SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

FACTORS AFFECTING TIME TO RESOLUTION OF SIGNS AND SYMPTOMS IN SYMPTOMATIC COVID-19 PATIENTS REPORTING TO THE PUBLIC HEALTH UNIT OF KORLE BU TEACHING HOSPITAL: A HISTORICAL COHORT STUDY

BY

YAO AHONON

(10876944)

A DISSERTATION SUBMITTED TO SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF GHANA IN PARTIAL FULFILMENT FOR THE AWARD OF THE MASTERS IN PUBLIC HEALTH (MPH) DEGREE.

MARCH, 2022

DECLARATION

I, Yao Ahonon, declare that except for the people's investigations which has been duly acknowledged, this work is the results of my own original research, and that this dissertation, either in whole or in part has not been presented elsewhere for another degree.

Yao Ahonon

Student

Signature:……

Date: 3rd March, 2022

Dr. Alexander Manu

(Supervisor)

Signature: ……...

Date: 3rd March, 2022

DEDICATION

This work is dedicated to the Almighty God who is my source of wisdom, knowledge and power; and to my family and friends.

ACKNOWLEDGEMENT

I am grateful for how far God has brought me for He has been my source of inspiration. I wish to express my profound gratitude to Dr. Alexander Manu, my supervisor whose contributions towards the completion of this work are immeasurable. I also want to thank Dr. Philip K. Amoo, Head of Public Health, KBTH for believing in me and supporting me throughout this work and my career.

Finally, I am grateful to my parents, Mr. Francis Ahonon and Madam Veronica Ahonon; my siblings: Portia, Clifford, Anthony, Joycelyn, Jessica, Jennifer, William and Benjamin; my Auntie, Pascaline Siba Zipper and my colleagues in the Public Health Unit of Korle Bu Teaching Hospital; Emmanuel Ekem Fergurson, Pascalina Tenguo, Hannah Adjei Mensah, Camilla Ewudzie and Prosper Kaba for their encouragement and assistance given to me when this project was carried out.

ABSTRACT

Management of positive COVID-19 patients who report to the Public Health Unit are discharged from the clinic after 14 days and are asked to report to work immediately especially for staff. So, it has become very important to understand the clinical features of COVID-19 and the time to resolution of signs and symptoms. The main objective of the study was to determine the symptoms and signs found among COVID-19 patients reporting to the Public Health Unit of the Korle Bu Teaching Hospital, the time to resolution of these symptoms and signs and determinants.

A historical cohort study involving COVID-19 cases reporting to the Public Health Unit of the Korle Bu Teaching Hospital from May to July, 2021 was employed. Cox proportional-hazards regression model was fitted. A statistical significance was defined at $P<0.05$. All analyses were done using STATA version 16.1 software.

A total of 148 COVID-19 participants were included in this study with a mean age of 36.6 years (SD±12.6). Hypertension was the commonest comorbid condition reported and the topmost symptoms reported was General Malaise. The median duration of symptom resolution of COVID-19 from the onset of symptoms is 7.2 days (95% CI: 1.0 – 14 days). It was estimated that 50% of the participants had their symptoms resolved after 4 days from the day of diagnosis. None of the factors were predictors of time to resolution of symptoms among participants in the study.

Early diagnosis and detection of COVID-19 especially in healthcare workers and other key workers in constant contact with the public is very crucial as they are the frontline workers when epidemic strikes. Our study revealed that the overall median time to resolution of COVID-19 symptoms from the onset of symptoms is 7.2 days. Hence, an average of 1 week were required to cure or discharge patients or staff with symptoms of SAR-CoV-2 in Ghana.

Table of Contents

List of Tables

List of Figures

Acronyms

COVID-19	Coronavirus Disease 2019
CDC	Centers for Disease Control & Prevention
GSS	Ghana Statistical Service
HCoVs	Human Coronavirus
IQR	Inter-quartile Range
KBTH	Korle Bu Teaching Hospital
MERS	Middle East Respiratory Syndrome
PHA	Proportional Hazard Assumption
PHEIC	Public Health Emergency of International Concern
PHU	Public Health Unit
RNA	Ribonucleic Acid
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus
WHO	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

According to the CDC, Coronavirous disease 2019 (COVID-19) is a novel coronavirus caused by severe acute respiratory syndrome coronavirus (SARS-CoV-2) (CDC, 2020a). It is a zoonotic virus from the Nidovirales' Coronaviridae family (Coronavírus, 2019). Coronaviruses are a viral family that causes respiratory illnesses that was initially discovered in 1937 and given the name coronaviruses after its crown-like appearance under a microscope (De Oliveira Lima, 2020).

The types of coronaviruses known so far are: the alpha coronaviruses HCoV-229E and HCoV-NL63; the beta coronaviruses HCoV-OC43 and HCoV-HKU1; SARS-CoV, which causes severe acute respiratory syndrome (SARS); MERS-CoV, which causes Middle East respiratory syndrome (MERS) (Su et al., 2016); and SARS-CoV-2. Human coronaviruses (HCoVs) were initially detected in people with cold in the 1960. More HCoVs have been found since then, including those that cause severe acute respiratory syndrome (SARS) and middle east respiratory syndrome (MERS). These viruses cause fatal respiratory disease in humans and others types typically infect animals. The virus spreads mostly through respiratory droplets and occur when infected individual coughs or sneezes or comes into contact with contaminated objects or surfaces. These respiratory droplets can enter a person through the person's mouth or nose. Other transmission routes include contact with contaminated formite or surfaces (Wei et al., 2020).

In Wuhan, Hubei Province, China, pneumonia incidents in a cluster that is retroactively linked to SARS-Cov-2 infection was discovered in mid-December 2019 (Huang et al., 2020). The World Health Organization (WHO) classified the ongoing lower respiratory tract infection epidemic caused by this SARS-Cov-2, a Public Health Emergency of International Concern (PHEIC) on

March 11, 2020 (OMS, 2020) . This is owing to the fact that at least one case occurred practically in every country in the world during this time.

As of 1st November 2021, over 247 million infections have been confirmed globally with over 5 million deaths and approximately 224 million recoveries (Worldometer, 2021 assessed on 2nd November, 2021). In Africa, as of September 30 2021, over 8.3 million infections have been recorded which represents around 3.7% of the world total confirmed cases. South Africa is the most severely affected country with more than 2.9 million infections and in Ghana, there are 130,077 confirmed infections with 0.9% COVID-19 deaths (Statista, 2021 assessed 1st November, 2021). Older age, high temperature in patients, male gender and coronary heart disease are some factors of the time to resolution of symptoms and signs of COVID-19 infections according to studies done in China and several western nations (Shi et al., 2020; X et al., 2021; Yan et al., 2020). Currently, there are vaccines that have passed all clinical trials and are being used worldwide. To lessen the consequences of the disease on various health systems, countries throughout the world are embracing preventive public health policies (Güner et al., 2020). The current method for limiting the spread is to take precautionary measures. This involves identification of cases, tracing of contacts, isolation and treatment as well as rehabilitation for residual disability caused by the disease. Research into the time to resolution of signs and symptoms of COVID-19 infections will help for planning purposes such as identification of cases especially those are severely infected and who would need urgent attention and treatment, the prevention of the spread of COVID-19, workplace and school arrangements in terms of shift running and also to identify the relationship between the number of signs and symptoms and its severity.

1.2 Problem Statement

SARS-Cov-2 patients can have a wide range of clinical symptoms, from asymptomatic to serious illness and some recover without the need for therapy. Some people on the other hand, become seriously ill and require extensive care or even die. Adults infected with SARS-Cov-2 can be classified into asymptomatic or presymptomatic infection, mild illnesses, moderate illnesses, severe illnesses and critical Illness (Guidelines, 2019). People who are elderly or have underlying condition such as cardiovascular disease, diabetes, chronic respiratory disease, or cancer are more susceptible to develop serious illness. Anyone can be infected with COVID-19 and get seriously ill or die at any age. As a result, COVID-19 is a silent killer which has killed over 5million persons globally (Worldometer, 2021 assessed on 2nd November, 2021) and most people suffer different forms of signs and symptoms which maybe mild, moderate or severe or a combination of the signs and symptoms. Some of these signs and symptoms are time dependents in the sense that it may take someone who has headache or fever more than 14 days to resolve or less days. The focus of most studies was conducted on patients that were affected by the disease (Wynants et al., 2020), some authors just described the situation of the general population (C. Wang et al., 2020) but surprisingly in Africa and Ghana to be precise, no studies has been conducted to determine the time to resolution of signs and symptoms shown by COVID-19 patients and determinants of these signs and symptoms and research in this area will help in the management of COVID-19 cases, planning purposes, prevention of spread of COVID-19 infection, workplace and school arrangement.

Symptom relief has been adopted as a criterion for discharging patients without laboratory tests. The WHO recommends that symptomatic patient should be discharged 10 days following the commencement of the symptom and at least 3 days without symptoms (World Health

Organization, 2020) but at the Korle Bu Teaching Hospital, patients are discharged after 14 days from the symptom resolution thus it is critical to grasp the clinical aspects of COVID-19 and the time it takes for the symptoms to resolve in order to discharge positive clients.

1.3 Significance of the Study

The knowledge envisaged to be gained from the findings of this study will enhance the clinicians in making decision on discharging SARS-Cov-2 infected patients at the Korle Bu Teaching Hospital (KBTH), Public Health Unit and the country as whole. It will also help in planning workplace and schools shift system as well as prevention of the spread. It will also provide useful insight into patients' knowledge about their condition. Finally, this study will unearth other areas for further research and ultimately help improve medical, psychological and social dimensions of issues that affect symptomatic COVID-19 patients.

1.4 Hypothesis

The true time to signs and symptoms resolution is not associated with the covariates of SARS-Cov-2 infection.

1.5 Research Questions

- What symptoms are prevalent among COVID-19 patients attending the Public Health Unit of Korle Bu Teaching Hospital?
- What is the time to resolution of symptoms among COVID-19 patients attending the Public Health Unit of Korle Bu Teaching Hospital?

- What are the factors associated with the time to resolution among COVID-19 patients attending the Public Health Unit of Korle Bu Teaching Hospital?

1.6 Objective of the study

To explore the determinants of time to resolution of symptoms among COVID-19 patients reporting to the Public Health Unit of Korle Bu Teaching Hospital.

1.6.1 Specific Objectives

- To describe the types of symptoms found among COVID-19 patients attending the Public Health Unit of Korle Bu Teaching Hospital.
- To determine the prevalence of symptoms found among COVID-19 patients attending the Public Health Unit of Korle Bu Teaching Hospital.
- To determine the time to resolution of key signs and symptoms found among COVID-19 patients attending the Public Health Unit of Korle Bu Teaching Hospital.
- To determine factors that affect the time to resolution of signs and symptoms found among COVID-19 patients attending the Public Health Unit of Korle Bu Teaching Hospital.

1.7 Conceptual Framework

The conceptual framework showing the determinants of symptoms of COVID-19 patients is shown in figure 1 below.

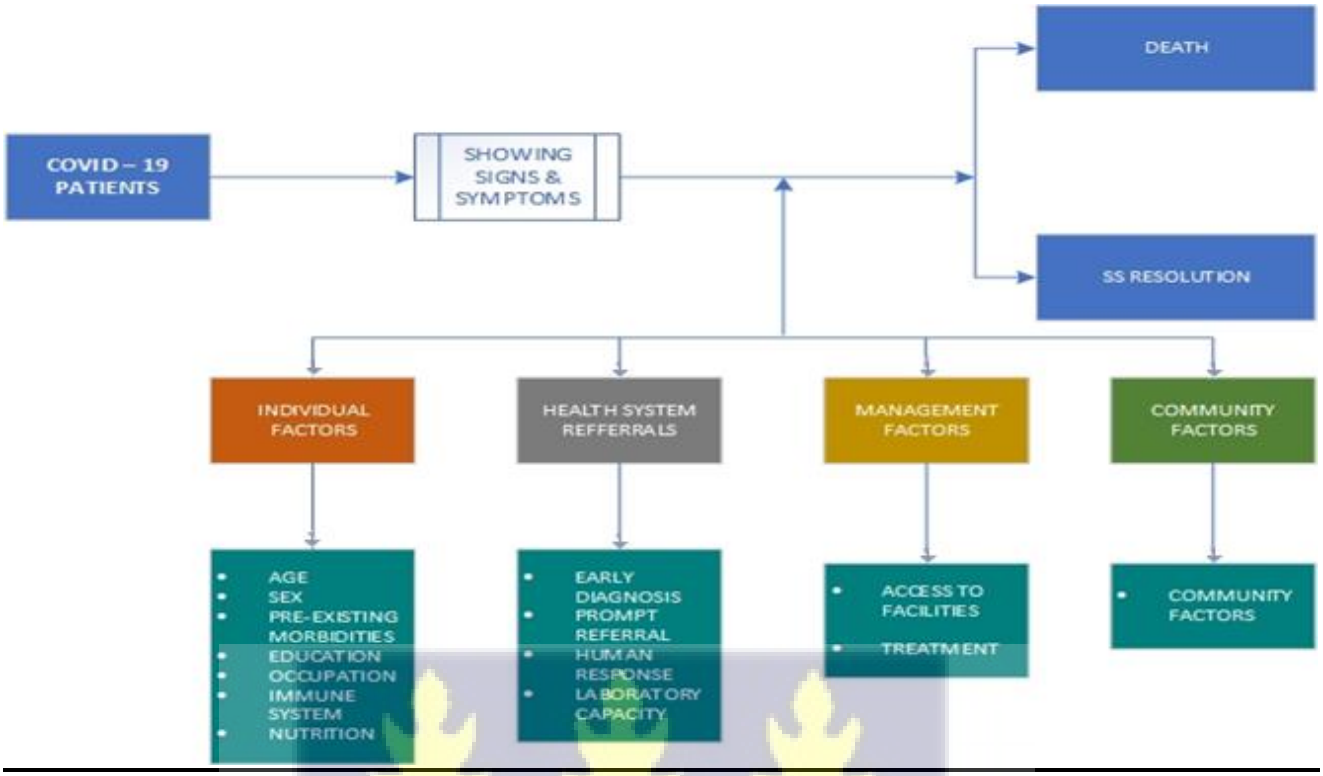

Figure 1. 1: Conceptual framework to determine factors that affect time to resolution of symptom of COVID-19 patients reporting to the Public Health Unit of KBTH

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Coronaviruses

The Covid-19 virus is a positive-strand ribonucleic acid virus with an enclosed genomes of up to 3.5 kb, making it one of the biggest of all ribonucleic acid viruses (al., 2018; Whelan et al., 2015). The severe acute respiratory syndrome coronavirus 2 is distinguished from different coronaviruses by a trimeric S glycoproteins found in the pleomorphic oval membrane (Hussain et al., 2020; Olwenyi et al., 2020). The virus's complicated structure is thought to contribute to the virus's capacity to live in aerosols for up to three hours (Olwenyi et al., 2020). SAR-CoV-2 Like other coronaviruses replicates by continuous RNA synthesis but it is unusual in the RNA world since it executes transcription via a discontinuous process which is a hallmark of the Nidovirales order. The crucial coronavirus N protein RNA chaperon, which increases transcriptional efficiency, is one of the elements that controls the discontinuous process (al., 2018).

