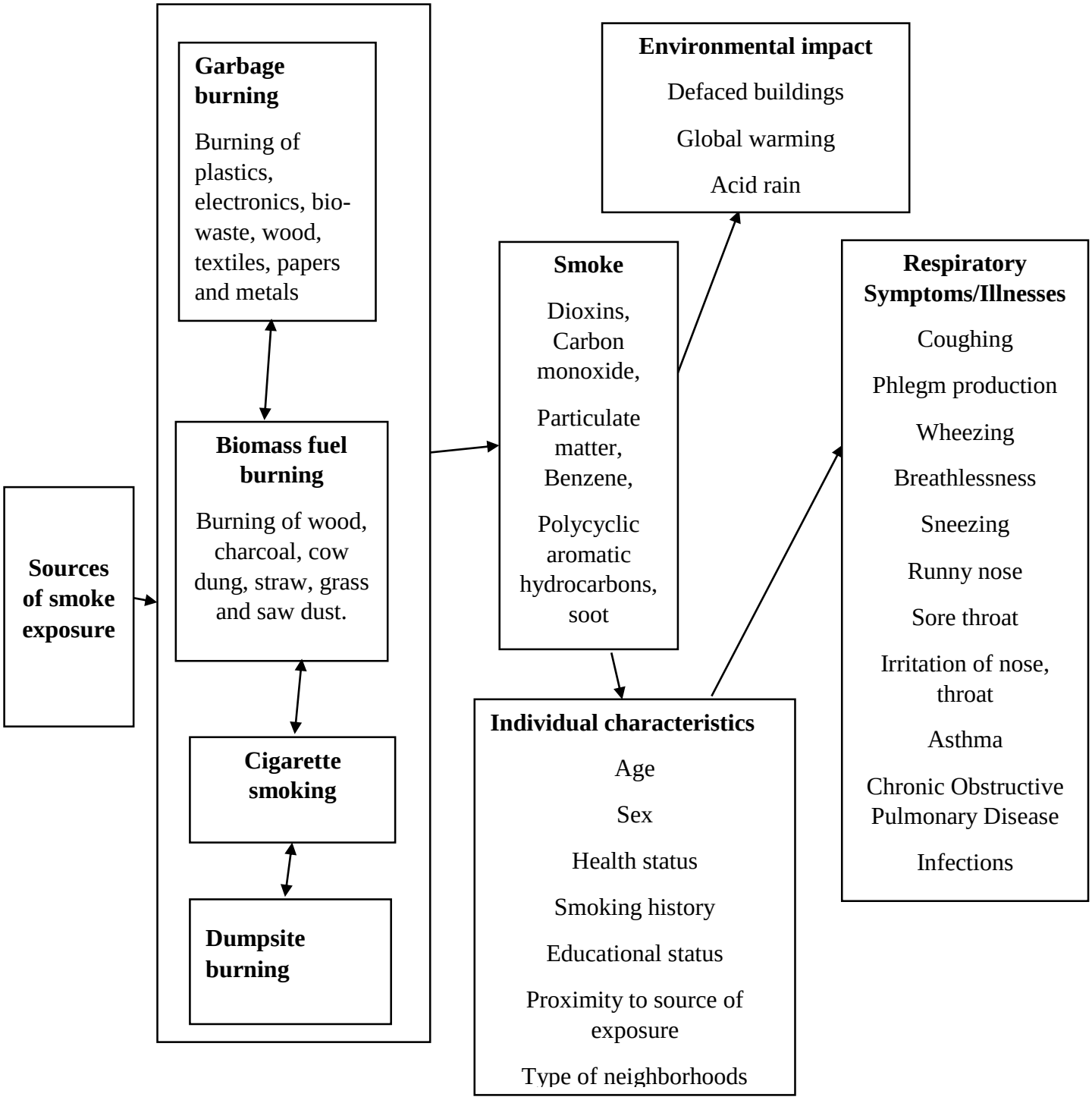

Figure 1: Conceptual framework of Relationship between exposure to smoke and respiratory symptoms among slum dwellers in the GEMA, Accra.

1.4 Narrative of Conceptual Framework

The conceptual framework is depicted in Figure 1. Activities contributing to air pollution and eventually affecting respiratory health are shown. The sources of smoke include garbage burning, biomass fuel burning, smoking and dumpsite burning. Toxic substance and particulate matter (PM) are released and influence both the environment and individual (USEPA, 2016; Stankovic *et al.*, 2011).

Smoke generated from the smoke exposure sources may contain dioxin, carbon monoxide, benzene, particulate matter (PM) and/or polycyclic aromatic hydrocarbons (PAHs) (Cogut, 2016; USEPA, 2019; Minnesota Pollution Control Agency, United States, 2019; Christian, 2015). Emissions of smoke have both environmental and health impacts. Environmental impact of smoke emissions may include defacing of building, global warming, acid rain, ozone depletion and smog formation (USEPA, 2016). However, this study is interested in understanding the relationship between exposure to smoke and respiratory symptoms. The respiratory system is the point of entry for air contaminants (European Respiratory Society, 2019). The respiratory system has different protective mechanisms aim at alleviating the effects of air contaminants (Stankovic *et al.*, 2011). The respiratory system is the initial area in which air pollutants' adverse effects is most obviously seen (Stankovic *et al.*, 2011).

The individual characteristics such as age, sex, health status, educational status, history of smoking, proximity to the source of exposure and the type of neighbourhoods affect the effects of smoke exposure on the respiratory system (USEPA, 2015; Stankovic *et al.*, 2011). Older individuals are more likely to be affected by smoke than younger ones due to their likelihood of having chronic heart or lung conditions (USEPA, 2015). Children are

also more prone to smoke due to their tendency to be active outdoors, high intake of air and on-going respiratory system development (USEPA, 2015). Women are more likely to be affected by smoke especially biomass fuel smoke and air pollution is also associated with chronic obstructive pulmonary disease (COPD) in women (Stankovic *et al.*, 2011). People with heart or lung diseases like heart failure, angina, COPD, emphysema or asthma are susceptible to smoke and experience health effects than healthy individuals (USEPA, 2015). Individuals who are less educated are more likely to be exposed to smoke such as cigarette smoke than highly educated persons because they may not allow people to smoke at their homes or to even burn garbage close to their residents or may not live in areas where burning is taking place (Saito, Shibanuma, Yasuoka, Kondo, Takagi & Jimba, 2018). People with a history of smoking are more likely to develop respiratory symptoms such as shortness of breath, productive cough and wheezing than those who have no history of smoking (Liu *et al.*, 2015). Neighbourhood burning activities, as well as proximity to the source of burning determine an individual extent of smoke exposure (Laumbach & Kipen, 2012 & Women in Europe for a Common Future (WECF), 2004).

This may cause coughing, sneezing, runny nose, sore throat, irritation of nose and throat and may also exacerbate pre-existing respiratory conditions such as asthma, COPD or respiratory infections (USEPA, 2019; Jiang, Mei & Feng, 2016; Feldman & Anderson, 2013).

1.5 Justification of the Study

Africa has 46% waste collection coverage and probably being one of the greatest percentages of residential open burning of waste and solid fuel. This serves as a substantial avenue for air pollution (Cogut, 2016; Verna et al., 2015). Unregulated garbage burning

clearly contributes to poor air quality due to the release of toxic substances and PM (UNEP, 2015). It is estimated that out of 7 million air pollution-associated deaths in the world annually, about 3.7 million deaths are as a result of outdoor air pollution (WHO, 2015). These deaths are caused by conditions associated with smoke exposure which include heart diseases, stroke, COPD, respiratory conditions (acute and chronic) and cancers (WHO, 2015). Exposure to tobacco or cigarette smoke can cause heart diseases, lung diseases and other adverse health outcomes in humans (American Cancer Society, 2017). Tobacco smoke emits radioactive materials which may be a major factor in smokers getting lung cancer (American Cancer Society, 2017).

Respective reduction measures and strategies need to be implemented to improving both indoor and outdoor air quality (WHO, 2015). Of particular importance is black carbon (WHO, 2015). The black carbon is a short-lived climate pollutant which constitutes a major part of harmful health of PM2.5 air pollution and is derived from biomass fuel burning, garbage burning and among other smoke exposure sources (WHO, 2015). It is imperative to understand that reducing black carbon emissions which persist in the air for a short time can have significant short-term climate and health benefits (WHO, 2105). Reduction in black carbon emissions (air pollution) can lead to a reduction of global warming of the climate (weather condition over a period of time such as temperature), improvement in crop yields and reduction of premature deaths (Climate and Clean Air Coalition, 2019; Climate dictionary, 2019). When air pollution is minimized in the environment, it leads to improvement of health and wellbeing of the population and decreases damage to crops, building, forest, ecology and other materials (Amann, Maas, Vandyck & Saveyn, 2017). As part of strategies to reduce the harmful health effects of air pollution, WHO provides

technical support to countries for monitoring and evaluation of air quality in the environment (WHO, 2019).

From the above indicators, it is important to study smoke exposure sources and respiratory symptoms among slum dwellers in the GEMA due to periodic smoke exposure from the dumpsite, use of biomass fuel, cigarette smoking and backyard garbage burning. This will help provide recommendations on how these exposure sources can be reasonably controlled to improve on the air quality in the environment and to reduce the risk of developing respiratory symptoms in the population of Ga East Municipal Assembly (GEMA).

1.6 Objectives

1.6.1 General Objectives

To provide understanding of the sources of smoke exposure and the relationship between smoke exposure and respiratory symptoms among slum dwellers in the Ga East Municipal.

1.6.2 Specific Objectives

1. To determine the prevalence of respiratory symptoms (e.g. chronic cough, wheezing, phlegm production, breathlessness).
2. To identify the sources of smoke exposure in the communities.
3. To determine the association between smoke exposure and respiratory symptoms.

CHAPTER TWO

LITERATURE REVIEW

2.1 Scope of the Literature Review

This section comprises of an overview of smoke and its constituents, the respiratory system and symptoms, biomass fuel and health symptoms/illnesses, garbage burning and health symptoms/illnesses, cigarette smoking and health symptoms/illnesses, dumpsite burning and health symptoms/illnesses and summary of literature review.

2.2 Smoke and Its Constituents

Smoke consists of minute solid, liquid and gas particles that are unburnt and is generated due to incomplete combustion of fuel of biomass fuel, garbage, tobacco or cigarette and other energy sources (Science Learning Hub, 2019). Visible smoke is mostly carbon (soot), tar, oils and ash but it can contain hundreds of various substances and fumes (Science Learning Hub, 2019).

Wood smoke is made up of volatile organic compounds (hydrocarbons). When these hydrocarbons burst into flames, the smoke is no more and the hydrocarbons are turned into water and carbon dioxide. Plastics' burning usually produces soot and poisonous gases such as carbon monoxide and hydrogen chloride (Science Learning Hub, 2019). Open waste burning produces smoke which contains significant quantities of greenhouse gases that are discharged into the environment (Cogut, 2016). Such compounds are methane, carbon dioxide and particulate matter, which are usually related to pollution of air and can result in severe forms of respiratory conditions (Cogut, 2016). Household equipment such as burn barrel fire pits and wood stoves produce fires at low temperatures. They receive

insufficient oxygen resulting in the production of a large amount of smoke, hence, production of a variety of toxic chemicals. Air releases from burn barrel include carbon monoxide (CO), carbon dioxide (CO2) and nitrogen oxides (NOx) (Minnesota Pollution Control Agency, US, 2019). Poisonous substances in smaller quantities can usually be detected in smoke (Minnesota Pollution Control Agency, US, 2019). These substances include formaldehyde, benzene, polychlorinated dibenzodioxins (PCDDs or "dioxins"), styrene, polychlorinated dibenzofurans (PCDFs or "furans"), polychlorinated biphenyls (PCBs), and heavy metals such as lead, arsenic and mercury (Minnesota Pollution Control Agency, US, 2019).

Dioxin is the main concern among environmental health risks posed by household garbage burning. It is carcinogenic in humans and is dangerous to the health of women, children and the elderly. It can also cause reproductive, developmental and immunological issues in humans (Minnesota Pollution Control Agency, US, 2019).

Cigarette smoke is made up of different substances. A greater number of the compounds are toxic and can harm cells of humans and many of them are carcinogenic (Christian, 2015). Tobacco and cigarette smoke mostly consist of tar, nicotine and carbon monoxide (Christian, 2015).

2.3 The Respiratory System and Symptoms/Illnesses

The respiratory system is divided into the upper respiratory tract and lower respiratory tract. The lungs are important components of the respiratory system. The upper respiratory tract consists of the oral cavity, nasal canal, pharynx and voice box (larynx). Oxygen enters the nostrils or the mouth through the sinuses which regulate the temperature and humidity of the oxygen. The lower respiratory tract consists of the trachea (windpipe), bronchi,

bronchioles, lungs and alveoli. The trachea filters the air that passes into the lungs. Each lung has a bronchus; a tube that connects to the trachea to form the bronchial tree and carries air into the lungs. Each bronchus branches off to form very tiny tubes called bronchioles which stretch out into every site of each lung. Each lung has about 30,000 bronchioles and each bronchiole end with a cluster of very small air sacs called alveoli. The alveoli are 600 million and each alveolus is surrounded with minute blood vessels known as capillaries where there is an exchange of oxygen into the heart and carbon dioxide out of the lungs. The ribs around the lungs and the diaphragm muscles help the lungs to contract and expand during breathing. The diaphragm also separates the abdominal and chest cavities (Iftikhar & Fisher, 2018; Zimmermann, 2019).

