AFRICA UNIVERSITY

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A COMPARATIVE APPRAISAL OF THE COVID19 WAVES IN KADOMA CITY, MASHONALAND WEST, ZIMBABWE 2021

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC IN THE COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

2022

Abstract

Covid19, an infection of the respiratory system, is a global pandemic that has ridden the world since November 2019. Countries have been implementing various mitigatory and response strategies to flatten the epidemic curve. Government has been up scaling Covid19 testing to improve case identification. This enables isolation of positive Covid19 cases and contact tracing, so as to contain the spread of contagion. The Viruses of Concern (VOC) have been mutating and exhibiting different characteristics of the waves, within the population. The pandemic has been described in terms of Covid19 waves, and these have exhibited different characteristics over time. This entails devising different response strategies to be used depending on the characteristics exhibited by each Covid19 wave. Case definitions are also very crucial in case identification and need to be reviewed regularly, based on current epidemiologic studies. This study was undertaken in Kadoma City which is situated in Mashonaland West, Zimbabwe. Descriptive statistics undertaken in Kadoma City on 2 July 2021 revealed an increase in Covid19 positive cases complaining of backache, sore eyes, itchy eyes, tingling sensation and night sweats, which were not on the case definition, which led to a lot of cases being missed, as they continue to spread infection. The study sought to compare characteristics of the Covid19 waves two and three, and determine the differences, so as to enable informed interventions and decision making. A retrospective analytical cross-sectional study was explored in Kadoma City using secondary data. 745 records from the Covid19 line list of the Covid19 waves two and wave three were employed for analysis of signs and symptoms, comorbidities, disease burden and treatment outcomes, by person, place and time. Univariate, bivariate and multivariate analysis were undertaken on the data. Mean age for contracting Covid19 was 35(Q1=28; Q3=50). Wave three had the highest: attack rate (86%) as compared to wave two (48%); p-value=0.0001, incident rate for wave three (0.863) compared to wave two (0.067); p-value= 0.0001, and wave three Mortality rate (71%) compared to wave two (11.2%); p-value=0.001, which were all significant differences between the two waves. Mean Survival Time for wave three was 4.7days. Factors associated with mortality were being aged 81 and above (ß=4.674; p=0.049), being vaccinated (ß=-83.768; p=0.014) and having pre-existing asthma (ß=162.712; p=0.005). From the findings of the study, it can be concluded that there were significant differences between the two waves. Wave three was more severe than wave two, and vaccines were protective against severe disease. Asthma had the worst outcome amongst other comorbidities in severe disease. The researcher recommends up-scaling of testing and vaccination so as to prevent poor disease outcomes, as well as equitable resource allocation amongst Kadoma suburbs and townships.

Keywords: Covid19 case definition; Covid19 waves; Kadoma City; severe disease; treatment outcomes

Declaration

I declare that this research study is my original work except where sources have been cited and acknowledged. The work has never been submitted nor will it ever be submitted to another university for the award of a degree.

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Acknowledgements

I would like to concede the unwavering support I got from my academic Supervisor, Dr E. Mugomeri for Africa University compliance checks and my field supervisor Dr D. Chirundu for their valuable input in this project, without which it could have been a flop. My gratitude also being extended to the Kadoma City Health Department and Executive team for their technical support and resources in coming up with this document. To all the Kadoma City health staff members who participated in this project, I want to say THANK YOU, you were a wonderful team and without you, this document would not have materialized.

Dedications

I consecrate my work to my ever supportive husband, Vincent, his love, reassurance and push for obstinacy strengthens me. Thanking my mother, Tapuwa Mtingwende, for her support throughout the process. Though in heaven, my father, Trust Mtingwende's, never surrender teachings and belief in the girl child have gotten me this far. To my two daughters, Trinity and Taeshia, they give me reason to keep pushing. Appreciation to my field supervisor, Dr. D. Chirundu for dedicating his time to develop my research skills.

I praise the almighty, for pulling me through very difficult times. Thank you Lord, in you I trust.

List of acronyms and abbreviations

AR	Attack rate
ß	Beta co-efficient
OR	Odd ratio
CFR	Case Fatality Rate
CDC	Centers for Disease Control
Covid19	Coronavirus disease of 2019
EIC	Information Education and Communication
EHO	Environmental Health Officer
EHT	Environmental Health Technician
EPR	Emergency Preparedness and Response
HPT	Hypertension
MoHCC	Ministry of Health and Child Care
P-Value	Probability value
Q1	25th percentile
Q3	75th percentile
Re	Effective reproduction number
R0	Infectivity rate
SARS-Cov2	Severe Acute Respiratory Syndrome-Coronavirus2
WHO	World Health Organization

Definition of terms

Term	Definition
Disease outcome	A quantifiable consequence of treatment or management of a disease
Significant difference	A difference between two or more variables that did not occur by chance
Covid19 positive	Confirmation of having Covid19 infection by a Covid19 test
Disease burden	Impact of the disease as measured by certain indicators

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CHAPTER 1 INTRODUCTION

1.1 Introduction

Coronavirus disease is a contagious disease that credits its characteristics to the SARS-CoV-2 virus. Coronaviruses (CoVs) originate from a group of viruses, many of which colonize the respiratory in humans, and cause respiratory infections. From mild ones like the general cold to other infrequent and severe infections much like the Severe Acute Respiratory Syndrome (SARS) and the Middle East respiratory syndrome (MERS). Both of these severe respiratory infections caused by Coronaviruses are characterized by high mortality rates, also discovered as novel infectious diseases, and initially in 2003 as well as 2012, respectively (Fauver et al., 2020). CoVs are categorized into four variants or genera, namely; alpha-, beta-, gamma- and delta-CoV. Currently the CoV variants known to pose harm and infect humans are those from the alpha- , the beta-and delta-CoV. Genera.

Majority of the CoVs are zoonotic, and can invade animal host species as well. A spill-over event (when the virus is conveyed from animals to people in the very first instance) occurred when Covid19 was discovered. Analysis of the viral genome structures also point out that SARS-CoV-2 is exceptionally adjusted to human cell receptors, and these facilitate its invasion of human cells and infect humans. There is a huge similarity between all published genetic structures of SARS-CoV-2 extracted from humans.

This is portentous of the fact that the outbreak stemmed from a distinct source in the human populace about the same time that the virus was first discovered and described in humans in Wuhan, China (Morens et al., 2020). Published genetic sequence analyses additionally implies the spill-over from an animal host to human host occurred during the last quarter of 2019. The precise and detailed contrivance of its advent in humans is still unknown (Morens et al., 2020). The index human cases of Covid19 caused by SARS-CoV-2, were initially re-counted in Wuhan, China, in December 2019 (Morens et al., 2020).

The first case of Covid19 in Africa was detected in February 2020. The continent recorded almost 10% of the aggregate quantity of Covid19 cases globally. The burden of the disease continued to rise, as South Africa reached 1million positive cases on 27 December 2020 and more than 35,000 deaths (Adepoju, 2020). The Viruses of Concern (VOC) have been mutating and exhibiting different characteristics of the waves, within the population. The pandemic has been described in terms of Covid19 waves, and these have exhibited different characteristics over time. This entails devising different response strategies to be used depending on the characteristics exhibited by each Covid19 wave. Case definitions are also very crucial in case identification and need to be reviewed regularly, based on current epidemiologic studies (Michelen et al., 2021).

Descriptive statistics undertaken in Kadoma City on 2 July 2021 revealed an increase in Covid19 positive cases complaining of backache, sore eyes, itchy eyes, tingling sensation and night sweats, which were not on the case definition, which led to a lot of cases being missed, as they continue to spread infection. The study sought to compare characteristics of the Covid19 waves two and three, and determine the differences, so as to enable informed interventions and decision making.

This study was undertaken in Kadoma City which is located in Mashonaland West, Zimbabwe, and it employed a retrospective analytical cross-sectional design. All 745 records of Covid19 secondary data for Covid19 waves two and wave three were employed, using complete sampling. This data was from the Covid19 wave two

(30/09/20-30/04/21 and three (31/05/21-30/08/21). The study population was all residents of Kadoma City, Mashonaland West, Zimbabwe. Study unit was a Kadoma city resident who tested positive for Covid19 between 30 September 2020 and 30 August 2021.

Line list data from the two Covid19 waves was captured and analysed using Epi-info 7 software version 7.2.4.0. Univariate analysis was then performed on the data and frequencies of the two waves obtained. Frequencies, proportions and means were generated and then compared using Chi-square test at 5% significance level. This enabled the researcher to determine if there was a statistically significant difference between the two waves. Secondary data on characteristics of Covid19 deaths between the two waves was also subjected to univariate analysis. Frequencies, proportions and means of age groups, comorbidities and symptoms in Covid19 deaths were also generated and compared using Chi-square test at 5% significance level. Multiple linear regression models was used to examine cross-sectional associations between age, sex, comorbidities, delay in seeking treatment and the number of deaths.

Confidentiality was assured and maintained by ensuring that no names were disclosed, and keeping records under lock and key. Permission to carry out the study was sought from Africa University Research Ethics Committee (AUREC). Results of the study were presented to Kadoma City health department and Africa University, and no names were disclosed.

1.2 Background to the study

The first Covid19 case in Zimbabwe was then reported on 20 March 2020. This is the period during which Zimbabwe put in place a National Covid19 response taskforce (Dzinamarira et al., 2020). This team was in charge of the undertaking the Covid19 Emergency Response Plan through the nine pillars that include: coordination, risk communication and community engagement, surveillance, case management, points of entry, infection prevention and control, and logistics and continuousness of crucial health services (Ministry of Health and Child Care, 2021.).

Zimbabwe then put in place several lockdowns so as to control the pandemic. Companies went on to reduce the number of people reporting for work and abide by shorter business hours. In October 2020, a warning was given to Zimbabweans, of a possible second wave, but complacency was noted, with prolonged period of lockdown restrictions as well as low risk perception being implicated (Michelen, 2021) Zimbabwe began to record a rise in daily Covid19 cases in November 2020, and by 31 December 2020, the 7-day rolling average for new cases had escalated by 12%. The aggregate amount of cases reported reached 13 867 as well as 363 deaths (MoHCC, 2021.). Meanwhile, Kadoma City 19 had recorded 186 cases, 16 deaths by 18 January 2021, 1406 cases and 113 deaths by 30 August 2021 (Kadoma City Health Department, 2021.).

The different SARS-CoV-2 variants of critical importance plagued different Covid19 waves, and manifested as different epidemiologic features in the population. These are variants of concern since they cause different demographic and clinical features of SARS-CoV-2 positive patients (Fauver et al., 2020). These differences ultimately led to differences in the characteristics of Covid19 outbreaks. These are critical differences, as they help inform decision making and outbreak response. Clinical manifestations, recovery rates, mortality rates, disease burden, among many other manifestations, differed between the Covid19 waves, owing to the different impacts the variants had on the population.