2.2 Pathology of Coronavirus

Coronavirus has long been known to infect livestock and other animals causing a range of devasting infections. Coronaviruses were assumed to generate solely self-limited infections in humans before SAR-CoV outbreak in 2002, (Whelan et al., 2015). Historically, coronaviruses have been found to be endemic to the human population which is low in toxicity and cause up to 30% of all respiratory infections annually (al., 2018; Whelan et al., 2015). The dissimilarity between the excess pathology caused by the non-human coronavirus and the moderate pathology caused by HCoV has traditionally been thought to explain the difference in resistance to genetic diversity (Whelan et al., 2015). SARS-Coronaviruses not only debunked the idea that coronaviruses couldn't produce life-threatening illnesses amongst people, but they put the viruses transmission from bats

to humans to the test. SARS-CoV-1, it is thought to have started with Chinese horseshoe bats, since it was related to almost 8000 cases and 700 fatalities during the 2002-2003 pandemic, in addition of the billions of money lost in economic transactions (Whelan et al., 2015). Bat SARS-associated Coronaviruses were discovered to be more related to SARS-Coronaviruses than other viruses previously detected and they exploited the same ACE2 receptor found in HCoVs (Whelan et al., 2015). Contamination with SARS-Coronaviruses caused with more serious infections and greater death rates in comorbid and older patients, as with most HCoVs. Surprisingly, the age-related increase in intensity observed in SARS-Coronavirus patients has been replicated by investigating the illness pathway in rats infected with particular virus strains (Whelan et al., 2015). Despite the fact that SARS-CoV-1 expanded to over 25 countries, viral transmission became exceedingly inefficient, with the best method of transmission being direct contact after infection (Olwenyi et al., 2020; Whelan et al., 2015). After the epidemic was declared handled in June 2003, the virus was substantially restricted by quarantining, with only a few documented cases (Whelan et al., 2015). In 2012, a new coronavirus MERS-CoV epidemic was controlled, with zoonotic contamination carried directly from camels to human beings. Approximately, 2500 people who have been infected with MERS and the over 868 people who have died as a result of the disease should not be neglected, contamination incidents have so far been limited to the Middle East due to extremely low transmission rates (Olwenyi et al., 2020).

2.3 COVID-19

CoV become located at some point of the 1960s. The Coronavirus Study Group, which is member of the International Committee on Virus Taxonomy, employed comparative genomics to validate and partition replicative proteins in coding sequences in order to find the components that

distinguish CoVat unique cluster rankings (Gorbalenya et al., 2020; Woo et al., 2005). CoV is related to contamination of assorted intensity. SARS (in 2002–2003) and Middle East respiratory disease (MERS) are the most severe types that have resulted in large-scale pandemics in the past (in 2012) (Cheng, Lau, Woo, & Kwok, 2007; J S M Peiris et al, 2020).

2.4 Epidemiology of Coronavirus

2.4.1 Clinical features

SARS-CoV-2 initially surfaced in December 2019 in Wuhan, China, as a cluster of atypical pneumonia case (*WHO's Response to COVID-19*, 2020). China revealed the first death caused by the rare coronavirus on January 11, 2020. The first instance of the virus was reported in the United States on January 21, 2020, with a middle-aged healthy male who reported cough and perceived fever upon returning from a visit to his own circle of relatives in Wuhan, in mid-January 2020 (Holshue et al., 2020). The WHO classified the atypical coronavirus a Public Health Emergency of International Concern on January 30, 2020, citing the growing signs of human-to-human transmission beyond China. The World Health Organization has raised the COVID-19 kingdom of emergency to pandemic status on March 11, 2020 (*WHO's Response to COVID-19*, 2020).

As of June 14 2021, there had been over 176 million showed instances of COVID-19 globally, with 3,822,518 mortalities according to the WHO (Worldometer, 2021). Europe and America have the highest proportions of the world infections; 47,221,084 (26.7%) and 70,844,412 (40.0%) respectively. Africa's cases accounts for only 2.8% of the world's infections (Worldometer, 2021). The WHO Americas Region continues to be the most afflicted, accounting for half of all reported cases and half of all deaths (WHO, 2021). As of 13th June, 2021, there has been over 5 million

cases of SARS-CoV-2 in the Africa region sub- region with 134,818 deaths and over 4.5 million recoveries. A total of over 49 million tests has been done so far in the region (Africa CDC, 2020). In Ghana, there is a total of over 1.2 million COVID-19 tests has been done and out of the total tests, there is 94,493 cases with 789 deaths and 92,589 recoveries as at 14th June, 2021. On March 12, 2020, Ghana recorded its first 2 cases and these cases were imported from Turkey and Norway. The country began its response with active surveillance for identification of cases and tracing of their contacts subsequently. Mandatory quarantine of tourists coming into the country was imposed on March 17, 2020. The borders have been eventually closed on March 22, 2020 and some restrictions of movement was placed on the Greater Accra region and the Ashanti region on March 30, 2020.

2.4.2 Criteria for diagnostic and Epidemiological analysis

WHO classifies COVID-19 asymptomatic individuals as mild, moderate, severe, or critical. Patients with mild illness fulfill clinical and epidemiological criteria and show no signs of viral pneumonia or hypoxia. When there are indicators of pneumonia, it is considered a moderate illness. Severe pneumonia exacerbated by the emergence of ARDS, septic shock, or sepsis is referred to as critical illness. Severe pneumonia is referred to as having more than 30 breaths per minute respiration rate or evidence of severe respiratory distress, whereas severe pneumonia that has been complicated by the onset of ARDS, septic shock, or a breathing rate of more than 30 breaths per minute or signs of severe respiratory distress is considered sepsis (WHO, Interim Clinical management report, 2020).

2.4.3 Epidemiology Risk factors of COVID-19

A study conducted in China on 72,314 individuals in the early days showed that age, male and comorbidities presence are all characteristics that enhance the risk of severe COVID-19-related illness and/or death (CDC, 2020b). Patients with one or more comorbidities are more likely to develop severe illness or be admitted to the ICU as compared to COVID-19 patients who do not have one or more comorbidities (J. Li, He, Yuan, et al., 2021).

A history of smoking is also a risk factor for severe COVID-19 cases in the intensive care unit (J. Li, He, Yuan, et al., 2021). Present-day smokers plus people with a history of smoking are prone to developing serious COVID-19 and the requirement for respiratory support, according to the most recent review of the smoking habits of COVID-19 persons; only a history of smoking is statistically significantly associated with an increase in deaths in hospitals (Charles, Sklavounos, Dutt, Seed, & Khajuria, 2021). Obesity was found to be common in COVID-19 positive patients than in COVID-uninfected controls in ICU patients requiring invasive mechanical ventilation (IMV) (Labreuche et al., 2020). The bulk of the US population can be classed as high-risk patients because to the bad prognosis of obese COVID-19 positive individuals.

2.5 Transmission

In view of the large number of infected people in the Wuhan wet market, which often sells live animals, it is speculated that this may be a zoonotic source of COVID19. Efforts have been made to find primary or intermediate reservoirs. Preliminary reports have identified two snakes that may be potential hosts for COVID-19; however, so far, there is no conclusive evidence of any other coronavirus reservoirs other than mammals and birds(Ji, 2020; Lanka et al., 2020) .

The SARS-CoV virus, which causes respiratory sickness, belongs to the coronavirus family. The virus generally spreads by respiratory droplets, but it has been shown to survive up to 72 hours on surfaces like plastics and chrome steels, as well as up to 24 hours on corrugated cardboard and up to 4 hours on copper surfaces in experiments (van Doremalen et al, 2019). The CDC has confirmed that aerosols infections can also occur (CDC, 2020). The COVID-19 transmission route appears to be comparable to the SARS-CoV transmission route (Riou & Althaus, 2020).

SARS-CoV emerged in 2002 as a result of cross-species transmission from animal to human, as well as human-to-human transmission. COVID-19 now has superspreading events (SSEs) associated with the same sample, resulting in a pandemic (Riou & Althaus, 2020).

Human to human transmission occurs through well-known routes such as direct aerosol-mediated transmission, contact and airborne transmissions and during medical procedures (Figure 1 below). Coughing and sneezing produce giant respiratory droplets (>5 μm) and exhalation and regular speech produce small aerosols (5 mm) (Dhand & Li, 2020). Studies on the effectiveness of face masks to reduce the spread of respiratory virus have shown that coronavirus is detectable in respiratory droplets and aerosol samples collected from patients who do not wear face mask covers (Zhou et al., 2020). Eyeglass safety is important to prevent spread, as the previous SARSCoV1 virus was detected in the tears of affected individuals and today's SARSCoV2 is transmitted via pathogens and droplets that can come into contact with the eye. (Chen et al., 2004; Marra et al., 2020).

The number one mechanism of transmission from human to human has been identified as droplets of respiratory mucus production and direct contact as the outbreak has progressed. The virus is released from the respiratory secretions via droplet transmission, which occurs when someone talks, sneezes, or coughs. Making direct touch with the mucous membrane of an infected patient

or person, the droplets have a tendency to transmit the virus. Droplets do now no longer travel distance greater than six feet and do now no longer linger withinside the air. This increases uncertainty concerning the mechanism of transmission possibly there are different feasible methods through which someone can get infected, for example, through touching surfaces or items which have the virus on it after which touching mouth, nostril or eyes (Rothe et al., 2020). A study report has shown the presence of SARS-CoV-2 in fecal and blood swab, similarly indicating the opportunity of multiply routes of transmission (Zhang et al., 2020). Previously, In the absence of a powerful vaccine, the most effective manner to manipulate and halt this outbreak was to apply isolation, common hand wash, and social distancing as a powerful preventive measure but several vaccines have been produced alongside the practice of the common preventive measure (Habas et al., 2020).

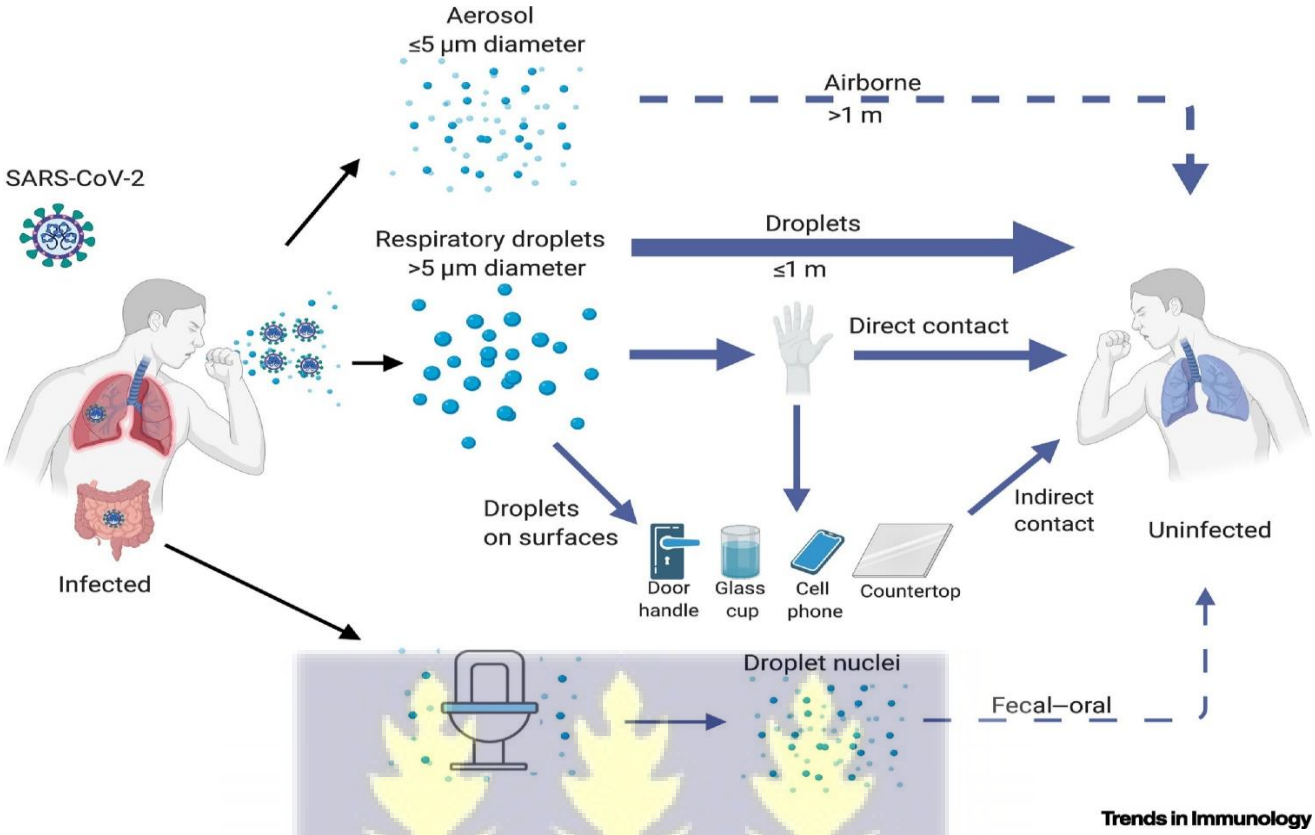

Figure 2. 1: Mode of transmission (Harrison et al., 2020)

2.6 Signs and Symptoms COVID-19 of COVID-19 Infection

The signs and symptoms of COVID-19 contamination appear after an incubation period of approximately 5.2 days (Q. Li et al., 2020). The duration from the beginning of COVID-19 signs to mortality varied between 6 and 41 days, with an average of 14 days. This time frame is determined the sick person's age and the state of his or her immune system. Patients over 70 years were shorter than those under 70 years (W. Wang et al., 2020). The most common signs developing a COVID-19 infection are fever, cough, and fatigue, but various signs include sputum production, headache, haemoptysis, diarrhoea, dyspnoea, and lymphopenia (Graham Carlos et al., 2020; Q. Li et al., 2020; Ren et al., 2020; W. Wang et al., 2020) (Figure 2). The clinical features shown as pneumonia on chest CT scan, however, there have been unusual capabilities which includes

RNAaemia, acute respiration distress syndrome, acute cardiac injury, and occurrence of grand-glass opacities that brought about loss of life (Huang et al., 2020). It is vital to notice that there are similarities withinside the signs and symptoms between COVID-19 and betacoronavirus which includes fever, dry cough, dyspnea, and bilateral ground-glass opacities on chest CT scans (Huang et al., 2020). COVID-19, on the other hand, validated a few specific scientific or clinical traits, including the targeting of the lower airway as a source of upper respiratory tract symptoms including rhinorrhoea, sneezing, and sore throat (Antonio et al., 2003; Assiri et al., 2013).