What remains a public health issue globally is the health effect after exposure to polluted air (Jiang, Mei & Feng, 2016). This has many huge negative effects on the health of human (Jiang et al., 2016). The existing evidence on toxicity, indoor pollution and the number of persons affected by air pollutants indicate that indoor air pollutants may contribute to major public health problems, especially increase the prevalence of respiratory symptoms and illnesses (Stankovic, Nicolic & Arandjelovic, 2011). People with chronic respiratory conditions like COPD and asthma are victims of the undesirable consequences of air pollution (Jiang et al., 2016). Cigarette smoking suppresses the protective function of the respiratory tract epithelium, macrophages of alveolar and dendritic cells (Feldman & Anderson, 2013). Smoking is epidemiologically associated with both upper and lower respiratory tract clinical manifestations (Feldman & Anderson, 2013). Respiratory infections related to smoking include community-acquired pneumonia, tuberculosis, non-tuberculosis mycobacteria, exacerbations of COPD and cystic fibrosis (Feldman &

Anderson, 2013). Exposure to smoke prone an individual to developing skin, lung, heart and respiratory diseases which are manifested as coughing, throat irritation, runny nose, sneezing, nasal blockage, breathlessness and chest pain (Verna, Vinoda, Papireddy, & Gowda, 2015; WECF, 2004; Human Rights Watch, 2017 & American Cancer Society, 2017).

2.4 Biomass Fuel and Health Symptoms/Illnesses

Amegah, Jaakkola, Quansah, Norgbe & Dzodzomenyo (2012) conducted a cross-sectional study involving 592 mothers and their babies in the Korle Bu Teaching Hospital, Accra, in the Greater Accra Region on choices of cooking fuel and waste burning as determinants of weight of newborns at birth, and reported that the use of char-coal as cooking fuel by the mothers during pregnancy was a strong determinant of average fetal growth and risk of low birth weight. Another cross-sectional study conducted in Ekiti State, Southern Nigeria by Desalu, Adekoya & Ampitan (2010) involving 269 adult women on risks of respiratory problems and biomass fuel use, using a questionnaire, reported that 59.9% of the women used biomass fuel. Desalu *et a*l. (2010) also reported respiratory symptoms' prevalence of women who used biomass fuel as cough 13.7%, wheezing 8.7% and breathlessness 11.8% in their study. There was also an association between biomass fuel use and cough, chronic bronchitis, wheezing and breathlessness (Desalu *et al.*, 2010). Amegah *et al* (2012) also reported that, the proportion of the mothers who used biomass fuel (charcoal) was 50.5%.

A cross-sectional study conducted in Ouagadougou, Burkina Faso by Sana, Meda, Badoum, Kafando & Bouland (2019) on cooking fuel choices and respiratory effects involving 1705 women indicated that, 59.53% of the respondents used biomass fuel as

primary cooking fuel. Biomass fuel use was associated with phlegm production, wheezing, shortness of breath and dry cough (Sana *et al.,* 2019).

Perez-Padilla *et al.* (2010) carried out a meta-analysis on many studies regarding solid fuel use (biomass fuel and coal) and respiratory diseases in the developing countries and indicated that in about 15-20 studies analyzed, there was strong evidence that COPD was associated with solid fuel use in women aged more than 30 years. In the same analysis, solid fuel use was also strongly associated with acute respiratory infections among children under five years of age (Perez-Padilla *et al.,* 2010). Solid fuel smoke exposure was also moderately associated with COPD in men more than 30 years of age, asthma in children aged 5-14 years and above 15 years and as well as tuberculosis in children above 15 years (Perez-Padilla *et al.*, 2010).

Laumbach & Kipen (2012) in a meta-analysis on air pollution and respiratory symptoms concluded that air pollution from biomass fuel burning (smoke) is a main avoidable cause of high incidence and aggravation of respiratory conditions. In cross-sectional descriptive study conducted in Phitsanulok Province, Thailand among 1134 rural households by Juntarawijiti & Juntarawijiti (2019) using a modified questionnaire from the British Medical Research on cooking smoke exposure and respiratory symptoms showed that about 64% of the subjects used liquefied petroleum gas, 32.1% used charcoal, 2.5% used wood and rest used electricity.

Juntarawijiti & Juntarawijiti (2019) study also reported that the most chronic respiratory symptoms experienced by the respondents included runny nose (46.3%), dyspnea (45.1%) and chronic cough (15.6%). In their quest to find out the respiratory symptoms the subjects have experienced for the past one month, the results indicated that cold was the most

common (47%) followed by coughing (46.6%) and then sputum production (21.2%). In a cross-sectional study carried by Ngahane, Ze, Chebu, *et al.* (2015) in Cameroon involving 300 women who used cooking fuel (145 women (48.3%) used wood and 155 (51.7%) women used alternative cooking fuel), suggested that wood as cooking fuel was associated with dyspnea on exertion and chronic cough which is an indication of chronic bronchitis.

A cross-sectional survey conducted in Solis, Northeast Mexico City by Regalado, Pe´rez-Padilla, Sansores, *et al.* (2006) among 841 non-smoking women who answered to questionnaires on respiratory symptoms and illnesses and on the use of wood (fuel) for cooking indicated that there were high concentrations of indoor particles in homes where biomass fuel was used for cooking even with a chimney. Regalado *et al.* (2006) also reported that all the women who were exposed to smoke due to cooking with biomass stoves had moderate airflow obstruction. Women who were using biomass fuel reported to have increased phlegm production and cough was more common in women whose homes had a high concentration of PM10 (Regalado *et al*., 2006).

A cohort study involving 11728 live-born babies whose mothers were exposed to smoke due to biomass fuel use and tobacco smoking were followed through for a period of six months in South India which reported that exposure to biomass fuel was associated with an adjusted 34% high incidence of respiratory illness (Tielsch, Katz, Thulasiraj, *et al.* 2009).

Exposure to smoke from biomass fuel burning was also associated with a high risk of acute respiratory infection in young infants (Tielsch *et al.*, 2009). A study conducted in Nis, Serbia by Stankovic *et al.* (2011) on indoor air pollution's effects on respiratory symptoms among 1082 never smoked women, who were not exposed to occupational indoor air

pollution using America Thoracic Society questionnaire showed that exposure to smoke from wood and coal burning affects the appearance of cough and breathlessness. Air pollution as a result of biomass fuel is evidenced to be associated with COPD (Stankovic *et al.*, 2011). The use of biomass fuel was found to be 32.9% among the respondents in Nis, Serbia which suggested that 357 (out of 1,082) homes of the respondents used biomass fuel (Stankovic *et al.*, 2011).

2.5 Garbage Burning and Health Symptoms/Illnesses

Amegah *eta al.* (2012) conducted a cross-sectional study involving 592 mothers and their babies in the Korle Bu Teaching Hospital, Accra, in the Greater Accra Region and reported that garbage burning at home by the mothers during pregnancy was a strong determinant of average fetal growth and risk of low birth weight.

A cross-sectional study carried out by Ediagbonya & Tobin (2013) in Sapele, urban dwelling in Nigeria among 400 respondents from 400 households on air pollution (bush burning, tobacco smoking, biomass fuel use and garbage burning) and prevalence of respiratory symptoms, indicated 10.5% prevalence of cough, 21.3% of phlegm production, 13.5% of wheezing and 14.8% of shortness of breath. Data was taken using a semi-structured questionnaire.

A study conducted by Kusi, Nyarko, Boamah & Nyamekye (2016) in Kpone engineered landfill, Abokobi controlled dump and Nkanfoa open dump-sites revealed that the landfills sites were close to residence, water bodies and highways. They also indicated that 65%-75% of wastes generated are ended up in dumping sites. Addo, Adei & Acheampong (2015) conducted case and survey study in Ghana which involved 256 households on solid

waste management and health effects on the residence of Kumasi Metropolis and reported that 10.9% of the respondents indicated they engaged in burning of waste.

Verna et al. (2015) indicated in their study in India on toxic pollutants from plastic waste that, plastic wastes burning increases the risk of heart diseases, irritates respiratory illnesses such as asthma and cause rashes, nausea or headaches. Usually, municipal solid waste (MSW) consisting of about 12% of plastics is incinerated; discharging toxic substances like dioxins (Verna *et al.,* 2015). Different chemicals that may be found in smoke from combustion of garbage are irritants and may result in immediate clinical manifestations such as nausea, headaches, irritation of the eyes, respiratory tract and the skin. This can lead to eyes problems, coughing, nasal problems, sore throat, cough and itching (United State Department of Veteran Affairs, 2013).

2.6 Dumpsite Burning and Health Symptoms/Illnesses

A cross-sectional study conducted by Jeffrey (2015) among 200 residents living close to Pantang dumpsite in the GEMA in the Greater Accra Region of Ghana suggested that 64% of their livelihoods were affected by fire and smoke emanating from the dumpsite.

According to a population-based cross-sectional study by Faye, Mberu, Kabaria and Dieng (2016) in Dakar City, Senegal among three communities with dumpsites involving 1178 respondents, reported that 66% of the respondents lived in the community for more than six years, 62% lived in their own houses, 99% had access to clean water and 95% used flush toilets. Of all the respondents, 15% perceived that they were exposed to smoke from the dumpsite but 84.9% of one dumpsite's (Keur Massa/Malika) residents perceived that they were exposed to smoke from the dumpsite (Faye et al., 2016). The following diseases were associated with the presence of the dumpsites in the communities studied in Dakar,

Senegal: skin problems, chest problems, asthma, heart diseases, allergies (Faye *et al.*, 2016).

2.7 Cigarette Smoking and Health Symptoms/Illnesses

A cross-sectional study by Sana et al. (2019) in Ouagadougou, Burkina Faso among 1705 women also reported that, 43.49% of the women were exposed to second-hand smoke.

Isabel, Alberto, Marı´a, Nerea, Xavier & Jordi (2005) conducted cross-sectional multi-center survey in Spain on habit of smoking and respiratory clinical manifestations among 2647 youth aged 20 – 44 years using a modified questionnaire on bronchial symptoms and observed high prevalence rates of smoking among the studied subjects with men being the higher proportion of smokers (55%) than women (44%). They attributed it mainly to the point that the number of subjects who smoke more than 1pack per day was most common among men than women. The study also indicated that majority of the non-smokers had frequent exposure to passive smoke (Isabel et al., 2005). Fell, Svendsen, Kim, *et al.* (2018) carried out a cross-sectional study on exposure to second-hand smoking (SHS) and respiratory symptoms among 8850 non-smoking adults in Telemark, Norway which suggested a correlation between nocturnal dyspnea and SHS exposure among women but was not found among men. A study conducted in Nis, Serbia by Stankovic *et al.* (2011) on effects of indoor air pollution on respiratory symptoms among 1,082 non-smoking women, aged 20-40 years who were not exposed to occupational indoor air pollution using America Thoracic Society questionnaire showed a significant high prevalence of common respiratory symptoms such as cough and breathlessness among individuals exposed to environmental tobacco smoke (ETS). The prevalence of respiratory symptoms among the

respondents was cough 362(33.4%), phlegm 193(17.8%) wheezing 89 (8.2%) and shortness of breath 355(32.8%) (Stankovic *et al.*, 2011).

A comparative cross-sectional study carried out by Tantisuwa & Thaveeratitham, (2014) in Thailand among 34 non-smoking youth and 34 smoking youth on effects of smoking on respiratory function showed that majority of the youth who smoked began it at the age of fifteen to eighteen years with average smoking duration of 1-3 years and less than or equal to 10 cigarettes smoked per day. The study further reported that, early effects of cigarette smoking among the youths may result in problems of the respiratory system.

A study was done in the United States among 4,135 adults (previous and current smokers) of age less than or equals 45 years using a secondary data which showed that increased duration of tobacco use had association with respiratory symptoms and COPD after adjusting for current smoking behaviour (Liu, Pleasants, Croft, *et al.* 2015). The same study by Liu *et al.* (2015) showed that adults with history of smoking and increased duration of tobacco use were related to a high probability of having COPD, frequent productive cough and frequent shortness of breath (SOB). Even after controlling for current smoking behaviour, shortness of breath affected physical activity (Liu *et al.*, 2015). Former smokers who stopped smoking for a duration of 10 years had a lower prevalence of COPD and respiratory symptoms than those who were then current smokers (Liu et al., 2015). Chronic Obstructive Pulmonary Disease prevalence was lower in men than in women at all levels of smoking duration (Liu *et al.*, 2015).