Descriptive statistics from a previous study undertaken in Italy showed significant differences in symptomatology, including higher mild and moderate severity of infections ominously higher in the Delta as contrasted to the Alpha variant (Fauver et al., 2020). This therefore, necessitates the need for constant genomic sequencing and epidemiologic studies, if the human race is to keep up with the virus' mutational abilities.

World Health Organization continues to encourage authorities to reinforce surveillance and sequencing capabilities, and apply a systematic approach to afford a representative indication of the magnitude of spread of SARS-CoV-2 variants constructed from the local context, a (Ng et al., 2021) and to identify unfamiliar epidemiological events

1.3 Problem statement

As per descriptive statistics undertaken on the 1st of July 2021, backache, which is not on the WHO case definition for Covid-19 employed in the second Covid19 wave, accounted for 14.63% (510) of the signs and symptoms that Covid-19 positive patients presented with in the third Covid19 wave. A number of cases who had been presenting with backache, itchy eyes, sore eyes and tingling sensation were being missed during Covid19 screening, as these symptoms were not on the WHO case definition. The latter, each accounted for 1.22% (510) of the signs and symptoms that Covid-19 positive patients presented with during the third wave. This therefore, posed a risk of further spread of infection, failure to contain the outbreak and a further strain on the resources.

1.4 Broad Objective

To compare the difference between SARS-Cov2 characteristics and epidemiologic features of the second and third waves of the coronavirus disease 2019 pandemic in Kadoma City, Zimbabwe 2021.

1.5 Specific Objective

1. To analyse the epidemiologic features of Covid-19 waves two and three between 30 September 2020 and 30 August 2021 in Kadoma City, Zimbabwe 2021

2. To analyse for any statistically significant differences between the two Covid19 waves, during the period 30 September 2020 and 30 August 2021 in Kadoma City, Zimbabwe, 2021

3. To analyse the Covid19 treatment outcomes (death) during the period 30 September 2020 and 30 August 2021 in Kadoma City 2021

1.6 Research questions

Is there a statistically significant difference between the epidemiologic features of the first and second Covid19 waves?

i. What are the epidemiologic features of the two Covid-19 waves between 30 September 2020 and 30 August 2021 in Kadoma City, Zimbabwe 2021
ii. Are there any statistically significant differences between the two Covid19 waves, during the period 30 September 2020 and 30 August 2021 in Kadoma City, Zimbabwe, 2021?
iii. What factors predict Covid19 treatment outcomes (death)

1.7 Hypothesis

H0: There is no statistically significant difference between SARS-Cov2 characteristics and epidemiologic features of the second and third Covid19 waves

H1: There is a statistically significant difference between SARS-Cov2 characteristics and epidemiologic features of the second and third Covid19 waves

1.8 Significance of the study

Backache accounted for a substantial proportion of the signs and symptoms that Covid19 positive individuals presented with during the Covid19 third wave contrasted to the case definition for Covid19 used during the second and Covid19 wave. This study will provide statistically backed evidence on the significant differences between SARS-CoV2 characteristics and epidemiologic features between Covid19 wave two and three. This will help add more knowledge to scientific literature, improve knowledge on Covid-19 to the scientific community and inform decision making. The study will, therefore, inform Ministry of Health decision making, resource allocation and policy formulation, improve response to outbreaks, containment of pandemics and the mitigation of the outspread of virus in Kadoma City.

1.7 Delimitation

Even though Covid19 is affecting the Covid19 negative people and the whole Mashonaland province, and Zimbabwe as a whole, the researcher narrowed down to Covid19 positive cases only, because of their vulnerability and due to the fact that they pose a huge risk of spread of infection. The study setting was as Kadoma City due to the fact that epidemiologic studies describing the disease burden in Kadoma were lacking.

The information obtained from the Covid19 line list had a potential of being adequately representative of the epidemiologic characteristics of the pandemic down to the local level. The study was more inclined towards describing the epidemiologic features of the two Covid19 waves, an angle the researcher feels lagging since most local studies available were fixated on vaccine effectiveness, hesitancy and how to contain spread of infection.

1.8 Limitations

The study was not without limitations. Incomplete data during collection reduced the usefulness currency of the data. This made the data difficult to analyse.

CHAPTER 2 REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter covers information on Covid19, exposure, disease dynamics and treatment outcomes. Peer reviewed literature available from electronic data repositories was used. In addition, grey literature was also reviewed. Key words used in the search of electronic databases were "Covid19 disease, Exposure of Covid19, Transmission dynamics, Covid19 pre-disposition and treatment outcomes"

2.2 Geographical distribution

Covid19 was initially described in Wuhan, China on Dec 31, 2019. By August 23 2020, more than 23.5 million cases had been infected and more than 800,000 deaths had been reported (Poorolajal, 2020b). It is a transmittable disease that has given rise to mammoth health and economic disaster globally.

The diseases was detected in almost all countries globally. Genetic variations are common across different geographic areas globally, and can cause variations in morbidity and mortality statistics. The disease surveillance system, comprehensiveness and punctuality of reporting can result in differences in disease mortality and morbidity rates in different geographic areas (Poorolajal, 2020b). Conversely, the geographical distinction in Covid19 cases and deaths is extensive, resulting in a mysterious pattern (Poorolajal, 2020a).

Prevalence of Covid19 is precisely high in the western hemisphere, though not very high in the eastern hemisphere, regardless of the economic status/level of the nation. The Americas consist of a vast number of countries with a prevalence that surpasses 10,000 cases per million. A small number of countries in the eastern hemisphere have recorded a high prevalence. Variation in the Covid19 mortality rate is more extensive in contrast to the disease prevalence in the western and eastern hemispheres.

The vast number of countries that reported death rates that surpass 200 deaths per million are more concentrated in the western hemisphere comprising of the Americas and Western European countries, whilst countries located in the eastern hemisphere rarely experienced such a high mortality rate. The prevalence and death rate of the disease is very low at the origin of this disease. Covid19 coronavirus was first discovered in China and spread rapidly beyond its borders. The country is the most populated globally but was less affected. This is a cryptic geographical distribution of the disease's cases and deaths, which is a question that still remain unanswered (Poorolajal, 2020b).

Africa accounts for 16.72% of the global aggregate population, though it is the least affected, accounting for 4.5% of the global burden of the Covid19 disease. Meanwhile, the hard hit parts of the world, which carry the largest disease burden, are those most developed, including Europe and North America. The first Covid19 case in Africa was detected in Egypt on, 2020, on the14th of February. The virus then spread swiftly after that, as more and more African countries continued to report new cases of Covid19. South Africa in addition to Morocco remain at the top, accounting for the highest disease burden in Africa, whilst Tanzania and St Helena account for the least proportion of the disease burden in Africa as at March 2022 . As at 20 April 2022, the global number of cases stands at 507 040 089, 247 336 for Zimbabwe, 30 840 cases in Mashonaland West and 2 285 cases for Kadoma City (SITREP 20 April, 2022).

2.3 Transmission dynamics

Zimbabwe is the second country, after South Africa to report B.1.351 as the dominant variant so far (Mashe et al, 2021). The variant has been concomitant with amplified transmissibility, and consequentially overwhelmed health-care systems and in heightened mortality in contrast to the first wave. Potential surveillance of SARS-CoV-2 by genome sequencing from Zimbabwe, from September, 2020, and January, 2021 (the epoch dubbed ‘second wave’) detected variants containing perturbing mutations as rampant in sequenced samples. During the same period, a novel variant under investigation (C.2), was detected. Some of the variants were not isolated or detected in Zimbabwe. Variants with perturbing mutations have all substituted formerly detected lineages in Zimbabwe. Phylogenetic examination of international genomes of the C.2 variant also showed that Zimbabwe was a probable source. The findings therefore, bring forth the importance of global surveillance by whole-genome sequencing of SARS-CoV-2 to identify sources and transmission routes, as well as inform strategy (Mashe, et al., 2021).

Transmission effect of the communication between the host and pathogen and the environment, thereby forming a transmission/ disease triangle. From an ecological perspective, it is a survival trick that the pathogen resorts to, so as to propel its offspring and ensure survival. Force of infection exhibits a linear relationship and increase with quantity of contacts, making transmission density-dependent (Antonovics, 2017). A study revealed that the Covid19 transmission rate had the most substantial effect on prevalence (Rahman & Kuddus, 2021). Recent virological and epidemiological modelling studies have revealed a huge proportion of asymptomatic Covid19 positive cases who are still capable of transmitting the infection (Kioutsioukis & Stilianakis, 2021).

Virological studies revealed recovered and asymptomatic Covid19 positive individuals were moderately to highly infectious during subclinical infections. Epidemiological modelling studies projected the serial interval (phase concerning symptom inception in the primary case and symptom inception in a secondary case) to be close to the incubation period which may point out infection before symptom onset (Kioutsioukis & Stilianakis, 2021).

Scientists have cautioned that Coronaviruses are highly capable of emerging from time to time. (Du et al., 2020). The virus is known to spread through droplet infection. It spreads from human to human through coughing, sneezing, and the spread of respiratory droplets or aerosols. Age (elderly) and pre-existing conditions such as diabetes, hypertension, asthma, HIV/AIDS have been found to predispose one to Covid19 infection (Lotfi et al., 2020). ACE2 is a cell receptor where the SARS-CoV virus can bind to, and is found in the lower respiratory tract of humans. The receptor controls both cross-species and person-to-person spread (Jia et al., 2005). Disease onset may advance to respiratory failure due to alveolar damage (as evidenced by transverse chest computerized-tomography images) and even death

The WHO case definition for Covid19 is acute inception of cough or acute inception of any three or more of the following; Fever, cough, general body weakness/fatigue, headache, muscle pain, sore throat, coryza, shortness of breath, anorexia/nausea/vomiting, diarrhoea, confusion. A mathematical model called stochastic transmission model revealed that contact tracing and isolation would be inadequate to curb the Covid19 pandemic within three months. This is due to too much adjournment from the inception of symptoms to isolation, therefore other preventive and control measures such as sensitive diagnostic approaches, isolation and lockdown measures are also hindered (Hellewell et al., 2020).