The clinical symptoms range from mild to severe or fatal. The most common symptoms of COVID19 are non-specific, including fever, cough, and muscle pain. Other mild symptoms include sore throat, headache, chills, nausea or vomiting, diarrhea, pain, and conjunctival congestion. COVID19 has been clinically divided into mild to moderate disease (not pneumonia and pneumonia) and severe disease (shortness of breath, respiratory rate exceeding 30%). min, oxygen saturation is less than 93%, PaO2 / FiO2 ratio is less than 300 and/or the lung infiltrates more than 50% of the lung field within 24-48 hours) and critically ill (respiratory failure, septic shock and/or dysfunction/ Multiple organs) (Bhatt et al., 2021; Raoult et al., 2020). Many elderly patients with severe diseases show signs of chronic underlying diseases, such as cardiovascular disease, lung disease, kidney disease, or malignant tumors (T. Wang et al., 2020).

The asymptomatic transmittance of COVID-19 occurs at excessive rate, a completely asymptomatic path is unlikely, accounting for as few as 1% of cases (Novel et al., 2020). The asymptomatic incubation duration is longer than the presymptomatic duration. Because the WHO class of illness begins off with clinical presentation, and symptomology can take greater than 14 days to present, active recognition signs and symptoms is critical to halting disease spread (Qin et al., 2020; WHO, Interim Clinical management report, 2020) . Fever and cough are the common

and contagious feature of COVID-19 infection. Fatigue, myalgia, and dyspnea are other typical complaints. Chills, GI trouble, and neurological abnormalities are all unusual indications of infection (Ghayda et al., 2020; Manabe, Akatsu, Kotani, & Kudo, 2020;T. Wang et al., 2020). Fever and shortness of breath were strongly correlated with those classified as serious, even as fever above 39 degrees Celsius was not statistically significant between the two groups, according to a meta-analysis comparing clinical features and outcomes of symptomatic COVID-19 patients classified as severe and non-severe. Cough, vomiting, migraine, sore throat, diarrhoea, muscle aches, and weariness were just not reported in either group (J. Li, He, Yuan Yuan, et al., 2021). When compared to other clinical symptoms and laboratory data, chills demonstrated a substantial positive link with COVID-19 diagnostic indicators (Ghayda et al., 2020).

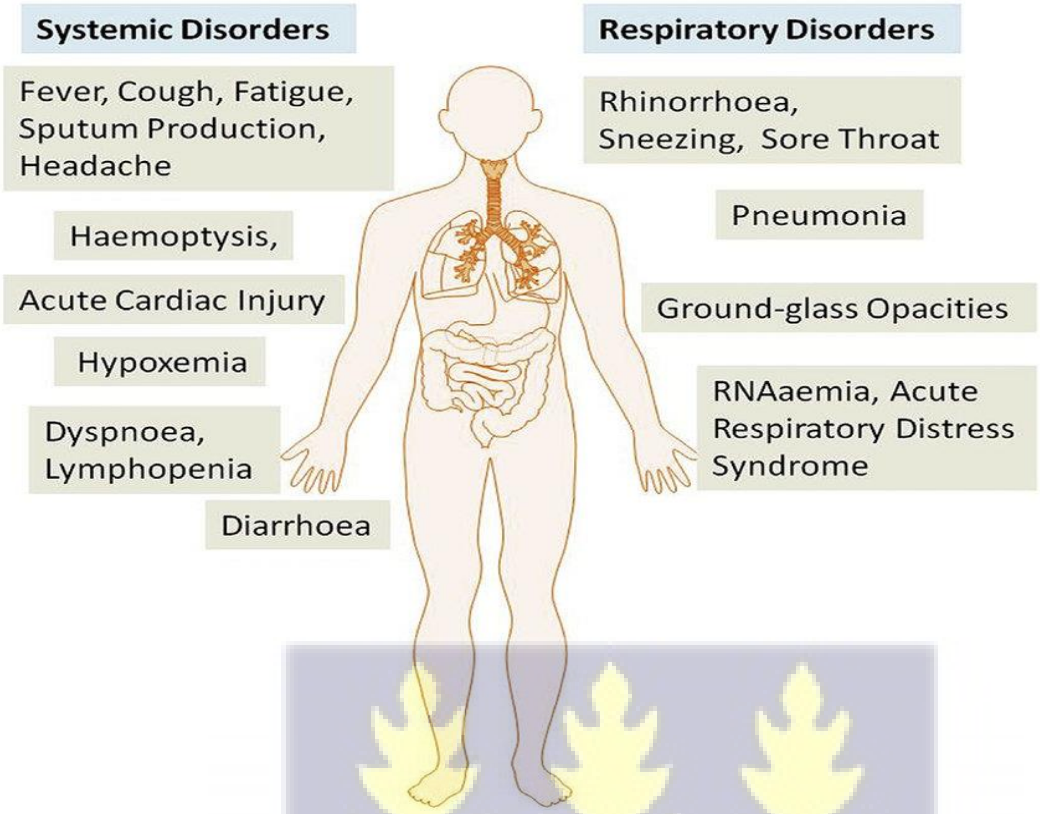

Figure 2. 2: The systemic and respiratory disorders caused by COVID-10 infection (Naz et al., 2021)

2.7 Mortality

More than 247 million infections have been confirmed worldwide since the first report of SARS-Cov-2, with over 5 million deaths (Worldometer, 2021 assessed on 2nd November, 2021). Data from China and Italy revealed a case-fatality rate of 2.3 percent in COVID-19 patients, with more than half of the fatalities occurring in patients who are 50 years of age or older (Rossella et al, 2020). In Northern Italy, mortality was 36 percent in patients aged 64 years and older compared with 15 percent in younger patients (Grasselli et al., 2020). The ability to prevent, detect and respond to outbreaks varies widely from country to country (Kandel et al., 2020).

2.8 Management and Treatment

Nearly 80% of COVID-19 patients have a minor sickness that does not require medical treatment or hospitalization (Stokes et al., 2020). The majority of patients with mild COVID-19 is referred to as the absence of pneumonia and hypoxemia and may be treated at home or in an ambulatory care environment according to the National Institutes of Health (NIH). Patients with moderate COVID-19 (viral pneumonia without hypoxemia) or serious COVID-19 (dyspnea, hypoxemia, or lung infiltrates higher than 50%) will need a personal assessment and careful supervision because respiratory disease can progress quickly and necessitate hospitalization (CDC, 2021). Healthcare practitioners should identify patients that are at a high risk of developing a serious condition. In an outpatient setting, These COVID-19 patients are being treated with supportive care while also taking efforts to decrease the danger of SARS-Cov-2 transmission, such as wearing face masks, isolating the patients, washing hands, and exercising social distance, among other things. This supportive care involves controlling symptoms, maintaining sufficient nourishment for patients, and addressing the hazards of social isolation, which are particularly frequent in older persons. COVID-19 disease can cause severe sickness and death in people of all age, even if no risk factors present.

2.9 Vaccination

Vaccination is widely considered as one of the most effective methods of disease prevention, as well as a cost-effective technique for improving population health (Bloom et al., 2005; Londono et al., 2021). Immunity at the population level against infectious illnesses like COVID-19 is important since it lessens the possibility of the disease spreading because many more individuals

are resistant to the microorganisms that cause COVID-19 (Randolph & Barreiro, 2020). Herd immunity to an infectious illness can emerge as a consequence of vaccination or naturally generated immunity as a result of previous infection. The WHO recommends building herd immunity by vaccination rather than exposing the community to an infectious illness.

Before disease infection rates begin to drop, a considerable proportion of the population would need to be vaccinated to develop herd immunity. (WHO, 2021). COVID-19 herd immunity levels are said to be in the 60-70 percent range to break the transmission chain (Aschwanden, 2021.). . In February 2021, the Ghanaian government stated that it aimed to get 17.6 million vaccination doses by the end of June 2021. The COVAX facility, as well as other bilateral suppliers such as Russia's Sputnik V vaccine, Johnson & Johnson, Pfizer Inc, and Moderna Inc, provided Ghana with its inaugural vaccination doses. According to the Ghana Health Service, a total of 3,188,114 vaccine doses were administered as of November 5th, 2021 (*COVID-19 Updates Ghana*, n.d.)

2.10 Time to Symptoms resolution

Time to symptoms resolution is defined as the duration it takes for a particular sign or symptom of COVID-19 to resolve. Several studies have been done globally but only few studies have been done in Africa. In Europe, a study done by Lechien et al involving 1420 patients showed that the mean duration of signs and symptoms till resolution was 11.5 days (SD=5.7 days) (Lechien et al., 2020). Chang et al reported the median time to symptom resolution of 8 days (IQR 6.25 – 11.5) (Chang et al., 2020). Park et al also found that time to symptoms resolution of 7 patients was 10 days with a range of 2-38 days (Park et al., 2020). Xu et al also found in a study in Wuhan on 113 patients with confirmed SARS-Cov-2, a mean duration of 11 days (Xu et al., 2020). No studies have been done in the Sub-Saharan African.

2.11 Health system referrals in the era of COVID-19

The coronavirus pandemic has caused more deaths than any other single disease since the outbreak was confirmed in Wuhan, China. The WHO in collaboration with the national and international health agencies continues to lead the way in bracing global healthcare systems in the fight against the pandemic (Dzando et al., 2022). Many countries, developed, developing and underdeveloped continue to struggle with the increasing daily number of cases.

The global impact of COVID-19 is overwhelming. The WHO predicted the gross impact when it announced at the early stages of the outbreak that the consequences of the virus at the time in Italy and Iran could be replicated in other countries. International and national health institutions across the globe moved into action and have remained in action since the commencement of the outbreak. The overbearing effect of the disease on these institutions has been enormous. Developed countries, with their best technology advancements and well-equipped systems continue to struggle with the efforts to contain the spread and fight the hefty effects of the pandemic. The impact of the pandemic in low resourced countries can be predictably devastating due to poor healthcare systems, lack of policy directions, disparities in healthcare accessibility and economic problems (Dzando et al., 2022).

The healthcare sector in Ghana operates on 3 main levels: national, regional and district levels and they are all under the auspices of the Ministry of Health which regulates the administration and operationalization of healthcare delivery in the country through policy development and coordination of health services(Ministry of Health of the Republic of Ghana, 2022). Under the MOH, there are provider institutions of which the Ghana Health Services is the largest healthcare provider of public health services. The system of service delivery varies from urban centers to rural centers (Krah et al., 2018).

Ghana has one of the best developed health systems in sub-Saharan Africa in terms of availability of health facilities and personnel. The country operates a pluralistic health system including the orthodox and non-orthodox sectors as well the popular sector efficiently, nonetheless the health system has many challenges which includes a weak referral system (Ghana Health Servce, 2016; MoH, 2012). A formal referral system requires patients to first access primary care and then be referred to an appropriate higher level which has all the expertise when the need arises(MoH, 2012). In Ghana, patients/clients in the conventional health system are expected to access services from primary services incrementally (e.g., the Community-based Health Planning Services, CHPS, and health centres), through secondary facilities (e.g., district hospitals) and if required to the highest services (regional and tertiary hospitals) as shown in Figure 2.3 below. During the peak of COVID-19 in Ghana, designated health centers were tasked to provide treatment to the positive cases. Some hotels were also used in monitoring travelers who had come into the country and had tested positive on arrival, they were kept for some number of days and were being attended to by Health professionals from different hospitals.