In Isabel et al. (2005) study conducted with a cross-sectional multi-center survey in Spain on the habit of smoking and respiratory function among 2647 youth, aged 20 – 44 years, it reported an increase in respiratory symptoms prevalence among smokers. The same study

by Isabel et al. (2005) further showed that smoking was associated with a high risk of chronic bronchitis and other respiratory symptoms (chronic cough, wheezing, chest tightness and breathlessness). It indicated also that, the higher the number of cigarettes smoked in a day, the higher the risk of developing chronic bronchitis and other respiratory symptoms (Isabel *et al.*, 2005). The study also showed that non-smokers were the highest percentage of subjects without respiratory symptoms and passive smokers had more asthma related symptoms and chronic cough than ex-smokers (Isabel *et al.*, 2005). Fell *et al*. (2018) analysis of sub-data of Telemark's study in Norway among non-smoking adults showed a significant statistical association between a productive cough and nocturnal dyspnea in the last 12 months and that of second-hand smoke exposure**.** On daily exposure to SHS and respiratory symptoms, Fell et al. (2018) further reported that, out of the respondents (256) who were exposed to SHS daily, 18% had wheezing, 24% had a cough at night and 11% had shortness of breath at night. The overall study suggested that 66.6% of the respondents (5892 out of 8346 respondents) had no respiratory symptoms for the past 12 months. Second-hand tobacco smoke (SHTS) exposure was also associated with a high risk of acute respiratory infection in young infants; a cohort study involving 11728 live-born babies whose mothers were exposed to smoke due to biomass fuel and tobacco smoking in South India reported (Tielsch *et al.*, 2009).

2.8 Summary of Literature Review

This review provided a background of smoke exposure sources and composition of smoke. Studies on smoke exposure and health symptoms/illnesses were also reviewed thoroughly and information relevant to this project selected.

Many studies reviewed showed a strong association between smoking and respiratory symptoms/illnesses. Many studies also revealed that there exist a strong association between the burning of waste and respiratory illnesses/symptoms. Likewise, other studies that found an association between biomass fuels use and respiratory illnesses/symptoms.

Generally, a majority of the studies used cross-sectional surveys, self-administered questionnaires, observations and others used cohorts and meta-analyses in conducting their studies. It is also observed that majority of the articles used were conducted out of Ghana as a result of limited articles available in the field of study particularly garbage burning and dumpsite burning and respiratory symptoms or illnesses in Ghana. There is, therefore, the need to research into the smoke exposure sources and respiratory symptoms in Ghana particularly among slum dwellers and communities living close to a dumpsite in Abokobi in the GEMA.

CHAPTER THREE

METHODOLOGY

3.1 A Brief Description of the Abokobi Air Quality and Health Study (AAQAHS)

This study was part of the ongoing Abokobi Air Quality and Health Study (AAQAHS). AAQAHS is a comparative population-based cross-sectional study involving children (0-8 years) and their parents living within 1km of the Abokobi dumpsite (Fig. 2) in the Ga East Municipal Assembly. A reference population of children 0-8 years and their parents were selected from Amonokrom which is about 8 km from the Abokobi dumpsite. 400 households were randomly selected from the index communities (Ablor Adjei, Evangelical Presbyterian area (EP), Paraku Estates and Pantang) and 200 households from the reference community. A household was enrolled into the study if (i) the household was located in the exposed or the reference community, (ii) there was a child between 0-8 yrs in the household (ii) one or both parents is/are biological parent of the child (iii) both parents and child lived permanently in the participating communities, (iv) head of household or the next in command was willing to follow study protocol to completion.

Figure 2: A Captured Picture Showing the Abokobi Dumpsite, the Abokobi Air Quality and Health Study (AAQAHS)

3.2 The Study Location

As indicated above, the study was carried out in four selected communities or slums located within 1km from the Abokobi dumpsite (**Fig 3**). The communities selected were Ablor Adjei, Evangelical Presbyterian area (EP), Paraku Estates and Pantang which are located in the Ga East Municipal Assembly (GEMA) in the Greater Accra region with Abokobi as the Municipal Capital. GEMA shares boundaries with the Ga West Municipal Assembly, Adenta Municipal Assembly and La Nkwantanang Madina Municipal Assembly (GEMA, 2019). It is located in the northern part of Accra and is 29 kilometers away from Accra, the capital of Greater Accra Region (Ghana Statistical Service, 2013). The municipality has a population density of 1,214 persons per square kilometer and average household size of

4.6 (Ghana Statistical Service, 2013). The number of households in each of the participating communities ranges from approximately 195 to 300 households. The Abokobi dumpsite started operation in 2003 and occupies about 800 square meters (0.08 hectares) (GEMA, 2013). The dumpsite used to receive waste from the Ga East Municipal Assembly, Ga West Municipal, Ledzorkuku Krowor Municipal, Adenta Municipal and Ga Central Municipal Assemblies (GEMA, 2019). The dumpsite was closed in 2017, however, sporadic burning activities emanate from the dumpsite.

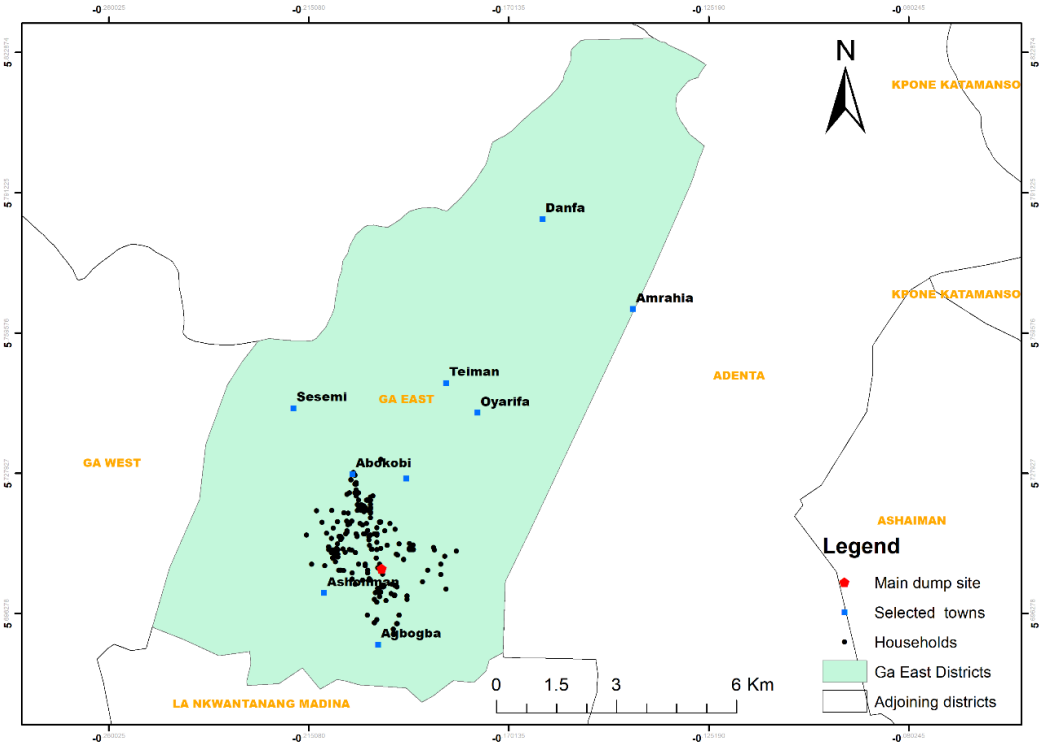

Figure 3: A map showing households that participated in AAQAHS of which 200 were included in the current study

3.3 The Study Design

A population-based cross-sectional design was adopted in this study. A quantitative method was used to assess the smoke exposure sources and the respiratory symptoms among slum dwellers in the GEMA. A modified questionnaire was used. The questionnaire was modified to get more information on the nature of the houses of the dwellers and their exposure to indoor smoke.

3.4 The Study Population

The source population for the study reported here included all adults living in the index communities (Ablor Adjei, Evangelical Presbyterian area, Paraku Estate and Pantang). From the source population, 200 adults (age 18 years and above) were randomly selected for this study.

3.5 Sample Size Calculation

The sample size of the study was determined based on chronic symptoms prevalence in the Abokobi Health Center in the Ga East Municipal Assembly (Ministry of Sanitation and Water Resources, 2018). It was calculated using the following parameters: 95% confidence interval (1.96, margin of error (0.05) and 14.6% upper respiratory infections prevalence rate in the Abokobi and its surrounding communities in the Ga East Municipal Assembly.

The formula for the sample size calculation is stated below

n= Z2 pq/e2 (Israel, 2013).

n=required sample size

Z2 is the abscissa of the normal curve that cuts off an area (equals the desired confidence level, i.e. 95%) = 1.96).

p = proportion of the population having the characteristic – 14.6%

q = 1-p

q=1-0.146

q=0.854

e= the desired precision level or margin of error - 0.05

So, n= (1.96)2*0.146*0.854/ (0.05)2

n= 3.842*0.125/0.0025

n= 0.481/0.0025

n=192.4

The sample size for the study was estimated as 200 participants.

3.6 Inclusion Criteria

A household inclusion criterion was the same as AAQHS described in section 3.1. However, in addition to that, an individual was included in this study if i. he/she was an adult in the household aged 18 years and above and willing to take part in the study and follow the study protocol to completion. This study focused on adult slum dwellers and hence adult participants were chosen base on the criteria set.

3.7 Exclusion Criteria

A household exclusion criterion was the same as AAQHS. Individual was excluded from the study if he/she was less than 18 years of age and/or unwilling to participate in the study and follow the study protocol to completion.

3.8 Study Variables

3.8.1 Main Determinants

The main determinants of interest were indicators of smoke exposure defined as (i) any exposure to smoke at home (this refers to smoke from biomass fuel combustion, or garbage burning, or cigarette or dumpsite) (ii) smoke from biomass fuel burning (iii) smoke from dumpsite (iv) smoke from garbage burning and (v) smoke from cigarette (i.e. from active and/or passive smoking)

3.8.2 Health Outcomes of Interest

The main health outcomes of interest were respiratory symptoms defined as phlegm production, chronic cough, breathlessness (shortness of breath) and wheezing in the last 12 months.

3.8.3 Potential Confounders

Potential confounders were socioeconomic status (SES), sex, age, highest education, household characteristics; number of years lived in the communities and issues related to sanitation. Selection of the confounders was based on literature (Amega et al., 2012; Laubach & Kipen, 2012; Desalu *et al* 2010; Stankovic *et al.,* 2011).

3.9 Field Data Collection

The field data collection was carried in four (4) phases: (i) training of field workers (ii) stakeholder meeting and scoping survey, (iii) household recruitment and (iv) Data collection

(i) Training of Field workers: 5-day training was provided to the Principal investigator of this study and four (4) other field workers (two nurses and two research assistants) at the School of Public Health, University of Ghana by my supervisor and his team. The

training begins at 08:30am to 15:30pm. In the first day, we were taken through the dos and don'ts in the field projects, research project management, the roles of field workers in the project, ethical issues such as the rights of study participants and interview techniques. The second day, we were taken through practical sessions in exposure monitoring. This includes finding appropriate location outdoor and indoor for the air quality monitoring, helping participants to wear apron and fixing personal monitors in aprons. Zeroing Particle and Temperature Sensor (PATS+) and reading data from monitors. The third day, we learnt how to use the spirometer and the BP monitors. In the fourth day, the use of a questionnaire on the Research Electronic Data Capture (REDCap) platform to conduct interview was discussed in detail. This discussion includes advantages and disadvantages of using the electronic data capture environment, features of REDCap such as the use of the calendar to schedule interview, data reports, data statistics, transfer of data onto a server, etc. In the fifth day, we were assigned specific roles we were expected to carry out in the field: two persons were assigned the role of using REDCap application on mobile devices to conduct interviews. The remaining three (3) were assigned each of the following roles, monitoring of quality indicators, and measurement of height/weight and lung function with spirometer and monitoring of blood pressure.

(ii) A stakeholder meeting and a scooping survey:

(a) The research team led by my supervisor and the five trained field workers (two research assistants, two nurses and the PI of this study) met with stakeholders in the selected communities to inform them about the project. A brief presentation was done to explain the objectives and the methodology. Permission was also sought to carry out the projects. A community representative who had good knowledge of the community and

fluent in the community dialect was nominated by the elders of the communities to lead the project team during home visits and field data collection for a scooping survey.

(b) Following this meeting, a short questionnaire was administered during a scooping survey to serve the following purpose (i) count the number of households in each of the participating communities (ii) inform the community members that project was coming off and also to take contact details of household heads or representatives. The stakeholder meeting and the scooping survey lasted for 1 week each.

(iii) Household recruitment: Recruitment of households in section (ii.b) were carried by fieldworkers led by a community representative starting with questions designed to check household eligibility. When a household meets inclusion criteria, the purpose of the study was explained to the adult or the household head or a representative. Each household that met the inclusion criteria was given codes. All eligible households were informed that selection of a household into the study was based on the concept of random selection and that not every household given codes will take part in the study. Following this, a random number generator was used to select households proportionately to each participating community. Households that were not considered for the study were notified. For those that were considered for the study, the date and time for the field data collection was decided and agreed by both the research team and the head of the household or a representative. From the eligible households for the AAQAHS, 200 households were proportionately selected from the participating communities for the current study ((Fig. 4) (as indicated in the broken box). Thus, the current study population include Ablor Adjei (51), EP area (71), Paraku Estate (33) and Pantang (45); and in each household an adult was considered for interview.