2.4 Serial interval of Covid19

This is the period between the onset of symptoms and illness of the primary case to the onset of illness or symptoms of the secondary case. It is a crucial epidemiological measure that determines the spread of Covid19 infection (Du et al., 2020). Meta-analysis of data from pooled means of various studies, as of March 2021, unearthed that the average serial interval of Covid-19 was 5.2 days (95%CI: 4.9–5.5) (Li et al., 2021)

2.5 Case fatality rate (CFR)

This is a severity estimate, critically required to evaluate the prospective impact of the pandemic in different demographic groups (Undurraga et al., 2021). It is one of the most crucial epidemiological measures of disease severity. Case fatality rates are obtained by determining the proportion of deaths over the aggregate amount of cases. The naive CFR is preferred by WHO and various countries due to its requirement of minimum information for computation, and ultimately congregates to the ultimate CFR, the fraction of aggregate deaths over the aggregate amount of cases when the epidemic is ended (Kim et al., 2021).

2.6 R-naught

R0 (R naught) is the basic reproduction number, and is also well-known as basic reproduction ratio/ rate. This is an epidemiological standard measure that is used to measure the transmissibility of contagious microbes as well as forecasting, when there is zero immunity in the population. R0 is derived from variables such as; duration of infectivity post infection of individual, possibility of spread of contagion per contact concerning a susceptible individual and an infectious case, as well as the contact rate (Achaiah et al., 2020). The metric is usually calculated retrospectively from sequential epidemiological records, alternatively, by using hypothetical mathematical models (which use differential equations)

The metric entails R0 < 1, denoting the disease dying down in the community, also R0 > 1, denoting how the infection will be transmitted quicker. The infectivity of the virus and period of infectiousness are biological constants, but the magnitude of human-to-human contact will vary, therefore R0 will vary depending on this factor. This concept, therefore depicts the significance of social distancing during the Covid19 pandemic.

Two mathematical models are employed to estimate R-naught, and these include the susceptible-infectious-recovered model or the susceptible-exposed-infectious-recovered model. Contact tracing data can also be employed by epidemiologists to calculate R0, and cumulative incidence data is the technique mostly used (Achaiah et al., 2020). R0 of Covid19 was originally projected by the World Health Organization (WHO) and ranged from 1.4 to

2.7 Re (effective reproduction number)

It is also called Rt, and is a metric that depicts the proportion of individuals in a population that are susceptible and at risk of being infected by an individual at any specific time. Re is used to estimate the transmissibility of the infective agent at any period in the epidemic. As the population gets immunized, the metric fluctuates, either by singular immunity post infection or vaccination as well as, as persons die (Achaiah et al., 2020).

Factors affecting Re include the amount of infected people, the amount of predisposed people with whom infected people are in contact, and people's behaviour, including social distancing.

2.8 Covid19 Symptomatology

The Covid19 symptoms as per WHO case definition for Covid19 are fever or chills, cough, dyspnoea, fatigue, myalgia, headache, loss of taste or smell, coryza, nausea or vomiting, diarrhoea. Headache, sore throat, cough and dyspnoea as the most frequently reported (CDC, 2022). Loss of taste is a new symptom that was added to the case definition after revisions based on study findings. New signs and symptoms such as backache, irritability and confusion, sore and itchy eyes, as revealed by Kadoma City descriptive studies undertaken on 1 July 2021, amongst many other symptoms are emerging, and require in depth studies that can determine their statistical significance.

These studies can help update the case definition as well as prevent the omission of Covid19 cases, who pose a potential risk of propelling infection undetected. Therefore both WHO and national case definitions are updated as more and more information on Covid19 aetiology and its epidemiologic features keeps changing (Suthar et al., 2022). Asymptomatic Covid19 infection during the Covid19 pandemic poses a huge challenge as the infection is not apparent. Virological studies have illustrated how asymptomatic individuals shed similar amounts of virions to symptomatic individuals, younger individuals are less probable to present with severe disease (Yanes-Lane et al., 2020). They therefore, have a high transmission potential, leading to difficulties containing the outbreak.

2.9 Age, Covid19 infection and deaths

A certain age group can be more at risk of infection and that of the disease complicating as compared to other age groups due to certain characteristics of that age group (e.g predisposition to comorbidities, productive age, biological factors etc). In USA, a study was conducted that revealed that the aggregate amount of surplus deaths (deaths surpassing average levels) from January 26 to October 3, 2020, ranged from as little as 841 in the youngest age group (<25 years) to a peak of 94,646 in adults of age group 75–84 years. Conversely, the mean percentage change in mortality over the period under study in contrast to preceding year was prevalent in adults between ages of 25–44 years (26.5%) (Rossen et al., 2020).

Another study revealed differences in age range and brutality of the disease between the first and second Covid19 wave, however the comparative epidemiologic features of the waves are still unknown (Iftimie et al., 2021). Over time, recent studies have illustrated a 300times increase in mortality, in Covid19 positive patients over 60years of age, as compare to those below 60, and the least mortality in those less than 20years old (Sousa et al., 2020). This, therefore, indicates a significant difference between outbreaks in terms of age, disease burden and mortality.

2.10 Sex, Covid19 infection and mortality

Sexual differences in Covid19 infection have been noted in previous studies, where males are more at risk of contracting Covid19 as opposed to females. Males are also more at risk of severe disease and also death (Alwani et al., 2021). Genetic and biological differences have been implicated in some studies (Mashe, Takawira, Martins, et al., 2021a). The disparity detected in sex and brutality of disease is further explained by a phenomenon called cell mosaicism, in which one of the X chromosomes in females is inactivated and therefore silenced so as to maintain a balanced gene expression dosage, resulting in females having 50% of their cells inactivating the maternal X chromosome, meanwhile inactivating the paternal X chromosome in the rest. This results in an increased responsiveness of the female immune system. Such studies therefore, provide in depth information on Covid19 predisposing factors, so as to inform decision making and allocation of resources (Lyon, 1961).

2.1.1 Pre-existing comorbidities and Covid19 deaths

A study revealed that in the wave two, more children, pregnant and post-partum women contracted Covid19 (Iftimie et al., 2021). Another study determined that Covid19 patients with pre-existing comorbidities had a higher probability of death (Sarin et al., 2020). It also revealed that pre-existing comorbidities in Covid19 patients were hypertension (39.5%), cardiovascular disease (12.4%), and diabetes (25.2%). Moderate, severe and uncontrolled Asthma have also been linked to disease severity and mortality (CDC, 2020b). Immune and metabolic disorders, respiratory diseases, cerebrovascular, any types of cancers, renal and liver diseases accounted for the least number of Covid19 deaths. The highest probability of mortality was detected among Covid19 patients who had pre-existing hypertension and cardiovascular diseases. The findings might actually inform decision making, resource allocation and the triaging, by healthcare workers, of the most susceptible Covid19 patients. It can also help inform precautionary measures during hospitalization, evaluate susceptibility to death, and prioritize treatment, which could possibly reduce Covid19 mortality.

2.1.2 Vaccination status

In India, a study revealed that vaccination was linked to lesser odds of death in hospitalized cases that had moderate to severe Covid19 (N. Singh et al., 2020). Vaccine rollout in Zimbabwe was commenced in February 2021. The vaccines were also not adequate enough for everyone in wave two, in contrast to the third wave. This could have affected the transmission dynamics of Covid19 between the waves. Vaccine hesitancy could have been higher in the wave two in contrast to the wave three due to absence of knowledge, concerns about safety and side effects, and a general absence of reliance on governments and the pharmaceutical companies that developed them (McAbee et al., 2021).

2.1.3 Travel history

History of travel predisposes one to the contraction of Covid19 as well as further propels the infection. This is very important information during history taking as it also facilitates contact tracing, and subsequently, the containment of a Covid19 outbreak. Travel history, however, is difficult to employ as a Covid19 screening and preventive tool against Covid19, as it is prone to concealment. Some countries such as Thailand, imposed a law which fines anyone who falsifies their history of travel, all in a bid to obtain accurate history that facilitates improved response (Joob & Wiwanitkit, 2020).

2.1.4 Delay in seeking medical care

A study determined how the Covid19 pandemic has seen a drastic decrease in emergency room visits for other illnesses such as stroke, appendicitis and heart attack. Patients have been dodging pursuing medical care for fear of getting the infected by Covid19 or as an unintentional result of travel restrictions. This adjournment in seeking healthcare may result in an increase in morbidity and mortality (Masroor, 2020).

A study revealed that the proportion of hospitalized cases in wave two showed an increase from that of the first wave, whilst patients in wave two were younger and the period of hospitalization and case fatality rate were lesser than the ones in wave one (Iftimie et al., 2021). A study by Manyati, 2021, revealed an increased postponement in seeking treatment by Covid19 positive patients, which was most common among males. The study participants alluded to using herbs and home remedies prior to seeking medical care, such as Citrus limon (lemons) (79%), Lippia javanica, (Zumbani, fever tree) (63%), Zingiber officinale (ginger) (60%), and Allium sativum (garlic) (57%). The patient to doctor/nurse ratio in developing countries such as Zimbabwe is also low, leading to the use of traditional medicines by the general populace instead (Chaachouay et al., 2021). The health seeking conduct of the population is therefore, a huge predictor of Covid19 disease severity, prognosis and outcome.

2.1.5 Reinfection

Covid19 reinfection occurs when are person gets infected by Covid19, recovers, then later succumb to the infection again. Studies have shown that most individuals acquire some level of protection/immunity from reinfection, numerous months post-infection, thereby reducing mortality. A restructured national surveillance case definition for Covid19 was announced on September 1, 2021, and takes account of standards for calculating new contagions (reinfections) after previous probable or confirmed infections. 1572(2.5%) of reinfections were detected in one study, which differed by sero-status. The study was suggestive of subsequent reduced household transmission with recurrent reinfection (Akinbami et al., 2021). More studies are required to substantiate the associations between reinfection, Covid19 disease and mortality.

CHAPTER 3 METHODOLOGY

3.1 Study Design

The study design was a retrospective analytical cross-sectional study. This study was centred on data from Covid19 wave two (30/09/20-30/04/21 and three (31/05/21-30/08/21). Line list data from the two Covid19 waves was captured and analysed using Epi-info 7 software version 7.2.4.0. Univariate analysis was then performed on the data and frequencies of the two waves obtained. Frequencies, proportions and means were generated and compared using Chi-square test at 5% significance level. This enabled the researcher to conclude if there was a statistically significant dissimilarity between the two waves.

Secondary data on characteristics of Covid19 deaths during the two waves was also subjected to univariate analysis. Frequencies, proportions and means of age groups, comorbidities and symptoms in Covid19 deaths were also generated and compared using Chi-square test at 5% significance level. Multiple linear regression models was used to examine cross-sectional associations between age, sex, comorbidities, delay in seeking treatment and the number of deaths.

3.2 Study setting

The study setting was undertaken in Kadoma city, Mashonaland West, Zimbabwe. The city lies approximately 166Km from Harare. The city is situated at the middle of a mining area. Kadoma has a population of 160 000.