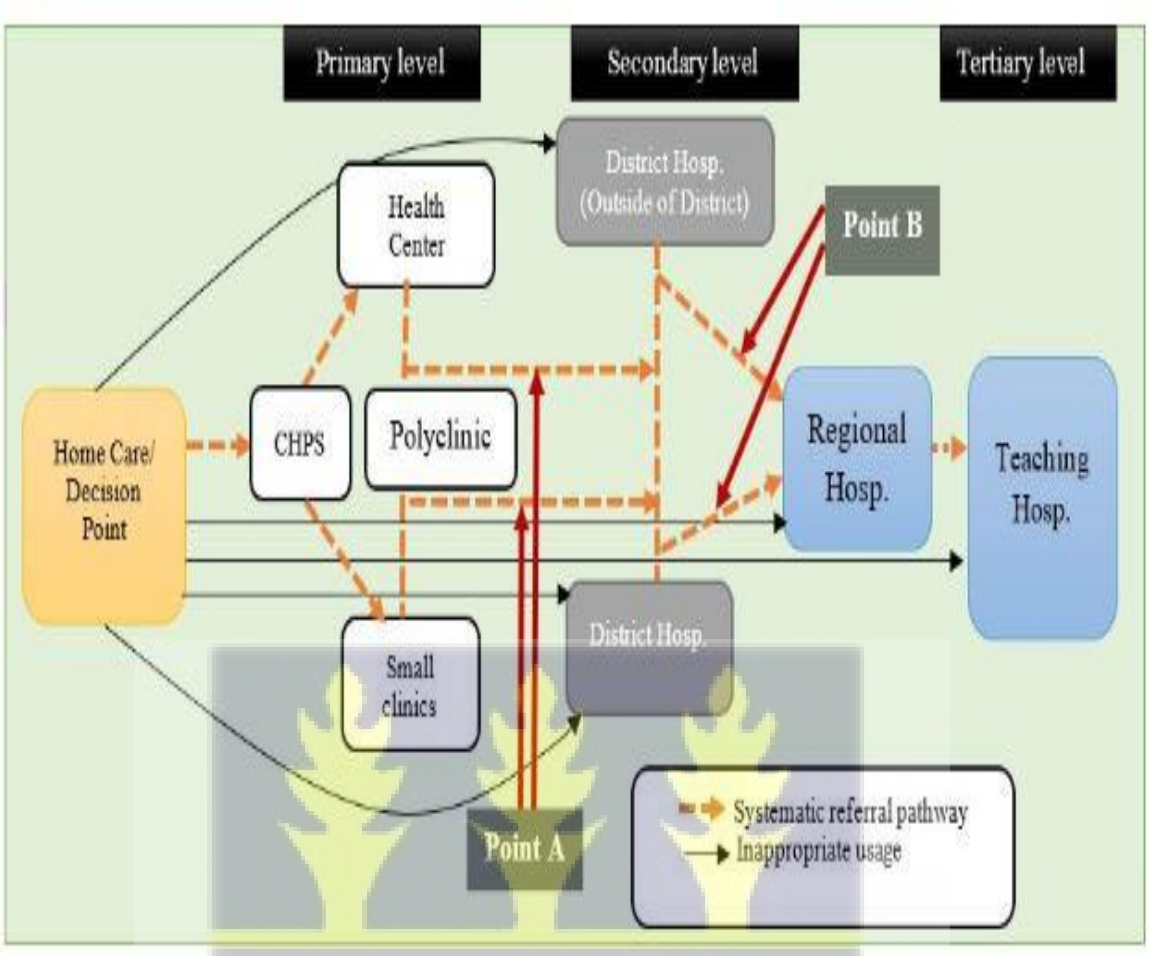

Figure 2. 3: Ghana Referral system (Aberese-ako et al., 2022)

2.12 Community factors affecting COVID-19 in Ghana

The COVID-19 pandemic has had devastating economic and humanitarian consequences around the world, as the virus's rapid spread has overwhelmed and devasted political, social, economic, and health systems and networks. The virus's emergence, combined with the effects of government-enacted policies, is expected to have serious consequences for the community (UNICEF Social Policy Research Institute (SPRI) National Development Planning Commission (NDPC), 2021). According to a study published in 2022 by Matilda et al, COVID-19 and the government's mitigation measures had a negative impact on vulnerable communities, including

loss of livelihood and income, inability of families to obtain enough food due to the lockdown, anxiety, depression, and poor health seeking behavior. To deal with COVID-19, people had to employ a variety of coping mechanisms (Aberese-ako et al., 2022).

Food prices have risen in countries such as Ghana, which is heavily reliant on imported food items. This has resulted in a lack of affordable food for the urban poor and their families. The strict enforcement of disease control protocols - partial lockdown and social distancing - at the disease's epicentres has resulted in low sales for food traders while causing severe financial distress for traders and vulnerable groups who have had to stay at home (Asante & Mills, 2020).

People were unwilling to seek healthcare even if they were ill because they were afraid of contracting the virus from health facilities, had misconceptions about COVID-19, and had a distrust of public health facilities due to a perceived failure of health facilities to follow standard protocols in dealing with COVID-19 cases (Aberese-ako et al., 2022).

It was reported that they were afraid to seek medical attention when they had a cough or other symptoms because it could be misinterpreted as COVID-19 or they could be tested for COVID-19 by health providers. A similar study conducted in Ghana's Cape Coast Metropolis discovered a decrease in the utilization of healthcare services as a result of the impact of COVID-19, and participants complained about negative reception at health facilities. Another study found that study participants were afraid of being treated as COVID-19 infected if they went to the doctor with symptoms like coughing, flu, and fever (Ishaque et al., 2021). Saah et al., on the other hand, reported that COVID-19 had a positive impact on the health seeking behavior of some of their study participants.

They now visit health facilities on a regular basis for check-ups because they have become more health-conscious of the risks of chronic diseases such as diabetes and hypertension, as well as the importance of managing them early (Ishaque et al., 2021).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study design

This study employed a Historical Cohort Study design using all symptomatic COVID-19 positive cases from May, 2021 to July, 2021 who reported to the Public Health Unit of Korle Bu Teaching Hospital. Data for this study was sourced from the Public Health Unit Database. These data may be regarded as secondary data since the data was recorded primarily for the use of the hospital.

3.2 Study Area

The study was undertaken at the Korle Bu Teaching Hospital (KBTH). Korle Bu Teaching Hospital is situated in Accra, the capital city of Ghana. The Hospital was established in 1923, by the British Colonial Governor, Sir Gordon Guggisberg as a hospital to serve the people of Accra. The Greater Accra Region presently has an estimated population of 5.1 million people (Ghana Statistical Service, 2020). With steady growth from a 192-bed facility to a 2000-bed facility, the KBTH is now the principal national referral centre, serving a country of an estimated 25.37 million individuals according to the 2010 population census (Ghana Statistical Service (GSS), 2013). The Korle Bu Teaching Hospital is the largest hospital in West Africa and the third largest in Africa, serving as a major referral point for the West African sub region. The hospital presently has 17 clinical and diagnostic departments/units and an annual total attendance of approximately 321,481 patients (Korle-Bu Teaching Hospital, 2016).

The KBTH Public Health Unit is the first comprehensive institutional public health service in Ghana established in April, 2009. The Unit exists to provide public health perspective and orientation on the clinical services of the Hospital towards achieving comprehensive health care

delivery. The Unit provides services such as direct patient and caregivers public health services, Primary level PH services, cross-cutting/Strategic PH services and Flagship PH health projects for short-term medium term.

3.3 Study Population

The study population was all COVID-19 patients that reported to the Public Health Unit, KBTH. A total of 1,410 samples were tested for COVID-19 and it recorded a total of 250 positive cases between May-July, 2021.

3.3.1 Inclusion Criteria

All COVID-19 cases who either manifested/ or reported any illness or symptoms or did not manifest any symptom from the onset of the diagnoses and consented and as well were followed up to the 14 days are to be part of the study.

3.3.2 Exclusion Criteria

- All COVID-19 cases that did not consent to the study when they were called
- Recovered symptomatic patients
- Those consented but failed to pick up their calls in order for us to record their symptoms in a day.
- Asymptomatic COVID-19 patients

3.4 Study variables

The variables measured in the study was divided into dependent and independent variables.

3.4.1 Dependent outcome

Time to key symptoms resolution is defined as the duration between when patient reported onset of the symptoms and the resolution of the symptoms.

3.4.2 Independent variables

The independent variables are as follows;

- Age
- Sex
- Occupation
- Educational level
- Comorbidities

3.4.3 Operational definitions of the study variables

The study variables and their operational definitions as well as scale of measurements are detailed in the table below (Table 3.1).

Table 3. 1: Operational definitions of dependent and independent variables

Variables	Operational definitions	Scale of measurement
Dependent Variable		
Time to symptom resolution	Duration between the onset of symptoms to the symptom resolution	Continuous
Independent Variables		
Age	Age at last birthday	Count
Sex	Male; Female	Nominal
Occupation	Employed; Unemployed	Nominal
Educational Level	Educated; Not Educated	Nominal
Comorbidities (Hypertension, Diabetics, Heart disease, Asthma, Chronic lung disease, Obesity)	Yes; No	Nominal

3.5 Sample determination and Sampling procedure

All Participants who reported to the Public Health Unit for COVID-19 testing and tested positive for SARS-CoV-2 (COVID-19) between May, 2021 and July, 2021 were recruited for the study. A total of 1,410 samples were tested during the period and 250 positives were recorded. Out of the 250 positives, 148 participants consented and participated in the study.

Disclosure was done by the Psychosocial team and are placed on treatment. These patients were then followed up for 14 days through a daily phone call and their symptoms are recorded into the Public Health REDCap database.

3.6 Data management and Analysis

Data collected was retrieved the PH Database exported to Microsoft excel. Data was cleaned and coded and later exported to STATA version 16.1 for further data analysis. Data was set to be survival time data. The dependent variable shown as a median with inter-quartile ranges (IQR) and the independent variables were presented as frequencies and percentage. The results were presented in tables and figures/Charts. Logrank test will be used to compare the symptom resolution experience of different categories of the covariates. The proportional hazard assumption (PHA) was checked using Schoenfeld residual. Cox regression model was fitted to determine the determinants of time to resolution of signs and symptoms among the symptomatic COVID-19 cases. Statistical significance was assessed at the 5% level. A 95% Confidence Interval was constructed around point estimate where appropriate.

3.7 Ethical Consideration

Ethical clearance was obtained from the Ethics and Protocol Review Board of Korle Bu Teaching Hospital as a pre-requisite for conducting research in the Hospital (KBTH-IRB/000148/2021). Introductory letter was obtained from the Department of Epidemiology and Disease Control of the School of Public Health, University of Ghana to the Korle Bu Teaching Hospital for permission prior to the study. Appropriate courtesy was also extended to the Head of Unit of the Public Health Unit prior to the commencement of the study for the release of the data.

CHAPTER FOUR

4.0 RESULTS

4.1 Demographics of participants

A total of 1410 samples were tested for SARS-CoV-2 (COVID-19) during the period under review and a total of 250 positives were recorded. Out of the total positives, 148 participants consented and participated in the study.

Table 4. 1: Age distribution of participants

Age Group	Frequency	Percent
0-9 years	1	0.7
10-19 years	5	2.7
20-29 years	45	30.6
30-39 years	49	33.3
40-49 years	22	15.0
50-59 years	19	12.9
60+ years	7	4.8
Total	**148**	**100.00**

Table 4.1 above shows the age distribution of the participants in the study. Majority of the participants were between the ages of 20-49 years (78.9%) which forms part of the working force of the country. Less than 5% were below the age of 20 years and the rest were above 50 years.

The ages of the 148 participants in the study ranged from 8 to 78 years with a mean age of 36.6 years and standard deviation of 12.6 years (95% C.I: 34.6 to 38.7 years).

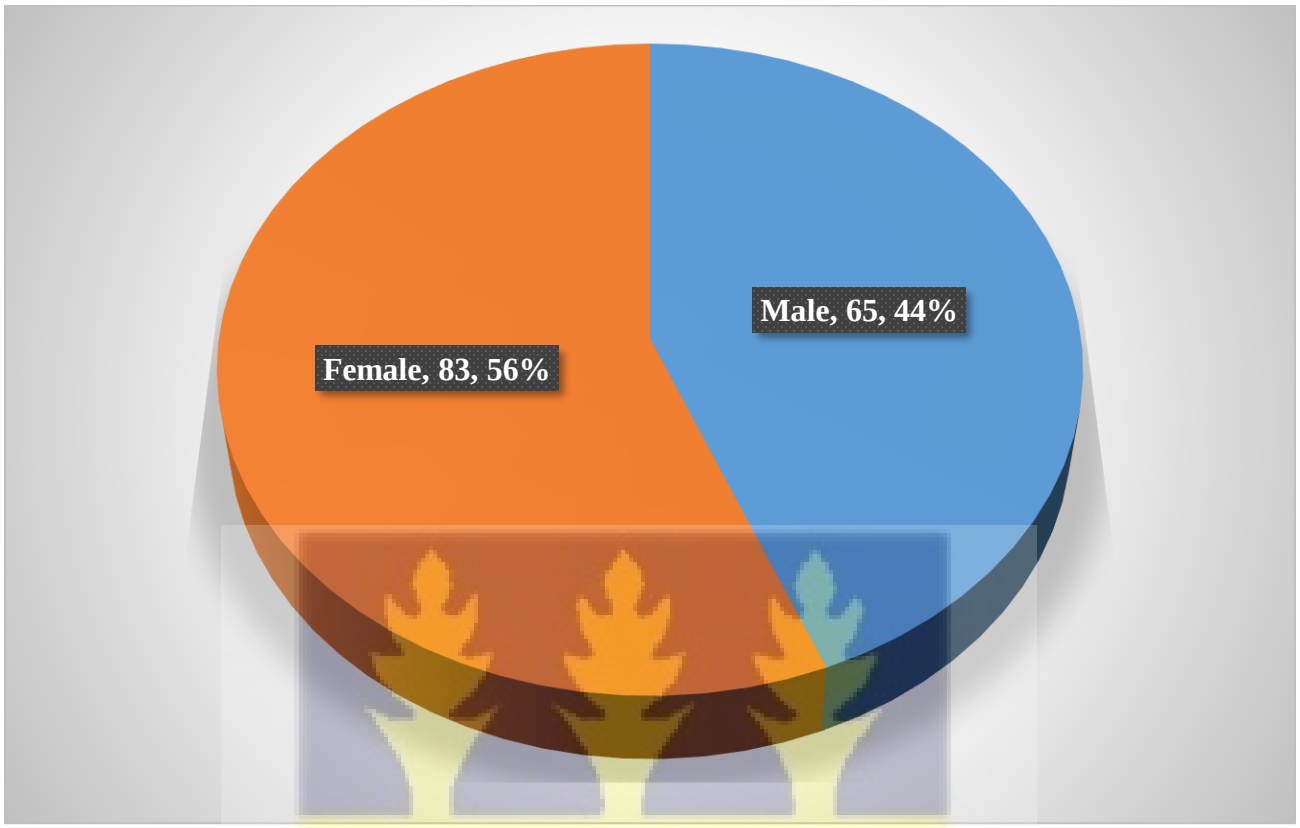

Figure 4. 1: Sex distribution of participants

The figure above shows the sex distribution of the participants. More than half (n=83, 56.1%) were females whereas the rest were males (n=65, 43.9%).