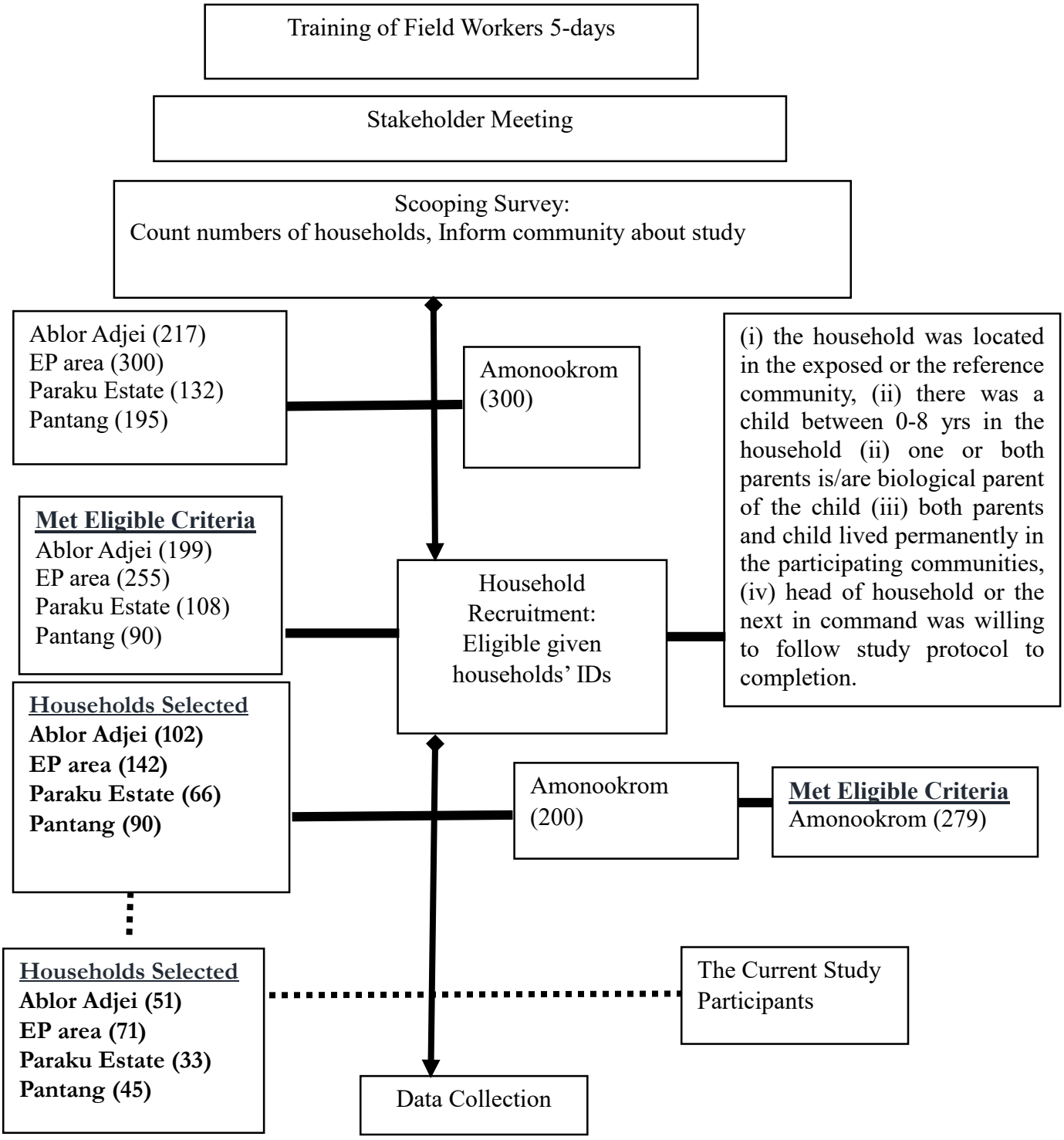

Figure 4: Showing Training, Sampling and collection Process, AAQAHS

(iv) Data collection: The PI of this study led the data collection with REDCap. A questionnaire loaded in a Research Electronic Data Capture (REDCap) application on android mobile phones for interviewing of participants (Fig. 5). Field workers lead by a community representative visited eligible participants in their homes. A REDCap, electronic data capture tool hosted at the University of Ghana was used to collect data from participants using Sumsung and Nokia mobile phones. The data were collected on the following; waste management practices in and around the house, sources of drinking water, availability of toilet facility, socio-demographic characteristics, exposure to smoke from cigarette smoking/second hand smoking (SHS), backyard garbage burning and from any dumpsite, biomass fuels and symptoms related to respiratory symptoms.

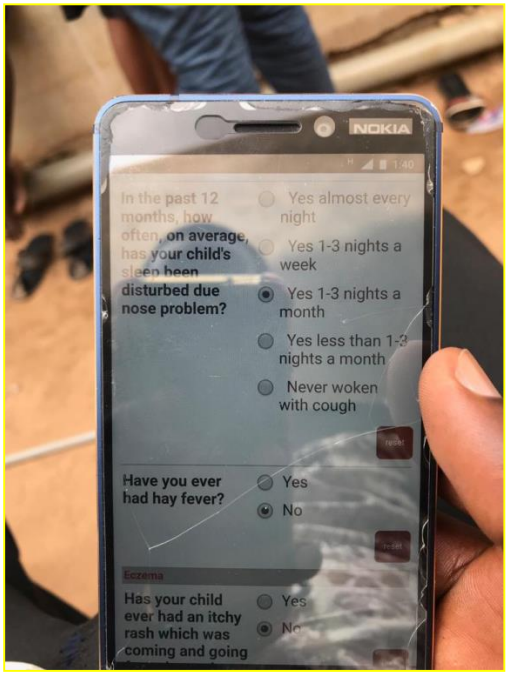

Figure 5: REDCap Device Used for the Collection of the Data, AAQAHS

3.10 Quality Control

Questionnaires administered were thoroughly examined and cross-checked by the principal investigator by the end of every day to ensure consistency and completeness.

3.11 Potential Risks

There was minimal risk involved in the collection of the data to some participants.

3.12 Data Analyses

The data collected were checked and cross checked by the principal investigator and the research assistants to identify missing values and reduce errors for accurate data entering and analyses. The data collected via the modified questionnaire with the use of the REDCap were imported into SAS version 9.4 and analyzed. A confidence level of 95% and p-value of <0.05 were considered in evaluating the findings of the study. The data were presented in frequency tables and charts. Chi-square analysis was used to determine associations. Proportions were computed for categorical variables.

3.13 Ethical Consideration

Ethical consideration with regards to this research and participants was strictly followed.

Ethical clearance was sought from the Ethical and Research Review Committee of the University of Ghana through the department of Biological, Environmental, Occupational Health Sciences.

Ethical clearance was obtained from Ghana Health Service-Ethics Review Committee with reference number GHS-ERC 032/05/19. Permission was sort from Ga East Municipal Assembly.

The objective and procedure of the study were explained to participants in the language each best understood. Consent form regarding the study was issued to the participants.

Each participant was taken through the consenting process to enable him/her make an informed decision to participate or otherwise. The relevant participant's information regarding the study was fully disclosed to the participants and each was given a free will to consent to the study after thorough and in-depth explanation and clarification and understanding of the research protocol. A written informed consent was obtained from the participants.

The participants were informed that there may be minimal risks involved in the study. They were also made aware that the findings of the study may not directly benefit them but might be beneficial to the whole community and the larger society in general.

The participants were informed that participation in the study was voluntary and may decide to withdraw from the study at any point of the study.

The information provided on the course of the study by the participants is confidential and is restricted to the investigators. The findings of this study may also be made public through seminars, meetings and journals devoid of their identities as their names were coded and reported as such. The participants were compensated for their precious time spent during the study.

The data collected is stored electronically and protected and is privy to only the investigators of the study. Information collected from the eligible respondents via interviewer-administered questionnaire are put under lock and key with strong passwords and antivirus. The data collected were not shared with any third party and were used purposely for academic affairs.

The findings of the study will be communicated to the appropriate authority. The data are at the care of the principal investigators, hence, the custodian of the data. The study was

partly funded by the principal investigator. There was no any conflict of interest involving the research team or any of the participants involved in the study.

3.14 Informed Consent

Informed consent was sought from the participants. The purpose and procedure of the study were spelled out to the participants in the language they best understood with the help of a translator. Any clarification arising out of the informed consent process was addressed tactfully. Pretest was done on selected participants upon obtaining informed consent from them at Agbogba a suburb of Ga East Municipal Assembly. Together with the research assistants, modified questionnaire was used to collect the information.

CHAPTER FOUR

RESULTS

4.1 Characteristics of study population

In all, 200 data on study participants were analyzed for this study. Many or most of the participants (28.50%) were between 41-50 years, had Pre-primary, Primary, Middle, Junior High School or Senior Secondary School education (86.50%), were unemployed, pensioner or a student (46%), had lived in the community for 45 years or more (27%), lived in rented or leased accommodation (52%), had less than four people in a household (53%) and lived in a shared home (54.74%). Most participants either used unimproved water source (53.81%) or unimproved toilet facility (69%) (Table 1).

Table 1: Characteristics of the Study Population, the Abokobi Air Quality and Health Study AAQAHS (n=200)

Variable	n.	%
Age (Years)		
<30	38	19.00
30-40	52	26.00
41-50	57	28.50
>50	53	26.50
Education		
Never attended School	6	3.00
Pre-primary/Primary/Middle/JHS/SSS	173	86.50
Technical professional certificate Technical professional diploma	10	5.00
Bachelor/postgraduate	11	5.50
Occupation		
Unemployed / pensioner/student	92	46.00
Manager/Manageress/Professional	16	8.00
Service / Sales worker	14	7.00
Skilled Agriculture /Forestry/Fishery worker/ craft and others	78	39.00
No. of years lived in the community.		
<1 year	42	21.00
1-3 years	50	25.00
4-5 years	54	27.00
>5 years	54	27.00

Table 1: Continued

Ownership of the house		
Borrowed	31	15.50
Rented or leased	105	52.50
Own house	62	31.00
Care taker	2	1.00
No. of people in household		
<4	106	53.00
4-6	63	31.50
7-8	28	14.00
>8	3	1.50
No. of rooms in a household		
1	104	54.74
2	45	23.68
3	29	15.26
4	7	3.68
5	5	2.63
Missing	3	
***Water source**		
Improved	91	46.19
Unimproved	106	53.81
Missing	3	
#Toilet facility		
Improved	62	31.00
Unimproved	138	69.00

n= number of respondents; %= percentage; ***improved water source** refers to piped household water connection system, borehole, protected spring, protected dug well, , public standpipe, rain water collection; ***unimproved water source** refers to unprotected spring, unprotected dug well, surface water (river, dam, lake, pond, stream, etc), bottled water, vendor provided water, tanker truck water); **#improved toilet facility** also refers to toilet facilities with sewer, connections, septic tank, pour-flush latrines, ventilated improved pit latrines and pit latrines with slab or covered pit; **#unimproved toilet facility** refers hanging latrines, bucket latrines, open defecation, pit latrines with no slabs or open pit); as defined by World Health Organization (2012).

4.2 Waste management practices

Our data show that on average, 71% of the study participants indulged in garbage burning. Of this, 63.08% burnt bio-waste or food waste, 73.40% burnt paper waste, 71.13% burnt plastic waste, 73.10% burnt textiles waste and 72.54% burnt wood. Few of the participants bury their waste (Figure 6).

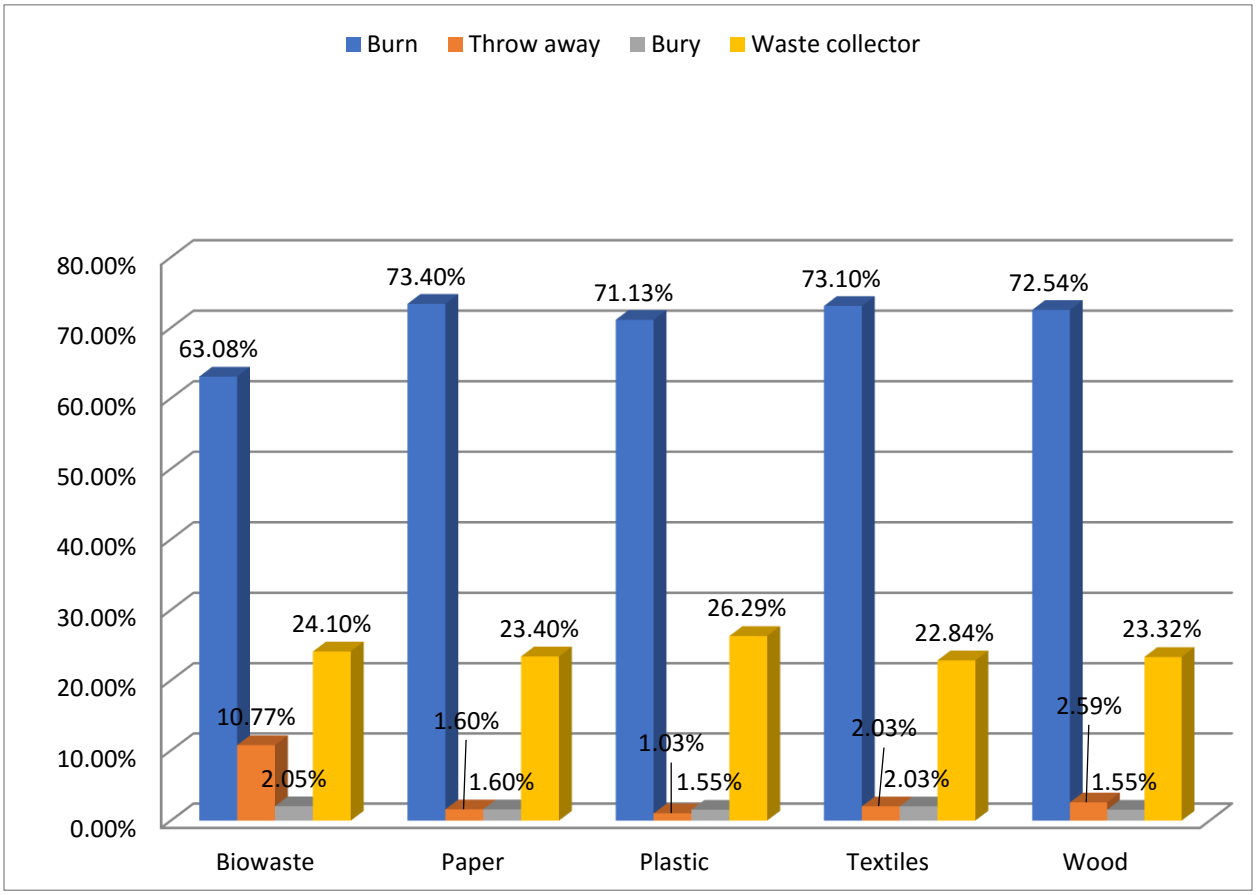

Figure 6: Distribution of Participants' Waste Management Practices, the Abokobi Air Quality and Health Study AAQAHS (n-200)

4.3 Prevalence of respiratory symptoms among the Study Participants

The prevalence of respiratory symptoms among the study population in the last 12 months were; chronic cough (20%,) phlegm production (17%), wheezing (17%) and shortness of breath (breathlessness) (14%) (Table 2).