3.3 Study population and Study Unit

The study populace was all residents of Kadoma City, Mashonaland West, Zimbabwe. Study unit was a Kadoma city inhabitant who tested positive for Covid19 between 30 September 2020 and 30 August 2021.

3.4 Sample size

745 Covid19 positive cases recorded on the line list between 30 September 2020 and 30 August 2021 were used for data analysis.

3.5 Sampling

This is a process during which statistical analysis is used to select study participants. In this study, complete sampling was employed to handpick all the confirmed Covid19 positive cases and deaths from the Kadoma Covid19 line list recorded between 30 September 2020 and 30 August 2021.

3.6 Data Capture and Analysis

The person, place and time aspect of the line list data on Covid19 cases from the two Covid19 waves was captured in to the project file (Prj) in Epi info. The data was cleaned up for duplication, missing information, out of range value and transcription errors. It was then subjected analysis of data by means of Epi info 7 software version 7.2.4.0. Continuous variables were described as mean (standard deviation) and median (interquartile range [IQR]), whilst categorical variables were be presented as counts (frequency or percentages).

This is called univariate analysis, and other parameters such as Odds ratios, Confidence interval and P-values were also calculated, so as to facilitate the comparison of the outcomes between groups. Univariate analysis was undertaken so as to determine the patterns and provide a description of the data that exists within it. P value <0.05 was considered to be statistically significant.

Chi-square test at 5% significance level was used for comparison of descriptive data between the 2 Covid19 waves by person (symptomatology, age group, gender, occupation, vaccination status, comorbidity, delay in seeking treatment) place

(History of travel, location/address), time(date of diagnosis), as well as disease transmission dynamics (Mortality Rate, Attack Rate, CFR, tests used, incident rate) (burden of disease).

Bivariate and multivariate analyses using the backward elimination model in Multiple Logistics Regression, was undertaken to examine cross-sectional associations between the disease characteristics and outcomes of Covid19 wave 3. Variables analysed were age, sex, comorbidities, delay in seeking treatment, recovery and death. A confidence interval of 95% and a P-value of 0.05 were used in the model.

3.7 Ethical considerations

Confidentiality was assured and maintained by ensuring that no names are disclosed. Records of the data were kept safe under lock at all times. Permission to carry out the study was obtained from Africa University Research Ethics Committee (AUREC). Results of the study were presented to Kadoma City health department and Africa University, and no names were disclosed.

CHAPTER 4 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

Research results are illustrated in this chapter. The results are presented as tables.

4.2 Descriptive statistics

A total of 328 and 745 Covid19 tested positive for SARS CoV-2 by PCR and antigen during the Covid19 wave two and three, respectively, in Kadoma city, between 01 September 2020 and 30/08/2021. Reference was also made to the findings of the Covid19 outbreak report by Manyati, 2021.

4.2.1 Determination of significant differences between Covid19 wave two and three

The table below depicts the descriptive statistics of Covid19 waves two and three, and if there is any significant difference between the two populations. Significant differences are therefore indicated by a *

Table 4.1: Descriptive statistics of Covid19 waves two and three, Kadoma City, 2021

Variable	**Frequency (%)**		**P-Value**
	Wave 2	Wave 3	
Sex	N=46	N=745	
M	24 (52.2)	404 (54.2)	0.787
F	22 (47.8)	341 (45.8)	0.787
Age group	N=46	N =745	
≤35	18 (38.9)	515 (30.9)	0.0001*
≥35	28 (61.6)	230 (12.2)	0.0001*
Mean Age (Q_1; Q_3)	35 (28;50)	39 (31;50)	0.0001*
Vaccination Status	N= 328	N=745	
Yes	44 (13.4)	75 (10.1)	0.107
No	284 (86.6)	644 (86.4)	0.952
Unknown	0	26 (3.5)	0.0006*
Mean Age vaccinated (Q_1;Q_2)	40 (32; 71)	29 (21;40)	0.0001*
Mean age not vaccinated (Q_1;Q_2)	47(35;73)	38(26.5;49)	0.0001*
Comorbidities	N =328	N= 745	
Hypertension	79 (24)	88 (11.8)	0.00001*
Diabetes Mellitus	30 (9)	43 (5.8)	0.0434*
HIV	13 (4)	27 (3.6)	0.7871
Pregnancy	0	13 (1.74)	0.0159*
Asthma	26 (8)	8 (1.1)	0.2713
Chronic lung disease	0	1 (0.13)	0.509
Total comorbidities	148 (45)	180 (24.2)	0.00001*
No comorbidities	180 (55)	565 (75.8)	0.00001*
Comorbidities by Sex:			
M	68 (46)	58 (32)	0.111
F	80 (54)	122 (68)	0.111
Symptomatic	N=46	N=745	
Yes	22 (47.8)	663 (89)	0.00001*
No	24 (52)	82 (11)	0.00001*
Symptomatic by Sex:	N=22	N=663	
M	17 (76)	597 (88.4)	0.536
F	18 (84)	292 (90.1)	0.0005*

*Significant difference

Variable	Frequency%		
	Wave 2	**Wave 3**	**P-Value**
Symptomatology	N= 162	N=745	
Cough	66 (41)	341 (45)	0.242
Fever	32 (20)	225 (30)	0.0076*
Headache	18 (11)	371 (49)	0.00001*
Fatigue	6 (4)	234 (31)	0.00001*
Coryza	6 (4)	84 (11.1)	0.0035*
Loss of taste	6 (4)	92 (12.2)	0.0013*
Loss of smell	6 (4)	52 (6.9)	0.1236
Chest pain	5 (3)	86 (11.4)	0.0012*
Sore throat	3 (2)	80 (10.6)	0.0004*
Anorexia	5 (3)	0	0.00001*
Diarrhea	3 (2)	35 (4.6)	0.101
Dyspnea	3 (2)	75 (10.1)	0.0007*
Vomiting	0	54 (7.2)	0.0004*
Loss of appetite	0	35 (4.6)	0.005*
Backache/muscle pain	0	107 (14)	0.00001*
Joint Pain	0	10 (1.3)	0.139
Abdominal pain	0	11 (1.5)	0.119
Irritability/Confusion	0	6 (0.8)	0.250
Admissions	N=28	N= 43	
Sex:			
F	16 (57)	26 (3.5)	0.7795
M	12 (43)	17 (2.3)	0.7795
Total Admissions	28(8.6)	43(5.8)	0.00001*
Age group	N=328	N=745	
1-11	0	2 (1.17)	0.347
11-21	3 (0.9)	4 (2.9)	0.478
21-31	7 (2.1)	7 (0.9)	0.112
31-41	9 (2.7)	5 (0.7)	0.006*
41-51	2 (0.6)	11 (1.5)	0.230
51-61	3 (0.9)	5 (0.7)	0.667
61-71	2 (0.6)	4 (2.9)	0.881
71-81	1 (0.3)	5 (0.7)	0.459
81-91	1 (0.3)	1 (0.1))	0.549
91-100	1	2	0.920

*Significant difference

Variable	Frequency% Wave 2	Wave 3	P-Value
History of travel:	N=44	N= 133	
M	26 (7.9)	78 (10.5)	0.960
F	18 (5.5)	55 (7.4)	0.960
Total	44 (13)	133 (18)	0.00001*
Age group	N=328	N=745	
1-11	1 (0.3)	2 (0.3)	0.920
11-21	3 (0.9)	3 (0.4)	0.298
21-31	6 (1.8)	25 (3.4)	0.168
31-41	9 (2.7)	42 (5.6)	0.040*
41-51	5 (1.5)	28 (3.8)	0.051
51-61	2 (0.6)	12 (1.6)	0.184
61-71	1 (0.3)	7 (0.9)	0.267
71-81	1 (0.3)	3 (0.4)	0.810
81-91	0	1 (0.1)	0.509
91-100	0	0	0.00001*
Location/Township:	N=328	N=745	
Rimuka	104 (31.7)	232 (31.1)	0.867
Eiffel flats	73 (22.3)	190 (25.5)	0.254
Mornington	6 (1.8)	21 (2.8)	0.342
Westview	43 (13)	86 (11.5)	0.465
Sabonabona	3 (0.9)	21 (2.8)	0.524
Ingezi	68 (20.7)	102 (13.7)	0.004*
Eastview	4 (1.2)	9 (1.2)	0.984
Destiny	3 (0.9)	7 (0.9)	0.968
Waverly	22 (6.7)	60 (8.1)	0.447
Pixie Combie	2 (0.6)	17 (2.3)	0.056
Delay in seeking treatment	N=217	N=601	
M	133 (40.5)	326 (44)	0.074
F	84 (25.6)	275 (37)	0.073
Total	217(66.2)	601(80.7)	0.00001*
	N=328	N=745	
Attack Rate	22 (48)	63 (86)	0.0001*
Incidence Rate	0.07 (CI:0.042-0.101)	0.86 (CI:0.798-0.932)	0.0001*
	N=328	N=745	
Mortality Rate	11.2	71	0.001*
M	51.4	65	0.002*
F	48.6	34.8	0.0001*
Case Fatality Rate (CFR)	N=328	N=745	
	11.3	12.3	0.072

*Significant difference

4.2.2 Analysis of Covid19 outcomes-deaths

Descriptive statistics

The table below shows the descriptive statistics of Covid19 deaths that occurred during the Covid19 wave two and three, and if there is a significant difference between the two populations.