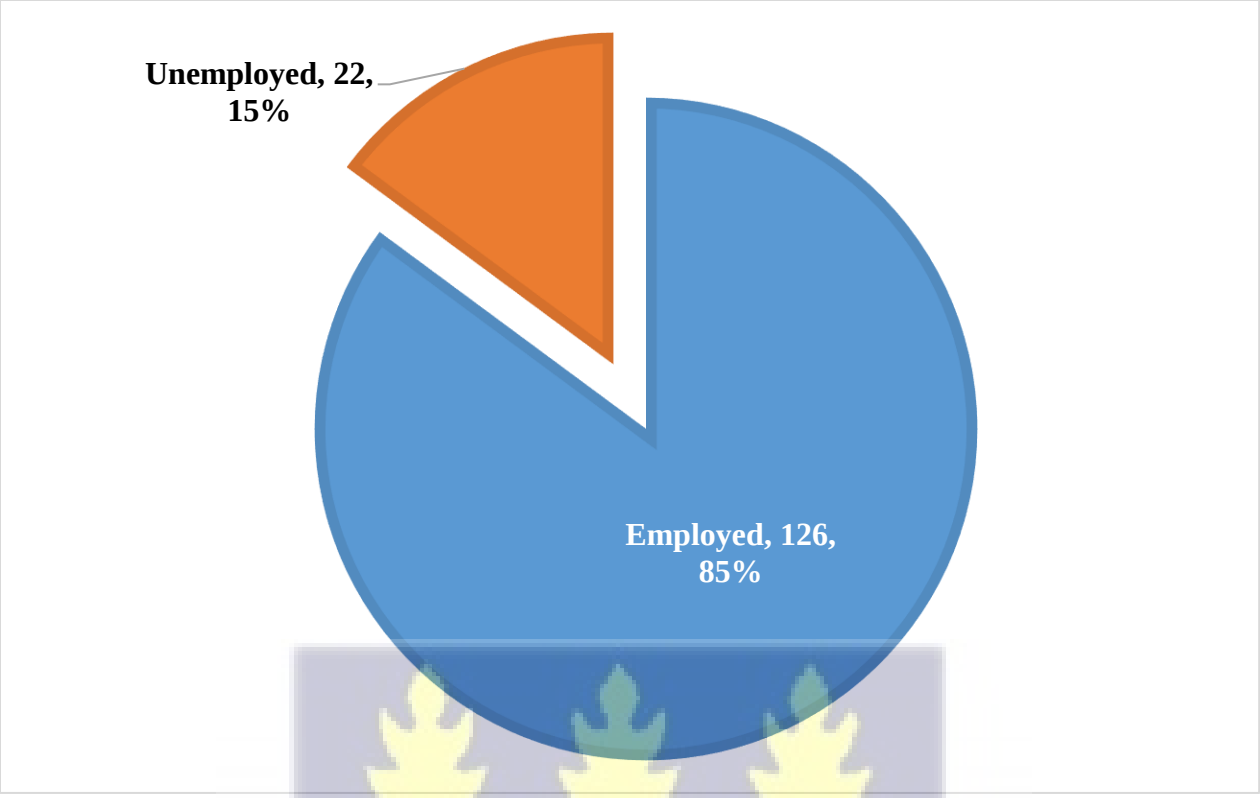

Figure 4. 2: Occupation status of participants

Occupation status of the 148 participants is shown in figure 4.2 above. Among the participants, almost all of them were gainfully employed (n=126, 85.1%) whereas the rest were unemployed (n=22, 14.9%).

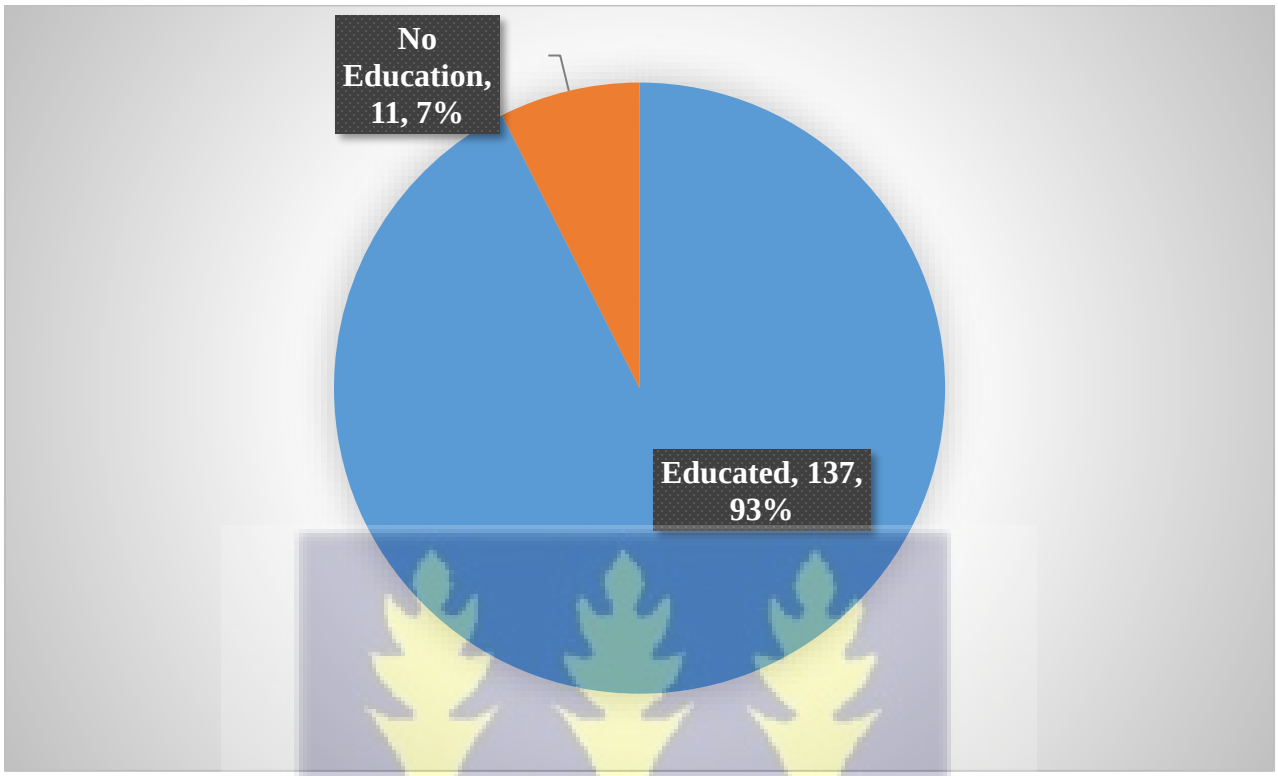

Figure 4. 3: Educational status of participants

The figure above shows the educational status of the participants. More than half of the participants were educated with at least a primary level of education and the rest of the participants were not educated at all.

4.2 Clinical features of Participants

4.2.1 Comorbidities reported by participants

Figure 4.4 shows the prevalence of comorbidities among the participants in the study. Fifty-three (35.8%) out of the 148 participants at least one comorbidity such as hypertension, diabetics, cancer, heart disease etc. The commonest co-morbid condition was hypertension which was present in more than half of those who reported having pre-existing morbidities.

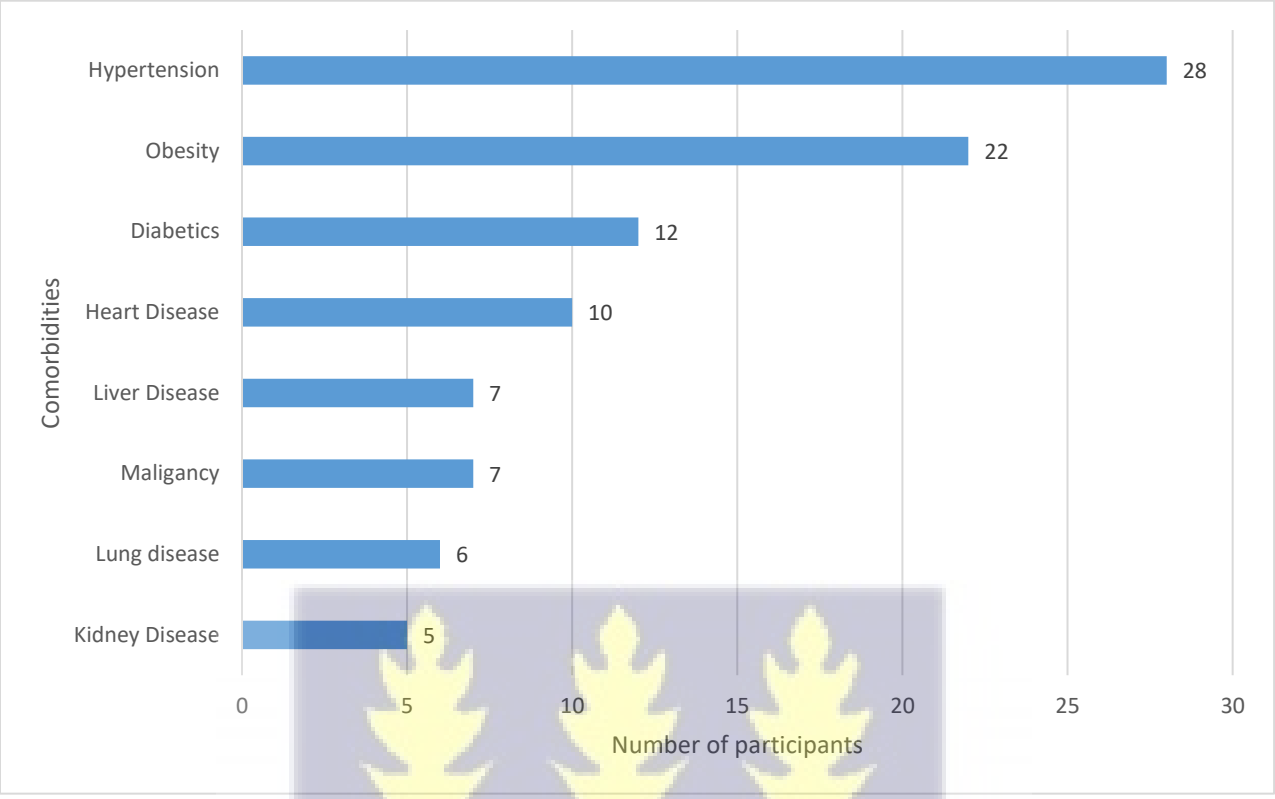

Figure 4. 4: Comorbidities reported by participants

4.2.2 Symptoms reported by the participants

Table 4. 2: Symptoms reported by the participants

Symptoms	Yes (N=148)	Percent
General Malaise	85	57.4
Fatigue	79	53.4
Headaches	78	52.7
Cough	67	45.3
Smell Loss	66	44.6
Body Pain	62	41.9
Loss of taste	58	39.2
Fever	57	38.5
Anorexia	52	35.1
Sore Throat	45	30.4
Chills	42	28.4
Hoarseness of voice	39	26.4
Chest Pain	38	25.7
Congestions	37	25.0
Breath Shortness	35	23.6
Abdominal Pain	29	19.6
Nausea	22	14.9
Diarrhoea	22	14.9
Confusion	14	9.5

The table above shows the symptoms reported by the participants. The top 5 symptoms were general malaise (57.4%), fatigue (53.4%), headache (52.7%), cough (45.3) and smell loss (44.6%). The least reported signs and symptoms were abdominal pain, nausea, diarrhoea and confusion.

4.3 Median duration of Comorbidities and Symptoms reported

4.3.1 Median duration of comorbidities

Table 4. 3: Comorbidities reported and their duration of symptoms resolution

Comorbidities	Median days of symptoms resolution (days)	IQR
Cancer	7.0	1.5-9.0
Kidney Disease	7.0	2.0-8.0
Obesity	3.0	1.0-5.8
Heart Disease	3.0	1.0-7.8
Hypertension	2.0	1.0-4.5
Liver Disease	2.0	1.0-8.0
Lung disease	2.0	1.3-5.8
Diabetics	1.5	1.0-4.8

Table 4.3 shows the comorbidities reported and its median duration of symptoms resolutions of participants in the study. Among the comorbidities reported, participants with cancers had the highest median days of symptoms resolution of 7 days and participants with diabetics had a median day of 1.5 for their symptoms to be resolved.

Table 4. 4: Symptoms reported and their duration of resolution

Symptoms	Median days of resolution	IQR
Nausea	6.0	4.3 – 7.8
Confusion	5.5	1.3 – 7.0
Headaches	5.0	1.0 – 8.0
Smell Loss	5.0	2.0 – 7.0
Taste Loss	5.0	2.0 – 7.0
Sore Throat	5.0	1.0 – 11.0
Anorexia	5.0	1.0 – 8.0
Body Pain	4.5	1.3 – 7.8
Fatigue	4.0	1.5 – 7.0
Malaise	4.0	2.0 – 7.0
Congestions	4.0	2.0 – 7.0
Breath Shortness	4.0	1.0 – 8.0
Chills	3.5	1.0 – 7.8
Chest Pain	3.5	1.0 – 6.8
Diarrhoea	3.5	2.0 – 6.0
Fever	3.0	1.0 – 7.0
Cough	3.0	1.0 – 6.0
Hoarse Voice	3.0	2.0 – 7.0
Abdominal Pain	3.0	1.0 – 7.0

Table 4.4 shows the duration of the symptoms reported by the participants. Among the symptoms reported, participants who reported nausea had their symptom resolved after 6.0 days and least median day for the resolution of participants who reported with abdominal pain was 3.0 days.