Table 2: Prevalence of Respiratory Symptoms in the last 12 Months among Slum Dwellers, the AAQAHS (n=200)

Variable	n	%
Chronic Cough		
No	160	80.00
Yes	40	20.00
Phlegm Production		
No	166	83.00
Yes	34	17.00
Wheezing		
No	166	83.00
Yes	34	17.00
Shortness of breath		
No	172	86.00
Yes	28	14.00

n= number of respondents; % = percentage.

4.4 Distribution of determinants of interest

Among the study participants, 53% were exposed to any exposure to smoke at home, 53% were exposed to smoke from dumpsite, 97.5% were exposed to smoke from backyard garbage burning and 41.5% were exposed to smoke from cigarette smoking. Most of the study participants were exposed to smoke from backyard garbage burning (42%), dumpsite (50%) or neighbourhood (38.5%) for more than once in a month (Table 3).

Table 3: Distribution of Determinants of Interest, the AAQAHS (n=200)

Main Determinants	n	%
***Any Exposure to Smoke**		
No	94	47
Yes	106	53
Exposure to Smoke from Dumpsite		
No	94	47
Yes	106	53
Exposure to Smoke from Garbage Burning		
No	5	2.5
Yes	195	97.5
#Exposure to Smoke from Cigarette Smoking		
No	117	58.5
Yes	83	41.5
Biomass Fuel Use		
No	106	53
Yes	94	47
Freq. of Exposure to smoke from Backyard Garbage Burning		
Almost daily	45	22.5
1-3 days a week	71	35.5
>Once a month	84	42
Freq. of Exposure to Smoke from Dumpsite		
Almost daily	95	47.5
1-3 days a week	5	2.5
>once a month	100	50
Freq. of Exposure to Smoke from Neighbourhood		
Almost daily	51	25.5
1-3 days a week	72	36
>once a month	77	38.5

n=number of respo

]ndents; % = Percentage; ***** Any exposure to smoke defined as exposure to smoke from dumpsite, garbage burning, cigarette smoking and/or biomass fuel use); #Cigarette Smoking defined as Active or Passive Smoking/Second-hand Smoking.

4.5 Any exposure to smoke at home by the study participants' characteristics.

Majority of the study participants between 30-40years of age (54%), who had Pre-primary/Primary/Middle/JHS/SSS education (57%), or were unemployed, pensioner or student (77%) or who lived in the community for less than 2 years (60%), rented or leased accommodation (67%), had more than eight people in a household (67%) and lived in a

shared room (58%) have been exposed to any exposure to smoke at home. In addition, most of the participants with unimproved water source (75%) and unimproved toilet facility (57%) had any exposure to smoke at home (Table 4).

Table 4: Any Exposure to Smoke at Home by the Study Participants' Characteristics, the Abokobi AQAHS (n=200)

Variable	Yes n (%)	No n (%)
Age in years		
<30	19 (50)	19 (50)
30-40	33 (63)	19 (37)
41-50	31 (54)	26 (46)
>50	23 (43)	30 (57)
Education		
Never Attended School	1 (17)	5 (83)
Pre-primary/Primary/Middle/JHS/SSS	99 (57)	74 (43)
Technical Professional Certificate/ Technical Professional Diploma	5 (50)	5 (50)
Bachelor / Postgraduate	1 (9)	10 (91)
Occupation		
Unemployed (pensioner/student)	71 (77)	21 (23)
Manager/Manageress/Professional	3 (19)	13 (79)
Service / Sales worker	3 (21)	11 (79)
Skilled Agriculture / Forestry/Fisheries worker and others	29 (37)	49 (63)
No. of years lived in the community		
<2years	39 (60)	26 (40)
2-6years	49 (52)	45 (48)
>6years	18 (44)	23 (56)
Ownership of the house		
Borrowed	6 (19)	25 (81)
Rented or Leased	70 (67)	35 (33)
Own house	29 (47)	33 (53)
Care taker	1 (50)	1 (50)

Table 4: Continued

Number of people in the household		
≤4	57 (54)	49 (46)
4-6	35 (56)	28 (44)
6-8	12 (43)	16 (57)
>8	2 (67)	1 (33)
No. of rooms in the household		
1	87 (58)	64 (42)
3	8 (40)	12 (60)
Missing	29	-
Water source		
Improved	26 (29)	65 (71)
Unimproved	80 (75)	26 (25)
Missing	3	-
Toilet Facility		
Improved	28 (45)	34 (55)
Unimproved	78 (57)	60 (43)

n= number of respondents; % = percentage; **Any exposure to smoke at home** from dumpsite, garbage burning, cigarette smoking and/or biomass fuel use);

4.6 Association between exposure to smoke and respiratory symptoms

The association between exposure to smoke and respiratory symptoms is shown in Table 5 and Table 6. There was a significant association between any exposure to smoke and chronic cough experienced by the participants in the last 12 months (3.7 (CI: 1.32, 4.54); p- value =0.003). There was no association between any exposure to smoke, and phlegm production (0.65 (0.31-1.37); p-value =0.265), wheezing (1.03 (0.48-2.17); p-value =0.99 or breathlessness (0.66 (0.29-1.49); p-value =0.321). There was also a significant association between chronic cough and the participants' exposure to smoke from dumpsite (2.7 (CI: 1.32, 3.54); p-value=0.029), cigarette smoking (2.8 (CI: 1.6, 5.83); p-value=0.002) and biomass fuel use (.6 (CI: 1.67, 3.37); p-value=0.047). However, there was no any significant association between exposure to smoke from dumpsite, backyard

garbage burning, cigarette smoking, biomass fuel use and phlegm production, wheezing or breathlessness among the participants in the last 12 months.

There was significant association between the participants' exposure to smoke from backyard garbage burning (2.95 (CI: 1.76, 4.94); p-value=0.013) or dumpsite (3.48 (CI: 1.72, 4.03); p-value=0.035) on every day a week and chronic cough experienced by the participants in the last 12 months. The participants' exposure to smoke from backyard garbage burning almost daily was also associated with phlegm production (3.7 (CI: 1.63, 5.55); p-value=0.001) and breathlessness (2.67 (CI: 1.56, 5.01); p-value=0.035) in the last 12 months. There was also association between the participants' exposure to smoke from backyard garbage burning for 1-3 days a week and wheezing (1.56 (CI:1.003,2.62)); p-value=0.047).

Table 5: Association between smoke exposure, chronic cough and phlegm production and among households in the GEMA, RR (95% CI)

Variable	Chronic Cough				Phlegm			
	Crude	P-value	Adjusted	P-value	Crude	P-value	Adjusted	P-value
***Any exposure to smoke**								
No	1.00		1.00		1.00		1.00	
Yes	2.72 (1.15-4.26)	0.001	3.70 (1.32-4.54)	0.003	0.62 (0.33-1.15)	0.134	0.65 (0.31-1.37)	0.265
Dumpsite smoke								
No	1.00		1.00		1.00		1.00	
Yes	2.72 (1.41-3.26)	0.029	2.70 (1.32-3.54)	0.012	0.62 (0.33-1.15)	0.134	0.65 (0.31-1.37)	0.265
Backyard garbage burning								
No					1.00		1.00	
Yes	-		-	-	0.84 (0.14-5.01)	0.854	1.04 (0.12-8.85)	0.967
***Cigarette Smoking**								
No	1.00		1.00		1.00		1.00	
Yes	2.27 (1.73-4.21)	0.003	2.87 (1.60-5.83)	0.002	0.98 (0.52-1.83)	0.966	0.76 (0.33-1.75)	0.531

Table 5: Continued

Biomass fuel use								
No			1.00		1.00		1.00	
Yes	2.24 (1.71-3.77)	0.043	2.26 (1.67-3.37)	0.047	1.26 (0.68-2.34)	0.447	1.31 (0.66-2.61)	0.432
No. of times smoke enters a room per week from Backyard garbage burning								
> Once a month	1.00		1.00		1.00		1.00	
1-3days	2.30 (1.89-3.89)	0.023	2.39 (1.87-3.22)	0.013	2.18 (0.97-3.77)	0.051	2.30 (0.99-3.13)	0.059
Almost daily	2.70 (1.80-3.60)	0.023	2.95 (1.76-4.94)	0.013	3.39 (1.62-5.14)	0.041	3.70 (1.63-5.55)	0.029
No. of times smoke enters a room from dumpsite burning								
>Once a month	1.00		1.00		1.00		1.00	
1-3days /week	2.16 (1.87-3.55)	0.028	2.21 (1.85-3.74)	0.027	1.37 (0.98-1.91)	0.059	1.36 (0.91-2.04)	0.131
Almost daily	3.36 (1.77-4.42)	0.028	3.48 (1.72-4.03)	0.034	1.89 (0.97-3.66)	0.059	1.85 (0.83-4.16)	0.131

Table 5: Continued

No. of times smoke enters a room per week from Neighbourhood							
>Once a month	1.00	1.00		1.00		1.00	
1-3days	-	-	-	1.13 (0.76-1.68)	0.537	1.19 (0.76-1.87)	0.438
Almost daily	-	-	-	1.28 (0.58-2.83)	0.537	1.42 (0.58-3.50)	0.438

Adjusted for socioeconomic status, age, highest education, household characteristics, number of years lived in the communities and issues related to sanitation. RR- Relative Risk; CI- Confidence Interval; *** Any exposure to smoke** (Exposure to smoke from dumpsite, garbage burning, cigarette smoking and/or biomass fuel use); *** Cigarette Smoking** (Active or Passive Smoking/Second-hand Smoking).

Table 6: Association between smoke exposure, wheezing and breathlessness respiratory symptoms among households in the GEMA, RR (95% CI)

Variable	Wheezing				Breathlessness			
	Crude	P-value	Adjusted	P-value	Crude	P-value	Adjusted	P-Value
***Any exposure to smoke**								
No	1.00		1.00		1.00		1.00	
Yes	0.99 (0.54-1.84)	0.994	1.03 (0.48-2.17)	0.933	0.66 (0.33-1.33)	0.250	0.66 (0.29-1.49)	0.321
Dumpsite smoke								
No	1.00		1.00		1.00		1.00	
Yes	0.99 (0.54-1.84)	0.994	1.03 (0.48-2.17)	0.933	0.66 (0.33-1.33)	0.250	0.66 (0.29-1.49)	0.321
Backyard garbage smoke								
No	1.00		1.00		1.00		1.00	
Yes	-	-	-		0.69 (0.11-4.13)	0.686	0.74 (0.08-6.57)	0.791
***Cigarette smoking**								
No	1.00		1.00		1.00		1.00	
Yes	0.87 (0.46-1.64)	0.672	0.87 (0.37-2.05)	0.764	0.66 (0.31-1.40)	0.285	0.50 (0.19-1.28)	0.152

Table 6: Continued

Biomass fuel use								
No	1.00		1.00		1.00		1.00	1.00
Yes	0.69 (0.37-1.31)	0.266	0.74 (0.36-1.51)	0.419	0.62 (0.30-1.28)	0.203	0.63 (0.29-1.40)	0.264
No. of times smoke enters a room per week from Backyard garbage burning								
>Once a month	1.00		1.00		1.00		1.00	
1-3days /week	1.56 (1.00-2.43)	0.047	1.56 (1.00-2.62)	0.049	1.24 (0.98-1.97)	0.057	1.29 (0.99-2.23)	0.050
Almost daily	2.44 (1.01-5.93)	0.047	2.44 (0.99-6.90)	0.050	2.54 (1.61-4.88)	0.035	2.67 (1.56-5.01)	0.035
No. of times smoke enters a room per week from dumpsite burning								
>Once a month	1.00		1.00		1.00		1.00	
1-3days /week	0.97 (0.71-1.32)	0.871	0.95 (0.64-1.41)	0.830	1.13 (0.79-1.60)	0.496	1.11 (0.72-1.71)	0.626
Almost daily	0.95 (0.51-1.76)	0.871	0.91 (0.42-2.00)	0.830	1.27 (0.63-2.58)	0.496	1.23 (0.52-2.92)	0.626

Table 6: Continued

No. of times smoke enters a room per week from Neighborhood								
>Once a month	1.00		1.00		1.00		1.00	
1-3days /week	1.19 (0.79-1.78)	0.391	1.15 (0.73-1.81)	0.524	1.55 (1.07-2.50)	0.045	2.65 (1.00-3.81)	0.052
Almost daily	1.42 (0.63-3.17)	0.391	1.33 (0.54-3.27)	0.524	2.90 (1.14-6.25)	0.043	3.74 (1.94-7.91)	0.052

Adjusted for socioeconomic status age, highest education, household characteristics, number of years lived in the communities and issues related to sanitation. RR- Relative Risk; CI- Confidence Interval; *** Any smoke exposure** (Exposure to smoke from dumpsite, garbage burning, cigarette smoking and/or biomass fuel use); *** Cigarette Smoking** (Active or Passive Smoking/Second-hand Smoking).