Table 4.2: Descriptive statistics of Covid19 outcomes-deaths, Kadoma City, 2021

Variable	**Frequency** **Wave 2** **n (%)**	 **Wave 3** **n (%)**	 **P-Value**
Number of deaths	N=37	N=92	
Age group:			
>1	0	0	0.0001*
1-11	0	1 (1.1)	0.522
11-21	0	0	0.0001*
21-31	2 (5.4)	3 (3.3)	0.569
31-41	5 (13.5)	6 (6.5)	0.197
41-51	8 (21.6)	14 (15.2)	0.222
51-61	6 (16)	13 (14)	0.764
61-71	8 (21.6)	13 (14)	0.384
71-81	7 (18.9)	17 (18.5)	0.952
81-91	1 (2.7)	20 (21.7)	0.008*
91-100	0	4 (4.3)	0.197
<100	0	1 (1.1)	0.522
Sex:			
M	19 (51.4)	60 (65.2)	0.144
F	18 (48.6)	32 (34.8)	0.144
Mean Age $Q_{1,}Q_3$	55 (45;70)	63.9 (47;80)	0.1376

*Significant difference

Variable	Frequency% Wave 2	Wave 3	P-Value
Symptomatology	N=37	N=92	
Fever	35 (95.6)	87 (94.6)	0.992
Cough	12 (32.4)	67 (72.8)	0.00001*
Vomiting	0	0	0.0001*
Headache	17 (45.9)	84 (91.3)	0.00001*
Fatigue	0	0	0.0001*
Coryza	0	1 (0.78)	0.522
Loss of taste	6 (16)	38 (41.3)	0.007*
Loss of smell	8 (21.6)	36 (39.1)	0.057
Shortness of breath	13 (35)	81 (88)	0.057
Diarrhea	2 (5.4)	5 (5.4)	0.992
Backache	0	0	0.0001*
Muscle pain	0	0	0.0001*
Comorbidities:	N=37	N=92	
Asthma	1 (2.7)	2 (2.2)	0.857
Cardiovascular disease (CVD)	0	1 (1.1)	0.522
Hypertension(HPT)	8 (21.6)	20 (21.7)	0.992
DiabetesMellitus(DM)	11 (29.7)	17 (18.5)	0.162
Tuberculosis(TB)	1 (2.7)	0	0.114
HIV	1 (2.7)	1 (1.1)	0.503
None	16 (43)	51 (55)	0.211
Vaccination status	N=37	N=92	
Yes	1 (2.7)	3 (3.3)	0.865
No	36 (97.3)	89 (96.7)	0.865
Delay in seeking treatment	N=37	N=92	
M	13 (41.9)	37 (66)	0.589
F	18 (58.1)	19 (34)	0.00001*
No delay	6 (16.2)	36 (39)	0.0121*
Total delayed	31 (84%)	56 (61%)	0.00001*
Complications:	N=37	N=92	
Nil	3 (8)	2 (2)	0.114
Acute Respiratory distress	34 (92)	90 (98)	0.114
Shock	0	0	0.0001*
Renal failure	0	0	0.0001*
Liver failure	0	0	0.0001*
Cardiac arrest	0	0	0.0001*

*Significant difference

Variable	Frequency% Wave 2	Wave 3	P-Value
Occupation:	N=37	N=92	
Government	2 (5.4)	4 (4.3)	0.795
Health worker	1 (2.7)	1 (1.1)	0.503
Informal	10 (27)	22 (23.9)	0.711
Other	20 (54)	58 (63)	0.347
Retail	4 (10.8)	6 (6.5)	0.412
Security	0	1 (1.1)	0.522
Treatment given	N=37	N=92	
Yes	18 (48.6)	72 (78.3)	0.0009*
No	19 (51.4)	20 (21.7)	0.0009*
Oxygen supplementation:	N=37	N=92	
Yes	9 (24)	34 (37)	0.168
No	28 (76)	58 (63)	0.168
Location:	N=37	N=92	
Rimuka	13 (35)	50 (54)	0.049*
Eiffel flats	2 (5.4)	16 (17.4)	0.075
Westview	2 (5.4)	10 (11)	0.332
East-view	4 (10.8)	3 (3.3)	0.087
Ngezi	3 (8.1)	5 (5.4)	0.569
Waverly	3 (8.1)	6 (6.5)	0.749
Mornington	2 (5.4)	1 (1.1)	0.142
Cecil Estates	3 (8.1)	1 (1.1)	0.038*
Sabonabona	5 (13.5)	0	0.0003*
Place of death	N=37	N=92	
Brought in dead	27 (73)	67 (72.8)	0.984
Isolation center	9 (24)	17 (18.5)	0.453
Old people's home	1 (2.7)	8 (8.7)	0.226
Admission/Isolation:	N=37	N=92	
Home/Community	20 (54)	73 (79.3)	0.004*
Institutional	17 (46)	19 (20.7)	0.004*
Outcomes	N=328	N=745	
Recovered	291 (88.7)	653 (87.7)	0.617
Not recovered	37 (11.3)	92 (12.3)	0.617

*Statistically significant

4.2.3 Mean survival time

The mean survival time was 4.7 days (2. 0; 5.0).

4.2.4 Bivariate Analysis of Covid19 wave two and three outcomes (deaths)

The table below illustrates the relationship between each individual risk factor and the number of Covid19 deaths in Kadoma city, 2021.

Table 4.3: Bivariate analysis of the number Covid19 deaths, Kadoma City, 2021

Variable	P-Value	Co-efficient
Sex (M/F)	0.0430	-9.626
Age group		
1-11	0.875	-19/500
21-31	0.795	-21.500
31-41	0.015*	114.167
41-51	0.699	28.864
51-61	0.456	58.429
61-71	0.970	-2.761
71-81	0.888	10.545
81-91	0.916	-7.846
91-100	0.758	-27.000
Comorbidities:		
Asthma	0.005*	168.040
Diabetes Mellitus	0.371	19.842
Hypertension	0.215	-27.461
Cardio-vascular disease	0.026*	172.875
Tuberculosis	0.725	-36.750
HIV	0.837	15.272
Symptomatology:		
Loss of taste	0.068	-35.094
Loss of smell	0.068	-35.094
Runny nose	0.120	161.789
Headache	0.239	26.093
Sore throat	0.495	-18.038
Shortness of breath	0.506	40.41
Cough	0.629	-9.071
Diarrhea	0.935	-4.021
Fever	0.999	0.037
No treatment given	0.724	7.051
Vaccination status	0.010*	-69.438

*Significant difference

Variable	**P-Value**	**Co-efficient**
Occupation:		
Health worker:	0.096	138.000
Informal	0.943	-3.188
Other	0.381	-37.54
Retail	0.008*	86.800
Security	0.589	-59.000
Re-infection	0.623	29.897
Oxygen supplementation	0.936	1.570
Type of test		
Ag/PCR	0.064	136.654
History of travel	0.952	-4.468
Place of death		
Isolation	0.577	11.250
Community	0.384	-31.867

*Statistically significant

4.2.5 Multivariate analysis

The table below illustrates the relationship between the independent risk factors and the number of deaths in Covid19 positive patients.

Table 4.4: Multivariate analysis of Covid19 outcomes (deaths), Kadoma City, 01 September 2020 to 30 August 2021

Variable	P-Value	Beta Co-efficient
Age group		
1-11	0.843	-24.554
21-31	0.7345	-28.181
31-41	0.118	124.616
41-51	0.5402	34.894
51-61	0.4262	61.083
61-71	0.9437	5.267
71-81	0.9222	7.271
81-91	0.0498*	4.674
91-100	0. 7106	-32.460
Vaccination status	0.014*	-83.768
No treatment given	0.289	21.841
Comorbidities		
Asthma	0.005*	162.712
Cardiovascular disease	0.095	194.159
Hypertension	0.1430	-31.807
HIV	0.3448	15.272
Tuberculosis	0.3337	-138.708

*Statistically significant

CHAPTER 5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter debates the study findings. The study was an analytical cross-sectional study design aimed at establishing if there were any significant epidemiologic differences between Covid19 waves two and three in Kadoma city from 01 September 2020 to 30 August 2021, as well as an analysis of the disease outcomes such as death. The null hypothesis was rejected based the discussion below.

5.1 Descriptive analysis of Covid19 waves two and three

For the Covid19 third wave, the study results were similar to preceding studies as they had more Covid19 positive males (52.2%) than females (47.8%), whilst wave two also had more Covid19 positive males (54%), in contrast to females (46%) (Manyati, 2021). This is similar to other studies (Tramontana et al., 2021). According to Mashe et al (2021), a larger fraction of contaminants were in males (55.5%) than females (44.85%), which is consistent with findings from previous studies (Alwani et al., 2021).

This variance in susceptibility could be owing to genetics and biological differences, or social factors (for instance, men are the heads of the families, which means they have a higher probability to travel to work, thereby predisposing themselves to Covid19 infection). The difference in proportions of Covid19 males and females was, however, not statistically significant (P=0.787) (Mashe et al., 2021b).

Mean age of the Covid19 cases in wave two was 39(Q1=31; Q3= 50), whilst during wave 3 it was 39(Q1=27; Q3= 50), which is coherent with the descriptive statistical analysis that was conducted in July 2021 at Kadoma City. These findings are also coherent with previous ones where Covid19 infections were most prevalent in the

20-40 age group (Mashe et al., 2021b). This revealed a statistically significant difference between the Covid19 positive average ages for Covid19 waves two and wave three.

The mean age of 39 is the working class and is also quite socially interactive. Legislation was passed in Zimbabwe, which allows employers to demand Covid19 tests as pre-requisites for employment as well as routine check-up of staff, among other rules employers were allowed put in place in order to contain Covid19 in the workplace. This means that the age group got tested more and the disease got detected much more frequently than in other age groups.

Due to the Covid19 regulations relaxation, more and more people started attending functions such as parties, clubbing, weddings, amongst many others, and this mean age interacted more, which led to spread of infection, and the mean age being affected more. Covid19 testing in health facilities was also increased, which could have also improved the detection of more Covid19 positive cases from this age group (Wells et al., 2021).

Since employers were now requesting Covid19 testing and vaccination certificates in the workplace, and the average age of 39 is the working class, this just goes to explain, that the age group got tested more. The awareness campaigns on vaccination, could have had an effect on the average age of 39, as they went on to get tested for Covid19 more. 13.4% of Covid19 positive cases were vaccinated during Covid19 wave two, whilst 10.1% were vaccinated during wave three. No statistically significant difference was detected between waves two and three (P=0.107). Vaccine hesitancy is still marked within the community, which possibly accounts for the low proportion of vaccinated people (Dubé et al., 2013)

. Some cases still have home remedies such as ginger and lemon as their first choice of care, as shown in one study (Manyati, 2021).

Mean vaccinated age for Covid19 wave two was 40(Q1= 32, Q3= 71), whilst that of wave three was 29(Q1= 21; Q3= 40). This difference was statistically significant difference (P=0.0001) between the mean vaccinated ages of the Covid19 positive cases. During wave three, younger vaccinated people tested positive for Covid19, as compared to those that tested positive during the second wave. This could be owing to the relaxation of National Covid19 regulations, where this average age became more socially interactive and people no longer wearing face masks consistently. Mean age not vaccinated for Wave two was 47(35; 75), whilst during wave three it was 39(26.5; 49). A statistically significant difference between the mean vaccinated age for Covi19 waves two and three was detected in the study (P=0.0001).

48.1% of the Covid19 were symptomatic in Covid19 wave two, whilst 89% were symptomatic in wave three. This difference was a statistically significant difference (P=0.0001). This means that the 52% of asymptomatic Covid19 positive cases from the second wave and the 11% asymptomatic cases of the third wave could still spread infection inadvertently and undetected. This is coherent with a previous study that illustrated that asymptomatic infection was frequent among younger ages, although other age groups also had asymptomatic cases (Gao et al., 2021)

Backache (14%), muscle pain, joint pain (1.3%), loss of appetite (4.6%), irritability and confusion (0.8%), as well as abdominal pain (1.5%), were all signs and symptoms that surfaced during wave three, but were not apparent during wave two. This difference was also statistically significant (P=0.0001), and coherent with the descriptive studies undertaken at Kadoma City Council in July 2021.