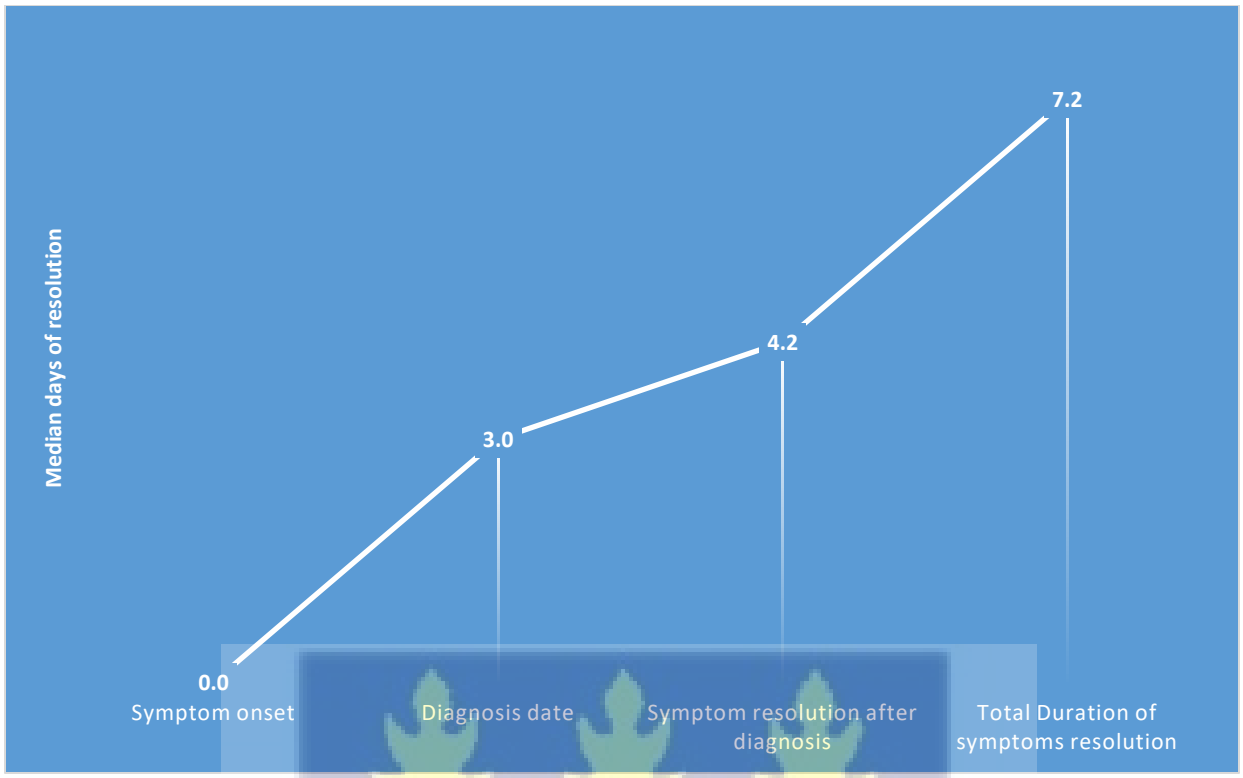

Figure 4. 5: Overall median duration of symptoms resolution

Figure 4.5 shows the overall median durations of symptoms of participants. The median time of identification of participants who reported to the Public Health Unit was 3 days after being symptomatic. The median time of the symptoms of the participants involved in the study was 4.2 days after diagnosis and the total duration for participants to have their symptoms resolve was 7.2 days.

4.4 Log rank test and Cox proportional hazard analysis of factors affecting time to resolution of signs and symptoms among COVID-19 patients.

4.4.1 Kaplan-Meier function survivor graph of participants

None of the participants censored in this study. The graph below shows the Kaplan-Meier survival estimate for the participants. It can be estimated 50% of the participants had their symptoms resolved after 4 days from the day of diagnosis.

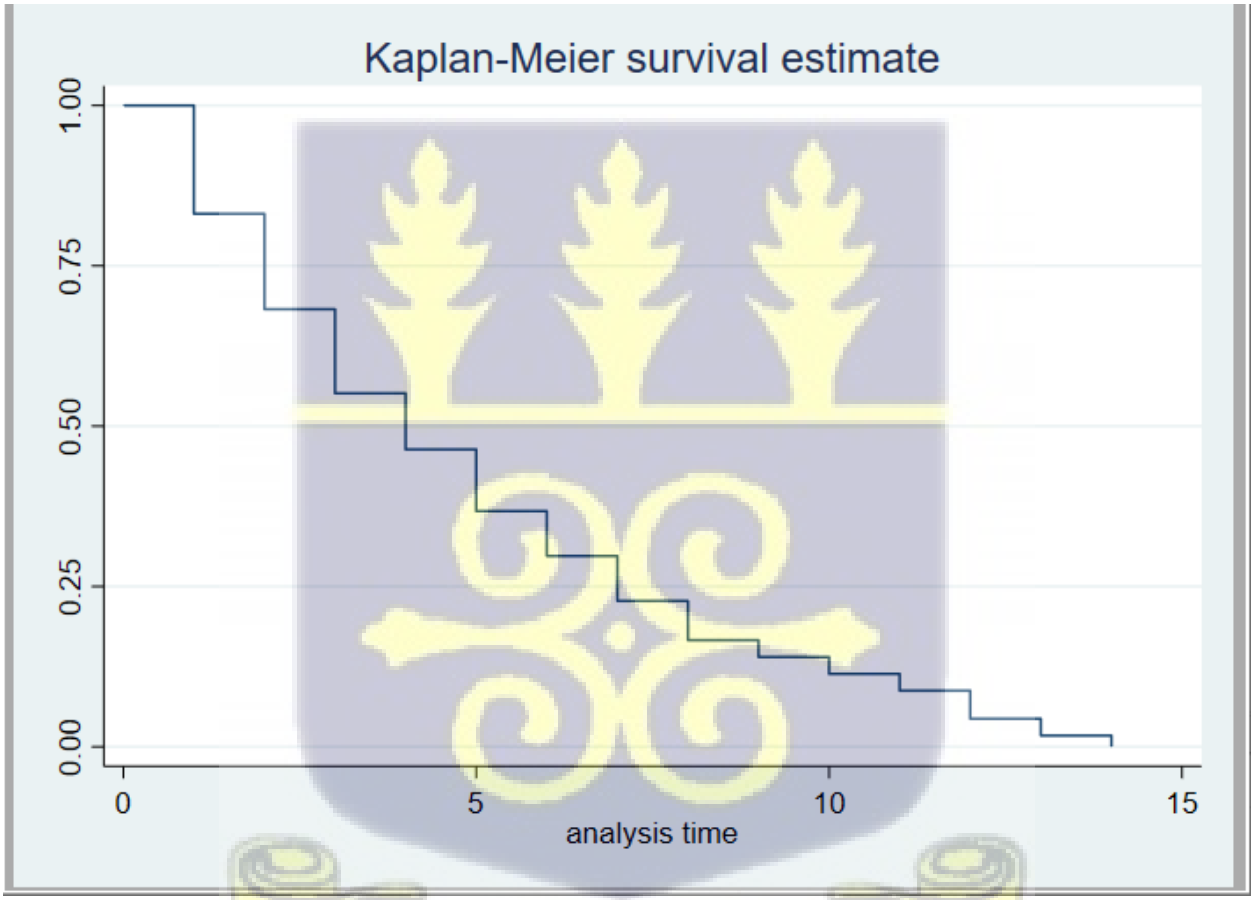

Figure 4. 6: Kaplan-Meier function survivor of duration of symptoms resolution of participants

Table 4. 5: Log rank test between covariates and median duration of symptom resolution

Variable		Chi2(1)	Log rank, P-value
Age group	**10-19 yrs** **20-29 yrs** **30-39 yrs** **40-49 yrs** **50-59 yrs** **60 yrs +**	8.56	0.199
Sex	**Male** **Female**	1.4	0.237
Educational Level	**Educated** **No education**	1.32	0.251
Occupation status	**Employed** **Not Employed**	2.15	0.143
Comorbidity	**At least 1 comorbidity** **No comorbidity**	1.75	0.185

Table 4.5 shows the log rank test of median duration of symptom resolution of the covariates in the study. Log-rank test was used to test the null hypothesis of no difference in survival (resolution of symptoms reported) between the covariates All the covariates; age group, sex, educational level, occupational status and comorbidity were not statistically significant ($p>0.05$) which means that the survival in covariates is equal.

Table 4. 6: Cox Proportional Hazards Analysis of factors affecting time to resolution of symptom among COVID-19 patients

Variables		Hazard ratio.	Std. Error	z	P>z	[95% Conf. Interval]
Age group	**0-9 years**	Ref.				
	10-19 years	0.525	0.585	-0.580	0.563	0.059-4.665
	20-29 years	0.660	0.691	-0.400	0.691	0.084-5.138
	30-39 years	0.505	0.529	-0.650	0.514	0.066-3.936
	40-49 years	0.689	0.729	-0.350	0.725	0.087-5.48
	50-59 years	0.802	0.853	-0.210	0.836	0.099-6.45
	60+ years or more	0.307	0.383	-0.950	0.344	0.027-3.538
Sex	**Female**	Ref.				
	Male	1.132	0.205	0.690	0.493	0.794-1.616
Educational Status	**Not Educated**	Ref.				
	Educated	0.539	0.300	-1.110	0.267	0.181-1.605
Occupation Status	**Not Employed**	Ref.				
	Employed	0.824	0.222	-0.720	0.473	0.486-1.398
Comorbidities	**No Comorbidities**	Ref.				
	At least 1 comorbidity	1.200	0.238	0.920	0.360	0.813-1.771

Table 4.6 shows cox proportional hazard analysis of the factors affecting time to resolution of symptoms among participants in the study. After adjusting for influencing covariates, there was no statistically significant difference in the median duration of resolution of symptoms among the age groups (p>0.05).

Holding other covariates, there was no statistically significant difference between sex and the median duration of symptoms resolution (HR=1.132, p=0.493) however, the expected hazard of having symptoms resolved among males is 13.2% times higher than females.

Being educated reduces symptoms resolution by a factor of 46.1%, there was no significant difference in the duration of resolution of symptoms between the educational levels of participants (p=0.267) if other covariates remain constant.

There was a 17.6% reduced risk of having symptoms resolved of employed compared to unemployed participants but there was no statistically significant difference between the occupation status holding other covariates constant (p=0.473).

There is a 20% increased incidence of resolving symptoms among participants who reported at least one comorbidity compared to those who did not have any comorbidity but there was no statistically significant difference in the duration of resolution of symptoms among those who reported comorbidities and those who did not have any comorbidities (p=0.360).

CHAPTER FIVE

5.0 DISCUSSIONS

5.1 Demographics characteristics of Participants

This study sought to determinants of time to resolution of symptoms among COVID-19 patients who reported to the Public Health Unit of Korle Bu Teaching Hospital between May, 2021 – July, 2021.

Majority of the patients recruited for this study were between the ages of 30-39 years which is in contrast to a study done in Ethiopia on 60 COVID-19 cases by Abdella et al which reported that the mean age was 34.8 years ± 14.2 years (Abdella et al., 2020).

The sex distribution in the this study showed that majority of participants were females which is similar to a study done in Europe among 18 hospitals shows that there were more females than males (females = 962 vs male = 458) (Lechien et al., 2020).

5.2 Clinical features of participants

This study findings showed 35.8% had at least one comorbidity and these common comorbidities among study participants were Hypertension, Obesity, diabetics and heart disease. This finding is similar to one found in a study done on the clinical feature of COVID-19 by Siordia Jr. et al. in 2020, which found that hypertension, diabetics and cardiovascular disease were the most frequent reported comorbidity (Jr, 2020).

Those with hypertension, obesity, heart disease, lung disease, liver disease, diabetes, and renal disease had their symptoms resolved by day 3. And the symptom resolution period of the participants who died, the number of cancer and kidney disease disappeared on the 7th day.

Respiratory and neurological illnesses were among the most commonly reported symptoms in the study participants. The top 5 symptoms reported are general malaise, fatigue, headaches, cough and loss of smell. The findings on the signs and symptoms from this study is similar to a study done by Abdella et al in Ethiopia (Abdella et al., 2020), Chang et al in China (Chang et al., 2020) and Siordia Jr et al (Jr, 2020) in 16 European Hospitals. In Ethiopia, the commonly reported symptoms in patients with COVID-19 were cough and headache; in China, it was cough and fever similarly amongst the 16 European hospitals, fever and cough were most reported signs and symptoms.

All participants in this study had signs and symptoms before the date of diagnosis for SARS-CoV-2 by rrt-PCR. The median duration of the resolution of signs and symptoms in this study is comparable to a study done in China by Chang et al and in Ethiopia by Abdella et al that reported a median duration of 8 days from the day of symptom onset (IQR: 6-10). However, this study's median duration is lower than the median duration of a study done in Soonchunhyang University Seoul Hospital which stated that the median duration was 10 days with a minimum of 2 to a maximum of 38 days (Park et al., 2020), in European hospitals stated 11.5 with a standard deviation of 5.7 days duration (Lechien et al., 2020), and in the hospitals outside Wuhan stated 11 days duration of symptoms resolution (Xu et al., 2020).

5.3 Factors affecting the time to resolution of signs and symptoms among study participants (COVID-19 patients)

There is little information on the factors affecting the duration of COVID-19 signs and symptoms resolution, however, the findings from this study revealed that none of the factors used in determining the duration of symptoms resolution were statistically significant.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

Our study revealed that the overall median time to resolution of COVID-19 symptoms from the onset of diagnosis 7.2 days. An average of 1 week were required to cure patients or staff with symptoms of SAR-CoV-2 in Ghana. Therefore, this knowledge envisaged from the findings of this study will enhance the clinicians in making decision on discharging patients infected with SARS-Cov-2 at the Korle Bu Teaching Hospital (KBTH), Public Health Unit and the country as whole. It has also helped in planning workplace and schools shift system as well as prevention of the spread.

6.2 Recommendations

The following recommendations are made:

6.2.1 Ministry of Health/Ghana Health Service

- A policy should be developed and implemented to enable case management teams in the various health facilities to discharge patients or isolate patients after 1 week of diagnosing them of COVID-19 especially for people with conditions such as cancers and kidney diseases. People with the following conditions, obesity, heart disease, hypertension, liver disease, lung disease and diabetics should be isolate or discharged if hospitalized due to COVID-19 after 3 days
- A policy should be developed and implemented to specifically ensure that management of companies and Schools should also give people infected with SARS-CoV-2 at least 1 week for isolation.