CHAPTER FIVE

DISCUSSION

The study assessed smoke exposure sources and respiratory symptoms in populations (slum dwellers) in the Ga East Municipal Assembly. The prevalence of respiratory symptoms among the study population ranged from 14% to 20% (chronic cough (20%), phlegm production (17%), wheezing (17%) and shortness of breath or breathlessness (14%)). The sources of smoke exposure identified among the study communities were biomass fuel use, garbage burning, dumpsite and cigarette smoking (active and passive smoking). The risks of chronic cough among the participants on exposure to smoke from dumpsite, cigarette smoking and biomass fuel use were statistically significant, hence, there was a strong association between the determinants of interest and chronic cough in the last 12 months. There was also association between exposure to smoke from backyard garbage burning almost daily per week and chronic cough, phlegm production and breathlessness experienced in the last 12 months. There was also association between exposure to smoke from backyard garbage burning for 1 to 3 days per week and wheezing experienced in the last 12 months. There was an association between the participants' almost daily exposure to smoke from dumpsite and chronic cough in the last 12 months.

5.1 Methodological Validity

The study has a number of strengths. The selection of the individuals into this study was first done by the use of screening tool which resulted to selection of the samples proportionately among the communities and random sampling of the participants with a high participation rate thereby minimizing selection bias. The study covered wide range of household smoke exposure sources (backyard garbage burning, neighbourhoods sources,

biomass fuel use, dumpsite burning and cigarette smoking). The health outcomes were measured with a modified questionnaire and the participants were given ample time to recall respiratory symptoms experienced in the past one year, hence reducing recall bias. There was also massive support from the stakeholders in the study communities as the communities' leaders selected community representatives to lead the research team in the conduct of the study. The study population shared similar characteristics, hence minimizing the effects of not measuring potential confounders. However, the study was also limited by possible miss-presentation of single occurrence of respiratory symptom(s) as chronic symptoms. But comparing this study to other studies in similar settings, the prevalence of respiratory symptoms reported are similar. Similar studies can be done in this field and area to measure association between occupational exposures and non-occupational exposures and respiratory symptoms.

5.2 Comparison with previous studies

The prevalence of respiratory symptoms among this current study population were chronic cough (20%), phlegm production (17%), wheezing (17%) and shortness of breath or breathlessness (14%). This current study's results are similar to that of a study carried out by Ediagbonya & Tobin (2013) in Sapele, urban dwelling in Nigeria among 400 respondents from 400 households on air pollution (bush burning, tobacco smoking, biomass fuel use and garbage burning), which reported 10.5% prevalence of cough, 21.3% of phlegm production, 13.5% of wheezing and 14.8% of shortness of breath. The highest respiratory symptoms' prevalence among the participants of both the current and the former studies reviewed in Africa was less than 25%. However, a study conducted in Ekiti State, Southern Nigeria by Desalu, Adekoya & Ampitan (2010) involving 269 adult women

on risks of respiratory problems and biomass fuel use, also reported the prevalence of respiratory symptoms among women who used biomass fuel as cough 13.7%, wheezing 8.7%, and breathlessness 11.8%. These results differ slightly in the prevalence of the respiratory symptoms as compare to this current study. These recent study's results were not far from a study conducted by Juntarawijiti & Juntarawijiti, (2019) in Phitsanulok province, Thailand among 1113 rural households on smoke exposure and respiratory symptoms which reported prevalence of chronic cough of 15.6%, dyspnea of 45% and phlegm production of 21.2%. The slight increase in prevalence of dyspnea could be as a result of differences in peri-urban and rural dynamics. Stankovic *et al. (*2011) report on prevalence of respiratory symptoms in a study in Nis, Serbia showed similar prevalence of phlegm production as compare to this current study but differed slightly in prevalence of cough (33.4%) and shortness of breath (32.8%) due to probably the larger sample size of over 1,000 respondents used in that study. A study carried out by Isabel et al. (2005) in Spain on smoking habit, respiratory symptoms and lung function among young adults, reported high prevalence of respiratory symptoms among smokers. Fell et al. (2018) analyzed a sub-data of Telemark's study in Norway and reported that respondents who were exposed to SHS daily, had 18% of wheezing, 24% of cough at night and 11% of shortness of breath at night. These findings were also similar to these current findings on the respiratory symptoms' prevalence in the GEMA.

The proportion of the participants who had exposure to smoke from biomass fuel use in this current study were 47%. A study by Amegah *et al.* (2012) in Accra, Ghana among mothers reported that, 50.5% of the mothers used biomass fuel (charcoal). This current study result is similar to that of Amegah *et al*. (2012). Also, a study conducted by Ngahane

et al. (2015) in Cameroon involving 300 women who used cooking fuels reported that, 48.3% of the respondents used biomass fuel. This current study results are similar to that of the study carried out in Cameroon as stated above. However, findings from studies by Desalu *et al.* (2010) in Nigeria and Sana et al. (2019) in Burkina Faso differed slightly from this current study as they reported that, almost 60% of the study population use biomass fuel. This could be due to the fact that, the study carried out by Desalu *et al.* (2010) was done among rural women and that of Sana *et al.* (2019) involved larger sample size of over 1700 respondents as compare to this current study that was done in peri-urban area and involving a smaller sample size. Also, Juntarawijiti & Juntarawijiti, (2019) in Phitsanulok province, Thailand's study reported that 34.6% of households studied used biomass fuel as source of fuel for cooking. The proportion of the participants who use biomass fuel in this current study was about 10% higher than the previous study conducted by Juntarawijiti & Juntarawijiti, (2019) in Thailand. This could be due to differences in socioeconomic status of the population studied in these two countries.

The proportion of the participants who indulged in garbage burning was 71% and participants who had exposure to smoke from garbage burning were 97.5%, the current study suggest. This study's results are contrary to a study carried out by Addo *et al.*, (2015) in Kumasi Metropolis in the Ashanti Region of Ghana among 256 households on solid waste management which reported that, 10.9% of the residents were indulged in garbage burning. The results are also contrary to that of a study conducted in Ghana by Anaman & Nyadzi (2015) in Gbawe, a suburb of Accra which reported a similar proportion of the households (10.8%) indulging in garbage burning. The reasons for the differences in the study results is due to the fact that, the residents in the previous studies used other means

of waste disposal such as dumping of waste at the dumpsite, open places and containers (Addo et al., 2015; Anaman & Nyadzi, 2015).

The proportion of the participants who had exposure to smoke from dumpsite were 53%. This study's result confirmed a study carried out among residents living close to Pantang dumpsite by Jeffrey (2015), which reported that over 50% of the residents were exposed to smoke from the dumpsite. A study by Faye et al. (2016) in Dakar City, Senegal among three communities with dumpsites involving 1178 respondents, reported that, in one of the dumpsites (Keur Massa/Malika), 84.9% of the respondents perceived that they were exposed to smoke from the dumpsite (Keur Massa/Malika). The study by Faye *et al.* (2016) was based on perception of respondents and this could account for the differences in the proportion of exposure.

Proportion of the participants who had exposure to smoke from cigarette smoking in this current study was 41%. This study confirms a cross sectional study conducted by Sana et at. (2019) in Ouagadougou, Burkina Faso among 1705 women also reported that, 43.49% of the women were exposed to second-hand smoke. However, Fell *et al.* (2018) analyzed a sub-data of Telemark's study in Norway and reported that 256 respondents (2.90%) were exposed to SHS daily which was not the case in this current study. This could be as a result of differences in methods of selection of the participants.

The risks of chronic cough among the participants who had exposure to smoke from dumpsite, cigarette smoking and biomass fuel use were statistically significant, hence, there was a strong association between the smoke exposure sources and chronic cough (2.7 (CI: 1.32, 3.54); p-value=0.029, 2.8 (CI: 1.6, 5.83); p-value=0.002 and 2.6 (CI: 1.67, 3.37); p-value=0.047). Other studies' findings in this field were consistent with this recent study

as they established strong relationship between exposure to smoke from dumpsite, cigarette smoking or biomass fuel and chronic cough. Nagahane *et al.,* (2015) reported that, there was association between the use of wood as cooking fuel and chronic cough. Air pollution as a result of biomass fuel is evidenced to be associated with chronic obstructive pulmonary disease (COPD) (Stankovic *et al.*, 2011). Biomass fuel use was associated with phlegm production, wheezing, shortness of breath and dry cough (Sana et al., 2019). There was also association between biomass fuel use and cough, wheezing and breathlessness (Desalu *et al.,* 2010). There was no association between biomass fuel use and phlegm production, wheezing and breathlessness in this current study, as found by Sana et al. (2019) and Desalu *et al.* (2010) in their studies in Burkina Faso and Nigeria respectively. Liu *et al.* (2015), reported that, adults with history of smoking and increased duration of tobacco use were associated with a high risk of having frequent productive cough and frequent shortness of breath (SOB). Fell *et al.* (2018) also reported a significant statistical association between productive cough and nocturnal breathlessness in the last 12 months and second-hand smoke exposure among the population studied. This current study showed association between exposure to smoke from cigarette smoking/SHS and cough among the participants but had no association between exposure to smoke from cigarette smoking/SHS and shortness of breath (breathlessness) as reported by Liu *et al*. (2015) and Fell *et al.* (2018). There was association between the exposure to smoke from backyard garbage burning almost daily per week and chronic cough, phlegm production and breathlessness experienced in the last 12 months. There was also association between exposure to smoke from backyard garbage burning for 1 to 3 days per week and wheezing experienced in the last 12 months. There was an association between the participants' almost daily exposure

to smoke from dumpsite and chronic cough in the last 12 months. This was also consistent with Verna *et al.* (2015) report that indicated that plastic wastes burning increases the risk of heart diseases and exacerbates respiratory illnesses.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The prevalence of respiratory symptoms among the study population was 14% to 20%. The sources of smoke exposure identified among the study communities were biomass fuel use, garbage burning, dumpsite burning and cigarette smoking (active and passive smoking). There was association between smoke exposure sources identified and chronic cough as well as association between almost daily exposure to smoke from backyard garbage burning and chronic cough, phlegm production and breathlessness. There was association between exposure to smoke from backyard garbage burning almost daily per week and chronic cough, phlegm production and breathlessness experienced in the last 12 months. There was also association between exposure to smoke from backyard garbage burning for 1 to 3 days per week and wheezing experienced in the last 12 months. It can be concluded that exposure to smoke is a significant determinant to the residents' risk of respiratory symptoms in the GEMA.

6.2 Recommendation

The following recommendations are emanated from the findings of this study. Residents should be advised to do regular checkup at the health facilities for early treatment of respiratory diseases and other conditions to reduce the risk of chronic diseases. Environmental health officials should routinely educate the residents on the need to avoid or reduce exposure to smoke from garbage burning and cigarette smoking to reduce the risk of respiratory symptoms. The GEMA should provide litter bins at vantage points as alternative means of waste management within the municipality and encourage residents

to patronize them to avoid frequent burning of garbage. Residents should gradually move from biomass fuel use for cooking to clean cooking technology such as use of gas, electricity, etc. to reduce the risk of exposure to smoke and ensure quality of air in the environment. The dumpsite should be closed down permanently by the GEMA.

References

Addo, I. B., Adei, D., & Acheampong, E. O. (2015). Solid Waste Management and Its Health Implications on the Dwellers of Kumasi Metropolis, Ghana. *Current Research Journal of Social Sciences*, *7*(3), 81–93

Amann, M., Holland, M., Maas, R., Vandyck, T. and B. Saveyn (2017). Costs, benefits and economic impacts of the EU Clean Air Strategy and their implications on innovation and competitiveness. IIASA report. (http://gains.iiasa.ac.at)

Amegah, A. K., Jaakkola, J. J., Quansah, R., Norgbe G. K., & Dzodzomenyo, M. (2012). Cooking fuel choices and garbage burning practices as determinants of birth weight. *Environmental Health: A Global Access Science Source*, 1–10.