The most significant differences between Covid19 wave two and wave three were detected on backache (P=0.00001), headache (P=0.0001), fatigue (P=0.00001) and anorexia (P=0.00001). There were also significant differences between waves on loss of appetite (P=0.005), vomiting (P=0.0004), dyspnea (P=0.0007), sore throat (P=0.0004), chest pain (P=0.002), loss of taste (P=0.0013) coryza (P=0.0035), fever (P=0.0076). Fever had the least significant difference amongst the symptoms among the waves (P=0.0076). Anorexia was not apparent in Wave three, as opposed to wave two.

45% of Covid19+ cases in wave two had comorbidities, whilst 24% of those in wave three also had comorbidities. This was a significant difference (P=0.0001) between the two waves. These findings were similar to those from earlier studies where the comorbidities that were most prevalent in Covid19 positive patients were hypertension, diabetes mellitus, cardiovascular diseases and respiratory diseases (Gallo Marin et al., 2021).

There was a reduction in the aggregate of Covid19+ cases who had comorbidities during the third wave, in contrast to the second wave. Significant differences between waves were also detected on Hypertension (0.0001), pregnancy (0.016) and Diabetes mellitus (P=0.0434), in their ranking order of significance. There were no significant differences between the waves on HIV (P=0.7871), chronic lung disease (P=0.509) and asthma (P=0.2713). There was a significant difference between the two waves on those who did not have any comorbidities (P=0.00001).

No statistically significant differences also detected between Covid19 positive females with comorbidities in wave two and three (P=0.111). More Covid19 positive females had comorbidities in wave three (25.4%) than in wave two (19.5%). This therefore means that Covid19 positive females with comorbidities were more frequent during wave three, as compared to wave two. The association between gender, comorbidities and Covid19 infection is similar to that from past studies (Gallo Marin et al., 2021)

Covid19 wave two had a higher (8.6%) proportion of Covid19+ admissions, as opposed to wave three, that had 5.8%. In one study, 25% of patients underwent admission (Sadeghi et al., 2020). The proportion of Covid19 admissions was therefore, lower in this study as compared to previous studies. The age was significantly higher among ICU admission group. There was a significant difference, however, between the aggregate sum of Covid19 admissions of the two waves (P=0.00001). Signs and symptoms differed statistically significantly between Covid19 positive females admitted during Covid19 wave two and those admitted during wave three (P=0.00001). No signs and symptoms differed in males admitted during both waves (P=0.775).

The city did not have adequate resources for isolation and therefore, those who had mild symptoms were isolated at home, whilst those that were severe and required oxygen supplementation, amongst other resources were institutionally isolated, which absolutely reduced the number of admissions in to isolation during the third wave. It could also be that there were less complications during Covid19 wave three, or that people delayed seeking treatment as well as preferred use of home remedies as first choice of care.

This is also evidenced by the increased number of community deaths during the Covid19 wave three (84.8%) from the 8.1% detected during wave two. There was also a statistically significant difference between the two waves where the age group

31-41 is concerned (P=0.006), as the number of Covid19 positive admissions of cases falling within this age range was reduced in wave three as opposed to wave two.

History of travel in the 14 days preceding the initial surfacing of symptoms was also analysed, from which a statistically significant difference between the two waves (P=0.00001) was detected. There was a greater history of travel (18%) during wave three as opposed to that of wave two.

Males travelled more (8%) than females (10.5%) in both waves. Men are usually the breadwinners in the city, therefore could have been the reason why they travelled a lot more than women, trying to make ends meet. The age group 31-41 also travelled the most (5.6%), followed by 41-51(3.8%) and 21-31(1.8%). The least travelling age groups were 81-91 and 91-100 during wave two and 91-100 during wave three. There was a significant difference in history of travel between the two waves within the age groups 31-41 and 91-100. The age group 31-41 travelled more, owing to the issue that it is constituted by a lot of working class people and also people with high/heightened social interaction. As travel restrictions got more and more relaxed, this age group travelled and interacted more, thereby increasing the extent of infection and increasing their individual risks of contracting the disease.

Delay in seeking treatment was measured as seeking treatment more than 5days post onset of symptoms. There was a significant difference in deferment of seeking health care between waves two and three (P=0.00001). Males (wave two: 40.5%; wave 3: 44%) delayed seeking treatment more than females (Wave two: 25.6%; wave 3: 37%) in both waves. This might be credited to the preferred first choice of care being home remedies such as ginger and lemon, as shown by one study where 31% of respondents preferred home remedies as first choice of care in the event that they suspected Covid19 (Manyati, 2021).

No data, however, is available on the efficacy of lemons in the treatment of respiratory illnesses (Silveira et al, 2020), as they only gain a false sense of security from the use of home remedies such as herbs and lemons. Most of the Covid19 positive cases in Covid19 wave two were located in Rimuka (31.1%), whilst in Coid19 wave three, most positive Covid19 cases were also in Rimuka (30.7%). This difference in proportions of Covid19+ cases between the two Covid19 waves in Rimuka was not statistically significant (P=0.867). During Covid19 wave two, the township with the most Covid19 cases was Rimuka (31%), followed by Eiffel Flats (22.3%), which was the same trend during wave three, where Rimuka (30.7%) was followed by Eiffel Flats (25%). This finding is coherent with previous Kadoma City descriptive analysis undertaken on the townships in July 2021. East-view had the least proportion of Covid19 cases during both wave two (0.8%), whilst Pixiecombie (0.9%) had the least proportion of Covid19 cases during wave three. A statistically significant difference between the two Covid19 waves was detected in the distribution of Covid19 positive cases in Mornington (P=0.023) and Ingezi (P=0.004).

The Attack rate was higher in wave three (86%), as opposed to wave two (48%). There was a statistically significant difference between wave two and three (P=0.0001), which could indicate the SARS-CoV2 variant being stronger and spreading much faster in wave three. The variant in wave three was also characterized by the surfacing of new symptoms such as backache, muscle and joint pain, which were not as characteristic of the previous variant from wave two. There was therefore a greater risk of contracting Covid19 in wave three.

Wave three had a higher incident rate of 0.863 than that of wave two incident rate of 0.067. The rate at which new Covid19 cases were identified in the two waves was higher during wave 3, therefore cases were detected at a faster rate during wave three. A statistically significant difference between the incident rates of both waves was detected (P=0.0001). Men (wave two: 51.4%; wave 3; 65%) died more than women (wave two: 48.6%; wave three: 34.8%) during both waves. There was a statistically significant difference in mortality rates between wave two and three (P= 0.001). This finding could be attributed to the deferment in seeking treatment mentioned above.

The results of the study were also that, men in wave three (40%) delayed seeking treatment more than the men in wave two (35%), which could have also contributed to an increased mortality rate during wave three. This finding brings up a new area for possible research as more women (25.4%) had comorbidities than men (17.8%) in wave three, which means the women would have been more at risk of contracting Covid19 and having negative outcomes from it, such as death, than the men.

However, the results of this study have proved the opposite true. There could possibly be other biological differences that could have contributed to the finding, such as females being having a better immune response to Covid19 due to them having hormones such as estrogen, where men have testosterone, which actually reduces their immune response to Covid19, as proven in previous studies (Tramontana et al., 2021). There was also no statistically significant difference in the Case Fatality Rate (CFR) and therefore, severity of disease among the two waves (P=0.072).

The age groups 41-51 and 61-71 from wave two had a higher mortality rate (21.6%) in contrast to the other age groups.

5.2 Analysis of Covid19 outcomes

5.2.1 Descriptive statistics

Age group 81-91 (21.7%) had the highest mortality rate among the different age groups during wave three. Mortality rate was about 68% in Covid19 admissions, which is much higher than the 21.6% from this study, and was also significantly elevated in older age groups, as seen one study (Sadeghi et al, 2020. CDC states that the rate of death is four times higher in in the 30-39 age group, and 340 times higher in the 85+ years age group (CDC, 2020a).

Which is consistent with the current study findings (Sadeghi et al., 2020). Statistically significant differences in the aggregate of Covid19 deaths among the two waves were unearthed among the age groups 81-91 from wave two and wave three (P=0.008), 11-21 (P=0.0001) and the >1 age group (P=0.0001). The most statistically significant difference in the proportion of Covid19 deaths was in the age group 11-21 (P=0.0001) and age group of >1 (P=0.0001) between Covid19 waves two and three. The least statistically significant difference in the amount of Covid19 deaths was in the age group 71-81 (P=0.952). The age group 71-81 still died a lot more frequently from Covid19 in both waves.

The study showed that males died more from Covid19 (Wave two: 65%; wave three: 51.4%) than females (wave two: 34.8%; wave three: 48.6%) in Covid19 waves two and three. As per CDC findings, the relative risk of disease severity and death from Covid19 was dependably raised in men through all age groups (Alwani et al., 2021). Which is coherent with results from this study. Research findings inferred that the expression of a protein called TMPRSS2 could facilitate the sex disparity detected in severity and mortality of Covid19. This protein confers elevated severity of Covid19 disease in males more than females (Alwani et al., 2021).

The disparity detected in gender and brutality of disease is further explained by cell mosaicism, in which one of the X chromosomes in females is inactivated and therefore silenced so as to maintain a balanced gene expression dosage, resulting in females having 50% of their cells inactivating the maternal X chromosome, meanwhile inactivating the paternal X chromosome in the rest (Lyon, 1961).

This therefore, affords females a higher plasticity and adaptability against infections. Additionally, other immune associated genes are incompletely reactivated in female lymphocytes so as to confer heightened immunity towards infections, making females more immune responsive than males. There were no statistically significant disparities in number of Covid19 deaths by sex among the two waves (P=0.144). The mean age of dying from Covid19 in wave two was 55(Q1=45; Q2= 70), and 64(Q1= 47; Q3= 80) in wave 3. There were no significant disparities between the two waves in terms of the average age of dying from Covid19 (P=0.1376).

The most common sign and symptom presented by the Covid19 cases who died during wave two (95.6%) and wave three (94.6%) was fever, followed by headache (wave two: 45.9%; wave three: 91.3%). Fever was also the most frequent symptom reported in moderate to severe Covid19 disease (Gallo Marin et al., 2021). The least presented sign and symptom during the two waves was diarrhea (wave two: 5.4%; wave three: 5.4%).

Backache, muscle, joint and abdominal pain, vomiting and fatigue in the Covid9 related deaths were apparent in wave three and not in wave two. No one who died from Covid19 during wave two complained of coryza, but 0.8% did so during wave three. There were also statistically significant differences between waves on fatigue (P=0.0001), vomiting (P=0.0001), loss of taste (P=0.007), backache and muscle pain (P=0.0001).

The majority of Covid19 related deaths had no comorbidities during both waves two (43%) and three (55%). There was no statistically significant difference between the two waves on the Covid19 related deaths that reported not having any comorbidities (P=0.211). The most common comorbidity in Covid19 related deaths during wave three was Hypertension (21.7%), whilst the majority of Covid19+ deaths had Diabetes mellitus (29.7%). This is coherent with previous studies on comorbidities in Covid19 such as one by Hornadoost et al, 2021, which revealed Hypertension as the utmost common comorbidity in Covid19 positive cases (29.6%).

Another study also hypertension and diabetes mellitus being the comorbidities most associated with hospitalization and severe disease (Savoia et al., 2021). CDC also detected close association between older aged diabetic cases and an increased severity of disease (CDC, 2022).

The least common comorbidities reported from Covid19 related deaths during wave two were CVD (0), Tuberculosis (2.7%), HIV (2.7%) and asthma (2.7%). In a previous study, CVD contributed a much higher percentage (12%) of hospitalizations and disease severity. The least common comorbidities reported from Covid19 related deaths during wave three were HIV (1.1%), CVD (1.1%) and Tuberculosis (0), which was not reported from any Covid19 related death. There were therefore, no statistically significant differences in comorbidities reported from Covid19 related deaths between the two waves (P<0.05).

Covid19 related deaths who were vaccinated, were more during wave three (3.3%), as opposed to 2.7% in wave two. This could credited to the increase in supply of vaccines at health facilities increased in wave three. In one study, 84.2% of unvaccinated Covid19 positive admissions were reported. The findings from this study, therefore, show a much lower (12%) proportion of admitted/hospitalized vaccinated Covid19 positive patients. There was a close association between disease severity and a lack of vaccination, and this association got stronger with immuno-competent patients (Bhowmik et al., 2021).

There were no significant differences in the number of vaccinated Covid19 related deaths between the two waves (P=0.865), and the increase in supply of vaccines during wave three saw an increase in the number of vaccinated people in wave three. However, an increase in unvaccinated Covid19 positive cases died from Covid19 in both waves (wave two: 97.3%; wave three: 96.7%) (DiPiazza et al., 2021).

More female Covid19 related deaths had delayed seeking treatment during wave two (48.6%), than men (35%). More male Covid19 related deaths had delayed seeking treatment (66%) than the females (34%). A total of 83% of patients who had severe Covid19 delayed seeking treatment, similar to a previous study where a disturbing lack of healthcare seeking in respondents who had severe Covid19 symptoms such as breathlessness were reported (Wilton et al., 2020). There were however, no statistically significant differences between male Covid19 related deaths who delayed seeking treatment during both waves (P=0.589). There was a statistically significant difference in the number of female Covid19 related deaths who delayed seeking treatment during wave three (P=0.00001). The study therefore, determined that there were statistically significant differences in the number of Covid19 related deaths that had delayed seeking treatment (P=0.0121). There was an increase in the number of deaths who had no deferment in seeking medical care during wave three, which was a statistically significant disparity among the two waves (P=0.0121).

The most frequently reported complication in Covid19 related deaths during both waves was ARD (wave two: 75.7%; wave three: 95.7%). Of the two waves, wave three reported the most cases of ARD in Covid19 related deaths. The two wave were significantly different in terms of the complications reported from the Covid19 related deaths (P=0.00001). There were no statistically significant differences between the two waves in terms of those who did not report any complications during wave two and three (P=0.503).

There were no statistically significant differences between the waves on other complications in Covid19 deaths such as liver failure, renal failure, cardiac arrest and shock (P=0.114). In previous studies, however, heart disease and renal complications were the most frequently reported complications, though respiratory complications were also included (Yang et al., 2021).

Most Covid19 related deaths had occupations in the ‘other’ category (wave two: 54%; wave three 63%). In this study, health workers died the least from Covid19 during both wave two (2.7%) and three (1.1%). This is credited to the fact that they had protective clothing to protect against the spread of contagion to begin with, and were given first priority for vaccination, which could have given them a protective effect. Working in close contact with Covid19 positive cases could also have afforded health workers some protective immunity against the infection. Also, females dominate the health field more than the men, and considering the finding from previous studies, that Estrogen boosts the immune response to Covid19, in contrast to the opposite effect of testosterone, then this could be a factor that contributed the finding (Alwani et al., 2021). Occupations with increased social care and contact with the general public were at a greater risk of contracting Covid19 and severe disease as reported in a previous study (Pearce et al., 2021). There were no statistically significant differences between both waves in terms of the Covid19 related deaths' occupations (P=0.548).

The largest number of Covid19 related deaths who had received treatment was during wave three (79.3%) as compared to those from wave two (46%). There was a statistically significant difference in treatment given to those who died from Covid19 between the two waves (P=0.0001). More Covid19 cases who died had received oxygen supplementation during wave three (37%) than in wave two (24%). Oxygen was administered to patients with difficulties in breathing as well as low oxygen saturation, and the results are coherent with those from a previous study where oxygen saturation and administration was a valuable predictor of disease severity and mortality (Sadeghi et al., 2020).

Wave three could have been characterized by a larger number of admissions due to improved availability of resources for the treatment of Covid19. There was therefore no statistically significant disparity among those who died from Covid19, but had received oxygen supplementation during the waves two and three (P=0.168).

Rimuka was characterized by the largest number of Covid19 related deaths in both wave two (35%) and wave three (54%), which is in line with previous descriptive analyses done on Kadoma City in July 2021. This might be credited to Rimuka having the largest population in Kadoma, therefore, an increased Covid19 infection burden as compared to other suburbs. Sabonabona also had the highest statistically significant differences between the two waves, in terms of the amount of Covid19 related deaths (P=0.0003), followed by Cecil Estates (P=0.038) and Rimuka (0.049). Mornington had the least number of Covid19 related deaths during both wave two and three (wave two: 27%; wave three: 1.1%) as well as Sabonabona which had 0% in wave three. Most Covid19 deaths were brought in dead from the community (wave two: 8.1%; wave three: 84.8%). wave three had the largest amount of Covid19 deaths brought in dead. Only severe cases were isolated/institutionalized, leaving majority of Covid19 cases home isolated.

This therefore, led to an elevated quantity of deaths reported from the community as opposed to those reported from the institution. There were no significant differences in Covid19 deaths that were brought in dead between the two waves (P=0.0001) and the number of those who died in an isolation center. During wave two (8.1%) and three (79.3%), most Covid19 related deaths had been admitted to an institution prior to death. There were no statistically significant differences in both waves, pertaining place of death (P>0.005).

There was a 1% drop in the quantity of recoveries of Covid19+ cases in wave two (89%) and wave three (88%). A recovery rate of 89% was significantly higher as compared to that of India, in a previous studies where they recorded a recovery rate of 60% (A. Singh & Chattopadhyay, 2021), considering India had become the third most Covid19 hard hit country in the world, as of 2021. A statistically significant disparity was unearthed among the two waves pertaining the Covid19 related deaths that did not recover (P=0.0001).

There was no statistically significant difference in recoveries, between both waves (P=0.617). ARD was the most frequently reported complication among the Covid19 cases that died (98.4%), whilst 1.6% of Covid19 positive patients did not have the condition progress to any complications, but still died. About 5% of Covid19 cases progressed to acute respiratory distress syndrome in one study (Alwani et al., 2021). This study therefore, had a heightened percentage of ARDS.

The mean survival time was 4.7days (2.0-5.0) between both waves, and there were no statistically significant differences in average survival time between the waves (P>0.05). In comparison with other studies, Brazil had median survival time of 12.5 days, whilst China had median survival time of 6.5 days. Timely identification and acknowledgment of medical care for Covi19 cases are crucial for reduction in mortality and increasing survival (Sousa et al., 2020).

5.2.2 Bivariate analysis

Bivariate analysis using Linear regression, of the 92 Covid19 related deaths against the independent variable sex, revealed that there was sufficient evidence (P=0.043) to conclude that an association between the number of either Covid19 positive males or females as well as the number of deaths, exists within the population (Alwani et al., 2021). Being an either male or female Covid19 positive patient contributed to the elevation in the aggregate of Covid19 related deaths.

This is coherent with the findings from a previous study that revealed that women possessed a stronger immune response to Covid19 as opposed to men, owing to the immune-enhancing effects of estrogen, whilst testosterone exhibits immunosuppressive effects (Tramontana et al., 2021). The results of this study, are therefore indicative of a biological difference in Covid19 disease outcomes.

A positive linear association was detected between the Covid19 positive age group 31-41 and the number of Covid19 related deaths (P=0.0151), where for every one year increase in age, there was a corresponding increase in number of Covid19 deaths by 114.167. These results are similar to earlier studies where mortality rate was increased by more than 300 times in ages above 60 (Sousa et al., 2020). The other age groups had no association with the number of Covid19 related deaths (P: 0.970 to 0.456).

The most strongly associated comorbidity with severity of Covid19 (death) was Asthma (P=0.005), which was coherent with previous studies, where moderate to severe/uncontrolled asthma, was closely related to disease severity (CDC, 2020b). Cardiovascular disease in Covid19 positive patients also had a positive linear association/correlation with an escalation in the aggregate of deaths (P=0.026), as seen in previous studies (Gallo Marin et al., 2021).

All the other comorbidities in Covid19 patients such as Diabetes mellitus, Tuberculosis, hypertension and HIV had P>0.005, had no relationship with mortality. These findings further emphasize those from previous studies, where comorbidities were significant predictors of disease severity and mortality

There was no association between Covid19 positive symptomatology, and the number of Covid19 deaths. Having a fever whilst Covid19 positive was not a predictor of death (P=0.999). There was no relationship between receipt of treatment and Covid19 mortality (P=0.724), which might owe to the concerning deferment in seeking treatment culminated in to Covid19 deaths, as they mostly received treatment after the disease had severely worsened and prognosis now poor (Sousa et al., 2020).

There were Covid19 deaths, despite the patients having received treatment, whilst other previous studies showed that early receipt of treatment increased survival time and improved prognosis (Sousa et al., 2020). The delay in seeking healthcare apparent in this study, therefore, negatively impacted prognosis and survival.

There was a negative association between being Covid19 positive, vaccination status (P=-0.014), and the number of Covid19 deaths. For every Covid19 vaccinated patient, there is a corresponding decrease in Covid19 deaths by 69.438 (DiPiazza et al., 2021).

No association was detected between the sum of professionals and the number of Covid19 deaths (P=0.623), contrary to preceding studies where occupations involving contact with the public had a close association with Covid19 infection and mortality (Pearce et al., 2021). The following factors were not associated with a change in number of Covid19 deaths: reinfection (P=0.936), oxygen supplementation (P=0.936), type of test used, i.e antigen/rapid tests and PCR (P=0.064), history of travel (P=0.952), place of death (Isolation: P=0.577; Community: P=0.384).

Previous studies confirm that reinfection is synonymous with reduced mortality, as prior infection offers a protective factor against disease severity on reinfection (Mensah et al., 2022). History of travel was however, associated with risk of Covid19 infection

5.2.3 Multivariate Analysis

The overall regression was not statistically significant (R2 =0. 15; P=0. 405). After factoring in other variables, age group 31-41 ceased to be linked to an elevated number of Covid19 deaths (P=0.118). The age group 81-91 significantly predicted the number of Covid19 deaths (ß=4.7, P=0.0498), which is linked to preceding studies where 60+ years of age was a significant predictor of mortality (Sousa et al., 2020).

For every one Covid19 positive case (aged between81-91) increase, there was a corresponding upsurge in the aggregate of Covid19 related deaths by 4.7. Therefore, the factors that significantly predicted the sum of Covid19+ deaths were age group 81-91(ß=4.674; P=0.0498), vaccination status (ß=-8.764, P=0.014) and asthma (ß=162.712; P=0.005), consistent with CDC reporting (CDC, 2020b). Hypertension, Tuberculosis, HIV, CVD and Diabetes mellitus did not significantly predict the number of Covid19 related deaths in this study (P>0.000). This finding not in line with other studies that reported pre-existing hypertension, CVD and Diabetes mellitus as a significant predictor of mortality (Mensah et al., 2022).

5.2.4 Conclusion

5.2.5 Conclusion on Hypothesis

Based on the study findings, we rejected the null hypothesis that there were no statistically significant disparities among the Covid19 waves two and wave three ($p < 0.05$).

5.2.6 Conclusion on Descriptive statistics and multivariate analysis

It was concluded that the mean age of contracting Covid19 was 39. Males being the most commonly affected. Females were most likely to have an underlying illness and get admitted after Covid19 diagnosis as compared to males, whilst the age group 41-51 was most commonly admitted post Covid19 diagnosis. Males were most probable to delay seeking treatment, travel out of the city and die from Covid19, in contrast to the women. Rimuka followed by Eiffel flats had the most number of Confirmed Covid19 cases in contrast to the rest of the other suburbs/townships. Health workers were less probable to contract Covid19 as compared to other occupations, which could indicate a protective factor.

Covid19 deaths were more expected to have succumbed to acute respiratory distress as compared to other complications. Covid19 positive cases were most likely to have hypertension and/or diabetes mellitus as an underlying condition as compared to other comorbidities, however, asthma was the most significant predictor of mortality in Covid19 patients. An increase in deaths amongst vaccinated and unvaccinated patients during the two was noted. However, the increases were not statistically significant.

Vaccination status remained a significant positive predictor of Covid19 mortality. Recovery rate also dropped by 1% during wave three, though it is still very high in comparison to that of other most Covid19 hard hit countries such as India as well as China. There were no disparities on Mean survival time among the two waves as people survived for 4.7days prior to death. Age, sex, vaccination status and pre-existing conditions remained significant predictors of Covid19 mortality as seen in previous studies.

5.2.7 Recommendations

5.2.8 Thematic area-specific recommendations

5.2.9 Case Investigation and Contact Tracing

Data collected was not complete, which made it difficult to analyse, therefore the researcher recommends that the Environmental Health and Clinical Services managers enable data collection and quality training of the nurses and EHOs assigned to case detection and case investigation during the third quarter of 2022, as well as supervise them thoroughly with immediate effect, to enable more comprehensive data collection.

5.2.10 Risk Communication and Community Engagement

The Environmental Health Manager to facilitate adequate resource allocation towards the Risk communication department, that are age-specific, and appropriate for the age group 31-41, aimed at health education and awareness on large social gatherings, travelling and vaccination. The department focal person should also ensure distribution of EIC material to organizations and work places, so that the working age group can also acquire the much needed preventative information. There is also need for the Departmental focal person to increase vaccination campaigns. More aggressive awareness campaigns on risk factors as well as consequences of deferment in seeking medical care to be arranged by health promotion officer and implementing partners, so as to facilitate behavioural change among males. This should be implemented by end of fourth quarter of 2022.

5.2.11 Infection Prevention and Control

The Kadoma city Clinical Services Manager and the implementing partners should liaise for consignment of more vaccines and the procurement of more Covid19 test kits for health facilities by the end of the fourth quarter of 2022. Testing in health facilities should be up-scaled so as to enable eradication of Covid19 within the community. A larger allocation of these, as well as response resources should be directed towards Rimuka and Eiffel flats, since they have the largest Covid19 burden. The signs and symptoms such as backache, muscle and joint pain, to be incorporated on the WHO case definition used for case detection at clinics, so as to avoid any cases being missed.

5.2.12 Coordination and logistics

The Kadoma City health directorate should liaise with implementing partners for the allocation of research resources towards the biological factor differences among males and females of African descent. Resources should also be allocated towards the determination of protective factor advantages against Covid19 acquired by health workers. All this to have been achieved by end of the fourth quarter of 2022.

5.2.13 Suggestions for further study

The study unearthed many unanswered questions. As alluded to above, the biological and molecular differences between females and males of African descent, that make males more susceptible to Covid19 and experience much more severity of disease, as opposed to women, is still not fully understood, and has only been studied in mice. It is only prudent to further explore the cell mosaicism phenomenon in humans, and of African descent, as well as its linkage to susceptibility to Covid19. Socio-cultural, socio-economical differences that pose the disparity in susceptibility to Covid19 between the two sexes could also be explored.

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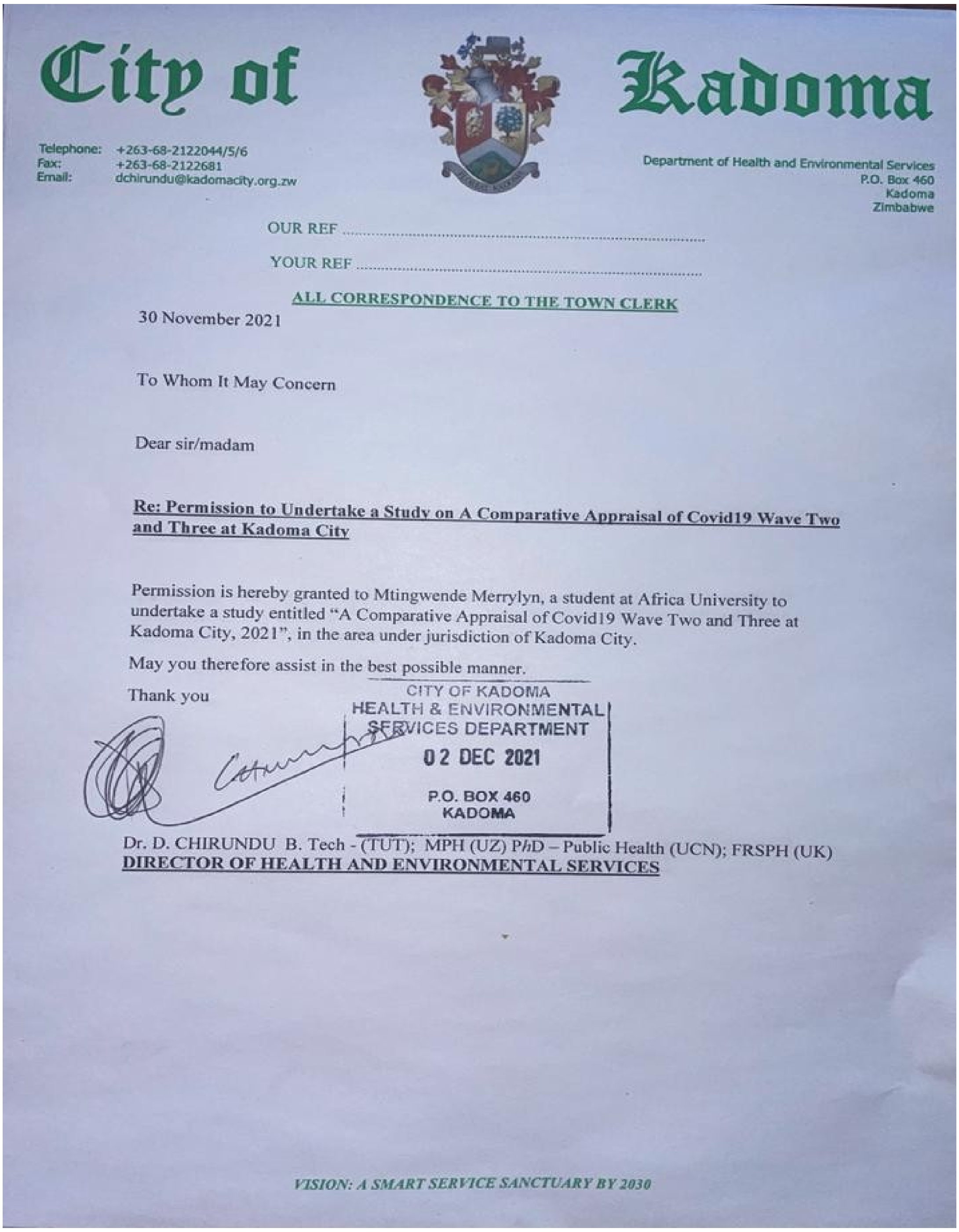
Appendix 1- Permission letter from Kadoma City Health Services Director



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Zimbabwe

OUR REF ....

YOUR REF ....

ALL CORRESPONDENCE TO THE TOWN CLERK

30 November 2021

To Whom It May Concern

Dear sir/madam

Re: Permission to Undertake a Study on A Comparative Appraisal of Covid19 Wave Two and Three at Kadoma City

Permission is hereby granted to Mtingwende Merrylyn, a student at Africa University to undertake a study entitled "A Comparative Appraisal of Covid19 Wave Two and Three at Kadoma City, 2021", in the area under jurisdiction of Kadoma City.

May you therefore assist in the best possible manner.

Thank you

CITY OF KADOMA
HEALTH & ENVIRONMENTAL SERVICES DEPARTMENT
02 DEC 2021
P.O. BOX 460
KADOMA

Dr. D. CHIRUNDU B. Tech - (TUT); MPH (UZ) PhD – Public Health (UCN); FRSPH (UK)
DIRECTOR OF HEALTH AND ENVIRONMENTAL SERVICES

VISION: A SMART SERVICE SANCTUARY BY 2030