6.2.2 Future Research

- Extensive research should be done on the factors that affect the duration of time to the resolution of symptoms of COVID-19 patients.

6.3 Limitations

- There could be chances that people with mild symptoms overlooked the symptoms and did not report.
- The sample used for the study was small

References

Abdella, S., Tessema, M., Defar, A., & Whiting, S. J. (2020). *Factors that influence the duration of symptom resolution in COVID-19 patients in Ethiopia : A follow up study involving 60 symptomatic cases . January 2021*. https://doi.org/10.21203/rs.3.rs-138076/v1

Aberese-ako, M., Immurana, M., Dalaba, M. A., Anumu, E. Y., Ofosu, A., & Gyapong, M. (2022). *The socio-economic and health effects of COVID-19 among rural and urban-slum dwellers in Ghana : A mixed methods approach*. 1–26. https://doi.org/10.1371/journal.pone.0271551

Africa CDC. (2020). Coronavirus Disease 2019 (COVID-19) – Africa CDC. In *Africa CDC Dashboard* (Vol. 2019, Issue December, pp. 1–7). https://africacdc.org/covid-19/

al., R. et. (2018). 乳鼠心肌提取 HHS Public Access. *Physiology & Behavior*, *176*(5), 139–148. https://doi.org/10.1146/annurev-virology-100114-055218.

Antonio, G. E., Wong, K. T., Hui, D. S. C., Lee, N., Yuen, E. H. Y., Wu, A., Chung, S. S. C., Sung, J. J. Y., & Ahuja, A. T. (2003). Imaging of severe acute respiratory syndrome in Hong Kong. *American Journal of Roentgenology*, *181*(1), 11–17. https://doi.org/10.2214/ajr.181.1.1810011

Asante, L. A., & Mills, R. O. (2020). Exploring the Socio- - Economic Impact of COVID-19 Pandemic in Marketplaces in Urban Ghana. *Africa Spectrum*, 55(2), 170-181

Aschwanden, B. C. (n.d.). Why herd immunity for covid is probably impossible. *Nature*, *591*(7851), 520–522. https://doi.org/10.1038/d41586-021-00728-2

Assiri, A., Al-Tawfiq, J. A., Al-Rabeeah, A. A., Al-Rabiah, F. A., Al-Hajjar, S., Al-Barrak, A., ……Memish, Z. A. (2013). Epidemiological, demographic, and clinical characteristics of 47 cases of Middle East respiratory syndrome coronavirus disease from Saudi Arabia: A

descriptive study. *The Lancet Infectious Diseases*, *13*(9), 752–761. https://doi.org/10.1016/S1473-3099(13)70204-4

Bhatt, T., Kumar, V., Pande, S., Malik, R., Khamparia, A., & Gupta, D. (2021). A Review on COVID-19. *Studies in Computational Intelligence*, *924*(April), 25–42. https://doi.org/10.1007/978-3-030-60188-1_2

Bloom, D. E., Canning, D., & Weston, M. (2005). *The Value of Vaccination*. *6*(3), 15–40.

CDC. (2020). The Science of Masking to Control COVID-19 Most SARS-CoV-2 Infections Are Spread by People without Symptoms. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/downloads/science-of-masking-full.pdf

CDC. (2022). Management of Patients with Confirmed 2019-nCoV CDC. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/clinical-considerations-index.html.

CDC. (2020). Coronavirus Disease 2019 (COVID-19) | CDC Online Newsroom | CDC. In *Centers for Disease Control and Prevention*. Retrieved from https://www.cdc.gov/media/dpk/diseases-and-conditions/coronavirus/coronavirus-2020.html

Chang, D., Mo, G., Yuan, X., Tao, Y., Peng, X., Wang, F. S., Xie, L., Sharma, L., Dela Cruz, C. S., & Qin, E. (2020). Time kinetics of viral clearance and resolution of symptoms in novel Coronavirus infection. *American Journal of Respiratory and Critical Care Medicine*, *201*(9), 1150–1152. https://doi.org/10.1164/RCCM.202003-0524LE

Charles, W. N., Sklavounos, A., Dutt, A., Seed, P. T., & Khajuria, A. (n.d.). *The effect of smoking on COVID - 19 severity : A systematic review and meta - analysis*. https://doi.org/10.1002/jmv.26389

Chen, Y. C., Chen, P. J., Chang, S. C., Kao, C. L., Wang, S. H., Wang, L. H.,……Hsueh, P. R. (2004). Infection Control and SARS Transmission among Healthcare Workers, Taiwan. *Emerging Infectious Diseases*, *10*(5), 895–898. https://doi.org/10.3201/eid1005.030777

Cheng, V. C. C., Lau, S. K. P., Woo, P. C. Y., & Kwok, Y. Y. (2007). Severe acute respiratory syndrome coronavirus as an agent of emerging and reemerging infection. *Clinical Microbiology Reviews*, *20*(4), 660–694. https://doi.org/10.1128/CMR.00023-07

China CDC Wkly (2020). The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19)—China, 2020. *China CDC weekly*, *2*(8), 113. https://doi.org/10.3760/cma.j.issn.0254-6450.2020.02.003

Cl, M. (2020). *de Manejo Clínico Protocolo da Covid-19 de Manejo Clínico na Atenção Especializada Protocolo da Covid-19*. https://bvsms.saude.gov.br/bvs/publicacoes/manejo_clinico_covid-19_atencao_especializada.pdf

De Oliveira Lima, C. M. A. (2020). Information about the new coronavirus disease (COVID-19). In *Radiologia Brasileira* (Vol. 53, Issue 2, pp. v–vi). Colegio Brasileiro de Radiologia. https://doi.org/10.1590/0100-3984.2020.53.2e1

Dhand, R., & Li, J. (2020). Coughs and Sneezes: Their Role in Transmission of Respiratory Viral Infections, including SARS-CoV-2. *American Journal of Respiratory and Critical Care Medicine*, *202*(5), 651–659. https://doi.org/10.1164/rccm.202004-1263PP

Dzando, G., Salifu, S., Donyi, A. B., Akpeke, H., Kumah, A., Dordunu, R., & Nonoh, E. A. (2022). Healthcare in Ghana amidst the coronavirus pandemic: A narrative literature review. *Journal of Public Health Research*, *11*(1). https://doi.org/10.4081/jphr.2021.2448

Echeverria-Londono, S., Li, X., Toor, J., de Villiers, M. J., Nayagam, S., Hallett, T. B., ... &

Gaythorpe, K. A. (2021). How can the public health impact of vaccination be estimated?. *BMC Public Health*, *21*(1), 1-12. Retrieved from https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-021-12040-9

Ghana Health Servce. (2016). *National Safe Motherhood Service Protocol 2nd edition*. *June*. Retrieved from https://www.moh.gov.gh/wp-content/uploads/2017/09/2016-Annual-Report.pdf.

Ghana Health Service. (2021). COVID-19 Updates Ghana.. Retrieved June 18, 2021 from https://ghs.gov.gh/covid19/

Ghana Statistical Service. (1999). *Ghana Statistical Services.* Retrieved 18 July, 2021 from https://www.google.com/search?q=Ghana+Statistical+Service+(2019)%2C+Population+by+Regions%2C+Greater+Accra%2C+https%3A%2F%2Fwww.statsghana.gov.gh%2Fregionalpopulation.php%3Fpopulation%3DMTM0NTk2MjQzOS4yMDE1%26%26Greater%2520Accra%26regid%3D3&rlz=1C1CHBD_e

Ghana Statistical Service (GSS). (2013). 2010 Population & Housing Census National Analytical Report. *Ghana Statistical Service*, 1–91. Retrieved from https://statsghana.gov.gh/gssmain/fileUpload/pressrelease/2010_PHC_National_Analytical_Report.pdf

Ghayda, R. A., Lee, J., Lee, J. Y., Kim, D. K., Lee, K. H., Hong, S. H.,….& Shin, J. Il. (2020). Correlations of clinical and laboratory characteristics of covid-19: A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, *17*(14), 1–15. https://doi.org/10.3390/ijerph17145026

Gorbalenya, A. E., Baker, S. C., Baric, R. S., de Groot, R. J., Drosten, C., & Ziebuhr, J. (2020). The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV

and naming it SARS-CoV-2. *Nature Microbiology*, *5*(4), 536–544. https://doi.org/10.1038/s41564-020-0695-z

Graham Carlos, W., Dela Cruz, C. S., Cao, B., Pasnick, S., & Jamil, S. (2020). Novel Wuhan (2019-NCoV) coronavirus. *American Journal of Respiratory and Critical Care Medicine*, *201*(4), P7–P8. https://doi.org/10.1164/rccm.2014P7

Grasselli, G., Zangrillo, A., Zanella, A., Antonelli, M., Cabrini, … & Pesenti, A. (2020). Baseline Characteristics and Outcomes of 1591 Patients Infected with SARS-CoV-2 Admitted to ICUs of the Lombardy Region, Italy. *JAMA - Journal of the American Medical Association*, *323*(16), 1574–1581. https://doi.org/10.1001/jama.2020.5394

Güner, R., Hasanoğlu, İ., & Aktaş, F. (2020). Covid-19: Prevention and control measures in community. *Turkish Journal of Medical Sciences*, *50*(SI-1), 571–577. https://doi.org/10.3906/sag-2004-146

Habas, K., Nganwuchu, C., Shahzad, F., Gopalan, R., Haque, M., Rahman, S., Majumder, A. A., & Nasim, T. (2020). Resolution of coronavirus disease 2019 (COVID-19). *Expert Review of Anti-Infective Therapy*, *18*(12), 1201–1211. https://doi.org/10.1080/14787210.2020.1797487

Harrison, A. G., Lin, T., & Wang, P. (2020). Mechanisms of SARS-CoV-2 Transmission and Pathogenesis. *Trends in Immunology*, *41*(12), 1100–1115. https://doi.org/10.1016/j.it.2020.10.004

Holshue, M. L., DeBolt, C., Lindquist, S., Lofy, K. H., Wiesman, J.,… Pillai, S. K. (2020). First Case of 2019 Novel Coronavirus in the United States. *New England Journal of Medicine*, *382*(10), 929–936. https://doi.org/10.1056/nejmoa2001191

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J.,… Cao, B. (2020). Clinical features of patients

infected with 2019 novel coronavirus in Wuhan, China. *The Lancet*, *395*(10223), 497–506. https://doi.org/10.1016/S0140-6736(20)30183-5

Hussain, A., Kaler, J., Tabrez, E., Tabrez, S., & Tabrez, S. S. M. (2020). Novel COVID-19: A Comprehensive Review of Transmission, Manifestation, and Pathogenesis. *Cureus*, *12*(5), 1–14. https://doi.org/10.7759/cureus.8184

Ishaque, F. S., Amu, H., Seidu, A., & Bain, L. E. (2021). Health knowledge and care seeking behaviour in resource-limited settings amidst the COVID-19 pandemic : A qualitative study in Ghana. 1–15. https://doi.org/10.1371/journal.pone.0250940

Jalali, R., Etemadfard, H., Kharaghani, H., Shad, R., & Sadeghi, V. (2021). *Prioritization and Allocation Model of COVID-19 Vaccine in Neighborhoods of Mashhad Using AHP and Fuzzy Logic*. *20*(4), 63–78.

Ji, W., Wang, W., Zhao, X., Zai, J., & Li, X. (2020). Cross-species transmission of the newly identified coronavirus 2019-nCoV. *Journal of medical virology*, *92*(4), 433-440. https://doi.org/10.1002/jmv.25682

Jr, J. A. S. (2020). Epidemiology and clinical features of COVID-19 : A review of current literature. *Journal of Clinical Virology*, *127*(April), 104357. https://doi.org/10.1016/j.jcv.2020.104357

Kandel, N., Chungong, S., Omaar, A., & Xing, J. (2020). Health security capacities in the context of COVID-19 outbreak: an analysis of International Health Regulations annual report data from 182 countries. *The Lancet*, *395*(10229), 1047–1053. https://doi.org/10.1016/S0140-6736(20)30553-5

Korle-Bu Teaching Hospital. (2016). 2016 Annual Report. *Ghana Health Service Reports*, 1–129. http://ghanahealthservice.org/downloads/GHS_ANNUAL_REPORT_2016_n.pdf

Krah, E., de Kruijf, J., & Ragno, L. (2018). Integrating Traditional Healers into the Health Care System: Challenges and Opportunities in Rural Northern Ghana. *Journal of Community Health*, *43*(1), 157–163. https://doi.org/10.1007/s10900-017-0398-4

Labreuche, J., Mathieu, D., & Pattou, F. (2020). High Prevalence of Obesity in Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) Requiring Invasive Mechanical Ventilation. *28*(7), 1195–1199. https://doi.org/10.1002/oby.22831

Lanka, S., Emirate, U. A., & States, U. (2020). The novel Chinese coronavirus (2019-nCoV) infections : Challenges for fighting the storm. December 2019, 1–4. https://doi.org/10.1111/eci.13209

Lechien, J. R., Chiesa-Estomba, C. M., Vaira, L. A., De Riu, G., Cammaroto, G., Chekkoury-Idrissi, Y., ... & Saussez, S. (2021). Epidemiological, otolaryngological, olfactory and gustatory outcomes according to the severity of COVID-19: a study of 2579 patients. *European Archives of Oto-Rhino-Laryngology*, *278*(8), 2851-2859. https://doi.org/10.1111/joim.13089

Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., ... & Feng, Z. (2020). Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. *New England journal of medicine*. *382*(13), 1199–1207. https://doi.org/10.1056/nejmoa2001316

Manabe, T., Akatsu, H., Kotani, K., & Kudo, K. (2020). Trends in clinical features of novel coronavirus disease (COVID-19): A systematic review and meta-analysis of studies published from December 2019 to February 2020. *Respiratory Investigation*, *58*(5), 409–418. https://doi.org/10.1016/j.resinv.2020.05.005

Marra, A. R., Marra, A. R., & Perencevich, E. N. (2020). *Examining the need for eye protection for coronavirus disease 2019 (COVID-19) prevention in the community Limited impact of*

selective susceptibility reporting of Escherichia coli and Klebsiella isolates from concurrent blood and urine cultures. 2020–2021. https://doi.org/10.7326/M20-1632.4.

Ministry of Health of the Republic of Ghana. (2022). The Ministry - Ministry Of Health. In *Ministry of Health Website*. https://www.moh.gov.gh/the-ministry/

MoH. (2012). Ministry of Health Referral Policy Guideline. In *Policy of Referring patients* (pp. 1–26).

National Institutes of Health. (2020). Coronavirus disease 2019 (COVID-19) treatment guidelines. Retrieved from https://www.moh.gov.gh/wp-content/uploads/2016/02/COVID-19-STG-JUNE-2020-1.pdf

Naz, S., Zahoor, M., Umar, M., Sahibzada, K., Ullah, R., & Alqahtani, A. S. (2021). *COVID - 19 and SARS - CoV - 2 : Everything we know so far – A comprehensive review*. 548–575.

Olwenyi, O. A., Dyavar, S. R., Acharya, A., Podany, A. T., Fletcher, C. V., Ng, C. L.,….& Byrareddy, S. N. (2020). Immuno-epidemiology and pathophysiology of coronavirus disease 2019 (COVID-19). *Journal of Molecular Medicine*, *98*(10), 1369–1383. https://doi.org/10.1007/s00109-020-01961-4

Park, S. Y., Yun, S. G., Shin, J. W., Lee, B. Y., Son, H. J., Lee, S.,….& Kim, T. H. (2020). Persistent severe acute respiratory syndrome coronavirus 2 detection after resolution of coronavirus disease 2019-associated symptoms/signs. *Korean Journal of Internal Medicine*, *35*(4), 793–796. https://doi.org/10.3904/KJIM.2020.203

Peiris, J. S. M., Lai, S. T., Poon, L. L. M., Guan, Y., Yam, L. Y. C., Lim, W., ... & SARS Study Group. (2003). Coronavirus as a possible cause of severe acute respiratory syndrome. *The Lancet*, *361*(9366), 1319-1325.

Qin, J., You, C., Lin, Q., Hu, T., Yu, S., & Zhou, X. H. (2020). Estimation of incubation period

distribution of COVID-19 using disease onset forward time: A novel cross-sectional and forward follow-up study. *Science Advances*, *6*(33), 1–8. https://doi.org/10.1126/sciadv.abc1202

Randolph, H. E., & Barreiro, L. B. (2020). Primer Herd Immunity : Understanding COVID-19. *Immunity*, *52*(5), 737–741. https://doi.org/10.1016/j.immuni.2020.04.012

Raoult, D., Zumla, A., Locatelli, F., Ippolito, G., & Kroemer, G. (2020). Coronavirus infections: Epidemiological, clinical and immunological features and hypotheses. *Cell Stress*, *4*(4), 66–75. https://doi.org/10.15698/cst2020.04.216

Ren, L. L., Wang, Y. M., Wu, Z. Q., Xiang, Z. C., Guo, L., Xu, T., ... & Wang, J. W. (2020). Identification of a novel coronavirus causing severe pneumonia in human: a descriptive study. *Chinese medical journal*, *133*(09), 1015-1024. https://doi.org/10.1097/CM9.0000000000000722

Riou, J., & Althaus, C. L. (2020). Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. *Eurosurveillance*, *25*(4), 1–5. https://doi.org/10.2807/1560-7917.ES.2020.25.4.2000058

Rothe, C., Schunk, M., Sothmann, P., Bretzel, G., Froeschl, G., Wallrauch, C.,……& Hoelscher, M. (2020). Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany. *New England Journal of Medicine*, *382*(10), 970–971. https://doi.org/10.1056/nejmc2001468

Shi, D., Wu, W., Wang, Q., Xu, K., Xie, J., Wu, J., ... & Li, L. (2020). Clinical characteristics and factors associated with long-term viral excretion in patients with severe acute respiratory syndrome coronavirus 2 infection: a single-center 28-day study. *The Journal of infectious diseases*, *222*(6), 910-918. https://doi.org/10.1093/infdis/jiaa388

Statista. (2021). Coronavirus cases by country in Africa 2021. Retrieved 24th December, 2021from https://www.statista.com/statistics/1170463/coronavirus-cases-in-africa/.

Stephenson, R., Baschieri, A., Clements, S., Hennink, M., & Madise, N. (2007). *Contextual Influences on Modern Contraceptive Use in Sub-Saharan Africa*. *97*(7), 1233–1240. https://doi.org/10.2105/AJPH.2005.071522

Stokes, E. K., Zambrano, L. D., Anderson, K. N., Marder, E. P., & Raz, K. M. (2020). *Coronavirus Disease 2019 Case Surveillance — United States ,*. *69*(24), 759–765.

Su, S., Wong, G., Shi, W., Liu, J., Lai, A. C. K., Zhou, J.,… & Gao, G. F. (2016). Epidemiology, Genetic Recombination, and Pathogenesis of Coronaviruses. In *Trends in Microbiology* (Vol. 24, Issue 6, pp. 490–502). Elsevier Ltd. https://doi.org/10.1016/j.tim.2016.03.003

UNICEF Social Policy Research Institute (SPRI) National Development Planning Commission (NDPC). (2021). Primary and Secondary Impacts of the Covid-19 Pandemic on. *Unicef*, 11–43. Retrieved from www.unicef.org/publications%0Ahttps://alliancecpha.org/en/system/tdf/library/attachments/unicefghanacovidimpacts2021.pdf?file=1&type=node&id=43741

Van Doremalen, N., Bushmaker, T., Morris, D. H., Holbrook, M. G., Gamble, A., Williamson, B. N., ... & Munster, V. J. (2020). Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *New England journal of medicine*, *382*(16), 1564-1567.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R. S.,…… & Ho, C. (2020). A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain, Behavior, and Immunity*, *87*(April), 40–48. https://doi.org/10.1016/j.bbi.2020.04.028

Wang, T., Du, Z., Zhu, F., Cao, Z., An, Y., Gao, Y., & Jiang, B. (2020). Comorbidities and multi-organ injuries in the treatment of COVID-19. *The Lancet*, *395*(10228), e52. https://doi.org/10.1016/S0140-6736(20)30558-4

Wang, W., Tang, J., & Wei, F. (2020). Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. *Journal of Medical Virology*, *92*(4), 441–447. https://doi.org/10.1002/jmv.25689

Wang, Z., Zhou, Q., Wang, C., Shi, Q., Lu, S., Ma, Y., …. & Chen, Y. (2020). Clinical characteristics of children with COVID-19: a rapid review and meta-analysis. *Annals of Translational Medicine*, *8*(10), 620–620. https://doi.org/10.21037/atm-20-3302

Wei, W. E., Li, Z., Chiew, C. J., Yong, S. E., Toh, M. P., & Lee, V. J. (2020). Presymptomatic Transmission of SARS-CoV-2 — Singapore ,. 69(14), 411–415. Morbidity and Mortality weekly report, 69(14), 411-415. https:\\doi.org/10.15585/mmwr.mm6914e1

Whelan, J., Editors, M. W. M., & Walker, J. M. (2015). Isolation of intact Mitochondria from the model plant species arabidopsis thaliana and oryza sativa. Methods in molecular biology, 1305,1-12. https://doi.org/10.1007/978-1-4939-2639-8_1

WHO. (2020). WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. In *WHO Director General's speeches* (Issue March, p. 4). https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020%0Ahttps://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19

WHO. (2021). WHO Coronavirus (COVID-19) Dashboard. WHO Coronavirus (COVID-19) Dashboard With Vaccination Data. In *Who* (pp. 1–5). https://covid19.who.int/

WHO. 2020. Timeline of WHO's response to COVID-19. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline

WHO. (2020). Criteria for releasing COVID-19 patients from isolation. *Scientific Brief*, *17 June*, 1–5. https://www.who.int/publications/i/item/criteria-for-releasing-covid-19-patients-from-isolation

Woo, P. C. Y., Lau, S. K. P., Chu, C., Chan, K., Tsoi, H., Huang, Y., ….. & Yuen, K. (2005). Characterization and Complete Genome Sequence of a Novel Coronavirus, Coronavirus HKU1, from Patients with Pneumonia. *Journal of Virology*, *79*(2), 884–895. https://doi.org/10.1128/jvi.79.2.884-895.2005

Worldometer. (2021). Coronavirus Update (Live): Cases and Deaths from COVID-19 Virus Pandemic. In *Worldometers* (p. 1).

Wynants, L., Van Calster, B., Collins, G. S., Riley, R. D., Heinze, G., Schuit, E., Bonten, M. M. J., … & Van Smeden, M. (2020). Prediction models for diagnosis and prognosis of covid-19: Systematic review and critical appraisal. *The BMJ*, *369*. https://doi.org/10.1136/bmj.m1328

Zhang, Y., Wang, Y., Van Driel, M. L., McGuire, T. M., Zhang, T., Dong, Y., ... & Dong, Y. (2019). Network meta-analysis and pharmacoeconomic evaluation of antibiotics for the treatment of patients infected with complicated skin and soft structure infection and hospital-acquired or ventilator-associated penumonia. *Antimicrobial Resistance & Infection Control*, *8*(1), 1-11.

Zheng, X., Chen, J., Deng, L., Fang, Z., Chen, G., Ye, D., Xia, J., & Hong, Z. (2021). Risk factors for the COVID - 19 severity and its correlation with viral shedding : A retrospective cohort study. April 2020, 952–961. https://doi.org/10.1002/jmv.26367

Xu, K., Chen, Y., Yuan, J., Yi, P., Ding, C., Wu, W.,… & Li, L. (2020). Factors associated with prolonged viral RNA shedding in patients with coronavirus disease 2019 (COVID-19). *Clinical Infectious Diseases*, *71*(15), 799–806. https://doi.org/10.1093/cid/ciaa351

Yan, D., Liu, X. Y., Zhu, Y. N., Huang, L., Dan, B. T., Zhang, G. J., & Gao, Y. H. (2020). Factors associated with prolonged viral shedding and impact of lopinavir/ritonavir treatment in hospitalised non-critically ill patients with SARS-CoV-2 infection. *European Respiratory Journal*, *56*(1). https://doi.org/10.1183/13993003.00799-2020

Zhang, W., Du, R. H., Li, B., Zheng, X. S., Yang, X.,….. & Zhou, P. (2020). Molecular and serological investigation of 2019-nCoV infected patients: implication of multiple shedding routes. *Emerging Microbes and Infections*, *9*(1), 386–389. https://doi.org/10.1080/22221751.2020.1729071

Zhou, Y., Song, W. M., Andhey, P. S., Swain, A., Levy, T., Miller, K. R., … & Colonna, M. (2020). Author Correction: Human and mouse single-nucleus transcriptomics reveal TREM2-dependent and TREM2-independent cellular responses in Alzheimer's disease (Nature Medicine, (2020), 26, 1, (131-142), 10.1038/s41591-019-0695-9). *Nature Medicine*, *26*(6), 981. https://doi.org/10.1038/s41591-020-0922-4

Appendices

Appendix I: Introductory letter

UNIVERSITY OF GHANA
DEPARTMENT OF EPIDEMIOLOGY AND DISEASE CONTROL
SCHOOL OF PUBLIC HEALTH

15th December, 2021

Research Office, Medical Directorate
Central Admin Block
Korle Bu Teaching Hospital
P. O. Box, 77
Accra, Ghana

Dear Sir/Madam,

INTRODUCTORY LETTER

I write to introduce **Yao Ahonon** who is a Master of Public Health student in the Department of Epidemiology and Disease Control (EPDC) of the School of Public Health, College of Health Sciences, University of Ghana, Legon.

He is conducting a research on the topic**: "FACTORS AFFECTING TIME TO RESOLUTION OF SIGNS AND SYMPTOMS IN SYMPTOMATIC COVID-19 PATIENTS REPORTING TO THE PUBLIC HEALTH UNIT OF KORLE BU TEACHING HOSPITAL: A HISTORICAL COHORT STUDY."**

I will be grateful if you can give him the necessary support to undertake his research work in your institution.

Thank you for your cooperation.

Yours sincerely,

Dr. Francis Anto
(Head of Department)

COLLEGE OF HEALTH SCIENCES
P.O. Box LG 13, Legon, Accra, Ghana.
· **Telephone:** +233 (0)28 910 9006 · **Email:** sph-epdc@ug.edu.gh · **Website:** www.publichealth.ug.edu.gh

Appendix II: Ethical Clearance

In case of reply the number
And the date of this
Letter should be quoted
My Ref. No. KBTH/MS/G3/22
Your Ref. No......

KORLE BU TEACHING HOSPITAL
P. O. BOX KB 77,
KORLE BU, ACCRA.

Tel: +233 302 667759/673034-6
Fax: +233 302 667759
Email: Info@kbth.gov.gh
pr@kbth.gov.gh
Website: www.kbth.gov.gh

2nd March, 2022

YAO AHONON
SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA, LEGON

FACTORS AFFECTING TIME TO RESOLUTION OF SIGNS AND SYMPTOMS IN SYMPTOMATIC COVID-19 PATIENTS REPORTING TO THE PUBLIC HEALTH UNIT OF KORLE BU TEACHING HOSPITAL: A HISTORICAL COHORT STUDY

KBTH-IRB /000148/2021

Investigator: Yao Ahonon

The Korle Bu Teaching Hospital Institutional Review Board (KBTH IRB) reviewed and granted approval to the study entitled: "Factors Affecting Time to Resolution of Signs and Symptoms in Symptomatic Covid-19 Patients Reporting to the Public Health Unit of Korle Bu Teaching Hospital: A Historical Cohort Study"

Please note that the Board requires you to submit a final review report on completion of this study to the KBTH-IRB.

Kindly, note that, any modification/amendment to the approved study protocol without approval from KBTH-IRB renders this certificate invalid.

Please report all serious adverse events related to this study to KBTH-IRB within seven days verbally and fourteen days in writing.

This IRB approval is valid till 30th January, 2023. You are to submit annual report for continuing review.

Sincere regards,

DR. DANIEL ANKRAH
VICE CHAIR (KBTH-IRB)
FOR: CHAIR (KBTH-IRB)

Cc: The Chief Executive Officer, KBTH
The Director of Medical Affairs, KBTH