American Cancer Society, (2017). Harmful Chemicals in Tobacco Products. Retrieved on April 21, 2019 from https://www.cancer.org/cancer/cancer-causes/tobacco-and-cancer/carcinogens-found-in-tobacco-products.html

Anaman, A. K., & Nyadzi, W. B. (2015). Analysis of Improper Disposal of Solid Wastes in a Low- Income Area of Accra, Ghana. *Applied Economics and Finance*, *2*(1). https://doi.org/10.11114/aef.v2i1.633

Baah, D., & Kharlamova, M. (2016). The Impact of Landfill sites in Accra-Ghana on the Surrounding Environment. Retrieved on May 16, 2019 from https://www.researchgate.net/profile/doris_baah/publication/325049471_the_impact_of_landfill_sites_in_accra_ghana_on_the_surrounding_environment/links/5af337a6aca2720af9c196ff/the- impact-of-landfill-sites-in- accra-ghana-on-the-surrounding-environment?origin=publication_detail

Chasant, M. (2019). Air Pollution in Ghana: Causes, Effects and Solutions. Retrieved on March 31, 2019 from https://cdn.shopify.com/s/files/1/0008/5947/1929/files/Air_Pollution_In_Ghana_Causes_Effects_And_Solutions_by_Muntaka_Chasant.pdf?15345125165928856586

Chasant, M. (2019). Air Pollution Killing More People in Ghana. Retrieved on May 31, 2019 from https://www.atcmask.com/blogs/air-pollution-in-ghana

Christian, N. (2015). What Chemicals Are in Cigarette Smoke? Retrieved on April 21, 2019 from https://www.medicalnewstoday.com/articles/215420.php

Climate and Clean Air Coalition (2019). Black Carbon. Retrieved on December 10, 2019 from https://www.ccacoalition.org/ru/slcps/black-carbon

Cogut, A. (2016). Open Burning of Waste: A Global Health Disaster. *R20 Regions of Climate Change*, (October).

Desalu, O. O., Adekoya, A. O., & Ampitan, B. A. (2010). Increased risk of respiratory symptoms and chronic bronchitis in women using biomass fuels in Nigeria.

Jornal Brasileiro de Pneumologia, *36*(4), 441–446. https://doi.org/10.1590/S1806-37132010000400008

Ediagbonya, T.F., & Tobin, A. E. (2013). Air Pollution and Respiratory Morbidity in an urban Area of By, *2*(January), 10–15.

Environmental Literacy Council, Washington DC (2015). What is waste? Retrieved on April 3, 2019 from https://enviroliteracy.org/environment-society/waste-management/what-is- waste/

European Respiratory Society (2019). Respiratory Health Effects. Retrieved on December 10, 2019 from https://www.erswhitebook.org/chapters/outdoor-environmental/respiratory-health-effects/

Faye, C. M., Mberu, B., Kabaria, C., & Dieng, C. (2016). *Solid Waste Management and Risks to Health in Urban Africa: A Study of Dakar City, Senegal*.

Feldman, C., & Anderson, R. (2013). Cigarette smoking and mechanisms of susceptibility to infections of the respiratory tract and other organ systems. *Journal of Infection*. https://doi.org/10.1016/j.jinf.2013.05.004

Fell, A. K. M., Svendsen, M. V., Kim, J. L., Abrahamsen, R., Henneberger, P. K., Torén, K., … Kongerud, J. (2018). Exposure to second-hand tobacco smoke and respiratory symptoms in non-smoking adults: Cross-sectional data from the general population of Telemark, Norway. *BMC Public Health*, *18*(1). https://doi.org/10.1186/s12889-018-5771-4

Ga East Municipal Assembly (2013). Municipal profile.

Ga East Municipal Assembly (2019). Ghanadisticts.com. Retrieved on May 18, 2019 from gaeast.ghanadistricts.gov.gh

Ghana Health Service (2015). The Health System in Ghana, facts and Figures. Retrieved from internal-pdf://0240438844/Facts-and-figures 2015_GHS.pdf%0Ahttp://www.moh.gov.gh/wp-content/uploads/2017/07/Facts-and- figures-2015.pdf.

Ghana Statistical Service, (2013). 2010 Population and Housing Census Regional Analytical Reports, Greater Accra Region. Retrieved on April 5, 2019 from http://www2.statsghana.gov.gh/docfiles/2010phc/2010_PHC_Regional_Analytical_Repo rts_Greater_Accra_Region.pdf

Hoornweg, D., & Bhada-Tata, P. (2012). *A global review of solid waste management*. *Urban Development Series Knowledge Papers* (pp. 1–116). Retrieved from https://openknowledge.worldbank.org/handle/10986/17388

Human Rights Watch. (2017). *"*As If You're Inhaling Your Death": The Health Risks of Burning Waste in Lebanon (Pp. 1–79). Retrieved from https://www.hrw.org/sites/default/files/report_pdf/lebanon1117_web_1.pdf.

Iftikhar, N., & Fisher, J. k., (2018). Breathtaking Lungs: Their Function and Anatomy. Retrieved on April 21, 2019 from https://www.healthline.com/human-body-maps/lung#respiratory- system

Isabel, U., Alberto, C., María, Q. J., Nerea, M., Xavier, B., & Jordi, S. (2005). Smoking Habit, Respiratory Symptoms and Lung Function in Young Adults. *European Journal of Public Health*, *15*(2), 160–165. https://doi.org/10.1093/eurpub/cki113

Israel, D. G. (2003). Determining Sample Size. Retrieved on April 24, 2019 from https://docplayer.net/25587124-Determining-sample-size-1.html

Jeffrey, A. (2015). An Assessment of the Phenomenon of Residential Development close to Solid Waste Dumpsites: The Case Study of the Pantang dumpsite. Retrieved on May 4, 2019 from http://ugspace.ug.edu.gh

Jiang, X. Q., Mei, X. D., & Feng, D. (2016). Air Pollution and Chronic Airway Diseases: What Should People Know and Do? *Journal of Thoracic Disease*. Pioneer Bioscience Publishing. https://doi.org/10.3978/j.issn.2072-1439.2015.11.50

Juntarawijit, Y., & Juntarawijit, C. (2019). Cooking smoke exposure and respiratory symptoms among those responsible for household cooking: A study in Phitsanulok, Thailand. *Heliyon*, *5*(5). https://doi.org/10.1016/j.heliyon.2019.e01706

Kusi, E., Nyarko, A. K., Boamah, L. A., & Nyamekye, C. (2017). Landfills: Investigating Its Operational Practices in Ghana. *Http://Www.Sciencepublishinggroup.Com*. *1*(1), 19. https://doi.org/10.11648/J.IJEES.20160101.14

Laumbach, R. J., & Kipen, H. M. (2013). Respiratory Health Effects of Air Pollution: Update On Biomass. *Journal of Allergy and Clinical Immunology*, *129*(1), 3–13. https://doi.org/10.1016/j.jaci.2011.11.021.Respiratory

Liu, Y., Pleasants, R. A., Croft, J. B., Wheaton, A. G., Heidari, K., Malarcher, A. M., … Strange, C. (2015). Smoking Duration, Respiratory Symptoms, And COPD in Adults Aged $^{3}45$ Years with A Smoking History. *International Journal of COPD*, *10*, 1409–1416. https://doi.org/10.2147/COPD.S82259

Ministry of Sanitation and Water Resources (2018). Greater Accra Resilient and Integrated Development Project: Final Environmental Impact Statement Rehabilitation, Closure and Aftercare Management of the Abloragyei Dumpsite, Ga East Municipality, Greater Accra. Retrieved on April 21, 2019 from http://documents.worldbank.org/curated/en/318291545116127962/pdf/AFR-Final- Abloragyei-ESIA-2nd-December-2018-P164330.pdf

Minnesota Pollution Control Agency, US, (2019). Concerns About Backyard Burning of Trash. Retrieved on April 21, 2019 from https://www.pca.state.mn.us/waste/concerns-about- backyard-burning-trash

Ngahane, B. H. M., Tenfack, E., Nganda, M., Ze, E. A., Chebu, C., Mapoure, N. Y. & Luma. N. H. (2017). Effects of Cooking Fuel Smoke on Respiratory Symptoms and Lung Function in Semi-Rural Women in Cameroon. Internal Journal of Occupational and Environmental Health 2015. Vol-21 no.1: D01 10.1179/2049396714Y.

Pare, P., Sansores, R., Perez-Padilla, R., Paramo Ramirez, J. I., Brauer, M., Regalado, J., & Vedal, S. (2006). The Effect of Biomass Burning on Respiratory Symptoms and Lung Function in Rural Mexican Women. *American Journal of Respiratory and Critical Care Medicine*, *174*(8), 901–905. https://doi.org/10.1164/rccm.200503-479OC

Perez-Padilla, R., Schilmann, A., Riojas-Rodriguez, H., & Murray, J. F. (2010). *Previous articles in this series*. *Int J Tuberc Lung Dis* (Vol. 14, pp. 1–4).

Saito, J., Shibanuma, A., Yasuoka, J., Kondo, N., Takagi, D., & Jimba, M. (2018). Education and indoor smoking among parents who smoke: The mediating role of perceived social norms of smoking. *BMC Public Health*, *18*(1). https://doi.org/10.1186/s12889-018-5082-9.

Sana, A., Meda, N., Badoum, G., Kafando, B., & Bouland, C. (2019). Primary cooking fuel choice and respiratory health outcomes among women in charge of household cooking in ouagadougou, Burkina faso: Cross-sectional study. *International Journal of Environmental Research and Public Health*, *16*(6). https://doi.org/10.3390/ijerph16061040

Science Learning Hub, (2019). What Is Smoke and Why Do Some Fires Seem to Have More Smoke Than Others? Retrieved on April 21, 2019 from https://www.sciencelearn.org.nz/resources/748-what-is-smoke

Stankovi, A., Nikoli, M., & Arandjelovi, M. (2011). Effects of indoor air pollution on respiratory symptoms of non-smoking women in Ni š, Serbia. Multidisciplinary Respiratory Medicine 2011; *6*(6):351–355.

Tantisuwat, A., & Thaveeratitham, P. (2014). Effects of Smoking on Chest Expansion, Lung Function, and Respiratory Muscle Strength of Youths. *Journal of Physical Therapy Science*, *26*(2), 167–170. https://doi.org/10.1589/jpts.26.167

Thompson, I. A. (2012). Domestic Waste Management Strategies in Accra, Ghana and Other Urban Cities in Tropical Developing Nations. Retrieved on April 4, 2019 from http://case.edu/med/epidbio/mphp439/Waste_Mgmt_Accra.pdf

Tielsch, J. M., Katz, J., Thulasiraj, R. D., Coles, C. L., Sheeladevi, S., Yanik, E. L., & Rahmathullah, L. (2009). Exposure to Indoor Biomass Fuel and Tobacco Smoke and Risk of Adverse Reproductive Outcomes, Mortality, Respiratory Morbidity and Growth Among Newborn Infants in South India. *International Journal of Epidemiology*, *38*(5), 1351–1363. https://doi.org/10.1093/ije/dyp286

United Nations Environment Programme (2015). African Regional Implementation Review for the 14th Session of the Commission on Sustainable Development

(CSD-14) Report on Atmosphere and pollution. Retrieved on May 20, 2019 from https://www.google.com/search?q=unep+2015+African+Regional+Implementation+report+on+atmosphere+and+air+pollution&oq=unep+2015+African+Regional+Implementation+report+on+atmosphere+and+air+pollution&aqs=chrome..69i57.78334j0j7&sourceid=chrome&ie=UTF-8#

United Nations Environment Programme. (2016). Ghana Air Quality Catalogue, 1–4. Retrieved on May 18, 2019 from airquality@unep.org

United State Department of Veteran Affairs, (2013). Burn Pits (Trash and Human Waste Exposures). Retrieved on March 30, 2019 from https://www.warrelatedillness.va.gov/education/factsheets/burn-pits.pdf

United States Environmental Protection Agency (2016). Environmental Impact of Smoke. Retrieved on May 13, 2019 from https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/env.html.

United States Environmental Protection Agency (2017). Learn About Dioxin. Retrieved on May 16, 2019 from https://www.epa.gov/dioxin/learn-about-dioxin

United States Environmental Protection Agency (2017). Wood Smoke and Your Health, Burn Wise. Retrieved on April 3, 2019 from https://www.epa.gov/burnwise/wood-smoke-and- your-health

Verma, R., Vinoda, K. S., Papireddy, M., & Gowda, A. N. S. (2016). Toxic Pollutants from Plastic Waste- A Review. *Procedia Environmental Sciences*, *35*, 701–708. https://doi.org/10.1016/j.proenv.2016.07.069

WECF. (2004). *Dangerous Health Effects of Home Burning of Plastics and Waste*. Munich. Retrieved on March 29, 2019 from http://www.wecf.eu/cms/download/2004- 2005/homeburning_plastics.pdf

World Bank, (2019). Urban Development; Brief Solid Waste Management. Retrieved on April 2, 2019 from http://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management

World Health Organization (2005). WHO Air Quality Guidelines for Particulate Matter, Oxone, Nitrogen dioxide, and Sulfur dioxide. Retrieved on December 8, 2019 from https://apps.who.int/iris/bitstream/handle/10665/69477/WHO_SDE_PHE_OEH_06.02_eng.pdf;jsessionid=F117D63154B8ECD11C59037E5DE82347?sequence=1

World Health Organization (2019). Children's Environmental Health. Retrieved on December 10, 2019 from https://www.who.int/ceh/risks/cehair/en

World Health Organization, Climate and Clean Air Coalition (2014). Air Pollution, Climate and Health. Retrieved on May 18, 2019 from https://www.who.int/sustainabledevelopment/AirPollution_Climate_Health_Factsheet.pdf

World Health Organization/United Nations International Children Education Fund Joint Report (2012). Water Sanitation and Hygiene. Retrieved on May 3, 2019 from https://www.who.int/water-sanitation-health/monitoring/jmp2012/key-terms/en/

Your Dictionary (2019). Climate. Retrieved on December 10, 2019 from https://www.yourdictionary.com/climate

Zimmermann K. A. (2019). Respiratory System: Facts and Diseases. Retrieved on April 21, 2019 from https://www.livescience.com/22616-respiratory-system.html

Appendix 1: Participant's Information Sheet for Residents in the Ga East Municipal Assembly, Accra

The information sheet provides information about the research for participants to make an informed decision of whether to participate in the study or not. It outlines the nature of the research, what the research involves, risks, benefits and compensation.

Research Title: Smoke Exposure and Respiratory Symptoms Among slum dwellers in the Ga East Municipal Assembly, Accra.

Introduction: I am Salifu Hadara, Msc student of University of Ghana – School of Public Health, Department of Biological, Environmental, Occupational Health Sciences, Box LG 13, Legon – Accra. I am conducting a study on exposure to smoke and respiratory symptoms in this Municipality. I am kindly inviting you to voluntarily take part in this study. You do not need to make a decision on it now. The details of the study will be explained to you appropriately. You can kindly contact me on **0200524705 or 0249639481** and salifuhadara21@gmail.com

Background and Purpose of Research: Nature of research: In Ghana, air pollution from indoor sources is the single leading contributor to adverse health outcomes such as cardiovascular and respiratory morbidities and mortalities (United Nations Environment Programme (UNEP), 2016). Indoor air pollution is associated with estimated 15,000 deaths yearly in Ghana and 3,000 deaths of children under five years (UNEP, 2016; Chasant, 2019). It is also a significant risk factor for non-communicable diseases in Ghana and possibly a biggest risk factor for women in the rural areas (UNEP, 2016). The study seeks to provide understanding of the sources of smoke exposure and the relationship between smoke exposure and respiratory symptoms among slum dwellers in the Ga East Municipal

Assembly. This cross-sectional study is taking place at GEMA involving 200 participants who are adults of age 18 years and above. You will be asked questions pertaining to your personal information, exposure to smoke from garbage burning, biomass fuel burning, dumpsite burning, cigarette smoking and second hand smoking and respiratory symptoms.

Duration /what is involved: It will take about 30 minutes to complete the questionnaire and measurement of your height and weight.

Voluntary participation/withdrawal: Your decision to take part in the study is completely voluntary and you can decide to withdraw at any time without any penalty and you will not be denied of any benefits if there is.

Potential Risks: You may be uncomfortable during the measurement of your height and weight and may spend time answering the questionnaire but this is a minimal risk.

Benefits: The findings of the study may not directly benefit you but might be beneficial to the whole community and the larger society in general.

Costs: You will not pay money for taking part in this study

Compensation: You will be compensated for the time spent in taking part of the study.
Confidentiality: All the information that will be taken from you will be kept private and confidential and used for academic purposes. The findings of this study may also be made public through seminars, meetings and journals devoid of your identity as your name will be coded and reported as such.

Outcome and Feedback: The findings of the study will not be given to you directly but will be given to the municipal assembly.

Funding information: The study will be partly funded by the principal investigator.

Sharing of participants Information/Data: The data collected will be stored electronically and protected and will be privy to only the investigators of the study. The data collected will not be shared with any third party and will be used purposely for academic affairs.

The data will be at the care of the principal investigators, hence, the custodians of the data. There will not be any conflict of interest involving the research team or any of the participants involved in the study.

Provision of Information and Consent for participants: A copy of the consent form and the information sheet will be given to you after you have signed or thumb printed.

Further Clarifications/Questions: Please you are free to ask any question or clarification now and you would be attended to. You can please contact **Salifu Hadara** for any further enquiries regarding the study on **0200524795 or 0249639481** or **Dr. Reginald Quansah**, the project supervisor on **0272620401.**

For any clarification on ethical issues regarding this study and your rights as a participant, you can please contact **Hannah Frimpong**, Ghana Health Service - Ethics Review Committee, Administrator on **0507041223/0243235225.**

Appendix 2: Consent Form for slum dwellers in the Ga East Municipal Assembly, Accra

STUDY TITLE: Smoke Exposure and Respiratory Symptoms Among Slum Dwellers in the Ga East Municipal Assembly, Accra.

PARTICIPANTS' STATEMENT

I acknowledge that I have read or have had the purpose and contents of the Participants' Information Sheet read and all questions have been satisfactorily explained to me in a language I understand (English □, Twi □, Ga □). I fully understand the contents and any potential implications as well as my right to change my mind (ie withdraw from the research) even after I have signed this form.

I voluntarily agree to be part of this research.

Name or Initials of Participant…….. ID Code ……..

Participants' Signature ……OR Thumb Print……

Date: …….

INTERPRETERS' STATEMENT

I interpreted the purpose and contents of the Participants' Information Sheet to the above-named participant to the best of my ability in the (Twi □, Ga □) language to his proper understanding.

All questions, appropriate clarifications sort by the participant and answers were also duly interpreted to his/her satisfaction.

Name of Interpreter……

Signature of Interpreter…….. Date: ……

Contact Details

STATEMENT OF WITNESS

I was present when the purpose and contents of the Participant Information Sheet was read and explained satisfactorily to the participant in the language, he/she understood (English □, Twi □, Ga □)

I confirm that he/she was given the opportunity to ask questions/seek clarifications and same were duly answered to his/her satisfaction before voluntarily agreeing to be part of the research.

Name: ……

Signature……. OR Thumb Print ……....

Date: ……

INVESTIGATOR STATEMENT AND SIGNATURE

I certify that the participant has been given ample time to read and learn about the study. All questions and clarifications raised by the participant have been addressed.

Researcher's name…….

Signature …….

Date…….

Appendix 3: Screening Tool for Household Eligibility
Tick where applicable

No.	Description	Yes	No
1.	Located within the proposed study site		
2.	Adults in the household age 18 years and above with a child or children (0-8 years)		
3.	Head of the household agreeing to allow occupants to take part in the study.		
4.	Individuals permanently staying in the house with their child or children		
5.	Is the household eligible for selection; meeting all the above descriptions?		

Appendix 4: Questionnaire

I am Salifu Hadara, Msc Occupational hygiene student from the School of Public Health, University of Ghana. We will be very grateful if you could spend part of your time to assist us in the study of smoke exposure and respiratory symptoms among slum dwellers in the Ga East Municipal Assembly. The study success is largely dependent on your participation. The information obtained from you will be limited to only the researcher and the assistants. You can opt out of the study at any point in time if you deem so. You will be assisted to answer this questionnaire and you may decide not to answer any question.

Please if you have any question or clarification you are free to ask or clarify.

Thank you so much for agreeing to take part in this very important research.

A. **General Information**

Name of Participant ……..

Contact of Participant ……

Name of interviewer ……

Date of interview ……

Place of interview …… Height …….. Weight ……

A. Demographic Characteristics

Please tick or fill in the following and tick where applicable

1. Age in years …….
2. Sex 1. Male [ ] 2. Female [ ]

3. Educational level 1. Neve attended [ ] 2. Pre-primary/Primary/JHS/SSS [ ] 3. Technical professional certificate/diploma [ ] 4. Bachelor/Postgraduate
4. Ethnicity 1. 1. Ga [ ] 2. Ewe [ ] 3. Akan [ ] 4. Others…….
5. Marital Status 1. Married [ ] 2. Single [ ] 3. Divorce [ ] 4. Cohabiting [ ] 5.widow [ ] 6. Others …….
6. Residence near a dumpsite? 1. Yes [ ] 2. No [ ]
7. Nearness to the dumpsite (distance in kilometers)? 1. Within 1km 2. 8 km
8. How many years have you stayed in the community? 1.<1 year [ ] 2. 1-2years [ ] 3. 3-5 [ ] 4. .5years [ ]
9. The house where you live is 1. Borrowed [ ] 2. Rented or leased 3. Own house 4. Care taker.
10. How many people are in your household 1. <4 [ ] 2. 4-6 [ ] 3. 6-8 [ ] 4. >8 [ ]
11. How many rooms are in your house 1. 1 [ ] 2. 2 [ ] 3. 3 [ ] 4. 4 [ ] 5. >5 [ ]
12. Source of water 1. Improved [ ] 2. Unimproved [ ]
13. Toilet facility 1. Improved [ ] 2. Unimproved [ ]
14. . Occupation 1. Unemployed/pensioner/student [ ] 2. Manager/professional [ ] 3. Service /sales worker [ ] 4. Skilled agriculture/forestry/fishery worker and others ……..
15. No. of Dependents 1. None 2. 1-5 [ ] 3. 6-10 [ ] 4. 11 and above [ ]
16. Income level 1. Sufficient [ ] 2. Insufficient [ ]
17. Do you have any chronic diseases? 1. Yes [ ] 2. No [ ]
18. If yes, indicate the disease ……
19. Do you have health insurance (national Health Insurance Scheme)? 1. Yes [ ] 2. No [ ]

B. Exposure to Smoke from Biofuels, Garbage Burning, Cigarette Smoking / Second-Hand Smoking.

Please tick the following where applicable

20. Do you use biomass fuel? 1. Yes [ ] 2. N0 [ ]
21. What type of fuel do you use? 1. Wood [ ] 2. Saw dust 3. Charcoal [ ] 4. LPG
22. How often do you use the fuel in a day? 1. Once [ ] 2. Twice [ ] 3. Thrice [ ]
23. What do you do with garbage? 1. Burn [ ] 2. Throw away [ ] 3. Bury [ ] 4. Waste collectors come to pick them [ ]

    What do you with the following waste?
24. Biowaste or food scraps 1. Burn [ ] 2. Throw away [ ] 3. Bury [ ] 4. Waste collectors come to pick them [ ]
25. Paper 1. Burn [ ] 2. Throw away [ ] 3. Bury [ ] 4. Waste collectors come to pick them [ ]
26. Plastic 1. Burn [ ] 2. Throw away [ ] 3. Bury [ ] 4. Waste collectors come to pick them [ ]
27. Glass 1. Burn [ ] 2. Throw away [ ] 3. Bury [ ] 4. Waste collectors come to pick them [ ]
28. Textiles 1. Burn [ ] 2. Throw away [ ] 3. Bury [ ] 4.Waste collectors come to pick them [ ]
29. Metals 1. Burn [ ] 2. Throw away [ ] 3. Bury [ ] 4. Waste collectors come to pick them [ ]
30. Wood 1. Burn [ ] 2. Throw away [ ] 3. Bury [ ] 4. Waste collectors come to pick them [ ]
31. Do you have any exposure to smoke at home? 1. Yes [ ] 2. No [ ]
32. Do you have exposure to smoke from garbage burning at home? 1. Yes [ ] 2.No [ ]
33. How often are you exposed to smoke from garbage burning at home? 1. Almost daily [ ]

    2. 1-3 days /week [ ] 3. >once a month [ ]
34. Does the dumpsite expose you to smoke 1. Yes [ ] 2. No [ ]

35. How often are you exposed to smoke from dumpsite? 1. Almost daily [ ] 2. 1-3 days /week 3. > once a month [ ]
36. Are you exposed to neighbourhood smoke 1. Yes [ ] 2. No [ ]
37. How often are you exposed to smoke from neighbourhood?. 1. Almost daily [ ] 2. 1-3 days /week 3. > once a month
38. Do you have exposure to smoke from cigarette smoking (active or passive)? 1. Yes [ ] 2. No []
39. Do you smoke cigarette? 1. Yes [ ] No [ ]
40. If yes, how many number of cigarettes do you smoke a day? 1. < 5 sticks of cigarette(s) [ ] 2. 5-10 sticks of cigarettes [ ] 3. > 10 sticks of cigarettes [ ]
41. Do you have exposure to second hand smoke? 1. Yes [ ] 2. No [ ]

C. Respiratory Symptoms

Please tick the following where applicable

42. Have you had cough related to ill health for the past 12 months? 1. Yes [ ] 2. No [ ]
43. Have you experience any cough two weeks prior to this study? 1. Yes [ ] No [ ]
44. Have you experienced phlegm production for the past 12 months? 1. Yes [ ] 2. No [ ]
45. Have you experience any wheezing two weeks prior to this study? 1. Yes [ ] No [ ]
46. Have you experienced wheezing for the past 12 months? 1. Yes [ ] 2. No [ ]
47. Have you experience any wheezing two weeks prior to this study? 1. Yes [ ] No [ ]
48. Have you had shortness of breath/breathlessness for the past 12 months? 1. Yes [ ] No []
49. Two weeks prior to this study, have you experienced any shortness of breath or breathlessness? Yes [ ] No [ ]

Thank you for participating in this very important study

Appendix 5 Ethical Clearance

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

MyRef. GHS/RDD/ERC/Admin/App /19 / 282
Your Ref. No.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
GPS Address: GA-050-3303
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com
9th July, 2019

Hadara Salifu
University of Ghana
School of Public Health
Legon

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC 032/05/19**
Project Title	Exposure to Smoke and Respiratory Symptoms among People Living close to Dumpsite in Abokobi in the Ga East Municipal Assembly
Approval Date	9th July, 2019
Expiry Date	8th July, 2020
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.
- Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra