INVESTIGATING KNOWLEDGE, ATTITUDES AND PERCEPTIONS OF COVID-19 VACCINES AMONG YOUNG PEOPLE IN SOWETO, SOUTH AFRICA

'A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the Master of Vaccinology'

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By

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DECLARATION

I, Jelioth Muthoni, declare that this research report is my own original unaided work. It is submitted in partial fulfilment of the Master of Medicine in Vaccinology, in the faculty of Health Sciences, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to this or other university.

_____

(Signature of candidate)

___ 30_____day of__March_____2023_____

DEDICATION

I dedicate this work to the youth in Soweto. Through their responses and participation in the study has help us have a better understanding of the reasons behind vaccine hesitancy.

ABSTRACT

Vaccination against SARS-CoV-2 is the most prominent strategy in the global fight against COVID-19. Studies continue to show that vaccines are one of the most dependable and cost-effective public health interventions available as they save life every year. However, World Health Organization (WHO) has identified vaccine hesitation as one of the primary threats to global health. Little is known, however, about the causes and nature of vaccine hesitancy in Africa. Moreover, in South Africa a significant drop of COVID-19 vaccine when it was rolled out the youth. The age group is of critical importance as they are becoming productive people who would be essential in the development of any country hence the need to protect them. Furthermore, understanding why youth are hesitant to get vaccinated is critical if we are to increase and sustain public demand for vaccination and preserve the tremendous achievements of vaccination programs on the continent. Unfortunately, there are limited studies that have investigated vaccine hesitancy among the youth populations and precisely looking at their knowledge, attitudes, and perceptions of the COVID-19 vaccine. Hence, the study aims to investigate knowledge, attitudes and perceptions of COVID-19 vaccine among young people in Soweto.

The study employed a quantitative method, whereby closed ended questionnaires were administered using Redcap a very power tool for collecting data. Quantitative method was the best fit for the study for it accommodates a large sample size. Soweto-Thembelihle Health Demographic Surveillance System database was in the identification of the samples. STATA version 13.0 was used for statistical analysis.

Out of a sample size of 380, the study recorded a 79.2% (301/380) hesitancy levels. The study population recorded to be knowledgeable on COVID-19 disease and vaccine. However, negative attitudes and perceptions based on the study participants responses in some important elements. The elements included '*COVID-19 is a hoax'* (p=0.011), '*I prefer to gain immunity by*

being sick rather than by having a vaccine '(p=0.000) and '*COVID-19 vaccine has serious side effects*' (p=0.000)

The study found out that infordemic has played a significant on the knowledge levels precisely among the youth. The study participants were well- informed, but they had poor attitudes and perception towards COVID-19 vaccine. These insights could help to reinforce national efforts to contain the pandemic across South Africa in particular Soweto and lessen other important consequences of the pandemic well-being.

Key words: South Africa, COVID-19, Soweto, vaccine hesitancy, youths

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TABLE OF CONTENT

Contents

LIST OF FIGURES

LIST OF TABLES

KEY TERMS

Attitudes - The Oxford Dictionary defines attitudes as one's thoughts or feelings toward someone or something.

Knowledge - According Merriam-Wester dictionary, knowledge is defined as the fact or condition of knowing something with the familiarity gained through experience or association

Perceptions- Perception is defined by Merriam-Wester dictionary as the capacity of an individual's comprehension or interpretation of a specific thing or issue

Vaccine hesitancy is the delay in acceptance or refusal of vaccines despite availability of vaccination services.

Young Population/youth – based on the South African Demographics it's people of age 18-35 years

LIST OF ACRONYMS

COVID-19 – Coronavirus 2019

ICTV - International Committee on Taxonomy of Viruses

NCoV -novel Corona virus

SARS-CoV-2 – severe acute respiratory syndrome coronavirus 2

Soweto – South-West Township

WHO – World Health Organization

CHAPTER ONE

INTRODUCTION

1.0 Background

Coronavirus disease 2019 (COVID-19) is a contagious disease that is caused by Severe Acute Respiratory coronaviruses (SARS-CoV-2 virus) (1,2). COVID-19 is the first disease in history to cause a pandemic on all the continents and it is currently ongoing (3). According to the World Health Organization (WHO), there have been 525,467,084 confirmed cases of COVID-19 and 6,285,171 deaths globally(3). This is of time period 30th December 2019 to 27th May 2022(3). While in Africa from 24th February 2020 to 23rd May 2022 8,976, 866 confirmed cases and 138,005 confirmed deaths have been reported of COVID-19 (3). In South Africa from 5th March 2020 to 27th May 2022, there has been 3,944,845 confirmed COVID-19 cases with 101, 092 deaths (4). The data will be updated regularly as figures continue to rise (3). COVID-19 symptoms can range from mild to severe (5). COVID-19 may be present in people who have fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, and diarrhoea (6,7).

Despite the severity of the disease, COVID-19 vaccines have played a significant role in reducing COVID-19 severity globally (8). Vaccination against SARS-CoV-2 is the most prominent strategy in the global fight against COVID-19 (2). The first effectiveness study is based on Israeli national surveillance data which shows that from the first 4 months of vaccination, two doses of Pfizer-COVID-19 vaccine reduced both symptomatic and asymptomatic infections, COVID-19 associated hospitalizations, severe disease, and death(2). The Modena, COVID-19 vaccine has a 94.1 percent efficacy in preventing COVID-19 illness, taking into account the severity of the disease (9).

Studies continue to show that vaccines are one of the most dependable and cost-effective public health interventions available as they save life every year (8,10). Edward Jenner is considered the founder of vaccinology in the West in 1796, when he inoculated a 13-year-old boy with vaccinia

virus (cowpox) and demonstrated immunity to smallpox. This led to the first development of small pox vaccine in 1798 (11). Over the 18th and 19th centuries, systemic implementation of mass smallpox immunisation crowned in its global eradication in 1979 (11). Over time there has been development of a wide array of vaccines using different technologies such as protein sub unit, nucleic acid, viral vector and whole virus (12). The researchers have embraced the four mentioned technologies in the fight against COVID-19 pandemic (12). The Covid-19 vaccination program was implemented in South Africa in February 2021. The implementation was phased in accordance with a national prioritization framework. The first phase focused on healthcare workers, while the second phase prioritized essential workers, people over the age of 60, adults with co-morbidities, and people in congregate settings. The third phase is concerned with the remaining population (13).

South Africa's population is 60 million people (14). To achieve herd immunity, 67 percent of the population must be immunized (13). The main impediment to achieving this goal, however, is vaccine hesitancy and scepticism among the population, not only in South Africa but also globally (8,15).

Vaccine hesitancy

Vaccine hesitancy is described by the WHO Strategic Advisory Group of Experts (SAGE) as a delay in accepting or refusing vaccination regardless of the accessibility of vaccination services (8). According to the WHO Strategic Advisory Group of Experts (SAGE) vaccine hesitancy as the delay in accepting or refusing vaccination regardless of the availability of vaccination services. While vaccine refusal is a sub-set of vaccine hesitancy. Moreover, the boarder between vaccine hesitancy and refusal is definitely blurred (16). This study focused on vaccine hesitancy.

Regarding the coronavirus disease 2019 (COVID-19) vaccines, vaccine hesitancy has several different root causes. This situation is not brand-new. Despite a wealth of data confirming its safety and lack of link to autism, infertility, or other negative effects, disagreement and false

information have been present regarding influenza and other vaccinations containing thimerosal for decades(17).

At the beginning of 2020, a study done in 19 countries that comprise of 55% of the global population, among people of 25-54 years old, recorded an acceptance rate of 71.5%. The likelihood that a respondent would accept a vaccine increased with their level of trust in information from official government sources (17). Although vaccine hesitancy differs from country to country and is disturbingly high in many places, a sizable fraction of the global population reports that there is reluctancy in getting vaccinated (18). Furthermore, a study done from 23 countries with a national representative of 1,000 individuals, investigated a global COVID-19 vaccine hesitancy. A hesitancy of 75.2% was recorded. The lack of trust in the COVID-19 vaccine's safety and scientific foundations, as well as doubts about its effectiveness, are factors that are common to all nations when it comes to vaccination hesitancy (19).

Yet, given the coronavirus epidemic and promises for quick development and implementation of a vaccine, the spread of anti-vaccination misinformation through social media has given it additional urgency. The Strategic Advisory Group of Experts in Immunization (SAGE), a carefully chosen team of WHO employees, looked at the escalating patterns related to the vaccination process and came with the concept of vaccine hesitancy. In relation to vaccine hesitancy, the WHO has identified three criteria (the "three C's") that are crucial: (1) Complacency refers to the perception of vaccine risks, side effects, and value. (2) By convenience, we mean the vaccine's price, accessibility, and availability, as well as how many elements are connected to it. (3) Confidence is related to confidence in the government and the industries that produce the vaccinations, as well as the efficacy and safety of vaccines (20). It suggests that people are aware of the advantages of vaccines and have confidence in medical personnel and services (20). WHO has emphasised that context-specific attitudes are what cause vaccine reluctance. It has been noted that people can reject one vaccine while still receiving others (20). The SAGE working group claims that a few particular factors, including cultural background, ethnicity, racial history, economic circumstance, person's attitude and beliefs, family's perception, environmental and

political factors, personal experience, and vaccine-specific issues, influence vaccine hesitancy (20). To assess the social, historical, and cultural impact that contributes to hesitancy, a larger understanding is necessary (20). Studies from the early 2000s to the present show that a significant portion of the content about vaccines on popular social media sites is anti-vaccination messages (20). Social media analysis by Wilson and Wiysonge clearly demonstrates an alarming footprint of vaccine hesitant groups. They could demonstrate that there is a significant relationship between social media and public hesitations about the safety of vaccines, whereby substantial relationship between foreign disinformation campaigns (21). Moreover, a study done in Sub-Sahara Africa from 14th March to 16th May 2021, recorded the prevalence of COVID-19 vaccine hesitancy to be lowest among newspaper readers (42%) and highest among TV (72%) and social media users (73%) (22). Vaccine hesitancy studies have been conducted among healthcare workers in countries such as Jordan, Uganda, and South Africa (8,23,24). However, no published research has been conducted in Soweto, South Africa, particularly among young people (18-35 years old).

Because few young people have comorbidities that would expose them to the severity of COVID-19, the majority of them present with asymptomatic to mild symptoms (25).

As a result, when they are not vaccinated, they pose a significant risk in the community. This is referred to as optimistic bias, whereby young people presume to be less susceptible to COVID-19 in comparison with the older population (26). Moreover, young adults have a higher potential to spread COVID-19 as a result of their high ability to socialize and reduced adherence to public health guidelines (27).

Natural Immunity vs Vaccination

The mortality and morbidity of this disease may be decreased by both natural immunity and vaccine-induced immunity, but there is still much debate over the most effective approach to handle this complicated socio-health problem (28). Data from four observational studies and

three vaccine efficacy trial done in United States of America, Israel and United Kingdom, found no significance difference in the overall level of protection provided by infection as compared with protection provided by vaccination (29). However, some researchers suggest vaccine-induced immunity is more effective while other suggest natural immunity is more effective (29). Furthermore, public health professionals must weigh additional information than efficacy alone when building policy. Among the many possible factors, three key issues must be considered when determining whether vaccine mandates should accommodate immunity following prior infection: (1) risk exposure; (2) reliability; and (3) sustainment (29).

Risk exposure is the first issue. Notably, each pathway to immunity exposes individuals to different levels of risk (29). People could have adverse reactions to vaccines or severe outcomes due to infection. Adverse effects have been minimal for COVID-19 vaccines, indicating a nominal level of risk exposure. SARS-CoV-2 exposure, meanwhile, carries significant and well-documented dangers. Risk therefore becomes the cornerstone for making public health policy decisions as the vaccine is far safer than natural infection. (29)

Reliability is the second issue. Without reliable information about the conditions conferring immunization, it becomes difficult to build policy (29). Vaccination uses the same formula each time, the same dosage, and with an identifiable date of vaccination, waning immunity can be documented with high reliability. Natural immunity is highly variable by comparison. People may not know which strain infected them without further testing, viral load during the infection, or precisely when their exposure occurred. Asymptomatic individuals may know none of this information. Serology testing for SARS-CoV-2 antibodies could also be unreliable due to timing and current serology test performance characteristics. Hence, vaccines thus provide a more reliable option than natural infection when constructing policy (29).

Sustainment is the third issue. COVID immunization may not result in lasting immunity, and so public health policy must consider requirements to sustain immunity among the population. Tracking vaccine-induced immunity is relatively simple due to higher reliability (29). In turn, coordinating booster shots becomes easier because protocols can be optimized in accordance

with prior vaccination. Boosters for natural infections are more difficult to coordinate. If date of infection is unknown, as with asymptomatic cases, and duration of waning immunity is unknown, as with most COVID cases, it becomes exponentially more difficult to build any consistent or meaningful policy. Vaccines represent the better option around which to coordinate boosters and ensure continuing immunity (29). However, despite of vaccines being proven the most sustainable public health intervention; vaccine hesitancy is one of the primary threats.

1.1 Statement of the problem

According to the WHO Strategic Advisory Group of Experts (SAGE), vaccine hesitation is defined as a delay in accepting or refusing vaccination regardless of the availability of vaccination services (8). The World Health Organization has identified vaccine hesitation as one of the primary threats to global health (13,23). However, evidence-based interventions are limited, as are tools for measuring vaccine hesitancy. Furthermore, the few tools available to measure vaccine hesitancy have not been validated in Africa. However, the few interventions that are currently available are incapable of addressing the root cause of vaccine hesitancy(30).

A rapid systematic review of 126 surveys on COVID-19 (covering 31 countries), including 23 academic studies and 103 opinion polls, published by the 20th of October 2020, established that global vaccine coverage had dropped from more than 70% in March to less than 50% in October. Furthermore, according to a three-year (2015-2017) WHO/UNICEF Joint Report Form data (JRF) analysis, vaccine hesitancy was recorded in more than 90 percent of the 194 member states, including countries from all WHO regions and income levels (23). South Africa is no exception, as research organizations have identified vaccine hesitancy among parents to be one of the major challenges confronting national and provincial Expanded Programme on Immunization (EPI) (31). Furthermore, vaccine hesitancy and refusal have been identified among South African parents, adolescents, and other stakeholders both before and after the implementation of the national school-based Human Papilloma Virus (HPV) vaccination program (32). Furthermore, vaccine hesitancy has been highlighted as a significant factor in various measles outbreaks in

South Africa between 2003 and 2011 (33). There has recently been an increase in cases of internet-based anti-vaccination lobbying (34).

Despite growing evidence on vaccine hesitancy, there are still few strategies to prevent and address it (23,35). South Africa's national COVID-19 vaccination program began in February 2021 (36).

The COVID-19 rollout program is being phased in accordance with the national prioritization framework. The program is currently in phase three, focusing on the remaining adult population of 18-35 years (23). A recent survey conducted by the University of Johannesburg in collaboration with the Human Sciences Research Council between June 25 and July 2021 revealed a 72 percent acceptance rate (37). The 72 percent are South African adults who have either been vaccinated or would definitely or probably take the vaccine. Acceptance was highest among those aged 55 and older, where it had increased from 74% to 85% (37). Furthermore, the acceptance rate for pensioners was 90%. However, acceptance was lowest among those aged 18-25, where it had dropped from 63 percent to 55 percent (37). While students recorded a 58 percent acceptance rate (37). This is depicted in figure 1.1 (38). This is a potential dangerous source of transmission for the community because of active social lives and the high level of mobility, such as study, work, and tourism activities, compared to other groups (39). There are a few studies that have been conducted in South Africa regarding vaccine hesitancy.

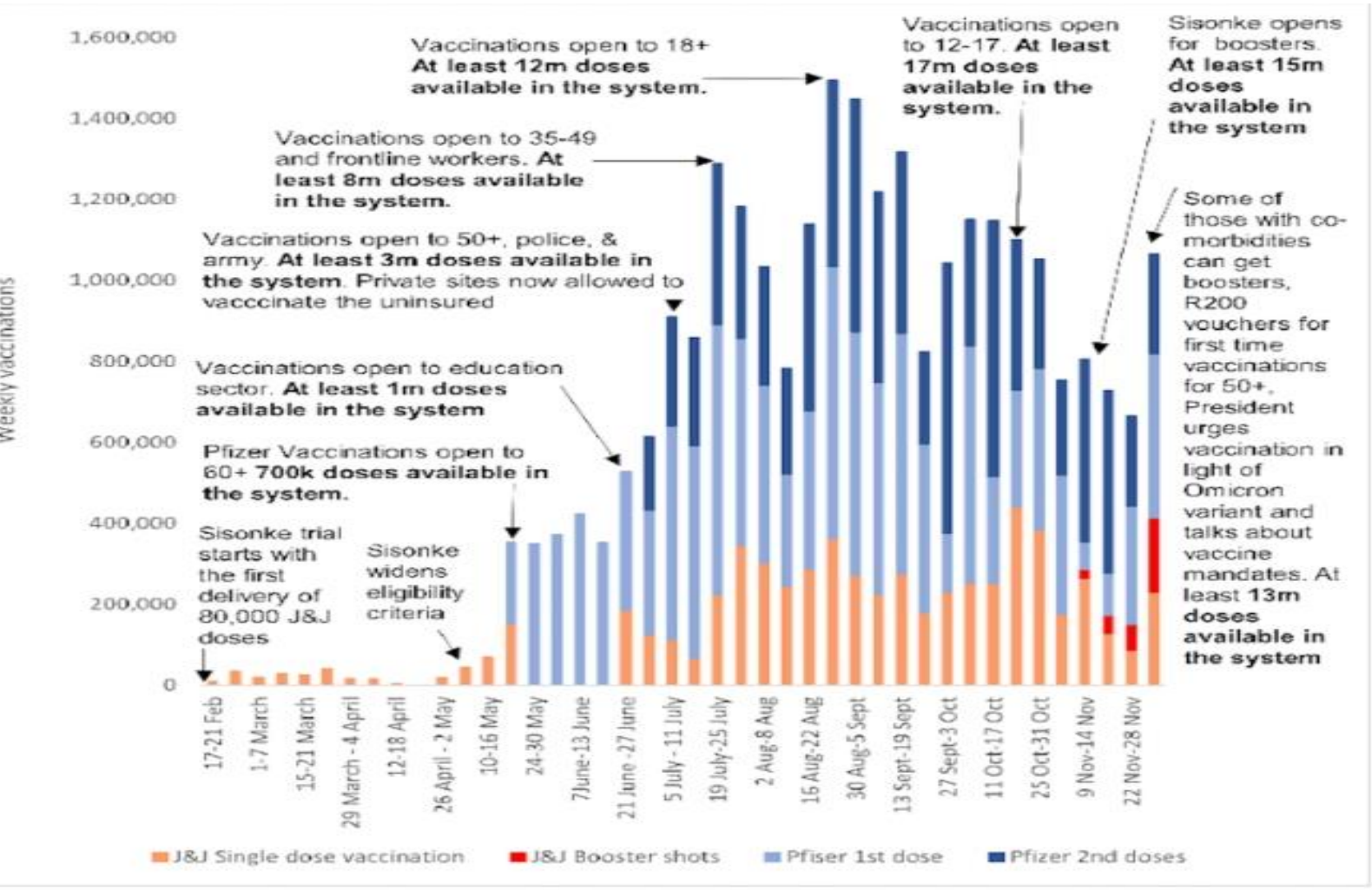


Figure 1: 1 Tracking vaccination roll out of different vaccines (38)**.**

The diagram depicts uptake of different COVID-19 vaccines from the very beginning in South Africa. The first delivery of COVID-19 vaccine in South Africa was 80,000 doses of Johnson and Johnson through the Sisonke trial. Healthcare workers, being the frontliners in the fight against COVID-19 were given the first priority. The uptake was gradual since healthcare workers are not so many in the country. In May 2021, the vaccine opened up to the elderly, 60 years and above and there was an increase in vaccine uptake. The vaccine uptake gradually increased as it was rolled out to people who are 50+ and 35-49 years respectively. However, when the vaccine was open to people who were 18 years and above, a steady decrease was recorded. The decrease in vaccine uptake continued to decline as the vaccine was rolled to young people of 12-17 years.

Interestingly, when the vaccine is opened for booster shots for people who 50 years and above, healthcare workers and the vulnerable, there is substantial increase of vaccine uptake (39).

1.2 Protection levels of Covid-19 among young people

An Epidemiological sero survey was done between October 22nd to December 9th 2021 in Gauteng province. The study recorded a significant difference between the vaccinated and the unvaccinated. The unvaccinated 18-50 years had a sero prevalence of 69.5, while the same age group and vaccinated had a sero prevalence of 93.1 (40). The age of 20-49 years in the same survey recorded the highest cases in the four waves compared to the other age groups (41). However, the highest rates of deaths is among the people who are 60 years and above in the four waves (41).

1.3 Rationale of the study

Current studies show that there is decline in general adult population vaccine acceptability (13). However, there are limited studies that have investigated vaccine hesitancy among the youth populations and precisely looking at their knowledge, attitudes, and perceptions of the COVID-19 vaccine. The age group is of critical importance as they are becoming productive people who would be essential in the development of any country hence the need to protect them. Furthermore, understanding why youth are hesitant to get vaccinated is critical if we are to increase and sustain public demand for vaccination and preserve the tremendous achievements of vaccination programs on the continent (30). Moreover, the young are the future parents, while some are already parents. There are concerns on the same vaccine hesitancy common among the young people (18-35 years) towards COVID 18 vaccines could trickle down to other vaccines e.g., vaccines recommended for pregnant women such as Influenza, Tetanus, Diphtheria, Pertussis or vaccines recommended few days after birth such as rota virus vaccine, pneumococcal conjugate vaccine, Haemophilus influenza type b vaccine. Yet currently there is a steady increases

on maternal and neonatal mortality globally, which can be avoided by vaccines (42). Throughout this study we will be able to highlight levels of knowledge, attitudes, and perceptions that young people (18-35 years) have toward COVID-19 vaccine in Soweto, South Africa.

Additionally, conducting the study in Soweto is paramount. This is because Soweto has the highest population of 1,271,628 in Gauteng as of 2011 in South Africa (43). Gauteng has the highest proportion of young people in South Africa (30%) (14). Moreover, 70% of the population in South Africa are the young people under the age of 35 years (14). Hence the findings of this study can be generalized to the population of Soweto. Moreover, the findings will be helpful in developing policies that could aid in solving vaccine hesitancy in Soweto. (14).

1.4 Study site

The site for the study is South West Township (Soweto) in Johannesburg, Gauteng. The name was selected following a competition instituted by the erstwhile Non-European Affairs Department of the Johannesburg City Council. As the name points out, Soweto lies southwest of the city of Johannesburg. Soweto is the largest black residential area in South Africa. Soweto covers an area of 9, 640 hectares and it consists of 34 suburbs namely; Tshiawelo, Diepkloof, Dlamini, Dobsonville, Doornkop, Dube, Emdeni, Jabavu, Jabulani, Klipspruit, Kliptown, Mapetla, Meadowlands, Mmesipark, Mofolo, Molapo, Moletsane, Moroka, Naledi, Noordgesig, Orlando, Phiri, Pimville, Power park, Protea Glen, Protea South,Protea North, Senaoane, Tladi, Zola and Zondi. This is depicted in the figure 1.2 (44).

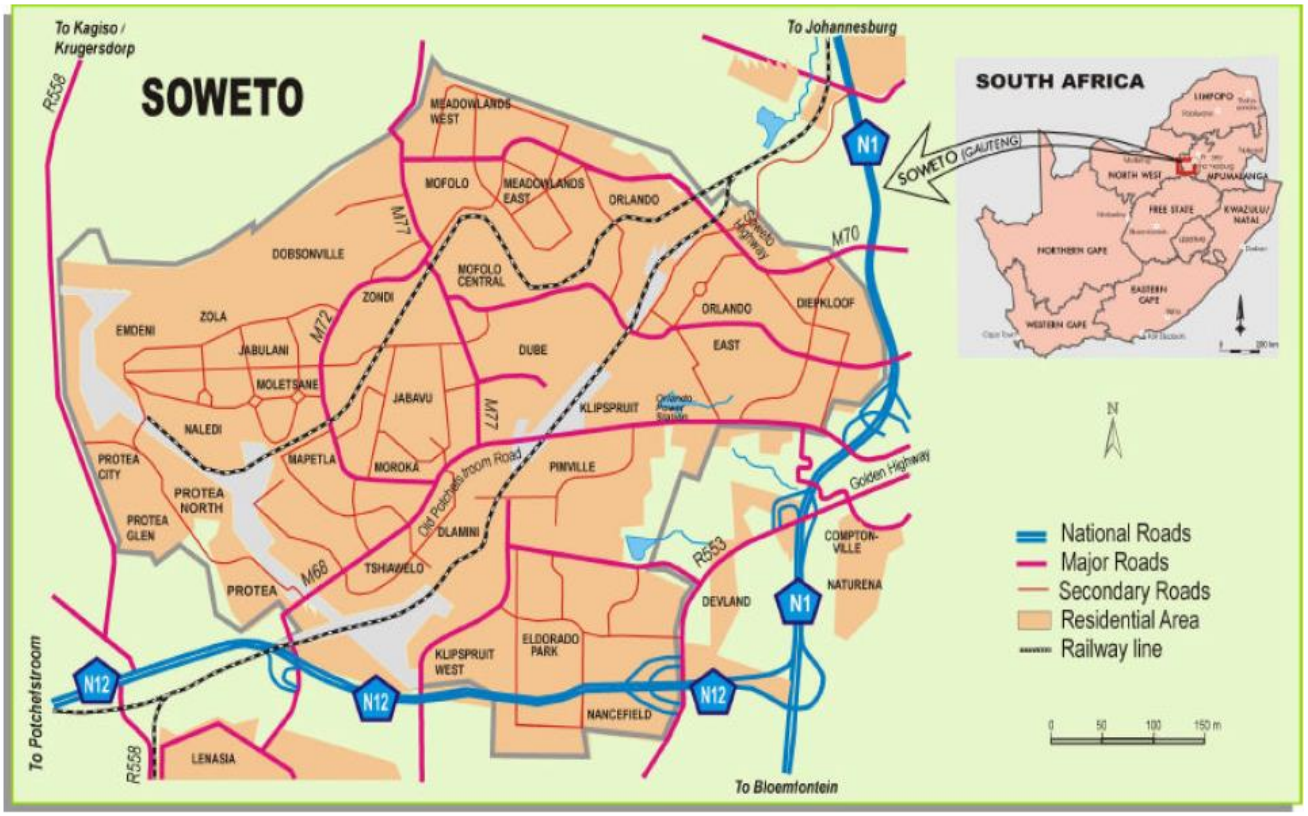


Figure 1: 2 Soweto Map

1.5 Study population

According to 2019 population estimate, most of the South African population are the blacks. The blacks constitute (47.4 million) 81% of the total of the South African population. The coloured population is estimated at 5.2 million, the white population at 4.7 million and Indian/ Asian population at 1.5 million. Of the total population in South Africa, slightly above fifty-one percent (30 million) of the population is female (45).

The population growth rate of 14 to 35 years is higher than the general population. The total population of the youth (18-35 years) in Soweto Thembelihle Health Demographic Surveillance System is 28,918 (unpublished data from Soweto Thembelihle Health Demographic Surveillance System).

According to South Africa department of Statistics, the youth (15-34 years) literacy level is 93.9% (14). The unemployment rate for the first quarter of 2022 in South Africa, for age group 15-24 years, it was at 63.9% and 42.1% for age group 25-34 years, while the current official national rates is at 34.5% (14). The high rate of unemployment has led to lack of trust to the government. This study merged formal, informal and self-employment as employment, while unemployment is one who is not economically active (46). The government being the spear-headers of vaccine roll-out has yielded to high vaccine hesitancy among the youth. A survey spear-head by Umakrishna, used the national representative National Income Dynamics Study – Coronavirus Rapid Mobile Survey (NIDS-CRAM) survey, during the fourth wave in South Africa, highlighted that being employed and being married increases the perception of COVID-19 is a high risk disease (47). Moreover, half of all of the South Africans, both men and women of 18-35 years are single (48). Most single people perceive COVID-19 to be a low risk disease (47), hence high rate of vaccine hesitancy in the age group of 18-35 years.

The study population included the youth of 18-35 years both male and female recruited from Soweto. People below 18 and above 35 years were excluded from the study. The communities in Soweto are mostly Black-African who are low-income earners. Soweto population has an urban setting with mixed ethnicities (predominantly of Zulu, Xhosa, Pedi, Tsonga, Venda, Tswana and Sotho ethnicities) (49).

1.6 Aim and Specific Objectives

The aim of this study was to investigate young people's knowledge, attitudes, and perceptions of COVID-19 vaccines in Soweto, South Africa. Specifically:

1. To describe the knowledge of COVID-19 vaccines among young people in Soweto, South Africa
2. To investigate the attitudes of COVID-19 vaccines among young people in Soweto, South Africa.
3. To investigate the perceptions of COVID-19 vaccines among young people in Soweto, South Africa

1.7 Research questions

The study intended to answer the following research questions:

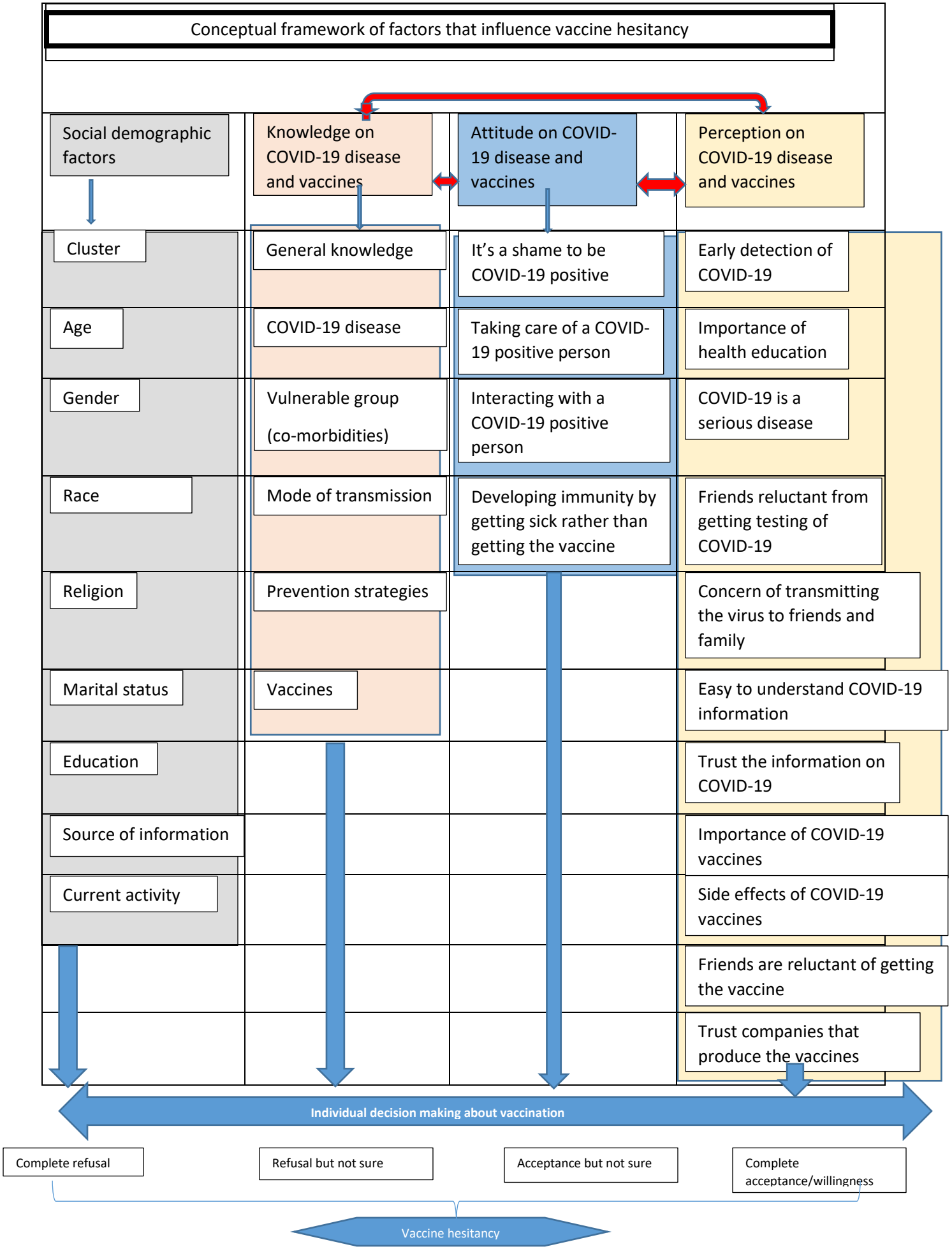
1. What are the knowledge levels on COVID-19 vaccines among young people in Soweto, South Africa?
2. What are the attitudes of COVID-19 vaccines among young people in Soweto, South Africa?
3. What are the perceptions of COVID-19 vaccines among young people in Soweto, South Africa?

1.8 Conceptual framework

A conceptual framework is a system of concepts, assumptions, beliefs that supports and informs research (50). Conceptual framework brings together related concepts to explain or predict a given event or give detailed understanding of the research problem and its asserted solution (51).

A survey done by the Human Science Research Council (HSRC) on the levels of knowledge and perceptions among people in South Africa who are 18 years and above (52). Most of the respondents were from Gauteng (52). The survey recorded only 22% perceived to be at a high risk while 32% perceived moderate chances of contracting COVID-19 virus (52). Knowledge on preventative measures of COVID-19 ranged from 85-97% (53). Despite of high levels of knowledge the attitudes was not always positive towards COVID-19 vaccines (52). Furthermore, an epidemiological surveillance study done in Soweto from April 2019 to March 2020 demonstrated that the perceptions and knowledge of COVID-19 differed across several demographic characteristics (54). In addition, lower perceived infection risk and greater concern about COVID-19 were correlated with higher COVID-19 prevention knowledge (54).

The conceptual framework served as a guide for the variables' proposed. First based on the main topics namely, Knowledge Attitudes and Perceptions. Lastly, variables were generated based on the sub-titles under the main topics. Hence, the conceptual framework informed the research tool.


Conceptual framework of factors that influence vaccine hesitancy
Social demographic factors
Knowledge on COVID-19 disease and vaccines
Attitude on COVID-19 disease and vaccines
Perception on COVID-19 disease and vaccines
Cluster
Age
Gender
Race
Religion
Marital status
Education
Source of information
Current activity
General knowledge
COVID-19 disease
Vulnerable group (co-morbidities)
Mode of transmission
Prevention strategies
Vaccines
It's a shame to be COVID-19 positive
Taking care of a COVID-19 positive person
Interacting with a COVID-19 positive person
Developing immunity by getting sick rather than getting the vaccine
Early detection of COVID-19
Importance of health education
COVID-19 is a serious disease
Friends reluctant from getting testing of COVID-19
Concern of transmitting the virus to friends and family
Easy to understand COVID-19 information
Trust the information on COVID-19
Importance of COVID-19 vaccines
Side effects of COVID-19 vaccines
Friends are reluctant of getting the vaccine
Trust companies that produce the vaccines
Individual decision making about vaccination
Complete refusal
Refusal but not sure
Acceptance but not sure
Complete acceptance/willingness
Vaccine hesitancy

CHAPTER TWO

STUDY BACKGROUND

2.0 Introduction

This chapter aims to set the study objective in context by introducing the background of Soweto's location. The recent data on Soweto's youth's literacy rates, educational attainment, and population ratios by gender and age. These chapters' descriptions and profile of Soweto are also applicable to other townships in South Africa. The reader is given an informed perspective of Soweto through the discussion of major demographic characteristics including literacy rate, gender disparities, and significant facts, figures, and statistics.

2.1. South Africa

2.1.1 Demographic information

To investigate a population's characteristics, demographic factors including age, gender, education level, and ethnicity are used. Social demographic factors are important because they shape and impact individual behaviour (55).

The majority of South Africans are black, according to the 2019 population estimate (45). Black people make up (47.4 million) 81% of South Africa's overall population (45). A little more than 51% (or 30 million) of South Africa's overall population is female, compared to 41% of men (56). The overall fertility rate, or live births per woman, was 2.4 as of 2020 (56).

According to a South African Statistics projection from 2019, 17, 84 million people, or one-third of the population, were aged 18 to 35. (57). Almost 30% (5.10 million) of the youth reside in Gauteng with 3.47 million in Kwa Zulu Natal, making almost half of the youth in South Africa (14).

In South Africa, 13% of those between the ages of 20 and 35 are graduates (14). This is because more rural provinces suffer from a significantly lower proportion of recent graduates. This is due to a variety of circumstances, including migration (57). Therefore, as of 2019, 66.3% of South Africa's population lived in an urban area. (56).

2.1.2 Socio-economic indicators

Socioeconomic indicators provide information on employment, housing, amenities, education, gender, poverty, and other economic factors. Social economic indicators are crucial for providing context to comprehend a country's health situation. (58).

Approximately 3% of 15-year-olds and almost 9% of 17-year-olds, respectively, dropped out of school, according to South African Statistics 2021. (4). Despite the fact that the majority of 18 and 19-year-olds were still enrolled in secondary education, approximately three out of ten 18-year-olds and four out of every nine 19-year-olds had left their respective schools (4). About 23% of the 20-year-olds were enrolled in college, technical and vocational education and training (TVET), or universities, while 18% were still in high school, meaning that the majority of them were not in the educational system (4).

In 2021, low academic performance (21,2%), illness and disabilities (22,7%), and financial hardship (19,6%) were the main causes of non-attendance at school.(4). The reasons reported for leaving school vary by gender, particularly for females who must leave because of a family obligation (13,4%), whereas nearly 5% of males left because they had no interest in study (4). The high school dropout rate is particularly concerning because those students will have less access to higher education, fewer employment possibilities, and poorer pay than their classmates who completed their education (4). According to the report, the age group of 20-year-olds is the largest age group attending tertiary education, followed by the age group of 21-year-olds (20,4%) (4). By the age of 24, only about 8% of young people were attending a tertiary educational facility, and nearly 90% of them were not in school (4). According to markers of self-perceived wealth and income evaluation, there is a negative correlation between educational

attainment and the prevalence of poverty, with families headed by less-educated individuals being more likely to be poor than those headed by more-educated individuals (4). The highest levels of subjective poverty were found in households led by people without a high school diploma, as measured by self-perceived wealth indicators (43,2%) and income evaluation indicators (4).

Contrary to what the minimum income indicator indicates, households headed by more educated people have the highest rates of poverty (4). In terms of educational achievement, families headed by people who had completed grade 12 (57,8%) and post-school (57,7%) had the highest subjective poverty levels (4). Rural areas had much higher poverty rates than urban areas, with respective values of 38,3% and 53,4% according to the self-perceived wealth and income evaluation indexes (4).

The minimal income indicator, however, revealed that urban households (57,7%) had the highest poverty levels compared to their rural counterparts (55,5%), which was the opposite of what the self-perceived and income appraisal indicators found(4).

Since poverty has many facets, it can be characterized in terms of many dimensions. (4). The definition of poverty determines how it will be measured (4). There are several main categories into which the measurement of poverty can be divided, including objective, relative, multidimensional, and subjective assessments (4). The most popular of these is the objective measurement of poverty using poverty lines, which looks at a defined minimum monetary amount below which an individual is categorised as poor. This method is also the official methodology employed by Statistics South Africa. (4). Many, however, contend that since people possess the necessary knowledge to determine their own welfare situation, they are the greatest judges of it. (4). Therefore, adding subjective poverty indicators to the existing objective poverty indicators enables a more reliable and comprehensive assessment of welfare in South Africa (4). An individual's appraisal of his or her own wellbeing or happiness, which is the topic of this study, is referred to as subjective poverty (4).

2.2 Soweto

2.2.1 General description of Soweto

Soweto is a township in the city of Johannesburg Metropolitan Municipality in Gauteng.
Gauteng is one of the eight and smallest provinces in South Africa. Despite of Gauteng being the smallest province, it is the economy centre of South Africa and the continent of Africa. Gauteng contributes to over 34.8% of the country's GDP (59). According to 2011 census, South Africa has a population of 51.7 million. Gauteng comprises the largest share of South African population, with approximately 15.2 million people (25.8%) living in this province (45). In Gauteng, the largest population is 20-29 years. This age group is part of our population of interest. This is as depicted in figure 2.1 (60). Gauteng is divided into three metropolitan municipalities, the City of Ekurhuleni, City of Johannesburg and City of Tshwane as well as two district municipalities, which are further subdivided into six local municipalities. The City of Johannesburg is the capital of Gauteng, the most populated city in South Africa and one of the largest cities in the world (14,60). Johannesburg contains two big urban centres namely, Johannesburg and Midrand and eleven more smaller urban centres namely Roodeport, Diepslot, Killarney, Melrose Arch, Randburg, Rosebank, Sandton, Soweto and Sunninghill (61). Soweto is the biggest townships in South Africa (62). Soweto sits at latitude 26°16'4.12''S and longitude 27°51'30.56''E (63) with a population of 2,271,628 (14).

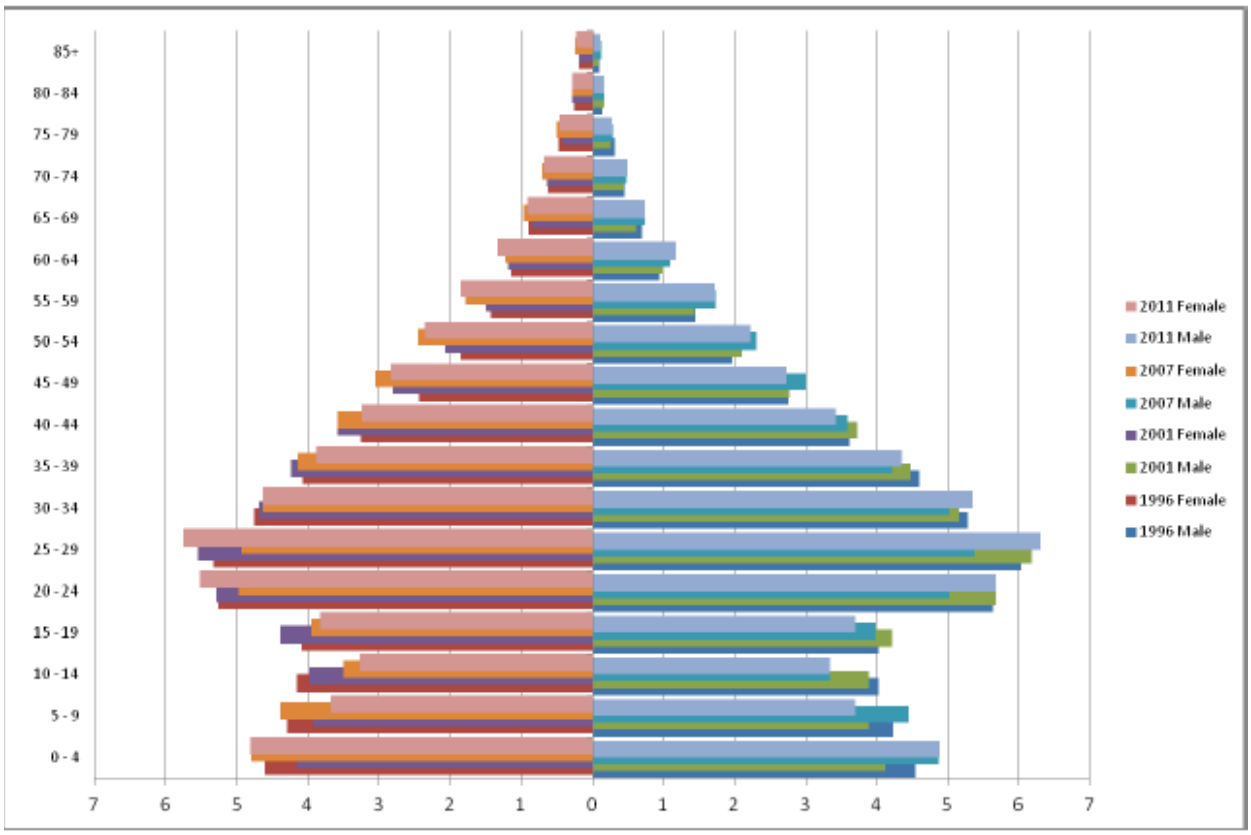


Figure 2: 1 Gauteng percentage distribution of population by five-year age groups and sex-census 1996,2001, 2011 and Community Survey 2007

Gauteng percentage distribution of population by five-year age groups and sex-census 1996,2001, 2011 and Community Survey 2007

2.2.2 Socio-economic indicators

The majority of black residents in South Africa live in Soweto. Black people make up 99% of the population in Soweto. (4). This is a result of the forced resettlement that occurs during the migration process, which is governed by political decisions (64). Soweto's population in 2011 was estimated to be 1.3 million by South African Statistics. There are 355,331 households in Soweto, with 3.4 people per home on average (14). Furthermore, women head 40.3% of the

homesteads (14). Due to the lack of industry in Soweto, the majority of residents commute to other areas of Greater Johannesburg for work. As a result, 43% of people who live in the City of Johannesburg reside in Soweto (65). But recently, tourism has become a more important source of income (66). On the other hand, Johannesburg's unemployment rate has been rising, going from 28.8% in the first quarter of 2018 to 32.7% in the first quarter of 2020 (67).

Gender differences between males and females were essentially nonexistent, according to the 2011 census. 50.4% of people were female, compared to 49.6% of men. The majority of people in Soweto are between the ages of 20 and 29 years. The aged (those 60 and older) make up roughly 9.0% of the population in South Africa. Additionally, Gauteng has the greatest percentage of elderly residents (23,9%) the same group of people who are susceptible to COVID-19 illness. The percentage of people who are 60 years of age and older is rising with time (45). When it comes to marital status, the majority of the population is single, followed by married persons. Although there are people of other races in Soweto, the majority—98.5%—are black (68).

According to the 2001 Census, both employed and unemployed people made up 23% of the population, students made up 12%, partial workers and pension, disability grants, caring for a family or children, and not working otherwise made up 11%, fill-ins made up 9%, the petite bourgeoisie made up 5%, and employed middle class made up 1%. Petite bourgeois are professionals who work for themselves or own tiny businesses, do not actively seek employment, and rarely have more than one or two employees. The semi-professional class (such as teachers and nurses) and intermediate class make up the middle class (routine white collar, skilled and supervisory workers)(69).

IsiZulu is the most widely used language, followed by Sesotho and Setswana. For most people, matric is the highest educational level, followed by some secondary levels, in terms of literacy levels. Surprisingly, people with matric qualifications have greater compliance rates with COVID 19 rules, closely followed by people with tertiary degrees (70). However, according to other

studies, confidence in the COVID-19 vaccine rises with education, which is similar to a study among pregnant women conducted in Durban. (70,71)

In South Africa, human development has been greatly influenced by religion over the past 30 years. In social sciences specifically, there has been a visible interest in religion and spirituality in relation to good youth development. This is so that young people can consider their own views and ideals in multicultural societies where religious participation is encouraged. Religion has demonstrated to provide certain young people with a feeling of direction, meaning, and emotional and social support (68). Soweto has embraced religious diversity. Christians make up about 40% of the population in Soweto. The Methodist Church, Anglicanism, Catholicism, and the Dutch Reformed Church are all included in this. While 1% of the population is Muslim, the majority of churches in Soweto accept traditional ideas, and roughly 46% of people practise ancestral traditions. Church leaders are well-respected and heavily involved in community decision-making (68,72). This has trickled down to vaccination decisions, as we can see even today, there is still a lot of impact from morality, religion, and personal ideologies, as well as from belief in alternative medicine and conspiracy theories (73).

2.3 How social economic indicators inform COVID-19 vaccine hesitancy.

Social economic indicators are crucial in informing COVID-19 vaccine hesitancy. Studies have highlighted that characteristics of the population influence the acceptance rate of vaccines. A study done in Japan between February 24 and March 1, 2021, recorded female, unmarried, childless, non-healthcare workers, not receiving treatment for physical illness presently or the past were less likely to receive the vaccine (74). Moreover, several studies have highlighted higher COVID-19 vaccine hesitancy among women compared to men (75).

2.4 Summary

South Africa population is dominated by the youth 18-35 years. 30% of the youth reside in Gauteng. Gauteng comprises the largest share of South African population since it's the country's economic center. The city of Johannesburg is the capital of Gauteng. The city of Johannesburg is sub divided into smaller urban centers. One of the urban centers is Soweto. Soweto is the biggest townships in South Africa. Ninety-nine percentage of the population in Soweto are blacks, while gender between female and male was almost the same. In terms of the marital status, most of the population they are never married followed by the married people. The most spoken language is IsiZulu, seconded by Sesotho then followed by Setswana.

CHAPTER THREE

LITERATURE REVIEW

3.0 Introduction

The purpose of this study was to investigate young people's knowledge, attitudes, and perceptions of COVID-19 vaccines in Soweto, South Africa. The study addressed the following research questions: (1) What are the knowledge levels on COVID-19 vaccines among young people in Soweto, South Africa? (2) What are the attitudes of COVID-19 vaccines among young people in Soweto, South Africa? (3) What are the perceptions of COVID-19 vaccines among young people in Soweto, South Africa? This chapter discusses literature written in this field. To give a clear perspective and to understand the background of this study, literature that shed light on the concepts used in this dissertation, as well as other areas related to the topic under study were reviewed.

3.1 Covid-19 Pandemic Overview

The first laboratory-confirmed case of 2019-nCoV infection manifested as illness on December 1, 2019, in Wuhan, Hubei, China (76). An outbreak affecting a nearby market, the Huanan Seafood Market, was reported in late December 2019 (76). Cases from Wuhan spread quickly to Hubei province and throughout China (76). As China prepared for the Chinese Lunar New Year on January 25, the spread quickened as a result of the increased traveling (76). The disease spread globally (76). This was accelerated, among other things, by the rapid rate of globalisation (76). About 60% of people in the world fly commercially to other countries (77).

The World Health Organization (WHO) gave the new virus the temporary name 2019 novel coronavirus on January 12. (2019-nCoV) (78). Later, the virus was formally identified as SARS-CoV-2 based on phylogeny, taxonomy, and accepted practises by the International Committee on Taxonomy of Viruses (ICTV) (78). On January 30, 2020, WHO classified SARS-CoV-2 a public

health emergency of global significance (79). WHO declared SARS-CoV-2 a pandemic on March 11th, 2020 (78). The first African case was reported on the 14th of February in Egypt (79) and on 5th March 2020, South Africa reported their first case (80). Africa's disease burden varies from country to country (80). As of 2nd March 2022, South Africa had the highest number of cases in Africa (81).

3.1 Restrictions and Compliance measures

After the first case, the number of COVID-19 cases in South Africa surged. On March 15th, COVID-19 was classified as a national disaster with 61 affected people (82). This was done to aid the government's efforts to prevent and contain the viral outbreak (82). On March 26, the authorities imposed a nationwide lockdown and travel ban (82). The actions played a part in breaking the chain of transmission, which stopped the virus from spreading (82). During the national state of calamity, the minister of trade and industry issued directives to safeguard customers against exorbitant, unfair, unjustified, or unjust pricing of products and services (82). A notification of compensating for temporary total disablement as a result of a proven COVID-19 case for up to 30 days was released on March 24 by the Compensation Commissioner (82). Nevertheless, despite the limitations and the compensation, the COVID-19 cases continued to increase and the nation's economy was suffering. As a result, the COVID-19 vaccination was introduced, which decreased the number of cases. As the number of cases reduces, the lock-down measures were gradually relaxed, with the President encouraging people to wear mask, frequent sanitize hands, cough in a flexed elbow and maintain social distance (70). The compliance rate of social distance differed between formal and informal settlements (70). Slightly higher compliance rates in social distancing among individuals in formal settlement was recorded compared to those individuals in the informal settlement (70). Additionally, there are conflicting responses on social trust between the formal and informal sectors. (70). In this study,

Meadowlands Zone and Soweto-Thembelihle represent formal and informal settlements respectively.

3.3 Sources of information

The public has been overwhelmed by a lot of misleading and false information during the COVID-19 pandemic (83). The World Health Organization (WHO) refers to this as an infodemic. When a disease outbreak occurs, infodemic refers to the excessive availability of information in both physical and digital contexts. The data includes inaccurate and misleading information (84). People lose trust in health authorities as a result, which destabilises the public health response and leaves them unsure of which information to believe. This leaves them open to misinformation (83).

Based on information gathered from Facebook and Instagram users in South Africa between May 24 and June 5, 2021radio and television were listed as the next most reliable information sources, after medical doctors and the WHO (83). However, news websites, family and South African government were less trusted, but more trusted than social media, friends, community leaders, celebrities and faith leaders (83). The level of trust in media outlets, such as TV, radio, and news websites, is generally higher than that of organisations like the WHO and the South African government (83). However, South Africans, place more trust in the WHO than in the government (83). The government is the messenger in South Africa, yet there is a trust deficit in the messenger, which has a negative effect on people's confidence in the message itself (85). This makes it more difficult for the government to inform its population about the benefits of immunisation (85).

According to studies, social media, particularly Facebook and Twitter, offer supporters of the anti-vaccine movement a fertile ground to spread any type of content, even scientific or medically sensitive materials that have the potential to reach a vast audience (73).

Social media significantly influences how individuals or parents decide whether to vaccinate their children (73). We discover that parents frequently base their decisions about whether or not to vaccinate their kids on information they read online (73). Additionally, the vast majority of people do not take into account the authenticity of the information's source (73). Furthermore, individuals and organisations opposed to vaccinations base their claims on their own experiences and beliefs (73).

Contrary to pro-vaccination organisations and groups, who frequently cite experts and academic works when expressing their opinions online (73). As a result, the language used, how frequently social media is used, the information that is produced, and its emotional appeal could all be elements that determine the success of the anti-vaccine movement online (73). A recent study also asserted that Twitter data might be a reliable method for measuring public opinion on public health and vaccine reluctance (73).

Other factors that influence vaccine intake include knowledge, attitudes and perceptions.

3.4 Knowledge of COVID-19 vaccines among young people in Soweto, South Africa

According Merriam-Wester dictionary, knowledge is defined as the fact or condition of knowing something with the familiarity gained through experience or association (86). Knowledge can be theoretical or practical understanding of a subject (87).

Level of knowledge on COVID-19 vaccines on a person or a group due to misinformation can influence vaccine acceptance or vaccine hesitancy (39). According to studies from China, the United States, and Bangladesh, people who are aware of the effects of COVID-19 have a moderately to favourably relationship with vaccination (39). People who were more worried about contracting COVID-19 were more likely to receive the vaccine than those who were not scared (39). Ad Abul Kalam and his colleagues have discovered a correlation between vaccination uptake and the severity of a COVID-19 infection (88).

Additionally, people who got unclear or confusing information from public health authorities or government regulations had a higher likelihood of refusing vaccinations than people who received consistent, unbiased information (88). Additionally, people who trusted the healthcare system were more likely to accept the COVID-19 vaccine than people who didn't (39). Additionally, people who followed official guidelines for mask use, social distancing or lockdown were more receptive to vaccinations than those who did not (39).

Recent research on the knowledge, attitudes, and behaviours of health care workers (HCWs) regarding COVID-19 in Uganda, Nigeria, Pakistan, and Saudi Arabia revealed generally high knowledge, positive attitudes, and good practises (89). According to a Ugandan study on COVID-19 among HCW, who were aged 18 to 39, using news media, such as television and newspapers, as a source of information was associated with better levels of knowledge, regardless of their professional degrees (90). The same study found that four-fifth of respondents had a negative attitudes toward COVID-19 (90). A study conducted in the Democratic Republic of the Congo highlighted that medical professionals (HCW) intended to use and suggest the COVID-19 vaccine based on their level of knowledge and attitudes about the vaccine (91). HCW are less likely to use and suggest the COVID-19 vaccine if they lack understanding and have a negative attitudes (91).

An Indian study of individuals with type 1 diabetes mellitus aged 18 to 30 found that they had an average level of knowledge that was 74% in line with COVID-19 (92). This was shown in their 98% positive attitudes toward COVID-19 and their healthy preventative activities (92). However, a different study conducted in an urban slum in Mumbai, Maharashtra, India with volunteers who were 18 years of age and older found that the majority (64.5%) of the young adults between the ages of 18 and 45 were not aware that the COVID-19 vaccine was available (93). The majority of the 64.5% who had less than a high school education were female (93). COVID-19 awareness varies depending on the social demographic characteristics (93). The occurrence of minor or severe side effects following immunisation may be the main cause of vaccine hesitancy (93).

Therefore, it is crucial to make information on vaccine safety and effectiveness available to the general public, preferably from a reliable, centralised source of information (93).

In Africa, vaccine safety was the top issue for vaccination hesitancy, with 25% of respondents saying the COVID-19 vaccine was risky and 18% indicating vaccines are generally not safe (94,95). Older respondents by age, those who lived in rural areas, and those who knew someone who had tested positive for COVID-19 were more likely to take a COVID-19 test than younger respondents, those who had not seen anyone infected with COVID-19, and those who lived in urban (94,95). One justification for not getting vaccinated is that COVID-19 doesn't exist or that its threat is exaggerated (94,95).

In South Africa, a meta-analysis found that concerns about side-effects (65%) were more common than concerns about the vaccine's efficacy (24%) and the perception that COVID-19 risk was low (17%) (13). Pregnant women under 22 were shown to be less likely to receive vaccinations than pregnant women over 39 in a study conducted in Kwadabeka, Durban, South Africa between September 4 and October 3, 2020 (71). Additionally, compared to those who lived with their partners, single pregnant women were less likely to accept the vaccine (71). Contrarily, pregnant women who were employed were four times more likely to accept vaccination than pregnant women who were unemployed (71). Another study conducted among South African students found that students who knew more about the COVID-19 disease were better prepared, had higher perceived resilience, and had higher self-efficacy than students who knew less (96). Due to this, the students are now more prepared to take precautions to avoid being infection (96). The effectiveness of public health response efforts to contain the pandemic is influenced by false information, particularly myths and misconceptions concerning COVID-19 transmission and prevention (97). A research in the South African regions of Gauteng and North West among internet users 18 years of age and older who had mobile phones found a high proportion of misinformation (97). Thus, as South Africa expands its state wide vaccination rollout, it is crucial to emphasise the need for targeted interventions to young people, students, those with low levels of education, and the self-employed in the two districts (97). Johnson and

Johnson was chosen over Pfizer in an evaluation of trials conducted in South Africa from February 2020 to March 2021 because it was a single-dose product. Since people prefer less exposures to needles (98).

3.5 Attitudes of COVID-19 vaccines among young people in Soweto, South Africa

The Oxford Dictionary defines attitudes as one's thoughts or feelings toward someone or something.

When the social benefits of vaccination are communicated, it has a favourable impact and protects the most vulnerable groups (99). Furthermore, individuals who cannot receive vaccinations for medical reasons—especially the vulnerable — cannot defend themselves, even if they chose to. Therefore, they depend on their fellow residents to keep them safe by stopping the virus's spread through their vaccination (99).

The primary causes of negative attitudes against the COVID-19 vaccination, according to a report on global attitudes (covering 15 developed nations) , were adverse effects and inadequate testing, which was conducted between March and May 2021 by Imperial College London (100). Additionally, a cross-sectional study conducted in Jordan in the fourth quarter of 2021 among those 18 years and older found that most people had negative views of the COVID-19 vaccine (101).

A study conducted in Ethiopia among college students from January 12 to January 26 found that half of the participants had a positive attitudes toward the COVID-19 vaccine (102). A cross-sectional survey conducted in North Central Ethiopia's Debre Tabor Comprehensive Specialized Hospital from February 5 to March 20, 2021, among medical personnel revealed a poor attitude regarding the COVID-19 vaccine. The poor attitudes is likely to trickle down to their patients and family members (103). Additionally, a different study conducted in Ethiopia between April and May 2021 among clinical practitioners highlighted that doctors who were affected by social media and their religious convictions were less likely to advocate for the COVID-19 vaccine (104).

The two biggest motivations for consenting to vaccination, according to a survey based on Statistics South Africa data, were wanting to protect oneself (29%) and wanting to protect others (25%) (23). While common reasons for not wanting to get vaccinated were worries about the vaccine's negative effects (25%), scepticism about its efficacy (18%), and lack of faith in the vaccination (14%), others were unsure (10%) (23).

A key indicator of someone's feelings or thoughts is behaviour. A research conducted in South Africa between the first and second COVID-19 waves found that social distance, avoiding close contact, and avoiding large groups have all significantly decreased (26).

In a survey by the South African Social Attitudes Survey, adults aged 16 years and older were asked three questions from the health module created by the International Social Survey Programme between February and March 2020 and November 2020 and February 2021 (the face-to-face survey was interrupted due to lock-down) (13). The questions sought to understand on how much they agree on the following statements: vaccination can lead to severe health condition; it is better to develop immunity by getting sick than by getting a vaccination and I believe that vaccinations prevent the disease they are supposed to prevent (13). There were 2,844 participants in all, and 34% of them believed that vaccination could result in serious side effects, while just 28% disagreed with the statement (13). In terms of immunity, the majority of participants (40%) agreed with the statement that infection-acquired immunity is superior to vaccine-acquired immunity, while just 26% disagreed (13). Regarding vaccine effectiveness, 58% of respondents indicated that they think vaccines work to prevent the diseases they are intended to prevent, as opposed to 10% who had doubts (13). While the proportion of respondents who thought infection-acquired immunity was superior to vaccine-acquired immunity increased from 33% to 44%, the percentage of respondents who thought vaccinations could cause serious health conditions increased from 28% in March 2020 to 36% in February 2021(13). From March 2020 to February 2021, the public's perception of the effectiveness of vaccines remained largely favorable (13).

3.6 Perceptions of COVID-19 vaccines among young people in Soweto, South Africa

Perception is defined by Merriam-Wester dictionary as the capacity of an individual's comprehension or interpretation of a specific thing or issue (87).

According to research, having a positive perception increases one's willingness to participate in vaccination campaigns (39). Therefore, research on public perception towards vaccination is a very helpful resource for policymakers as they formulate appropriate ways to drive citizens' awareness into action and so increase the rate of vaccination (39). Moreover, a deeper understanding of COVID-19 perspectives helps in the identification of potential intervention areas for the prevention of the pandemic and provides insight into the health and social issues that South Africa is currently experiencing as a result of the pandemic (105). These discoveries may eventually strengthen South Africa's national efforts to contain the pandemic and mitigate other significant effects on the country's well-being (105).

6,000 participants were randomly selected from an email survey study conducted among Vietnamese students in March 2021 in Ho Chi Minh City (39). According to the study, the students perceived COVID-19 to be an extremely serious disease (39). In addition, 83.41% of the students supported vaccination while only 16.59% were hesitant (39). More importantly, the study revealed that the top three reasons for people's hesitation and/or unwillingness to get vaccinated are their perception of the vaccine's importance, worries about the vaccine's negative effects, and a lack of access to information (39). Similar research was conducted in Hamilton, Ontario, Canada, and it made use of an ongoing longitudinal observational cohort study there. The study enrolled 1,367 people, and the three most prevalent vaccine reluctance factors were long-term side effects, rapid side effects, and lack of trust in the vaccine (106). A cross sectional study done in India among the general population of age 18 years and above recorded 49.9% of the study participants believed that the vaccine could offer protection (107). According to a cross-sectional study conducted in Pakistan among adults 18 years of age and over in the month of April 2021, 79.9% of study participants would recommend others to get vaccinated. Despite the study subjects' poor knowledge of the COVID-19 vaccine, positive attitudes and perceptions

were recorded (108). According to a report by the Africa Center for Disease Control, which was released in February 2021, the top five reasons for vaccine hesitancy in 15 countries were lack of confidence in the vaccine, denial that the vaccine even exists, concern over the vaccine's safety, the belief that some people were not at risk of contracting the virus, and a lack of sufficient information to make a decision (109). Furthermore, a cross-sectional study conducted in May 2021 among healthcare professionals in Dessie City, North-Eastern Ethiopia, found that negative attitudes toward the COVID-19 vaccination were statistically associated to vaccine hesitancy for the disease. The Covid-19 vaccine would cause an infection, and vaccines could amplify any pre-existing medical issues. These concerns led to vaccine hesitancy (110).

According to a September 2021 anonymous cross-sectional research of the adult population in South Africa, respondents who had doubts about the government's ability to implement vaccination policies were about 13 times more likely to be vaccine-hesitant than those who had faith in the government. Additionally, the study identified a need for trustworthy and understandable information on the COVID-19 vaccine's safety (111). Furthermore, a qualitative study conducted between June and July 2021 in Soweto among a group of young community healthcare workers between the ages of 21 and 30 found that one of the factors contributing to vaccine hesitancy is fear of the vaccines stemming from rumours and theories in the community (112).

A research conducted in Soweto among adults aged 25 and older between the dates of the level 5 lockdown (26 March 2020 to 30 April 2020) and the subsequent level 4 lockdown's start on May 1, 2020 (113). The study employed a mixed methodology and found that hand washing with soap and water, staying at home, and covering your mouth when coughing or sneezing were the most popular preventative measures (113). Furthermore, majority of study participants consider COVID-19 to be a serious illness (113). The study showed that perceptions of risk and concern varied with age and educational attainment. Contrary to gender differences, COVID-19 participants with a secondary education or higher reported frequently perceiving a risk

associated with exposure to cough, shared meals, and touching others, whereas those with less education (no schooling or primary school) reported greater concern about contracting the disease. (113). The use of face covers, physical distance, staying at home, and disinfecting surfaces were prioritised by those with more education and wealth. (113).

3.7 Summary

After discussing the contextual issues in South Africa in line with the demographic information, socio-economic indicators, covid-19 pandemic overview, restriction and compliance measures and sources of information. This highlighted the knowledge, attitudes, and perception of COVID-19 vaccine among young people in globally. Moreover, narrowing it down to Africa, precisely South Africa, Soweto. The literature highlights high levels of knowledge correlate with positive attitudes and perceptions towards COVID-19 vaccine.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.0 Introduction

This chapter describes the procedures followed in conducting this study. It gives an overview of the processes that were followed, and the methodology used in collecting data for research. Only quantitative approach was used. The chapter will highlight the prons and the cons of quantitative method. The chapter describes the ethical considerations, identifies the target population and the sampling techniques used as well as the reliability of the research instrument. All the methodological elements have been chosen specifically to address the objective of the study which was to investigate knowledge, attitudes, and perceptions of COVID 19 vaccines among the youth in Soweto, South Africa.

4.1 Research design

A research design refers to the overall strategy chosen to integrate different components of the study in a coherent and logical way, therefore ensuring the researcher effectively addressed the research problem (114). It must be efficient to yield the sought-after knowledge. Research design can be seen as the glue that holds the research project together. Its purpose is to structure the research and to show all the major parts of the research project. According to Maxfield and Babbie (1998), the design has two major aspects. First is the exact specification of what is to be determined; secondly, it is to determine the best way to do exactly that (115). Hagan (2000) explains that research design should address issues flowing from the problem formulation and other critical issues identified for observation (116).

This study used a quantitative method to investigate young people's knowledge, attitudes, and perceptions toward COVID-19 vaccines in Soweto, South Africa. This is the first study to look at vaccine apprehension in Soweto. A quantitative study entails the collection and analysis of

numerical data (49). In this study, a quantitative survey was used. A quantitative survey is a series of questions designed to elicit detailed information from youth about the research objectives.

4.1.1 The survey questionnaire as a research instrument for this study

In this study, a survey questionnaire was used as a research instrument. The questionnaire was created by the researcher and uploaded to Redcap. This is well illustrated in Appendix VII. The survey questions were structured in a closed-ended manner. For the survey, the structured questionnaire was pre-tested, piloted, refined, and finalized. Furthermore, pre-testing was to improve the adaptability and development of the research instrument. While developing the questions, the researcher consulted others at Child Health and Mortality Preventions (CHAMPs) – Social Sciences team, who are familiar with the construction and refining of the questionnaire. Once, the first draft was written, it was independently pretested by three reviewers in relation to the construct, clarity of expression, and probable difficulty.

Changes were made in response to the reviewer's comments. The questionnaire was shown to the reviewers once more for additional feedback. This procedure was repeated until there was a general agreement (117). The questionnaire was piloted among 15 young people from Thulani in Soweto between the ages of 18 and 35. To avoid bias, the site was different from where the data was collected. The 15 participants were chosen at random from among those who met the inclusion criteria in an even number. Piloting was critical for determining the validity of the questionnaire, the length of the session, the logic of the questions, any ambiguity, and the overall flow. Adjustments were made accordingly. Vaccine hesitancy was defined based on responses that state disagree or strongly disagree on vaccination-related questions (37).

4.1.1.1 Justification of using a questionnaire

A quantitative survey was the most ideal for this study for it allowed inclusion of a large population hence captured the state of knowledge, attitudes, and perceptions. Moreover, quantitative surveys embrace objectivity and accuracy. Hence quantitatively the study objectively and accurately brought out the levels of knowledge, attitudes and perceptions of COVID-19

vaccines that correlate with vaccine hesitancy. However, in quantitative survey the voice of the study participant is limited to strongly agree, agree, disagree or strongly disagree response. Rather than given them a platform to express why they are for a certain response. Thus, the study is missing reasons behind the answers.

4.2 Research Study population

A population is any group of individuals that has one or more characteristics in common. Population is defined as every possible cause that could be included in a study (115). A population is the entire group of people that the researcher desires to learn about (115), any set of persons or objects that possess at least one common characteristic (115) or a target group who would, in the ideal world, be the subject of the research, and about whom one is trying to say something (115). A population is the aggregation of units or groups of interest to which a researcher wishes to generalise the results of a research study (115).

In this study, the population of interest was youth of 18-35 years both male and female. The age group has recorded to have the highest hesitancy levels compared to other age groups (39). People below 18 and above 35 years were excluded from the study. The youth in South Africa are defined by people of age group 18-35years. Those above 12 years and below 18 years were excluded from the study. Including above 12 years and below 18 years, would entail a rigorous ethical procedure. However, the study being a masters level report, majored on 18-35 years. Moreover, based on the scope of the study 18-35 years were independent enough to make an objective decision. Hence, upholding the principle of autonomy. The study included everybody of 18-35 years, whether pregnant or not. The main focus of the study was the youth (18-35 years). The study did not compare with pregnant women because it was not an objective in the study.

4.2.1 Soweto and Thembelihle Health Demographic Surveillance Systems

Demographic Surveillance Systems are frequently used to monitor populations and their health over time within geographically specified demographic surveillance zones (DSSs). In areas where vital statistics are not reliably gathered, DSS are longitudinal data gathering platforms that monitor births, deaths, migrations, and changes in socioeconomic and health conditions over time. When illness surveillance is integrated with the DSS—either passively through hospital-based surveillance or actively through community surveillance—the entire system is referred to as a health and demographic surveillance system (HDSS).

Soweto and Thembelile Health Demographic Surveillance System (STHDSS) is specific to Soweto-Thembelile as the geographical site. Soweto is an urban township with around 1.3 million individuals covering an area of 200 km2 in about 100 sub-places; Thembelihle and its adjoining areas are informal urban settlements with a population of over 20,000. The HDSS catchment areas cover eight mostly non-contiguous sub-places of low socio-economic status, with an area of 17.7km2 in Soweto; Thembelihle and its surrounding informal settlements has an area of 19.0km2 (118) . Moreover, the STHDSS is used for nested studies and intervention programmes aimed at improving health and well-being of the population under surveillance (119).

4.2.2 Sampling procedure

In this study, a multi-stage sampling strategy was used, including cluster sampling, convenient sampling, and finally, random sampling of households.

Cluster sampling was done selecting two clusters based on their social demographics. The two clusters are Meadowland and Thembelihle, representing formal and informal settlement respectively. After identifying the clusters, we conveniently identified households with the youth of 18-35 years. The households were sampling frame. On the households we did simple random sampling. Simply put, simple random sampling means that each sample in the population has an equal chance of being chosen. As a result, a general representation of the population in Soweto, South Africa is provided (4,120). Hence, provided an estimate of vaccine hesitancy in

Soweto, a version in the study population. Calculator.net was used to calculate the proper sample size. Using a 95% confidence interval, a 5% margin of error, a 50% response distribution A 50% response refer to the assumed COVID-19 vaccine hesitancy, since there was no published study that highlighted on the prevalence of COVID-19 vaccine hesitancy in Soweto among the youth.Moerover, a total population of 28, 918 youth (18-35) in the Soweto-Thembelihle Health Demographic Surveillance System (STHDSS) in South Africa 2021, of the 28,918 youth (18-35) twenty- two thousands, one hundred and ninty-four were from the selected clusters (Thembelihle and Meadowlands) (unpublished data). The study used the power of 80%. The power of a test is the probability of rejecting the null hypothesis when it is false.

The following cross section study design, sample size formula was used for calculating the specific sample size on the prevalence of COVID-19 vaccine hesitancy among the youth (18-35 years) in Soweto (121):

$$n = \frac{Z^2\ P(1\text{-}P)}{d^2}$$

n is the sample size,

Z is the statistic corresponding to level of confidence. The study used 95% confidence interval.

P is expected prevalence (the study used 50% since there was no published data on the COVID-19 vaccine hesitancy in Soweto

d is precision (corresponding to effect size). The study used 28, 918, which is the total number of youth 18-35 years in STHDSS.

This resulted in a sample size of 380. (4). The sample outcome is a one-sample dichotomous outcome (122).

4.2.1.1 How to randomly select the samples?

Under the Child Health and Mortality Prevention Surveillance (CHAMPs) Programme, samples were drawn at random from the Soweto-Thembelihle Health Demographic Surveillance System (STHDSS). The STHDSS has 9 clusters: Braamfisherville Extension, Thulani, Emdeni, Mapetle, Phiri/Senoane, Mofolo North, Meadowland Zone 4, Meadowland Zone 5, and Thembelihle. The sampling frame is made up of these clusters, which have a total population of 38,165 people as of 2022. These are the natural groupings of people based on households (14). Two of these clusters were conveniently sampled in this study based on their socioeconomic status. Vaccine hesitancy differs according to socioeconomic status, according to studies (123). This is referred to as convenient cluster sampling.

Meadowlands Zone and Soweto-Thembelihle are the names of the two clusters, which represent formal and informal settlements, respectively. Based on the STHDSS database, we easily identified households with the age group of interest (18-35 years), in the selected clusters. The identified households were assigned unique identifiers, which aided in the random sampling of study participants found in the identified households. The sampling unit was households. Randomization took place by selecting an even number of households that had at least one youth member of 18-35 years. All of the youth from the selected households were asked to participate in the study without coercion.

Study participants were recruited until a sample of 190 study participants per cluster was attained. The sum of the two clusters was 380. A sample size of 380 was adequate to provide a general result of vaccine hesitancy. The researcher and research assistants invited and recruit participants for the study from the Soweto-Thembelihle Health Demographic Surveillance System (STHDSS) with the support of the foot soldiers in each cluster. The STHDSS database assisted us in identifying households with the age group of interest.

4.3 Data collection process

4.3.1 Gaining access to Soweto Thembelihle Health Demographic Surveillance System (HDSS) Data base

The research assistant wrote a letter (see Appendix III) to the HDSS program manager requesting for access of the HDSS data base. The database was used to identify households with the youth of age 18-35 years. The HDSS approved the request and issued an agreement to use the database (see Appendix IV).

Once the database was available, the researcher filtered out data from other clusters, thus remaining with the dataset only Meadowland and Thembelihle. The researcher divided the data set into based on the two clusters.

On each cluster set, the researcher added a new column on the right after the column on date of birth. The new column was labelled 'Age.' The following formula was used to calculate the age of the study participants, based on the date the study commenced,

=DATEDIF(S5686 - This is the first cell that has under the date of birth column ,TODAY(),"Y"). The study commenced on the 23rd of April 2022

The researcher clicked on the data tool bar, then clicked on the filter icon. As illustrated in figure 4.1. This helped the researcher to filter in, the participants of age between 18-35 years. The data set was numbered 1-4 repeatedly. The researcher filtered in all participants who took number 2 and 4, through random selection. The researcher, research assistants and the foot soldiers used the data set to identify the homes of the study participants.

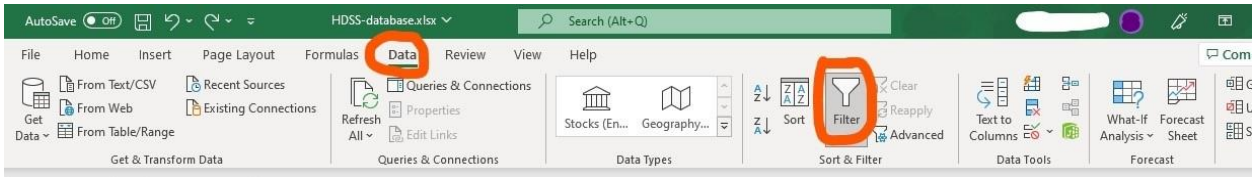


Figure 4: 1 Demonstration on filtering of data

4.3.2 Gaining access in the community.

The researcher and her two-research assistant paid a courtesy visit to the gate keepers of the two cluster groups namely, Meadowlands and Thembelihle. STHDSS has a community advisory board which has several community leaders of high reputation and reliable. These are referred to as gate keepers. The gate keepers approached in the study are the same who are involved in the STHDSS. To meet with the gatekeepers, the research assistants, having had a rapport with them out of their line of duty, made appointments per cluster with them on the days which were convenient to them. During the visit the researcher introduced the proposed study topic in detail in a language they could easily understand. The gatekeepers were very receptive, excited about the study and willing to guide us to the homes that had our participants of interest.

4.3.3 Informed consent administration

After identifying a study participant who met the inclusion criteria, the researcher and the research assistants explained to the participants on what the study was about. Thereafter the participants were asked if they were willing to participate in the study without coercion or if they had any questions. When the participant accepted to participate in the study, a hard copy informed consent form was administered, upholding the COVID-19 protocols; whereby the social distance was maintained, face masks were on and hand sanitization was done before administering and signing of the consent form.

4.3.4 Questionnaire administration

The researchers administered questionnaire using Redcap. Redcap is a power data collecting tool that ensures accurate capture of data, in a fast and flexible manner. The researchers verbally ask the questions and concurrently filled in the questionnaire in a tablet that is Redcap installed.

4.4 Study variables

4.4.1 Dependent variable

The dependent variable for this study is vaccine hesitancy and it has been defined by the question "COVID-19 vaccine is NOT important". This variable has two outcomes, hesitancy or non-hesitancy. As depicted in table 4.1.

Table 4: 1 Definition of dependent variable

Definition of dependent variable	**Variable definition**
Outcome variable Vaccine hesitancy	COVID-19 vaccine is NOT important?
	Disagree and strongly disagree-non-hesitancy (0) Agree and strongly agree – hesitancy (1)

4.4.2 Independent variable

The independent variables were tested in relation to the outcome variable of vaccine hesitancy

4.4.2.1 Demographic variables

The demographic characteristics measured were the respondents' gender, age, racial group, education, marital status, and religion. The respondents' age was measured in years, and it was later re-grouped into two age groups 18-24 years and 25-35 years. Racial

4.4.2.2 Socio-economic variables

The social-economic variable was derived from the employment status variable. Those who were unemployed remained unemployed, those employed full time, employed part time, self-employed, volunteering and studying retained the same category. Education level those who had no formal education, primary education was re-classified primary or no level of education, those with some high school or finished grade 12 were re-classified as secondary level, those with some tertiary or completed tertiary were re-classified as tertiary.

4.5 Hypothesis

4.5.1 Knowledge on COVID-19 is associated with less vaccine hesitancy.

4.5.2 Negative attitudes towards COVID-19 vaccine is associated with vaccine hesitancy.

4.5.3 Negative perceptions towards COVID-19 vaccines is associated with vaccine hesitancy.

4.6 Data analysis

The variables that were analysed included age, level of education, employment and marital status, knowledge, attitudes, and perceptions. The tool was created into RedCap and analysed using STATA version 13. Data was presented in form of frequency tables, pie charts for descriptive analysis. The study also embraced inferential statistics and utilise factor analysis, bivalent correlation, chi-square in crosstabs, univariate and multivariate regression as basic tools to find association in the three specific objectives.

4.6.1 Regression

Simple linear regression (univariate regression) is an important tool for understanding relationships between quantitative data, but it has its limitations (124). One obvious deficiency is the constraint of one independent variable, limiting models to one factor, such as the cumulative different effects on adherence (125). Real relationships are often much more complex,

with multiple factors. To allow for multiple independent variables in the model, we can use multiple regression, or multivariate regression. The multivariate regression is similar to linear regression, except that it accommodates for multiple independent variables. The model for a multiple regression can be described by this equation:

$y = \beta 0 + \beta 1x1 + \beta 2x2 + \beta 3x3 + \varepsilon$

Where y is the dependent variable, xi is the independent variable, and βi is the coefficient for the independent variable. The coefficients can be different from the coefficients you would get if you ran a univariate regression for each factor. Multiple regression finds the relationship between the dependent variable and each independent variable, while controlling for all other variables (124).

When we talk about the results of a multivariate regression, it is important to note that:

- ✓ The coefficients may or may not be statistically significant
- ✓ The coefficients hold true on average
- ✓ The coefficients imply association not causation
- ✓ The coefficients control for other factors

R Squared

Adjusted R Squared

Coefficients for each factor (including the constant)

P value for each coefficient

The R Squared is the proportion of variability in the dependent variable that can be explained by the independent variables in the model. A large R Squared value is usually better than a small R Squared value, except when overfitting is present (125).

Adjusted R Squared

The adjusted R Squared is the R Squared value, but with a penalty on the number of independent variables used in the model. The R Squared value can only increase with the inclusion of more factors in the model, the model will just ignore the new factor if it does not help explain the dependent variable. This poses a problem as if we were to select the best model based on its R Squared value, we end up selecting models with more factors rather than fewer factors, but models with more factors have a tendency to overfit. The adjusted R Squared can become smaller as you include more variables. When choosing the best prescriptive model for your analysis, you would want to choose the model with the highest adjusted R Squared(125).

Coefficients

The coefficient is the change in the number of units of the dependent variable associated with an increase of 1 unit of the independent variable, controlling for the other independent variables. The coefficients can be used to understand the effects of the factors (its direction and its magnitude). However, the coefficients should not be used to predict the dependent variable for a set of known independent variables (125).

P Value

The p value is the statistical significance of the coefficient. By comparing the p value to the alpha (typically 0.05), we can determine whether or not the coefficient is significantly different from 0. An independent variable with a statistically insignificant factor may not be valuable to the model (125).

Multicollinearity

Multicollinearity is a problem because it produces regression model results that are less reliable (126). Variance Inflation (VIF) Run on all variables to check for collinearity. All variables were moderately collinear with an VIF of 1.18 to 1.05, Hence, multivariate analysis was excluded. The

most appropriate way to control for multicollinearity is to remove the variables that are correlated.

4.7 Ethical Considerations

The Human Research Ethics Committee at the University of the Witwatersrand reviewed the study for ethical approval. Ethics clearance certificate number H22/01/16.

The research was guided by the Belmont principles of research ethics: privacy, confidentiality, and respect of autonomy. In this study, privacy was maintained by ensuring that the interviews were performed at a place that is comfortable for the participant to express themselves. A high level of confidentiality was maintained by removing any personal identifier such as name or date of birth during data entry. Rather, the participant's identity was coded for anonymity. Respect for autonomy was upheld by explaining to the participants what the study entails and allowing them to make an informed decision on whether to participate in the study or not, without coercion. Moreover, the study participants were at liberty to drop off from the study at any time at their free will. In addition, no service was withheld from those who failed to participate in the study. An effort was made to treat all participants in an equal manner and fully respect their integrity throughout the course of the investigation. Privacy was maintained by storing data in password protected tablets and computers.

4.8 Study Limitations

The study was limited to understanding the reasons behind the negative attitudes and perceptions, out of the study design being quantitative. The tool used in the study fro data collection was unvalidated. The study was limited in comparing the knowledge attitude and perceptions with other age groups, since it focused on 18-35 years, who are defined as the youth in South African government. Moreover, the research objective was meant for those for only the youth who can make a decision independently. In addition, the study design was limited in

extrapolating the finding to the South African population. However, the study gives an indication on how things might in other settings.

4.9 Significance of the study

The study highlights knowledge, attitudes and perceptions that cause the youth to be vaccine hesitant**.** These will help in developing tools or coming with strategies to solve vaccine hesitancy in Soweto and in South Africa. Moreover, the study will inform the policy makers in the development of policies that will aim at solving hesitancy in Soweto. In addition, the knowledge, attitudes and perceptions of the local population towards the COVID 19 vaccine is critical to understanding the epidemiological dynamics of disease control, the effectiveness, compliance, and success of the vaccination program.

4.10 Summary

Chapter four the method used to achieve the study objectives. The primary objective is to investigate knowledge, attitudes, and perceptions on COVID 19 vaccines among the youth in Soweto, South Africa. The study employed a quantitative method, whereby closed ended questionnaires were administered using Redcap a very power tool for collecting data. Quantitative method was the best fit for the study for it accommodates a large sample size. However, the method leaves behind reasons at the rear of the answers. The chapter explains ethical procedure to ensure ethical standards for studies with human subjects and describes the data analysis procedure that was followed. The steps taken to ensure the validity and readability of the study were explained.

CHAPTER FIVE

RESEARCH FINDINGS

5.0 Introduction

This chapter contains data that was collected from young people aged 18-35 years. The main goal of this study was to investigate knowledge, attitudes, and perceptions of COVID-19 vaccines among young people in Soweto, South Africa. The study used closed ended questions, in the Likert scale[1] form. The response options were strongly agreed, agree, disagree, and strongly disagree.

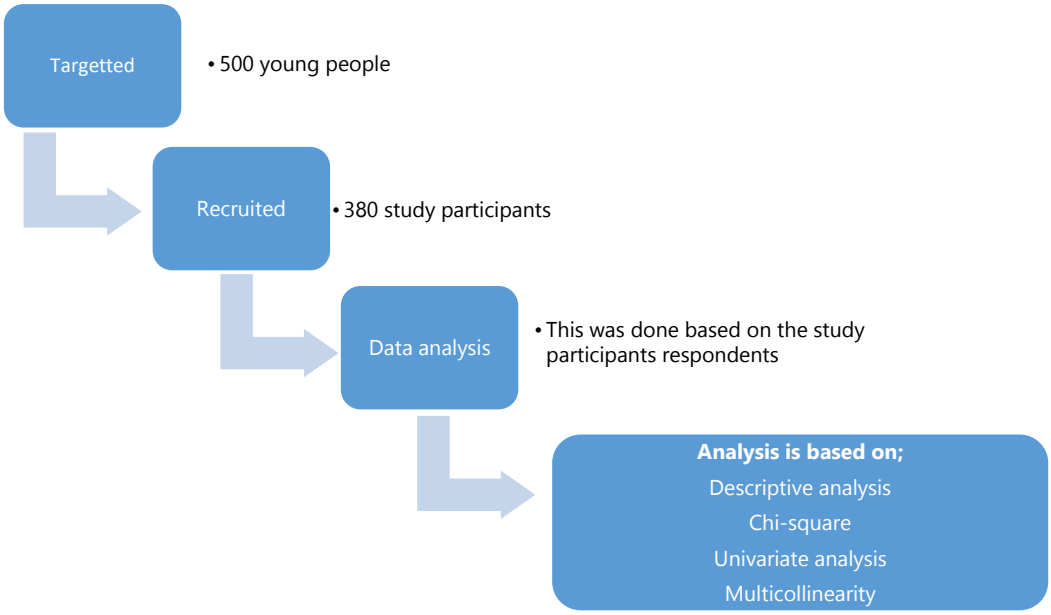


Figure 5: 1 A Flow chart illustrating on the response rate and data analysis.

[1] Likert scale is a form of a closed ended questionnaire that is based on 4 responses categories in line with this study, namely strongly agree, agree, disagree and strongly disagree.

5.1 Social Demographic Characteristics

The demographic characteristics of the population selected are shown in Table 5.1 below. As highlighted, the following was observed: racial groups were mainly of black origin at 97.1%; in terms of education the participants were largely of secondary schooling and above at 99.2%; religion was of Christians[2] were the majority (72.9%) precisely of Protestant denominations (36.6%), female were dominant (60%) and marital status mostly were never married 95.5%. Data was collected from Soweto Themebelihle Health Demographic Surveillance System specifically Thembelihle (50%) and Meadowlands (50%) clusters. Moreover, the study participants were not very mobile, as most (86.3%) had resided in the specified clusters in the last 4 months. The study participants were of mean age 23.8, standard deviation of 0.3 and median of 23, interquartile range of 19-27.

Table 5: 1 Social demographic and social economic characteristics

Variable	**Responses**	**Total Number**	**(%)**
Cluster name	Soweto Thembelihle	180	50
	Meadowlands	180	50
Age	18-24 years	234	61.6
	25-35 years	146	38.4
Gender	Male	151	40
	Female	229	60
Ethnic group	Black	378	99.5
	Colored	2	0.5
Education	Primary or None	3	0.8
	Secondary	324	85.3

[2] Christians is a combination of Roman Catholic church, Evangelic Charismatic, African Independent Church and Christian Protestant

	Tertiary	53	14.0
Marital Status	Never married	363	95.5
	Once married	2	0.5
	Married	14	3.7
	Other (Dating)	1	0.3
Religion	Roman Catholic Church	21	5.5
	Evangelic Charismatic	44	11.6
	African Independent Church	73	19.2
	Christian protestant	139	36.6
	Muslim	8	2.1
	African tradition[3]	75	19.7
	Other	20	5.3
Residence the last 4 months	No	52	13.7
	Yes	328	86.3

[3] African tradition is a type of religion that past and present elders play a significant role. People maintain a spiritual connection with their ancestors through rituals. The tradition has spiritual leaders called 'sangomas' that are responsible for spiritual and physical healing as well as counselling about the future.

Sources of Information to COVID-19 disease and COVID-19 vaccine (n=380)

Internet was the major (49.5%) source of information followed by TV (24.2%). This is depicted in figure 5.2.

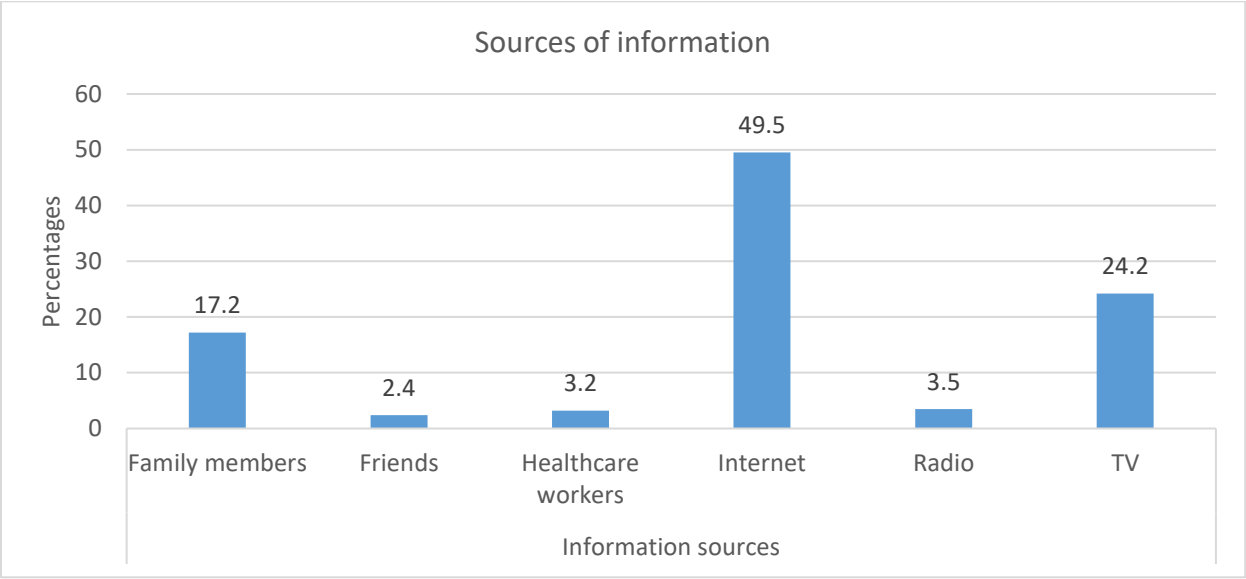


Figure 5: 2 Distribution on the sources of information

Social Demographics and Vaccine Hesitancy

Based on socioeconomic demographic factors, Table 5.2 shows the various percentages of COVID-19 vaccine hesitancy. The following fields were highlighted as having higher vaccine hesitancy: age range of 18 to 24 years (59.5%), black racial group (99.3%), secondary level education (86.1%), marital status (never married) (95.0%), religion (Christian protestant, 37.2%), and study participants whose internet was their main source of information (49.8%).

Table 5: 2 Distribution of responses on social demographic characteristics based on COVID-19 vaccine hesitancy

Variable	**Response**	**Non-hesitancy (%)**	**Hesitancy (%)**	**Total (380)**	**p-value**
General population		20.8	79.2	100	
Marital status	Never married	97.5	95.0	95.5	0.468
	Once married	0.0	0.7	0.5	
	Married	2.5	4.0	3.7	
	Other (specify)	0.0	0.3	0.3	
Racial group	Black	100	99.3	99.5	0.226
	Colored	0	0.7	0.5	
Religion	Roman Catholic church	2.5	6.3	5.5	0.531
	Evangelic Charismatic	10.1	12.0	11.6	
	African Independent Church	25.3	17.6	19.2	
	Christian protestant	34.2	37.2	36.6	
	Muslim	1.3	2.3	2.1	
	African tradition	22.8	18.9	19.7	
	Other	3.8	5.7	5.3	
	Family members	21.5	15.6	16.8	0.186

Source of information	Friends	3.8	2.0	2.4
	Healthcare workers	1.3	3.7	3.2
	Internet	43.0	49.8	48.4
	Radio/School	6.3	5.3	5.5
	TV	24.1	23.6	23.7

COVID-19 vaccine hesitancy by age group

In relation to age category, 18-24 years had a higher (59.5%) hesitancy compared to 25-35 years. COVID-19 vaccine hesitancy based on age category p-value 0.09 and 95% confidence interval of -0.2 – 0.2. However, the p-value was not statistically significant This is represented in figure 5.3.

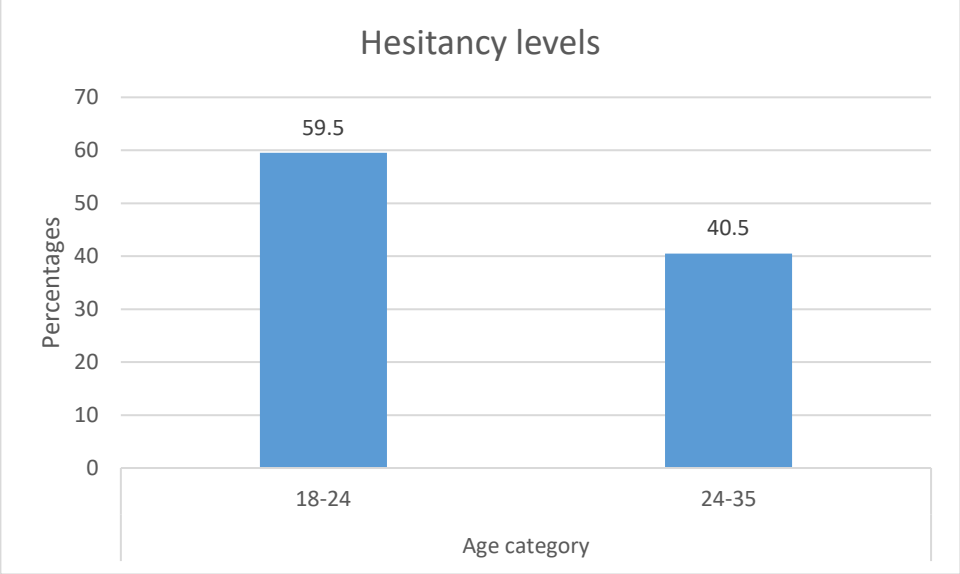


Figure 5: 3 COVID-19 vaccine hesitancy based on age category.

COVID-19 vaccine hesitancy by gender

In terms of gender, higher vaccine hesitancy was captured among the female (62.1%) compared to male. This depicted in figure 5.4.

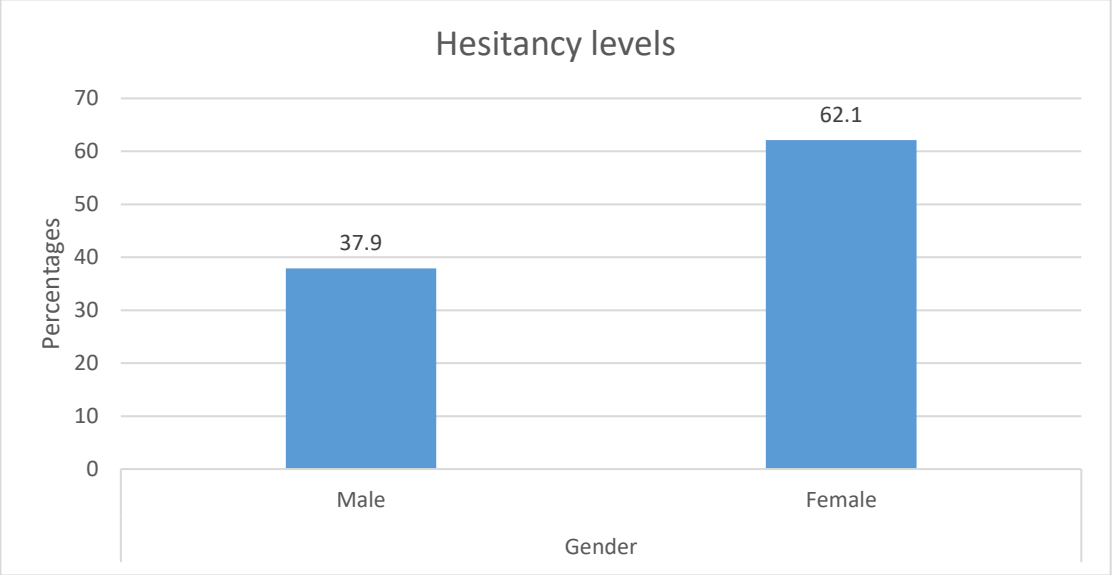


Figure 5: 4 COVID-19 vaccine hesitancy based on gender**.**

COVID-19 vaccine by education category

Study participants who had some secondary level of education were the most (86%) hesitant compared to those with tertiary or some primary level of education. This is highlighted in figure 5.5.

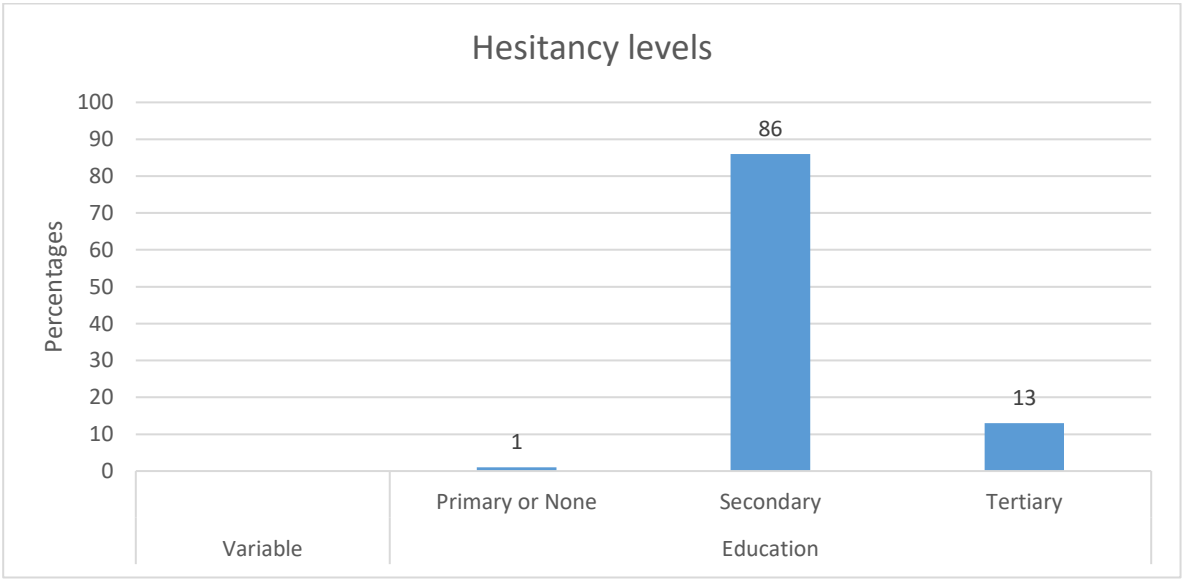


Figure 5: 5 COVID-19 vaccine hesitancy based on education

5.2 Knowledge of COVID-19

The first objective of this analyses is: to describe the knowledge of COVID-19 disease and COVID-19 vaccines among young people in Soweto, South Africa. This was done by utilizing the following variables as highlighted in Tables 5.3 to 5.5. Of note from these results linked to the objective is the following statements that were used to describe knowledge on COVID-19 vaccine: '*COVID-19 is a hoax*', '*Wearing masks prevents COVID-19*' and '*Currently there is a cure for COVID-19*'.

5.2.1 COVID-19 is a Hoax

Out of the total study participants (380), 53.2 % disagreed to the statement that *'COVID-19' is a hoax.* This is as illustrated in table 5.3. Moreover, a statistical significance of 0.011 was captured.

Table 5: 3 Overall responses on the statement 'COVID-19 is a hoax'.

Responses	**Numbers**	**Percentage**	**Summary (%)**
Strongly agree	36	9.5	46.8
Agree	142	37.4	
Disagree	190	50.0	53.2
Strongly disagree	12	3.2	
Total	380	100	100
p-value of 0.011			

Of the 53.2 % study participants who disagreed to the statement, 85.6% were hesitant. While, of the 46.8% study participants who agreed to the statement, 71.9% were hesitant

5.2.2 Wearing of masks prevents COVID-19

The following statement "*Wearing of masks prevents COVID-19*" was found to have substantial statistical significance of p value 0.001

Out of the total study participants (380), 90.3% agreed to the statement that *'wearing of masks prevents COVID-19'.* Of the 90.3% sixty-three-point two percent agreed to the statement while 27.1% strongly agreed as illustrated in table 5.4.

Table 5: 4 Overall responses on the statement 'wearing of masks prevents COVID-19'.

Responses	**Numbers**	**Percentage**	**Summary (%)**
Strongly agree	103	27.1	90.3
Agree	240	63.2	
Disagree	30	7.9	9.7
Strongly disagree	7	1.8	
Total	380	100	100
p-value of 0.001			

Of the 90.3% study participants who agreed to the statement, 81.9% were hesitant. While, of the 9.7% who disagreed to the statement 54% were hesitant.

5.2.3 Currently there is a cure for COVID-19

Out of the total study participants (380), 54.5% disagreed to the statement that *'currently there is a cure for COVID-19* while, 45.5% agreed to the statement as illustrated in table 5.5.

Table 5: 5 Overall responses on 'wearing of mask prevents COVID-19' and 'currently there is a cure for COVID-19'' based on the hesitancy levels.

Responses	**Numbers**	**Percentages**	**Summary (%)**
Strongly agree	14	3.7	45.5
Agree	159	41.8	
Disagree	176	46.3	54.5
Strongly disagree	31	8.2	
Total	380	100	100
p-value of 0.005			

Of the 54.5% study participants who disagreed to the statement, were 72.4% were hesitant. Of the 45.5% study participants who agreed to the statement, 87.3% were hesitant.

5.3 Attitudes towards covid-19

The second objective is linked to: the attitudes of COVID-19 vaccines among young people in Soweto, South Africa. Attitudes was measured with the following variables: *'If a teacher is COVID-19 positive they should be allowed to continue teaching*', '*I prefer breaking physical contact with people who are COVID-19 positive*' and '*It is better to develop immunity by getting sick rather than by getting a vaccine*'.

5.3.1 "If a teacher is COVID-19 positive they should be allowed to continue teaching".

The following statement "*if a teacher is COVID-19 positive they should be allowed to continue teaching*" was found to have substantial statistical significance of p value 0.009.

Out of the total study participants (380), 86.6 % disagreed to the statement that *'if a teacher is COVID-19 positive they should be allowed to continue teaching* while, 13.4 % agreed to the statement as illustrated in table 5.6.

Table 5: 6 : Overall responses on 'if a teacher is COVID-19 positive they should be allowed to continue teaching' based on the hesitancy levels

Responses	**Numbers**	**Percentages**	**Summary (%)**
Strongly agree	8	2.1	13.4
Agree	43	11.3	
Disagree	161	42.4	86.6
Strongly disagree	168	44.2	
Total	380	100	100
p-value of 0.009			

Of the 86.6% study participants who disagreed to the statement, were 81.2% were hesitant. While of the of the 13.4% study participants who agreed to the statement, 66.7% were hesitant.

5.3.2 "I prefer to break physical contact with people living with COVID-19 disease".

The statements "*I prefer to break physical contact with people living with COVID-19 diseases*" with a statistical significance of p-value of 0.045.

Out of the total study participants (380), 73.7% agreed to the statement that *'I prefer to break physical contact with people living with COVID-19* while, 26.3 % disagreed to the statement as illustrated in table 5.7.

Table 5: 7 Overall responses on 'I prefer to break physical contact with people living with COVID-19' based on the hesitancy levels.

Responses	**Numbers**	**Percentages**	**Summary (%)**
Strongly agree	41	10.8	73.7
Agree	239	62.9	
Disagree	87	22.9	26.3
Strongly disagree	13	3.4	
Total	380	100	100
p-value of 0.045			

Of the 73.7% study participants who agreed to the statement, 81% were hesitant. While of the 26.3 % study participants who disagreed to the statement, 74% were hesitant.

5.3.3 "It is better to develop immunity by getting sick rather than by getting a vaccine".

The statements "*It is better to gain immunity by being sick rather than by having a vaccine*" were shown to have high statistical significance of p-values 0.000.

Out of the total study participants (380), 69.2% disagreed to the statement that *'it is better to gain immunity by being sick rather than by having a vaccine* while, 30.8 % agreed to the statement as illustrated in table 5.8.

Table 5: 8 Overall responses on 'It is better to gain immunity by being sick rather than by having a vaccine' based on the hesitancy levels

Responses	**Numbers**	**Percentages**	**Summary (%)**
Strongly agree	31	8.2	30.8
Agree	86	22.6	
Disagree	214	56.3	69.2
Strongly disagree	49	12.9	
Total	187	100	100
p-value of 0.000			

Of the 69.2% study participants who disagreed to the statement, 85.9% were hesitant. While of the 30.8% study participants who agreed to the statement, 64.1% were hesitant.

5.4 Perceptions on Covid-19

Perceptions was measured in the final objective which was to: To investigate the perceptions of COVID-19 vaccines among young people in Soweto, South Africa. This objective used the following variables: '*I believe that the COVID-19 vaccine can stop me from being infected*', '*Quarantining people with COVID-19 is the best way to prevent the disease*' and '*COVID-19 vaccine has serious side-effects*'.

'5.4.1 I believe that the COVID-19 vaccine can stop me from being infected'

Out of the total study participants (380), 56.9% disagreed to the statement that *'I believe that the COVID-19 vaccine can stop me from being infected'* while, 43.1% agreed to the statement as illustrated in table 5.9. A statistical significance of 0.000 was recorded.

Table 5: 9 Overall responses on 'I believe that the COVID-19 vaccine can stop me from being infected'' based on the hesitancy levels

Responses	**Numbers**	**Percentages**	**Summary (%)**
Strongly agree	21	5.5	43.1
Agree	143	37.6	
Disagree	185	48.7	56.9
Strongly disagree	31	8.2	
Total	380	100	100
p-value of 0.000			

Of the 56.9% study participants who disagreed to the statement, 69.4% were hesitant. Of the 43.1% study participants who agreed to the statement, 92.1% were hesitant.

5.4.2 'Quarantining people with COVID-19 is the best way to prevent the disease'

Out of the total study participants (380), 86% agreed to the statement that *'Quarantining people with COVID-19 is the best way to prevent the disease* while, 14% disagreed to the statement as illustrated in table 5.10. A statistical significance of 0.000 was captured.

Table 5: 10 Overall responses on 'Quarantining people with COVID-19 is the best way to prevent the disease' based on the hesitancy levels

Responses	**Numbers**	**Percentages**	**Summary (%)**
Strongly agree	59	15.5	86
Agree	268	70.5	
Disagree	38	10	14
Strongly disagree	15	4.0	
Total	380	100	100
p-value of 0.000			

Of the 86% study participants who agreed to the statement, 83.2% were hesitant. While of the 14% study participants who disagreed to the statement, 54.7% were hesitant.

5.4.3 'COVID-19 vaccine has serious side-effects'.

Out of the total study participants (380), 74.7% agreed to the statement that *'COVID-19 vaccine has serious side-effects'* while, 25.3% disagreed to the statement as illustrated in table 5.11. A statistical significance of 0.000 was captured.

Table 5: 11 Overall responses on 'COVID-19 vaccine has serious side-effects' based on the hesitancy levels

Responses	**Numbers**	**Percentages**	**Summary (%)**
Strongly agree	116	30.5	74.7
Agree	168	44.2	
Disagree	82	21.6	25.3
Strongly disagree	14	3.7	
Total	380	100	100
p-value of 0.000			

Of the 74.7% study participants who agreed to the statement, 83.1% were hesitant. While, of the 25.3% study participants who disagreed to the statement, 67.7% were hesitant.

UNIVARIATE ANALYSIS

Social demographic characteristics

Age: The Odds of being COVID-19 vaccine hesitant was 1.6(0.9-2.7) times more likely among study participants of age 18-24 years compared to 25-35 years.

Gender: The Odds of being COVID-19 vaccine hesitant was 1.4(0.9-2.4) times more likely among female study participants compared to male study participants.

Knowledge:

COVID-19 is a hoax: The Odds of being COVID-19 vaccine hesitant was 2.3(1.4-3.9) times more likely among study participants who disagreed on COVID-19 is a hoax compared to study participants who agreed on the same statement.

A statistical significance of p value of 0.01 was highlighted between the vaccine hesitant and non-vaccine hesitant in relation to COVID-19 is a hoax. This statistical significance was not <0.001 but tended to move towards significance thus showing a close correlation of note.

Wearing of mask prevent COVID-19 disease: A statistical significance of p value - 0.0003 was highlighted between the vaccine hesitant and non-vaccine hesitant in relation to wearing masks

The Odds of being COVID-19 vaccine hesitant was 0.3(0.1-0.5) times less likely among study participants who disagreed on the statement on wearing masks protects you from COVID-19 compared to study participants who agreed on the same statement.

Currently there is a cure for COVID-19 disease: The Odds of being COVID-19 vaccine hesitant was 2.6(1.5-4.5) times less likely among study participants who agree on the statement '*COVID-19 is curable*' compared to study participants who disagreed on the same statement.

A statistical significance of p value- 0.0003 was highlighted between the vaccine hesitant and non-vaccine hesitant in relation to the statement that COVID-19 is curable.

Attitudes:

COVID-19 positive teacher should be allowed to teach:

The Odds of being COVID-19 vaccine hesitant was 2.2(1.1-4.1) times more likely among study participants who disagreed on teachers to be allowed to teach while positive for COVID-19 disease compared to study participants who agreed on the same statement.

A statistical significance of p value- 0.0239 was highlighted between the vaccine hesitant and non-vaccine hesitant in relation to the statement on teaches who are COVID-19 positive should be allowed to teach.

I prefer breaking physical contact with COVID-19 positive people: The Odds of being COVID-19 vaccine hesitant was 4.1(2.2-7.7) less likely among study participants who agreed on the importance of breaking physical contacts on people who are positive for COVID-19 disease compared to study participants who disagreed on the same statement.

A statistical significance of p value- 0.0000 was highlighted between the vaccine hesitant and non-vaccine hesitant in relation to the statement on '*I prefer to break physical contact with people who are COVID-19 positive*'.

It is better to develop immunity by getting sick rather than getting the vaccine: The Odds of being COVID-19 vaccine hesitant was 3.4(2.0-5.7) more likely among study participants who disagreed on the statement on it is better to develop immunity against COVID-19 disease by getting sick rather than through the vaccine compared to those who strongly agreed on the same statement.

A statistical significance of p value- 0.0000 was highlighted between the vaccine hesitant and non-vaccine hesitant in relation to the statement on '*it is better to develop immunity by getting sick rather than by getting the vaccine*'.

Perception:

I believe COVID-19 vaccine can stop me from infected: The Odds of being COVID-19 vaccine hesitant was 5.1(2.7-9.7) more likely among study participants who agreed on the statement '*COVID -19 can stop one from getting infected'* compared to those who disagreed on the same statement.

A statistical significance of p value- 0.0000 was highlighted between the vaccine hesitant and non-vaccine hesitant in relation to the statement on '*COVID-19 can stop you from getting infected*'.

Quarantining people with COVID-19 vaccine is the best way to prevent COVID-19 disease: The Odds of being COVID-19 vaccine hesitant was 4.1(2.2-7.6) more likely among study participants who agreed on the statement '*quarantine is the best way to prevent COVID-19 disease'* compared to those who disagreed on the same statement.

A statistical significance of p value- 0.0000 was highlighted between the vaccine hesitant and non-vaccine hesitant in relation to the statement on '*Quarantine is the best way to prevent COVID-19 disease*'.

COVID-19 has serious-side effects: The Odds of being COVID-19 vaccine hesitant was 2.3(1.4-4.0) more likely among study participants who agreed on the statement '*COVID -19 has serious side effects'* compared to those who strongly disagreed on the same statement.

A statistical significance of p value- 0.0019 was highlighted between the vaccine hesitant and non-vaccine hesitant in relation to the statement on '*COVID-19 vaccines have serious side effects*'. This is as illustrated in table 5.12.

Table 5: 12 Univariate analysis factors associated with COVID-19 vaccine

Variables	Responses	Univariate analysis	
		OR (CI)	p-value
Age	18-24 years	1.6 (0.9-2.7)	0.0947
	25-35 years	1	
Gender	Female	1.4(0.9-2.4)	0.1498
	Male	1	
Knowledge			
COVID-19 is a hoax	Disagree	2.3(1.4-3.9)	0.0010
	Agree	1	
	Disagree	0.3(0.1 – 0.5)	0.0003

Wearing masks prevents COVID-19 disease	Agree	1	
Currently there is a cure for COVID-19	Agree	2.6(1.5-4.5)	0.0003
	Disagree	1	
Attitudes			
COVID-19 positive teacher should be allowed to teach	Disagree	2.2(1.1-4.1)	0.0239
	Agree	1	
I prefer breaking physical contact with COVID-19 positive people	Agree	4.1(2.2-7.7)	0.0000
	Disagree	1	
It is better to develop immunity by getting sick rather than getting the vaccine	Disagree	3.4(2.0-5.7)	0.0000
	Agree	1	
Perceptions			
I believe COVID-19 vaccine can stop me from being infected	Agree	5.1(2.7-9.7)	0.000
	Disagree	1	
Quarantining people with COVID-19 vaccine is the best way to prevent COVID-19 disease	Agree	4.1(2.2-7.6)	0.000
	Disagree	1	
	Agree	2.3(1.4-4.0)	0.0019

COVID-19 vaccine has serious side-effects	Disagree	1	
Level of significance is at 0.05			

Univariate analysis controlling for age and sex.

Table 5: 13 Univariate analysis associated with COVID-19 vaccine controlling for age and sex.

Variable	**Prob > F**	**Controlled variables**	**Co-efficient**	**p-value**	**CI**	**R^2**
Race	0.0264	Age	0.01	0.04	0.00 – 0.02	0.0242
		Gender	0.05	0.22	-0.03 – 0.14	
		Race	0.11	0.09	-0.02 - -0.24	
Education	0.0324	Age	0.01	0.03	0.00 – 0.02	0.0226
		Gender	0.05	0.21	-0.03 – 0.14	
		Education	-0.09	0.13	-0.20 – 0.02	
Marital status	0.0974	Age	0.01	0.05	4.93 – 0.02	0.0166
		Gender	0.05	0.22	-0.03 – 0.14	
		Education	0.02	0.85	-0.19 – - 0.24	
		Marital status	0.02	0.85	-0.19 - -0.24	
Religion	0.0166	Age	0.00	0.04	0.00 – 0.17	0.0166
		Gender	0.05	0.22	-0.03 – 0.4	
		Religion	-0.00	0.85	-0.03 – 0.02	
Knowledge	0.0020	Age	0.01	0.07	-0.00 – 0.02	0.0385
		Gender	0.03	0.51	-0.06 – 0.11	
		Covid-19 disease is a hoax	0.12	0.00	0.04 – 0.21	
	0.0001	Age	0.01	0.02	0.00 – 0.02	0.0526
		Gender	0.05	0.19	-0.03 – 0.14	
		Covid-19 disease has a cure	0.16	0.00	-0.24 - -0.07	
	0.0001	Age	0.01	0.04	0.00 – 0.02	0.0545
		Gender	0.03	0.45	-0.05 – 0.11	

		Covid-19 disease has a cure	0.27	0.00	0.13 – 0.41	
Attitudes	0.0044	Age	0.01	0.02	0.00 – 0.02	0.0342
		Gender	0.05	0.23	0.03 – 0.13	
		Covid-19 positive teacher should be allowed to continue teaching	0.16	0.01	0.04 – 0.28	
	0.0000	Age	0.01	0.04	0.00 – 0.01	0.0678
		Gender	0.03	0.44	-0.05 – 0.11	
		Physical distance is important in the prevention of COVID-19 disease	0.28	0.00	0.15 – 0.40	
	0.0000	Age	0.01	0.09	-0.00 – 0.01	0.0692
		Gender	0.02	0.72	-0.07 – 0.10	
		Developing immunity by getting sick is better than being vaccinated	0.21	0.00	0.12 – 0.30	
Perceptions	0.0000	Age	0.01	0.03	0.00 – 0.02	0.0914
		Gender	0.04	0.36	-0.04 – 0.12	
		COVID-19 vaccines stop one being infected with COVID-19 disease	0.23	0.00	0.15 – 0.30	
	0.0000	Age	0.01	0.033	0.00 – 0.02	0.0735
		Gender	0.04	0.360	-0.04 – 0.11	

		Quarantine is the best way to prevent COVID-19 disease	0.28	0.000	0.17 – 0.40	
	0.0009	Age	0.01	0.04	0.00 – 0.02	0.0426
		Gender	0.05	0.27	-0.04 – 0.13	
		COVID-19 vaccine has serious side effects	0.15	0.00	0.06 – 0.24	

Race group

2.42% of the COVID-19 vaccine hesitancy can be explained by race controlled by age and gender.

The regression model output shows age predictor variable has a statistical significance with a p-value of 0.037. For every unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy as illustrated in table 5.13.

Education

2.26% of the COVID-19 vaccine hesitancy can be explained by education controlled by age and gender.

The regression model output shows age predictor variable has a statistical significance with a p-value of 0.027. For every unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy as illustrated in table 5.13.

Marital status

1.66% of the COVID-19 vaccine hesitancy can be explained by marital status controlled by age and gender.

The regression model output shows age predictor variable has a statistical significance with a p-value of 0.05. For every unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy, as illustrated in table 5.13.

Religion

1.66% of the COVID-19 vaccine hesitancy can be explained by religion controlled by age and gender.

The regression model output shows age predictor variable has a statistical significance with a p-value of 0.04. For every unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy, as illustrated in table 5.13.

Knowledge

COVID-19 is a hoax

3.85% of the COVID-19 vaccine hesitancy can be explained by respondents who disagreed with the statement COVID-19 is a hoax controlled by age and gender.

The regression model output shows COVID-19 is a hoax predictor variable has a statistical significance with a p-value of 0.004. For every individual who disagree with the statement COVID-19 disease is a hoax, there is a 0.12 increase in being COVID-19 vaccine hesitant, as illustrated in table 5.13.

COVID-19 has a cure

5.26% of the COVID-19 vaccine hesitancy can be explained by respondents who agreed with the statement COVID-19 disease has a cure controlled by age and gender.

The regression model output shows age and statement on COVID-19 disease has a cure predictor variable has a statistical significance with a p-value of 0.021 and 0.000 respectively. For

every unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy. For every individual who agree with the statement COVID-19 disease has a cure, there is a 0.16 increase in being COVID-19 vaccine hesitant, as illustrated in table 5.13.

Wearing of masks prevents one from COVID-19 disease.

5.45% of the COVID-19 vaccine hesitancy can be explained by respondents who agreed with the statement wearing of masks prevents one from COVID-19 disease controlled by age and gender.

The regression model output shows age and the statement on wearing of masks prevents one from COVID-19 disease variables has a statistical significance with a p-value of 0.039 and 0.000 respectively. For every unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy. For every individual who agree with the statement wearing of mask prevents one from COVID-19 disease, there is a 0.27 increase in being COVID-19 vaccine hesitant, as illustrated in table 5.13.

Attitudes

A COVID-19 positive teacher should be allowed to continue teaching.

0.4% of the COVID-19 vaccine hesitancy can be explained by respondents who disagreed with the statement a COVID-19 positive teacher should be allowed to teach controlled by age and gender.

The regression model output shows age and the statement on a COVID-19 positive teacher should be allowed to teach variables has a statistical significance with a p-value of 0.020 and 0.009 respectively. For every unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy. For every individual who disagree with the statement a COVID-19 positive teacher should be allowed to teach, there is a 0.16 increase in being COVID-19 vaccine hesitant, as illustrated in table 5.13.

Physical distance is important in the prevention of COVID-19 disease.

6.78% of the COVID-19 vaccine hesitancy can be explained by respondents who agreed with the statement physical distance is important in the prevention of COVID-19 disease controlled by age and gender.

The regression model output shows age and the statement on physical distance is important in the prevention of COVID-19 disease variables has a statistical significance with a p-value of 0.042 and 0.000 respectively. For every unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy. For every individual who agree with the statement physical distance is important in the prevention of COVID-19 disease, there is a 0.28 increase in being COVID-19 vaccine hesitant, as illustrated in table 5.13.

Developing immunity by getting sick is better than being vaccinated

6.92% of the COVID-19 vaccine hesitancy can be explained by respondents who disagreed with the statement developing immunity by getting sick is better than being vaccinated controlled by age and gender.

The regression model output shows the statement developing immunity by getting sick is better than being vaccinated variables has a statistical significance with a p-value of 0.000. For every individual who disagreed with the statement developing immunity by getting sick is better than being vaccinated, there is a 0.21 increase in being COVID-19 vaccine hesitant, as illustrated in table 5.31.

Perceptions

COVID-19 vaccines stop one being infected with COVID-19 disease.

9.14% of the COVID-19 vaccine hesitancy can be explained by respondents who agreed with the statement COVID-19 vaccine stops one from being infected with COVID-19 disease controlled by age and gender.

The regression model output shows age and the statement on COVID-19 vaccine stops one from being infected with COVID-19 disease variables have a statistical significance with a p-value of 0.026 and 0.000 respectively. For every one unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy. For every individual who agreed with the statement COVID-19 vaccine stops one from being infected with COVID-19 disease, there is a 0.22 increase in being COVID-19 vaccine hesitant, as illustrated in table 5.31.

Quarantine is the best way to prevent COVID-19 disease.

7.35% of the COVID-19 vaccine hesitancy can be explained by respondents who agreed with the statement quarantine is the best way to prevent COVID-19 disease controlled by age and gender.

The regression model output shows age and the statement on quarantine is the best way to prevent COVID-19 disease variables have a statistical significance with a p-value of 0.033 and 0.000 respectively. For every one unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy. For every individual who agreed with the statement quarantine is the best way to prevent COVID-19 disease, there is a 0.28 increase in being COVID-19 vaccine hesitant, as illustrated in table 5.31.

COVID-19 vaccine has serious side-effects.

4.26% of the COVID-19 vaccine hesitancy can be explained by respondents who agreed with the statement COVID-19 vaccine has serious side-effects controlled by age and gender.

The regression model output shows age and the statement on COVID-19 vaccine has serious side-effects variables have a statistical significance with a p-value of 0.038 and 0.001 respectively. For every one unit increase in age, there is a 0.01 increase in COVID-19 vaccine hesitancy. For every individual who agreed with the statement COVID-19 vaccine has serious side-effects, there is a 0.15 increase in being COVID-19 vaccine hesitant, as illustrated in table 5.31.

5.5 Conclusion

This study found very high (79%) levels of COVID-19 vaccine hesitancy. This is attributed to high levels of poor knowledge on COVID-19 disease and COVID-19 vaccine, negative attitudes and perceptions on COVID-19 vaccine.

These findings highlight influence of internet, which was the main source of information. The study has shown that the youth are getting information from the internet, most likey social media leading to vaccine hesitancy.

CHAPTER SIX

DISCUSSION

6.0Introduction

This chapter contains discussion of the findings based on the broad and specific objectives of the study which were guided mainly to investigate knowledge, attitudes and perceptions of COVID-19 vaccine among young people in Soweto, South Africa. Furthermore, the findings are discussed by using the conceptual framework which stipulates that low levels of knowledge on COVID-19 disease and COVID-19 vaccine, negative attitudes and perception towards COVID-19 vaccine are associated with vaccine hesitancy.

The findings will be discussed by looking at the social demographics; knowledge; attitudes; and perceptions of the study participants and their respective levels of COVID-19 vaccine hesitancy.

6.1 Social Demographics and vaccine hesitancy

According to WHO, vaccine hesitancy is one the primary threats to global health (8). However, little is known on the causes and nature of vaccine hesitancy in Africa and precisely in South Africa. Poor knowledge, negative attitudes and perceptions have been associated with vaccine hesitancy (39,104). Yet, there is little data available on the knowledge, attitudes and perceptions on COVID-19 vaccine among youth (18-35 years) in South Africa. This study found high (79%) levels of COVID-19 vaccine hesitancy. This is attributed to poor knowledge, negative attitudes and perceptions on COVID-19 vaccine; associated with the internet (most likely social media) as their main source of information.

Majority of the study population were of the age group 18-24 years (62%) of whom had a higher COVID-19 vaccine hesitancy levels compared to those in the age group 25-35 years (40.5%). Females were the majority and recorded a higher hesitancy compared to male. The study participants were literate as more than 85% had some level of secondary education and above. Of interest was that study participants with some level of secondary education had the highest (86%) COVID-19 vaccine hesitancy compared to primary/no education (1%) and tertiary level

(13%). Internet use was recorded to be the prominent (49.5%) source of information among the study participants. This concurs with several studies (127–129). The similarity of the findings could be because the studies majored on the youth. The study population being young, there are higher levels of influence among people living together/cohabiting/married compared to people who are single, attributing to high COVID-19 vaccine hesitancy.

In line with level of education, study participants with some secondary level of education are likely to have some information on COVID-19 disease but not comprehensive enough to help them make a concrete decision. While study participants with primary/no formal education have no basis to urge against COVID-19 vaccine. This is consistent with a finding done among teachers from preschool to higher education (26). Moreover, people obtaining information from the internet, precisely social media, which is commonly used by the young people, have high chances of being ensnared to misinformation (28). In addition, studies have depicted a variation on the levels of COVID-19 vaccine hesitancy, based on the different social demographic characteristics (130). Other factors that have contributed to COVID-19 vaccine hesitancy are availability health insurance. Mostly among people who are working (131). This was unlike the majority in the population who were unemployed. Moreover, vaccine accessibility has been a contributing factor to COVID-9 vaccine hesitancy (132). This was unlike this study where healthcare facilities were easily accessible.

6.2 Knowledge about COVID-19 disease and COVID-19 vaccine and its relation to COVID-19 vaccine hesitancy

This section discusses some important elements of knowledge about COVID-19 disease and COVID-19 vaccine which includes whether COVID-19 disease is real or a hoax; prevention measures such as wearing of a mask; and whether there is a cure for COVID-19 disease.

4.1 COVID-19 disease is a hoax

More than half of study participants (53%) believed that COVID-19 disease was not a hoax, meaning it is real, while 47% believed it's a hoax. The later could be attributed to misinformation. Interestingly, irrespective of believing COVID-19 disease is a hoax or not, a high rate of vaccine hesitancy was captured. However, a higher hesitancy was among those agreed (86%) compared to those who disagreed (72%). However, a number of studies recording people are starting to believe that COVID-19 disease exists; they remain hesitant (11).

A study done in Kenya among 18 years and older in February 2021 in four counties showed that one of the reasons for vaccine refusal was lack of belief that COVID-19 disease really exists (12,13). Moreover, studies have shown that most young people obtain their health-related information from the internet, healthcare workers and television (14,15). It is possible that the study participants also found misinformation from the same sources. Misinformation has been attributed to high levels of vaccine hesitancy. For example, cross-sectional study done in Gauteng and Northwest provinces South Africa among 18 years and above revealed that misinformation is one of the factors that contributed to vaccine hesitancy (16). Vaccine hesitancy is a behavioural trait which tends to sometimes run contra levels of knowledge. The study depicts knowledge does not translate to behaviour change. This explains why in univariate analysis study participants who disagreed were 2.3 times likely to be hesitant compared to those who agreed. Moreover, studies in HIV and AIDS behavioural change attest to this fact (17). People are aware condoms will protect them from HIV. However, they still don't use condoms. Condomless sex is the primary mode of transmission of HIV in Sub-Sahara Africa, including South Africa (17). The same has been reflected in COVID-19 disease pandemic. People are aware of the existence of COVID-19 disease, but they are highly hesitant towards the vaccine. The similarity of the findings could be attributed to targeting the young people (18-35years).

4.2 Wearing of masks.

In our study, 90% of the study participants agreed to the statement that '*wearing of masks prevents COVID-19 disease*'. Despite of high rate of mask acceptance, a higher rate of vaccine

hesitancy was captured among those who agreed (82%) compared to those who disagreed (54%).

Studies have also shown that most people prefer wearing a mask rather than getting a vaccine. This is also confirmed by a qualitative study done in Ho Chi Minh City, Vietnam among students. The study recorded, individuals adhering to the government regulations of wearing masks, social distancing or lock down, were more willing to be vaccinated compared those who did not (9). The difference can be attributed to the differences in the social demographic characteristics. This means that study participants preferred wearing a mask rather than being vaccinated meaning wearing a mask was considered a convenient or 'safer' option. However, wearing of masks complements the effect of COVID-19 vaccines (18).

4.3 Cure for COVID-19 disease

The study found just over half of the study participants (54%) believe that COVID-19 disease has no cure, while the other half (46%) believed that there is a cure for COVID-19 disease. However, this study has found that irrespective of whether one believed that there was a cure for COVID-19 disease or not, vaccine hesitancy among this population was very high (79.2%).

A study done among healthcare workers of 18 years and above in Makere University Teaching and Referral Hospital in Kampala, Uganda, recorded that most people believed COVID-19 disease has no cure (19). The similarity of the findings could be attributed to the same age group, 18 years and above. Moreover, there is growing literature in development of COVID-19 related treatments (20,21).

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6.3 Attitudes on COVID-19 disease and its related COVID-19 vaccine hesitancy

This section deliberates some important elements of attitudes towards COVID-19 disease and COVID-19 vaccines which includes whether a teacher should be allowed to teach while positive;

preference of breaking physical contact with COVID-19 positive people, and preference of developing immunity by getting sick rather than getting a vaccine.

A teacher positive with COVID-19 should continue to teach.

Most study participants (87%) disagreed with the statement *'If a teacher is COVID-19 positive they should be allowed to continue teaching.'* This means they would prefer a teacher who follows COVID-19 prevention measures, which include self-isolation. This infers the population is knowledgeable that one can transmit the virus in close contact. Moreover, a very small proportion (13%) agree with the statement. This proportion is likely to believe that '*COVID-19 disease* is not real' or they are in a state of fatalism. Hence, translating to 67% hesitancy levels in the group.

Despite the majority (87%) pointing out they are cognisant that COVID-19 disease is real by the preference of distancing themselves with a positive individual, a high rate of vaccine hesitancy was captured. Precisely, among the group that agreed with the statement (81%). This can be explained by the fact that the COVID-19 positive teacher is in self-isolation, hence no need to vaccinate since they are 'safe.'. This is similar to a qualitative study done among Community Health workers (31). The similarity could be attributed to the same age group (20-30 years) and site (Soweto) population, Moreover, a study done on HIV among Gabolese and Malians living in Gabon, West Africa expressed high rate of fatalism despite of the knowledge that HIV is real (30). Similar to the findings in this study on COVID-19 disease and COVID-19 vaccines.

Prefer breaking physical contact .

More than half of the study participants agreed to (74%) breaking physical contact with COVID-19 positive people. This translates to the study population being knowledgeable about COVID-19 disease and vaccines and of its existence. However, a proportion of 26% disagreed with the statement. Interestingly, a higher proportion of vaccine hesitancy is recorded among study participants who agreed (81%) to the statement compared to the population that disagreed

(74%). This deduces that people who prefer breaking physical contact with COVID-19 positive, find no need for a vaccine. As they choose the 'safer' and easier way.

Several studies have highlighted people prefer social distancing with COVID-19 positive people (31). The studies embracing the same population group of young people, could be the contributing factor to their similarity. Moreover, some studies have highlighted that COVID-19 disease attacks mostly the elderly (18). Hence, no need to break physical contact with COVID-19 positive people, out of the perception of being safe and having a strong immunity. Study populations that disagree with the statement are likely to believe that COVID-19 disease is not real or are in a state of fatalism. Similar to a qualitative study done in North West, South Africa on HIV (40). Despite of the differences in the study design, the correlation in the findings could be attributed to the attitude of hopelessness that yields to fatalism.

Develop immunity by getting sick foregoing the vaccine.

Slightly more than half of the study population (69%) disagreed with the statement on the preference of getting sick rather than being vaccinated. We see a change of attitude towards COVID-19 vaccination when reality dawns. However, a substantial proportion (31%) prefer getting sick rather than being vaccinated. Of the 69% of those who disagreed, 86% were hesitant. The reason behind high hesitancy levels could be associated with the sources of information. This study population recorded a high use of the internet (49%). Moreover, the internet had the highest proportion of the hesitant group (50%). Several studies have recorded the internet to be a source of misinformation and infodemics, that translates to vaccine hesitancy (27,28). Furthermore, a meta-analysis survey that investigated acceptance of COVID-19 vaccine, conducted in South Africa from February 2020 to March 2021 recorded that 40% of the study participants agreed with the statement that infection acquired immunity is better than vaccine acquired (13). Slightly higher to our study. This could be attributed to the difference in study populations as our study was the first to be done in STHDSS. Moreover, the time-period for data collection was different. Our study collected data from April to June 2021. Furthermore, our study

took a step further by analyzing the hesitancy levels between the two groups that agreed and disagreed.

6.4 Perceptions on COVID-19 disease and its related COVID-19 vaccine hesitancy

This section discusses some important elements of perceptions towards COVID-19 disease and COVID-19 vaccine which includes COVID-19 vaccine protects one from infection; quarantining is the best way to prevent COVID-19 disease; and COVID-19 vaccine has serious side-effects.

COVID-19 vaccine can stop one from being infected.

Our findings had a tentative 50-50% response that disagreed (57%) and agreed (43%) to the statement. This reveals levels of uncertainty among the study population, deducing lack of information. However, a good proportion (57%), highlights being knowledgeable on the role of COVID-19 vaccines. As COVID-19 vaccines aim to offer protection against severe disease, hospitalization and mortality rather than infection (33). Of the 57% who disagreed, 69% were hesitant. This could be attributed to lack of information or exposure to misleading information (28). This is similar to a number of studies that attribute COVID-19 vaccine hesitancy to be associated with lack of information (34). This explains why a higher hesitancy (93%) was recorded in the group that agreed compared those who disagreed. As the group that agreed to the statement don't expect to turn positive for COVID-19. However, when they turn positive, they have high levels of mistrust on the vaccine, resulting in hesitancy. Similar to our findings, a longitudinal observational study done in Ontario community, Canada recorded lack of trust in the COVID-19 vaccine among study participants of age between 18 to 65 years to be prevalent among the COVID-19 vaccine hesitant group (35). Despite of the difference in the study design and a larger sample size, the finds were in concordance. Moreover, the risk perception of being infected with COVID-19 does not explain one would be open to getting a vaccine. Moreover, the

uptake of COVID-19 vaccine is influenced by several factors. This has been highlighted to various studies, inclusive of a study done in Soweto that reported people who have been infected with COVID-19 disease are still hesitant to vaccination (133).

Quarantine is the best way to prevent COVID-19 disease.

In our findings, most of the study population (87%) preferred quarantine to be the best way to prevent COVID-19 disease. This was complemented by the majority of the study population having a preference of a COVID-19 positive teacher is not allowed to teach (87%) and breaking physical contact with COVID-19 positive people (74%). Most of the study population that preferred to quarantine to prevent the disease, a higher hesitancy (83%) was recorded, compared to the group that disagreed with the statement. Hence, the population is inclined towards breaking physical contact with people who are positive with COVID-19, rather than being vaccinated. To the study population this was the 'easier' or 'safer' way, depicting lack of concrete information. However, this approach is biased as most young people tend to present with asymptomatic to mild symptoms. As a study done among patients classified based on the severity of COVID-19 disease, depicts similar findings (18). Hence young people, form a fertile ground in being super-spreaders. Studies have recorded a high rate of infection among 20-49 years compared to other groups and high rates of deaths among 60 years and above (34). This depicts that the population is knowledgeable but there are gaps on the levels of knowledge. As the study highlights, the internet is the main source of information among the study population. The Internet is inclusive of social media that habours a lot of misinformation and misconceptions (28,34). Unlike any other research, this study has highlighted the levels of hesitancy based on the responses.

COVID-19 vaccine has serious side-effects.

Of the total study participants 75% perceived COVID-19 vaccine to have serious side-effects. Almost a quarter (25%) disagreed with the statement. In this study out of the 75% who agreed

COVID-19 vaccine has serious side-effects 83% were hesitant. Of the study participants that disagreed with the statement, a lower hesitancy level (68%) was captured compared to the previous group. Majority of the studies have recorded side-effects to be one of the top reasons for COVID-19 vaccine hesitancy (36). Despite of the studies having different study designs and populations, there was an agreement in the findings. Moreover, a study done in in March 2021, among Vietnam students perceived side effects on COVID-19 vaccine to be one of the top reasons that contribute to vaccine hesitancy (34). Interestingly, of the study population that disagreed to the statement, yet a substantial proportion were hesitant; this could be attributed to knowledge does not translate to behavior change. As it has been recorded in several HIV studies (38). Moreover, there is a lot of peer pressure among the young population (39).

6.5 Conclusion

The focus of this chapter was to correlate other studies findings on investigate knowledge attitudes and perceptions of COVID-19 vaccines with other studies having the same objective. The studies were very comparable with few differences that could be attributed to diversity on the social demographic characteristics of the populations. The chapter highlights the study population were knowledgeable, but they had poor attitudes and perception towards COVID-19 vaccine.

Internet was the main source of information more likely to be social media causes the study population to have a negative attitudes and perceptions towards COVID-19 vaccine, resulting to hesitancy. Hence, the study found out that infordemic has played a significant on the knowledge levels precisely among the youth.

Hence, the findings are very useful to guide policy makers in having a greater understanding of COVID-19 vaccine perceptions and attitudes. Through this, the policy markers will be able to identify areas of intervention for effective raising awareness about COVID-19 disease prevention as well as facilitate insight into the health and social challenges that South Africa are facing as a

result of the pandemic (105) Eventually, these insights could help to reinforce national efforts to contain the pandemic across South Africa in particular Soweto and lessen other important consequences of the pandemic well-being (105).

6.6 Recommendations

The study being quantitative was limited to highlighting reasons behind the responses that were given, hence, recommending a qualitative study on the same population.

Vaccine hesitancy differs between formal and informal settings. The study was conducted in an informal setting. Hence, the study recommends for a comparative study in formal setting, to bring out the similarities and differences based on causes of vaccine hesitancy.

The study recommends invention of tools to measure vaccine hesitancy. Currently, there are no existence and validated tools that can be used to measure vaccine in Africa. Moreover, there are few interventions that are currently available yet incapable of addressing the root cause of vaccine hesitancy. The study recommends tools that can address the root cause of vaccine hesitancy. As COVID-19 disease is not the last pandemic. We are likely to experience more pandemics in the coming future. Hence, need to address vaccine hesitancy, a problem that has been with us for a while. Yet vaccine, are the most prominent strategy in the global fight against COVID-19 disease.

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PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Jelioth Muthoni (Student number: 2528120) am a student registered for the degree of Masters in Vaccinology in the academic year Two.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature:  Date: 27th October 2022

09200453:Jelioth_Muthoni-Masters_Report.docx

ORIGINALITY REPORT

11%	8%	5%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	sellsidehandbook.com Internet Source	2%
2	Submitted to University of Sheffield Student Paper	1%
3	Submitted to University of Stirling Student Paper	<1%
4	Bobo Hi Po Lau, Samson Wai Hei Yuen, Ricci Pak Hong Yue, Karen A. Grépin. "Understanding the societal factors of vaccine acceptance and hesitancy: evidence from Hong Kong", Public Health, 2022 Publication	<1%
5	new.esp.org Internet Source	<1%
6	www.minervamedica.it Internet Source	<1%
7	sajp.org.za Internet Source	<1%

APPENDIX II

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Muthoni

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H22/01/16**
PROJECT TITLE	Investigating knowledge, attitudes, and perceptions of COVID-19 vaccines among young people in Soweto, South Africa
INVESTIGATOR(S)	Miss J Muthoni
SCHOOL/DEPARTMENT	School of Pathology/
DATE CONSIDERED	28 January 2022
DECISION OF THE COMMITTEE	Approved Risk Level: Minimal
EXPIRY DATE	27 February 2025

DATE 28 February 2022 **CHAIRPERSON** _____
(Professor J Watermeyer)

cc: Supervisor : Dr N Myburgh and Mr A Sokani

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to submit an amendment of the protocol to the Committee. **I agree to completion of a regular progress report. For Minimal and Low studies, this is due annually on 31 December. For Medium and High Risk studies, this is due twice annually on 30 June and 31 December.**

_____ 28 / 02 / 2022
Signature **Date**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

APPENDIX III

Jelioth Muthoni
University of the Witwatersrand
Faculty of Health Sciences
Johannesburg

6th December 2021

University of the Witwatersrand
Vaccine Infectious Disease Analytics
Child Health and Mortality Prevention System

Dear Dr Pedzisai,

Re: Request to access Soweto-Thembelihle Health Demographic Surveillance System (STHDSS) under Child Health and Mortality Prevention Surveillance (CHAMPs) Programme

I am Jelioth Muthoni, a Master student in Vaccinology at the University of Witwatersrand. My project topic is on to investigate knowledge, attitudes, and perceptions of COVID-19 vaccines among young people in Soweto, South Africa. My supervisors are Dr. Nellie Myburg and Mr. Andile Sokani.

I hereby, kindly request to access STHDSS in my sample collection. STHDSS will be used as the sampling frame, with your approval. The sample collection is aimed to start between February and March 2022, after Ethics approval. The sample collection will take 2- 3 months. The STHDSS will help in identifying households of age 18-34 years, who are our target population. Moreover, in case of a lockdown, we can perform telephone interviews by accessing phone numbers from the STHDSS.

High level integrity and confidentiality will be upheld when using STHDSS.

Kind regards,

Jelioth Muthoni

APPENDIX IV

WITS-VIDA

Chris Hani Baragwanath Academic Hospital · +27 (0) 11 983 1862
info@wits-vida.org · https://www.linkedin.com/company/vidaresearchunit · https://wits-vida.org/

Jelioth Muthoni
MA Student
Faculty of Health Sciences
27 St. Andrews Rod
Parktown, Johannesburg, 2193

DEAR JELIOTH MUTHONI,

This refers to you request to use the Wits-VIDA Health and Demographic Surveillance System population as a sampling frame for your Master's research study aimed at investigating knowledge, attitudes, and perceptions of COVID-19 vaccines among young people in Soweto, South Africa.

It is my pleasure to inform you that your study has been granted access to use our HDSS as a sampling frame for your study.

However, for us to provide you with the sample, we will require you to present proof of ethics approval of your research proposal by the relevant body in your faculty.

Wishing you all the best in your academic journey.

Sincerely

Dr. Pedzisai Ndagurwa, Ph.D.
HDSS Programme Manager

pedzisai.ndagurwa@wits-vida.org
Mobile: +27 71 199 8315

WITS VIDA
UNIVERSITY OF THE WITWATERSRAND
VACCINES & INFECTIOUS DISEASES ANALYTICS

Wits VIDA Research Unit, Nurses Residence
Chris Hani Baragwanath Academic Hospital
Chris Hani Road, Soweto
Johannesburg, South Africa

09/02/2022

APPENDIX V

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Participant Information sheet

Dear Sir / Madam,

My name is Jelioth Muthoni, a Masters student in Vaccinology at the University of Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating knowledge, attitudes, and perceptions of COVID-19 vaccines among young people in Soweto, South Africa under the supervision of Dr Nellie Myburgh and Dr Andile Sokani. The study aims to explore knowledge, attitudes, and perceptions of COVID-19 vaccines among young people in Soweto, South Africa.

As part of this project, I would like to invite you to take part in answering a questionnaire. My two research assistants and I will concurrently administer questionnaires. COVID-19 protocols will be upheld; the study participants will sanitize hands before filling in the questionnaire and signing the consent, study participants and the researchers will be in protective face masks and social distance must be maintained. This activity will take around 30 minutes. You are at liberty to participate and drop out anytime.

There will be no personal costs to you if you participate in this project, you will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any questions if you do not want to. The questionnaire will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely and not disclosed to anyone else.

If you have any questions during or afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. The data collected from this research project will be stored in CHAMPs. With your permission, the data collected from this research project may be used by other researchers in an anonymized format. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrec non-medical@wits.ac.za

For more information about COVID-19 and vaccine, please visit the following websites:
South African government - https://www.gov.za/covid-19/vaccine/vaccine
NICD - https://www.nicd.ac.za/
WHO - https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines
CDC - https://www.cdc.gov/coronavirus/2019-ncov/vaccines/index.html
Yours sincerely,

Jelioth Muthoni
Researcher:
Jelioth Muthoni; Email: 2528120@students.wits.ac.za

Supervisors:
Dr Nellie Myrburg, Email: nellie.myburgh@wits-vida.org
Mr. Andile Sokano, Email: andile.sokani@wits-vida.org

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

APPENDIX: VI

TITLE: Investigating knowledge, attitudes and perceptions of COVID-19 vaccines of young people in Soweto, South Africa

Name of researcher: Jelioth Muthoni

I, ……. agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study	YES	NO
I agree that direct quotations from my hard copy questionnaire may be used by the researcher in their research dissertation and manuscript	YES	NO
I agree that my participation will remain anonymous (my name will not be used by the researcher in their research dissertation and manuscript)	YES	NO
I agree that other researchers may use the information I provide in my hard copy questionnaire (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on	YES	NO

…… (signature)
…… (name of participant)
…… (date)

…… (signature)
…… (name of researcher/person seeking consent)
…… (date)

APPENDIX VII

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Standard Operating Procedure

Investigating Knowledge Attitude and Perception of COVID-19 vaccines among young people in Soweto, South Africa

Data management on REDCap - SOP

Version 0.0, 1st April 2022

Author:	Name: Jelioth Muthoni
	Signature: 
	Date: 1st April 2022

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

1 Purpose/Applicability:

1.1 This standard operating procedure (SOP) describes the procedure for Investigating Knowledge Attitude and Perception of COVID-19 vaccines in Soweto, South Africa on questionnaire development and data management on REDCap.

1.2 This SOP therefore serves to ensure that the data on Investigating Knowledge Attitude and Perception of COVID-19 vaccines in Soweto, South Africa is handled as per the protocol requirement.

2 Responsibilities:

2.1 It is the responsibility of the researcher and research assistants to follow the SOPs that impact the research performed.

2.2 The researcher is responsible for the preparation, review and updating the SOPs relative to their daily operations.

2.3 It is the responsibility of the researcher to ensure that this SOP is implemented as written.

3 Equipment

3.1 Tablets

3.2 Laptop

4 Acronyms/Abbreviations:

4.1 SOP - Standard Operating Procedure

4.2 IRB – Institutional Review Board

5 Procedure for questionnaire development on REDCap

5.1 The researcher requested for an activation of their REDCap account.

5.2 The researcher's account was re-activated. The researcher created a new project by clicking the icon New Project on the top left hand corner.

5.3 **A dialogue box pops-out, with the following fields to fill; project title, project purpose, project notes (optional) and project creation option.**

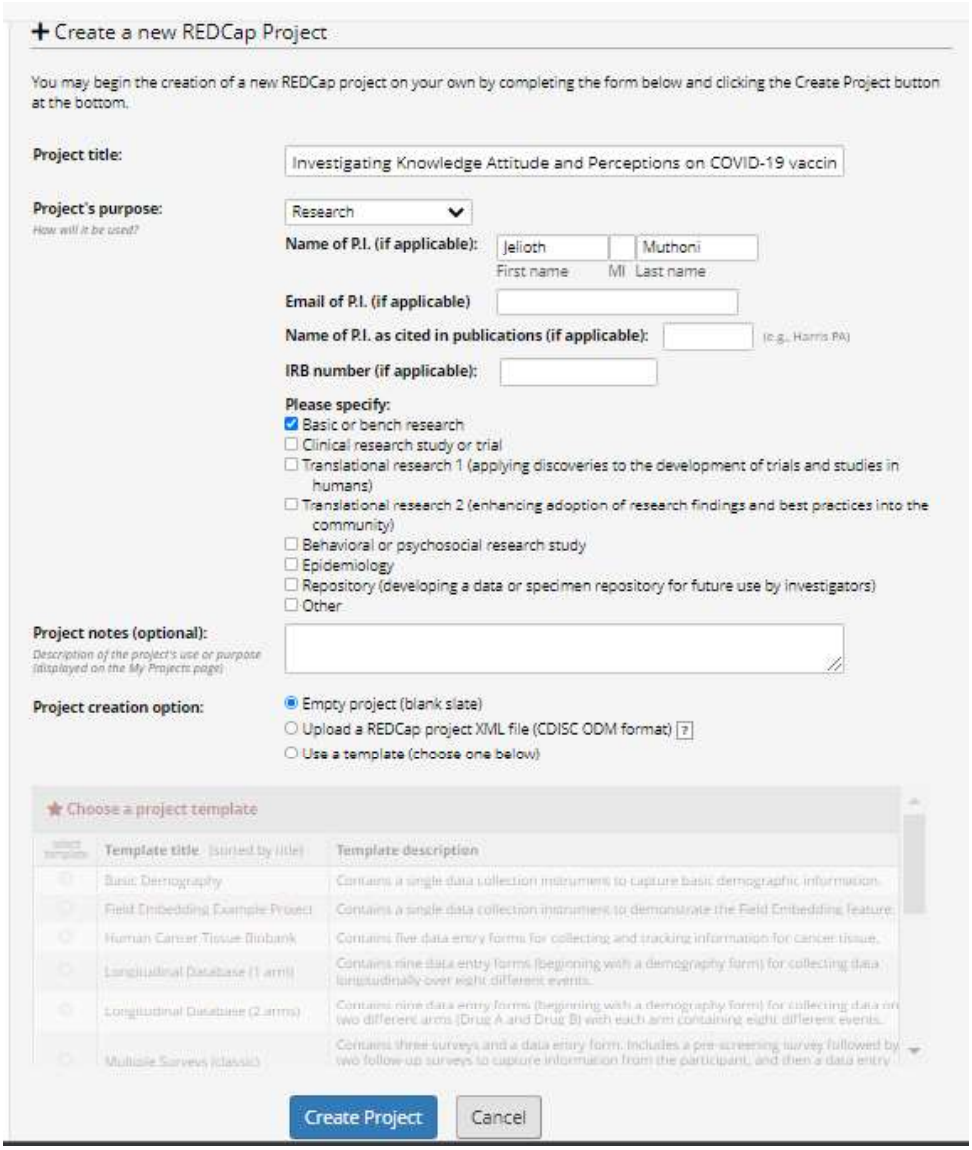
5.4 **The fields were filled as follows:**

Project title: Investigating Knowledge Attitude and Perception of COVID-19 vaccines in Soweto, South Africa

Project's purpose: Research. Fill the name, email of the principal investigator and IRB number if applicable.

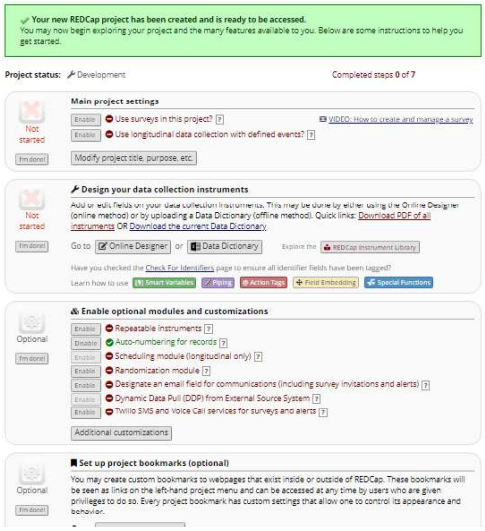
Project notes: Was not filled

Project creation option: Empty project (blank slate) (1)

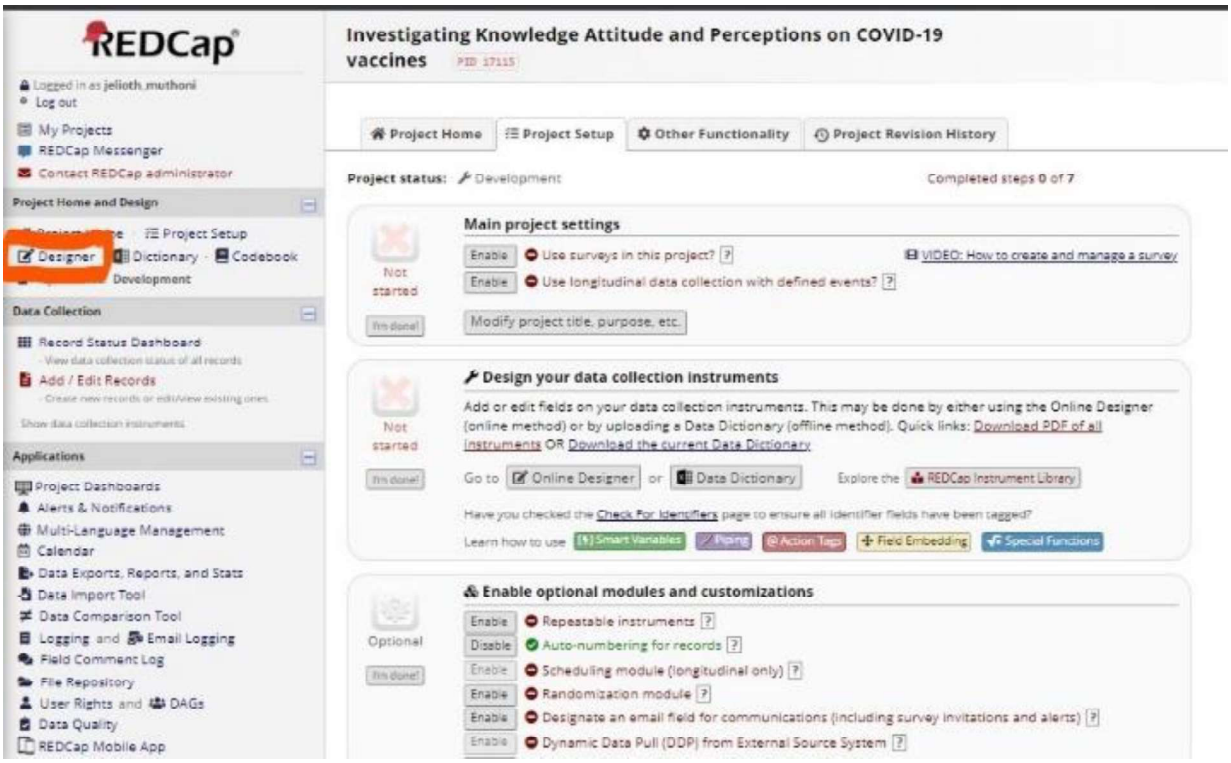


5.5 After filling the fields click Create Project

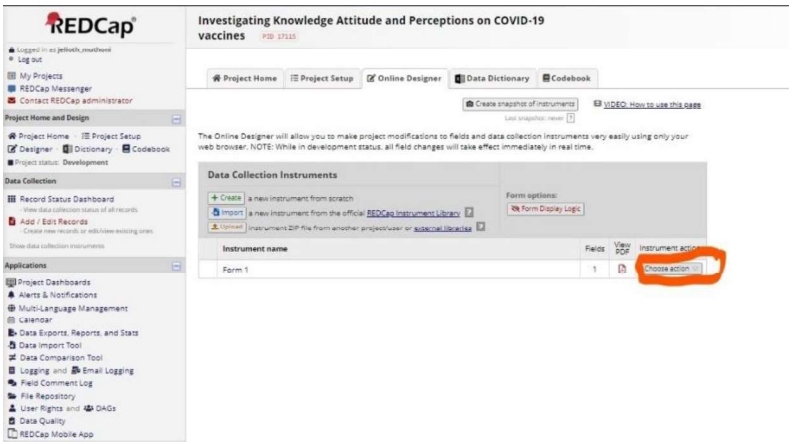
5.6 A green pop-up window will appear, informing of the success of creating a project. Project set up tab is immediately openedafter project creation. This is a checklist of steps that help you create and test your project. The steps can be completed in any order and not all steps are required.



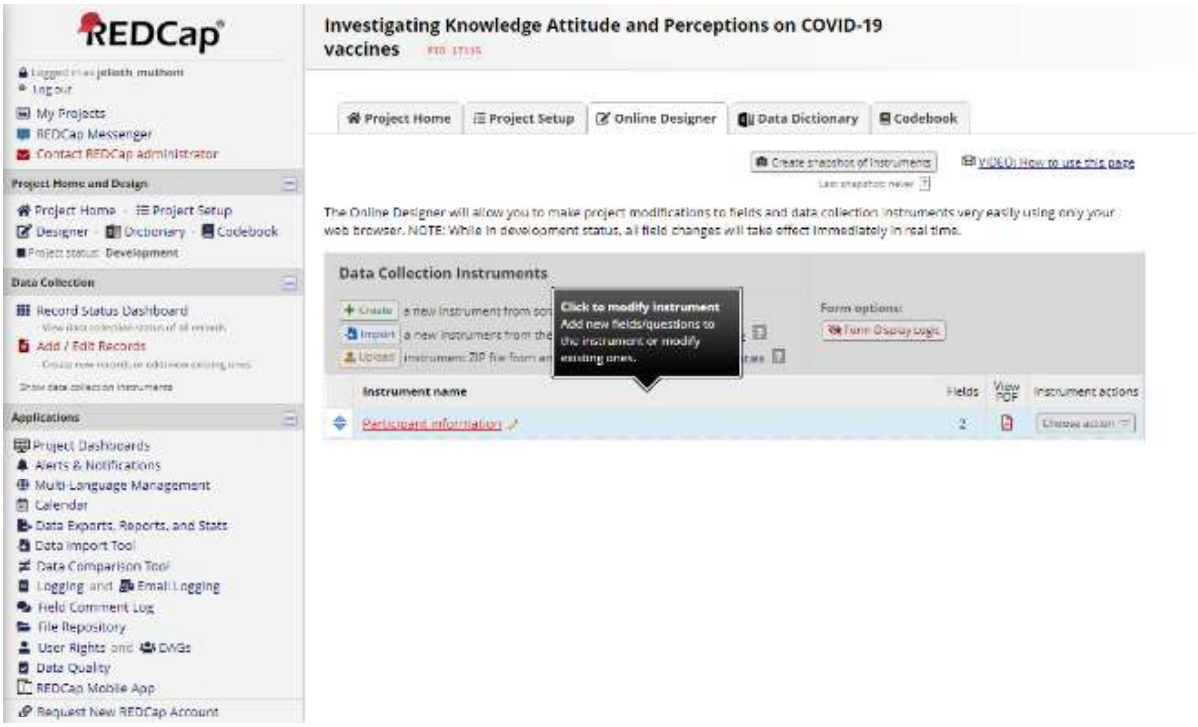
5.7 Under Project set-up click on “Online Designer” to start designing the questionnaire



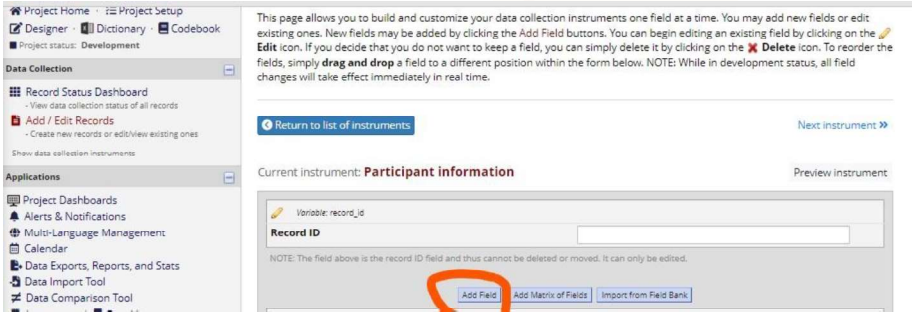
5.8 On the right hand side under instrument actions click choose action.



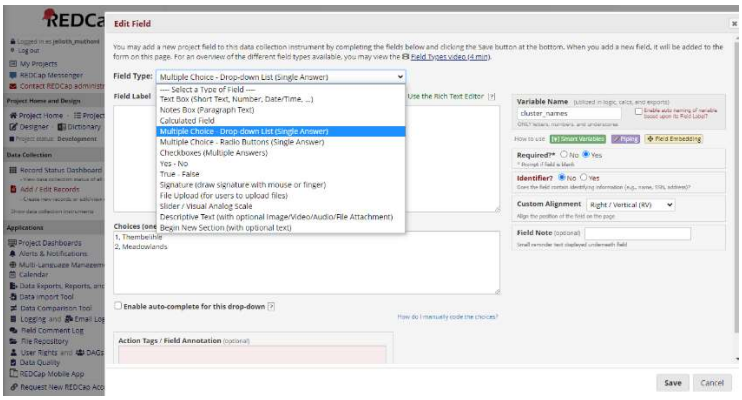
5.9 A drop-down list appears then click on rename option
5.10 Rename your instrument to Participant information and click save
5.11 Click on the Participant information, which is the instrument's name to open the instrument



5.12 Click on **'Add field'** to start adding your fields

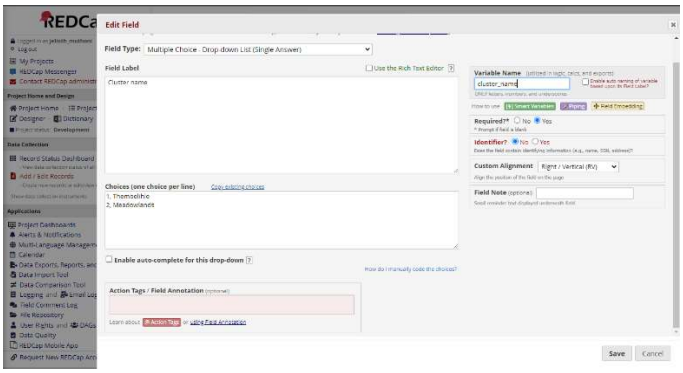


5.13 Select the field type e.g. multiple choice –drop down list (single answer) if you want a single answer e.g. cluster name.

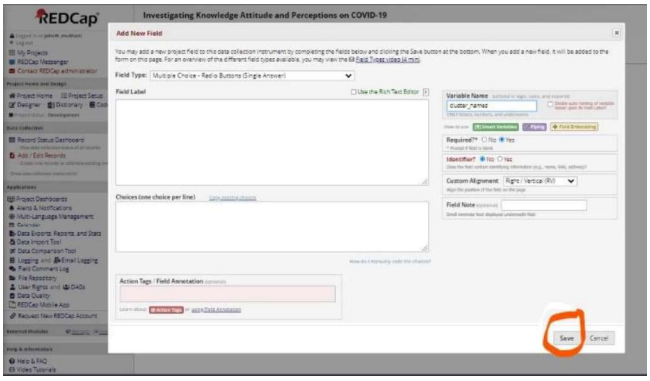


5.14 Type the Field label and variable name e.g. cluster name and under required click 'Yes' meaning the field cannot be left blank.

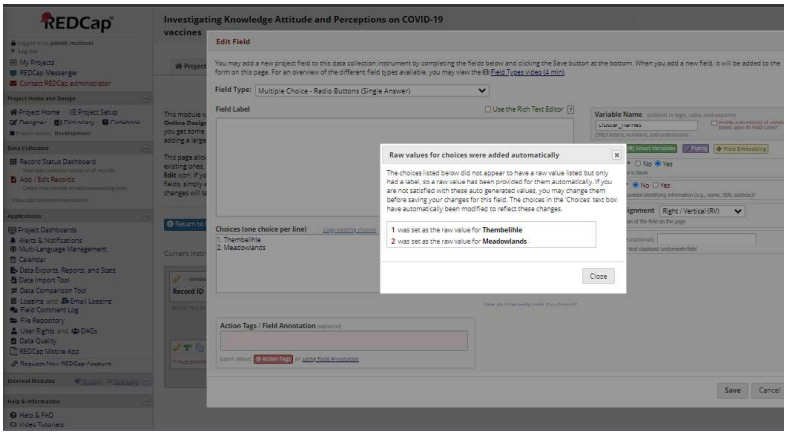
5.15 Under Choice, type the choices of the variable e.g. under cluster name type Thembelile and Meadowlands



5.16 Then click 'Save'



5.17 After saving a pop-up window will appear asigning the options raw values. From our example Thembelile is raw value = 1 while Meadowlands is raw value = 2. Click on close then click save.

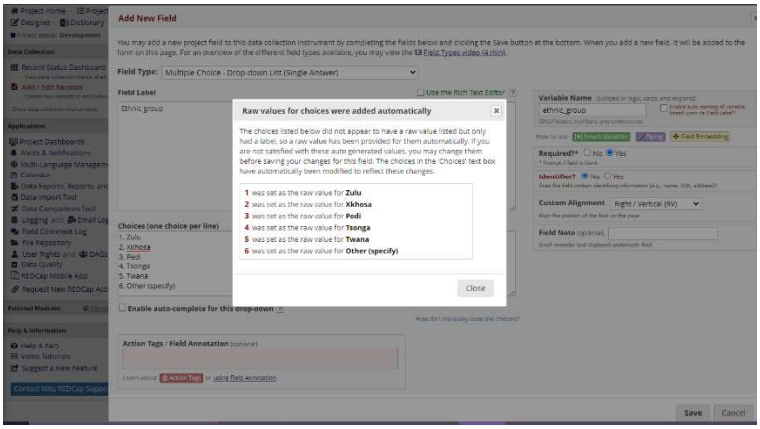


5.18 Follow the same produce to add other fields under participant information. Appropriately assign the correct field type per field name.

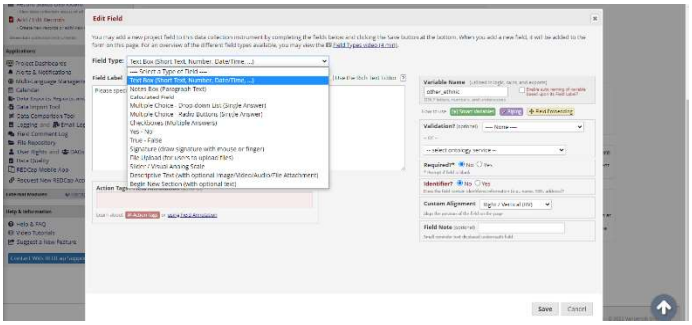
Branching logic

Branching logic are used when a certain field should appear only when a certaincondition is true.

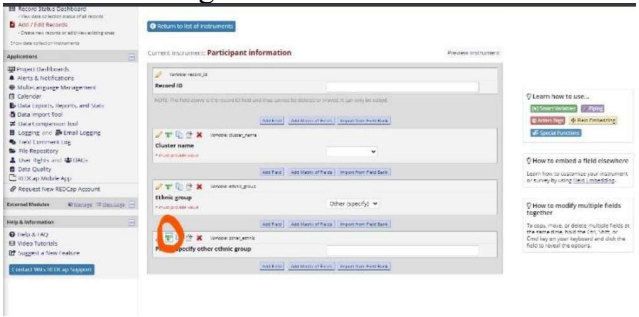
5.19 For example after creating Ethnic group as a field name and listing all ethnic groups that you know, in the list you can have **other**. Other option will be selected if the participant ethnic group is not listed.



5.19 Create a new field after Ethnic group
5.20 Name the field label as ‘Please specify other ethnic group’
5.21 Field type select ‘Text box’ and variable name as other_ethnic

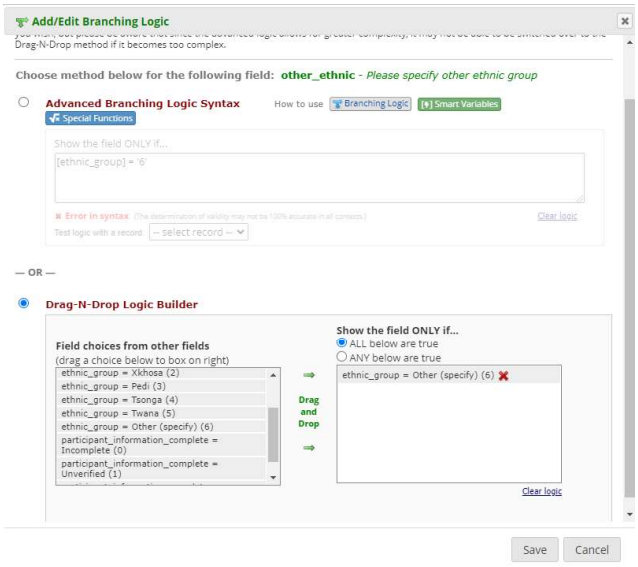


5.22 Click save
5.23 Click on the branching logic icon on the “Please specify other ethnic group’ field as shown in the diagram below.



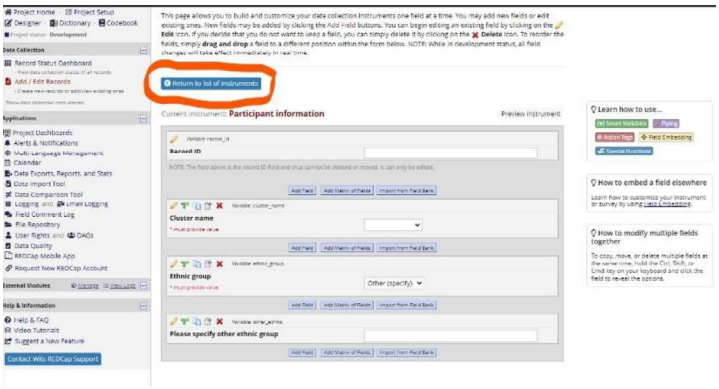
5.24 Select drag and drop logic builder

5.25 Drag and drop 'ethnic_group=other' to the next window, as illustrated in the diagram below

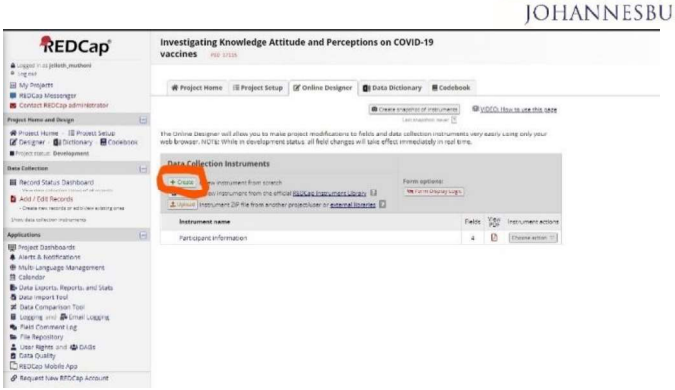


5.26 Click save

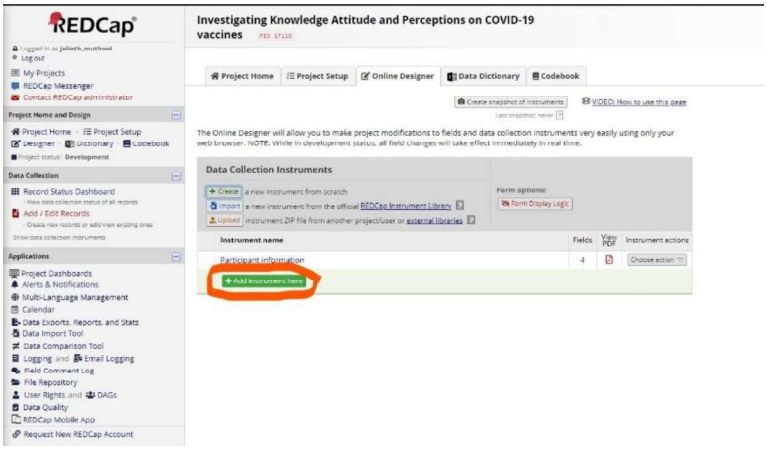
5.27 After creating all the fields, click on 'Return to list of instruments'



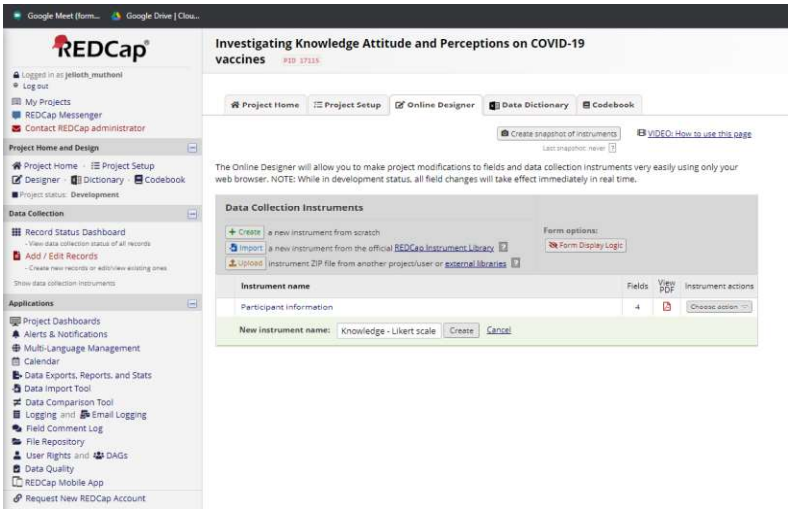
5.28 Create another instrument by clicking 'create' under data collection instruments



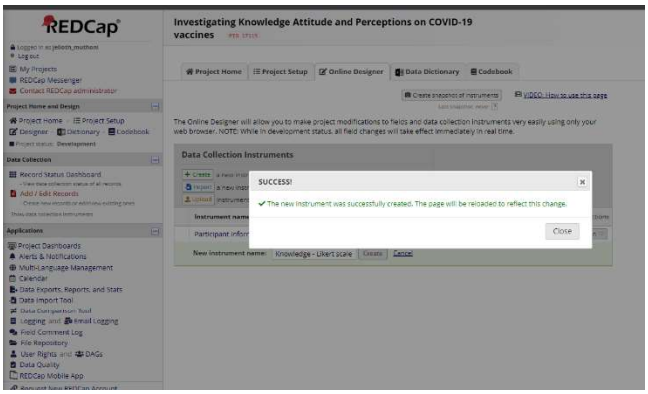
5.29 Click on 'Add instrument here'



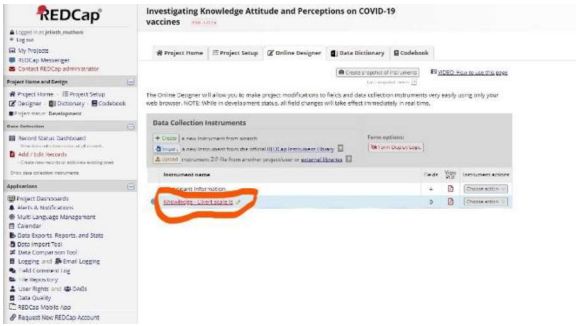
5.30 Name the new instrument Knowledge- Likert scale and click create, being the first objective



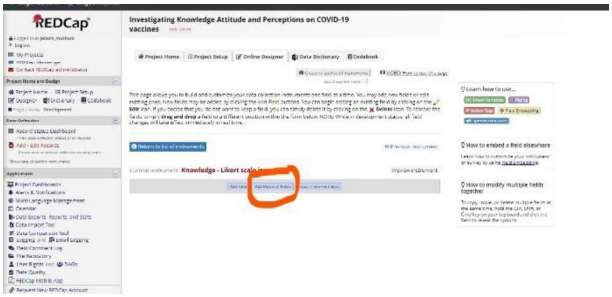
5.31 You will receive a notification that the instrument has been successfully created. Click close.



5.32 Click on the new instrument



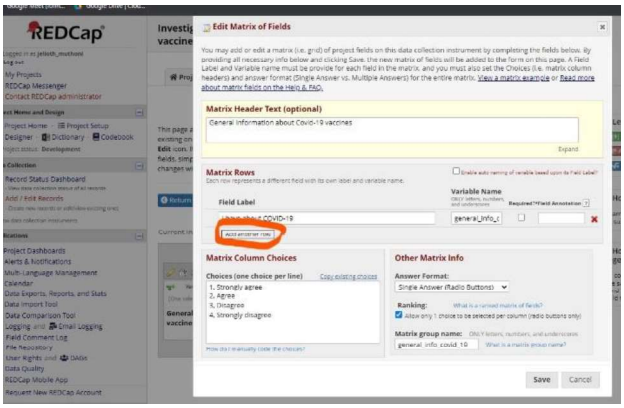
5.33 Click on 'Add Matrix of fields' as shown in the diagram below



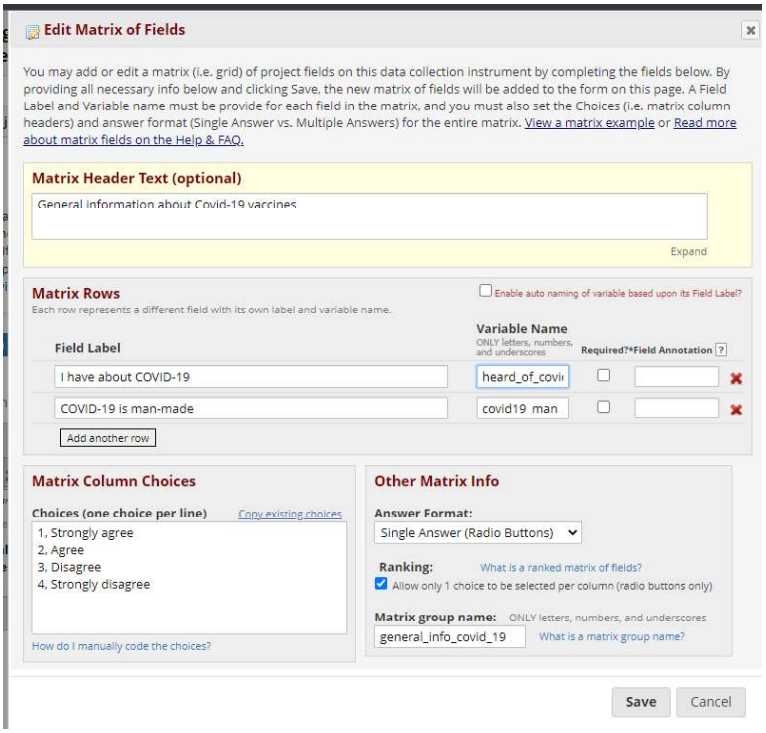
5.34 Type in the Matrix header text - 'General information about Covid-19 vaccines'
5.35 Under field label, type in the field names you want to enter e.g 'I have heard about COVID-

19' and under variable name type 'general_info_covid'

5.36 Add another row to add another field label. E.g. name the field label as '

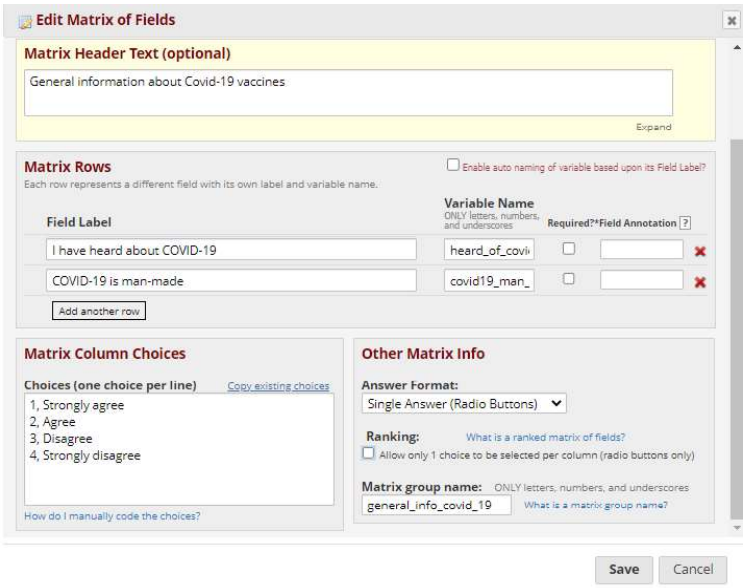


5.37 Name the field label e.g. COVID-19 is man-made and type in the variable name as covid-19 man-made



5.38 You can add more field labels as you desire

5.39 Under choices (one choice per line) type strongly agree, agree, disagree, and strongly disagree and provide the matrix group name as 'general info covid-19' as shown in the diagram below



5.40 Click save

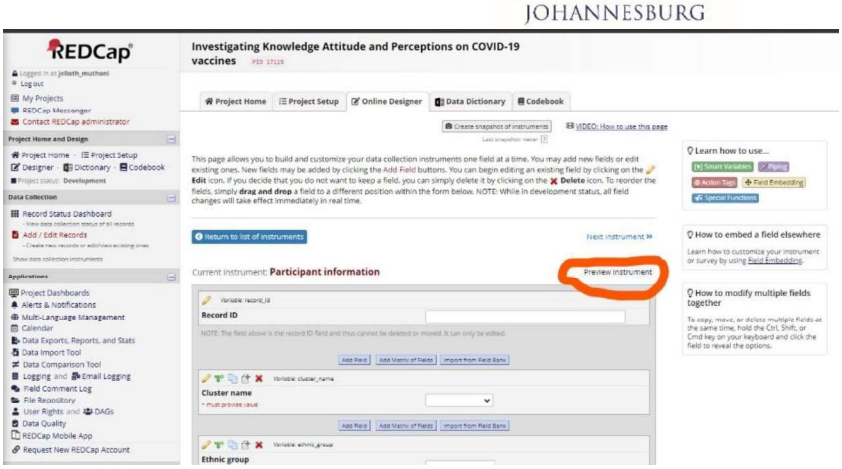
5.41 To have different sections e.g on

- Knowledge of COVID-19 disease
- Vulnerable group
- Transmission
- Prevention strategies
- Vaccines

Repeat the same procedure from 5.33 to 5.38

5.42 Repeat the same procedure from 5.30 to 5.38 for the other two objects on Attitudes and **Perceptions**

5.44 Under each created instrument, click on preview instrument. This is to enable you to see how the instrument will appear when collecting data.



6 Testing the tool

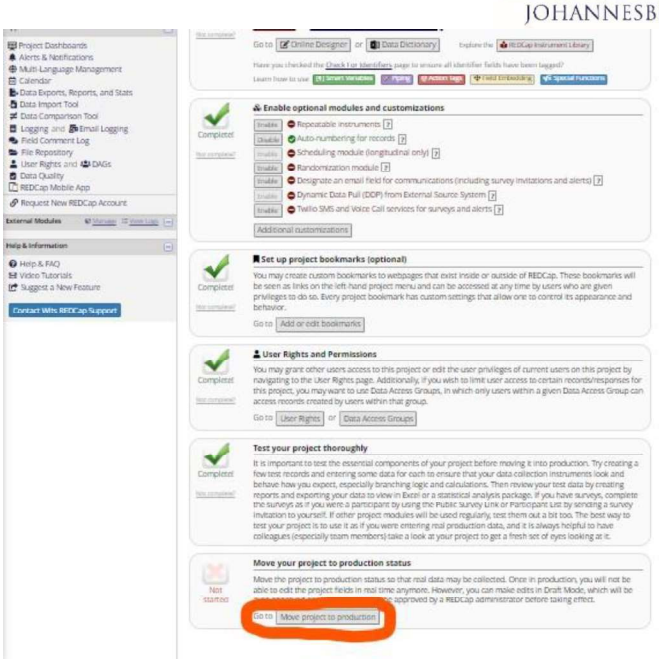
6.1 Click on 'add/edit records' and add new record to test your tool.

6.2 Enter dummy data to ensure all fields are working accordingly. Adjust accordingly, if there is need to.

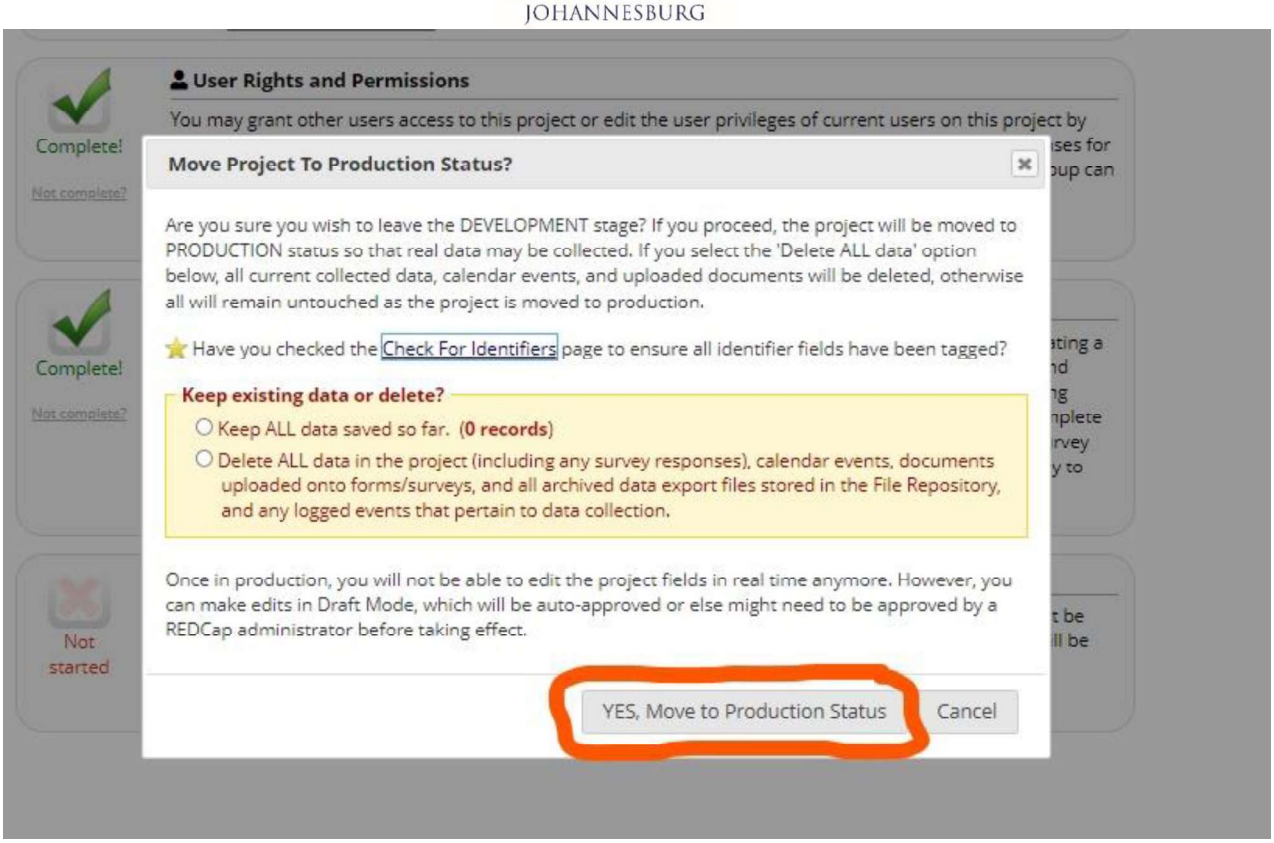
Moving the Project to Production Status

6.3 After thoroughly testing the project. Then move the project to production. Click on 'move project to production'

The project is moved to production so that real data is collected. When the project is in production, it gives a summary of any change that will be made in the project e.g changes that a field is added, removed or modified. Any changes made will not happen in real-time until a REDCap administrator approves the changes. This protects the data from corruption or deletion.



6.4 Click on ‘Keep all data saved so far’ or ‘Delete all data in the project’ then Click ‘YES, Move to Production Status.’



7 REDCap Mobile App

7.1 REDCap Mobile App is a complementary offline data collection tool, accessible on mobile devices.

7.2 Once a project is downloaded on a Mobile App, data can be entered offline. Offline data entry does not change how online users work with REDCap. While data is being entered on the Mobile App offline, the online version of the project continues to work as usual, including data entry.

7.3 Offline data is collected and stored on the mobile devise.

7.4 When the internet connectivity is reliable, offline data can be synced from the devise back to the online REDCap project. This is called synchronization.

7.5 Three tablets will be used as data entry mobile devices in this study.

7.6 REDCap Mobile App can only be used with the online version of REDCap

7.7 The REDCap Mobile App can be downloaded on the mobile devices. This is called the Set-up step. It creates a copy of the project on the mobile devise.

7.8 Click on the REDCap Mobile App on the left-hand side under applications.

Setting-up the Mobile project

7.9 Click on 'REDCap Mobile App' and then click on set up project tab.

7.10 To start the application on the tablet or any devise is to download the REDCap Mobile

App on that devise on Google play store and install

7.11 Go back to the REDCap mobile app (on the online version), then set up projects on the devices

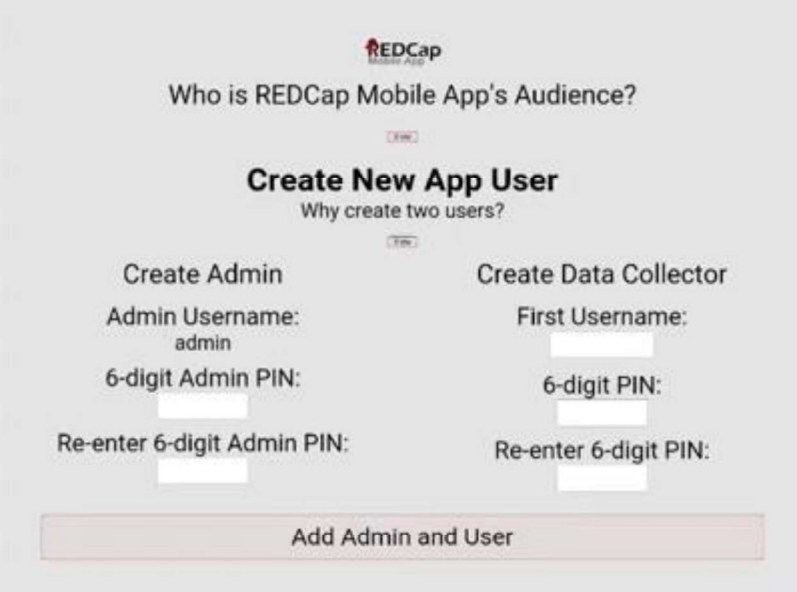
7.12 Open the mobile app, agree to the license terms for the mobile application.

7.13 Then create an administrator and a first data collector username and password

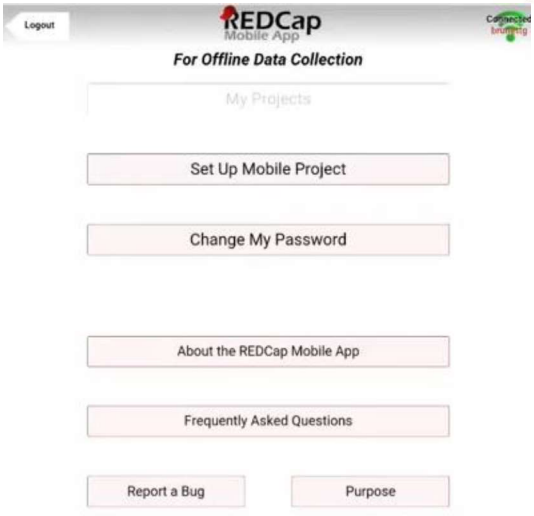
7.14 Then click add admin and user

7.15 Once this is done, you will click on 'Set up Mobile Project' it will ask you to set the project on the devise using either a code or a QR code

7.16 You will first need to generate an API token key on 'Set up project tab'. There will be a box asking for you to request an API token. You'll have to click on that and the QR code will be generated.



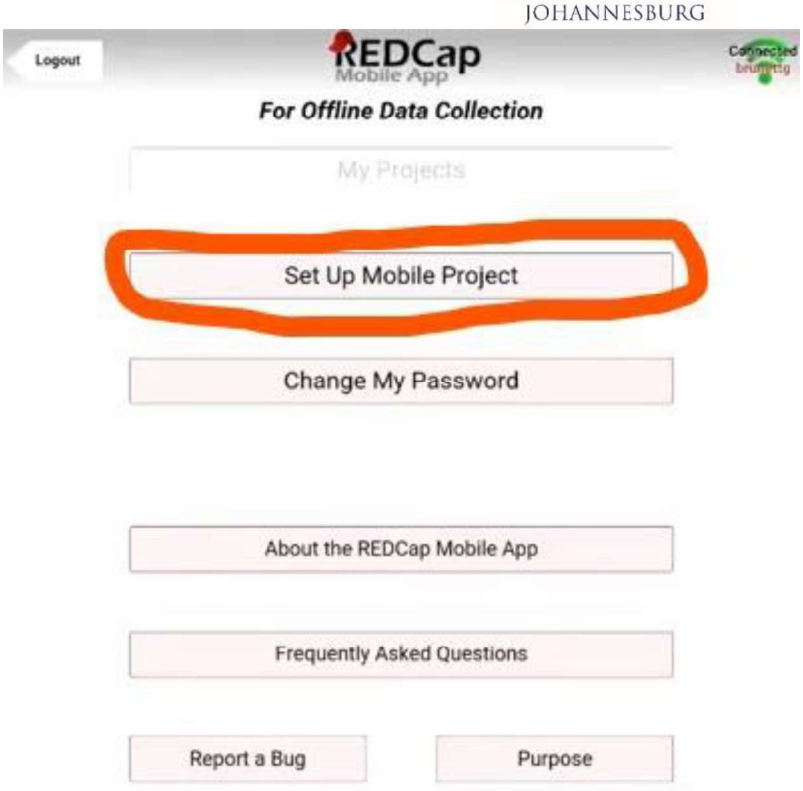
7.17 The figure below will be the first screen when you log in



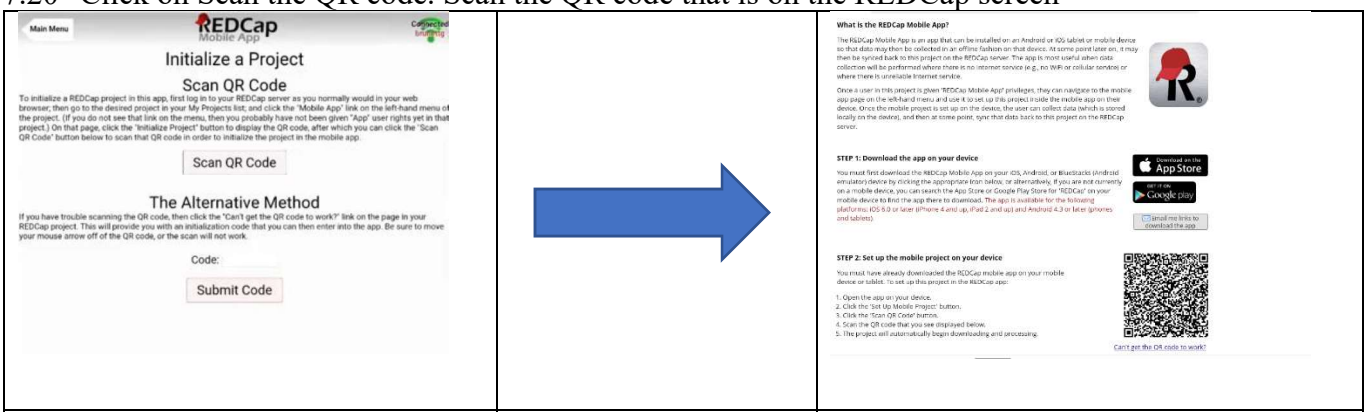
Initializing a project

7.18 To initialize the project you must be connected to the internet

7.19 Click on Set Up Mobile Project

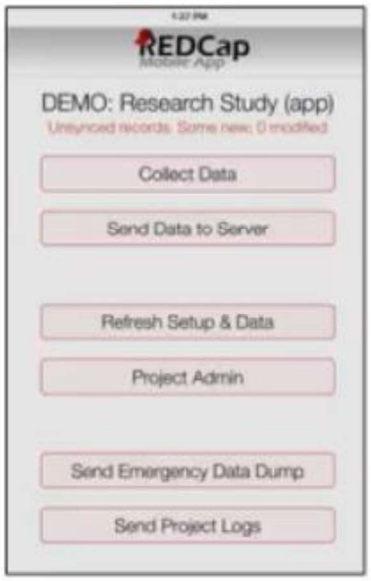


7.20 Click on Scan the QR code. Scan the QR code that is on the REDCap screen



7.21 Click on the project to complete the downloading of the prohect. Click on either of the three or two options, depending on whether there is already existing data

7.22 At this point the project is set up and you can:
Collect data on the project
Send data to server
Refresh Setup & Data
Log into the administrator page
Send Emergency Data Dump, when sending data to server is unsuccessful
Send Project Logs to REDCap

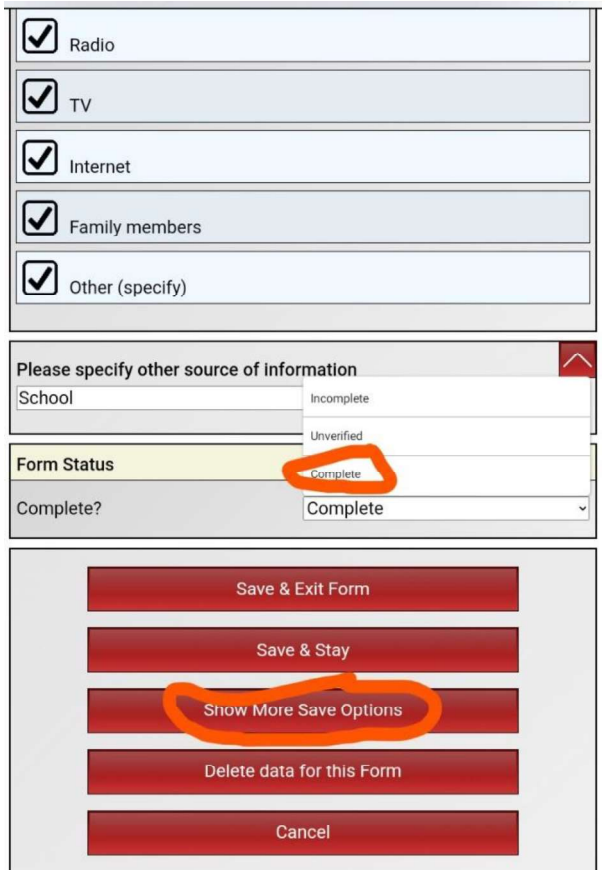


Collecting Data

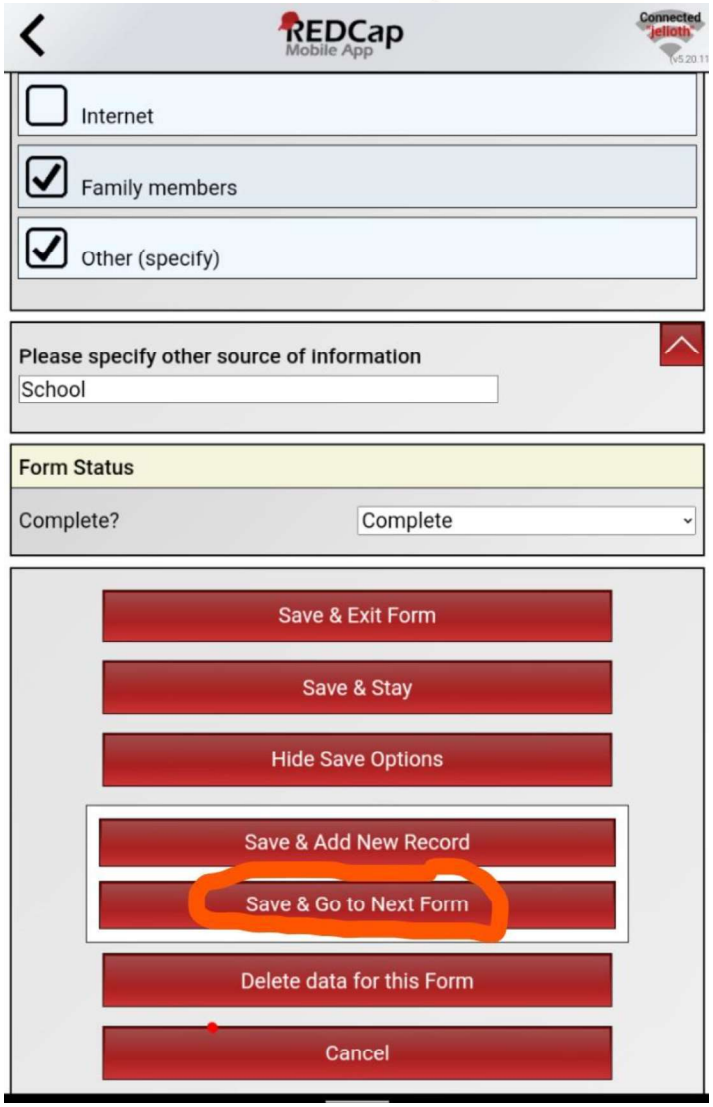
7.23 Click on collect data
7.24 Click on the instrument you want to collect data from. Begin with the participant's information

7.25 After completing participant's information, under form status click on "Complete" – meaning all the required fields have been filled.

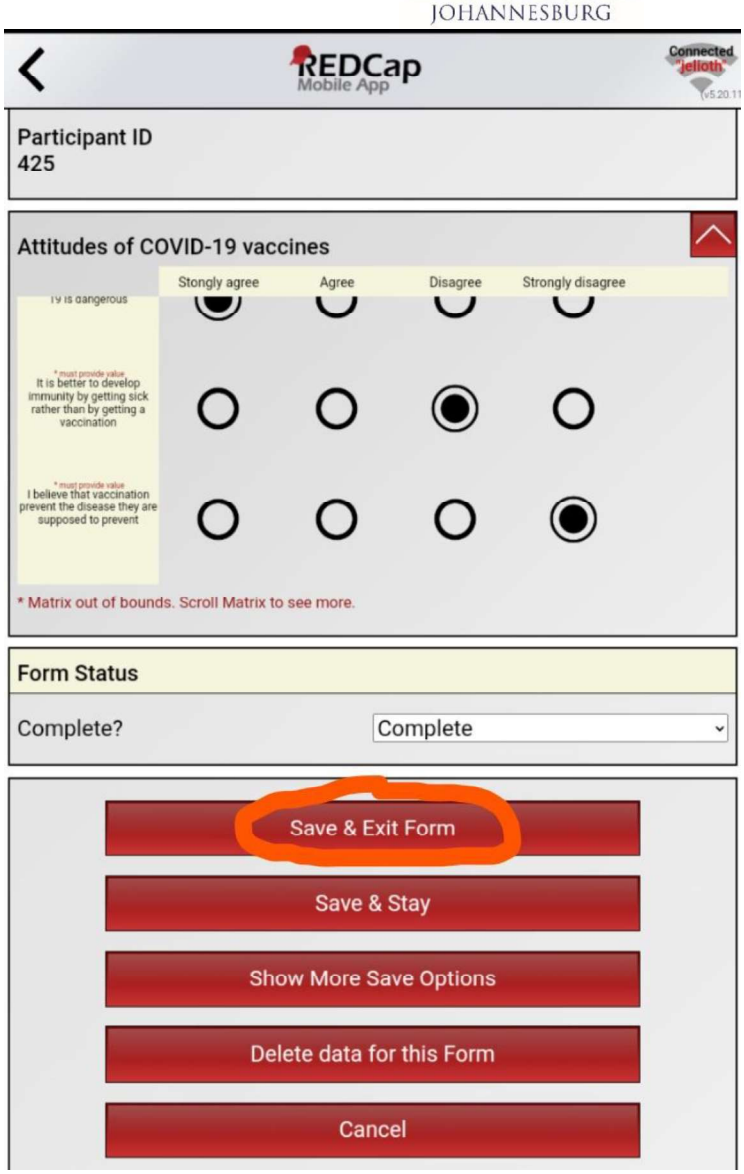
7.26 Click Show more save options



7.27 Click on Save & Go to Next Form. This will take you to Likert scale Knowledge of Covid-19 disease

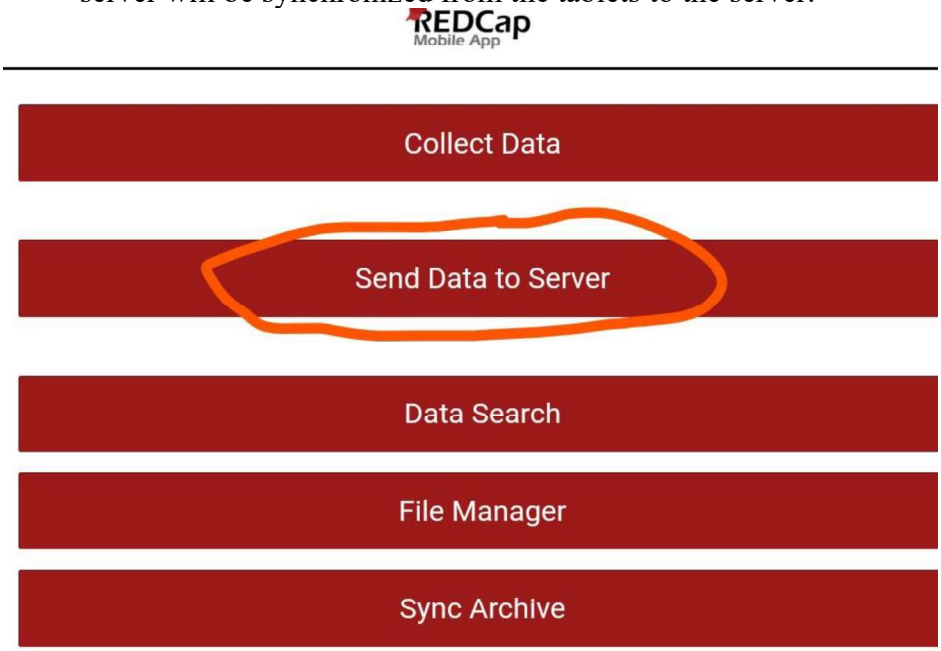


7.28 Repeat 7.21 to 7.23 for the other two Likert scales. However, the last Likert scale on Attitudes instead of clicking on 'Save & Go to Next Form' click on 'Save & Exit form.'



7.29 After data collection of that particular day, click on 'Send Data to Server.' Data sent to

server will be synchronized from the tablets to the server.

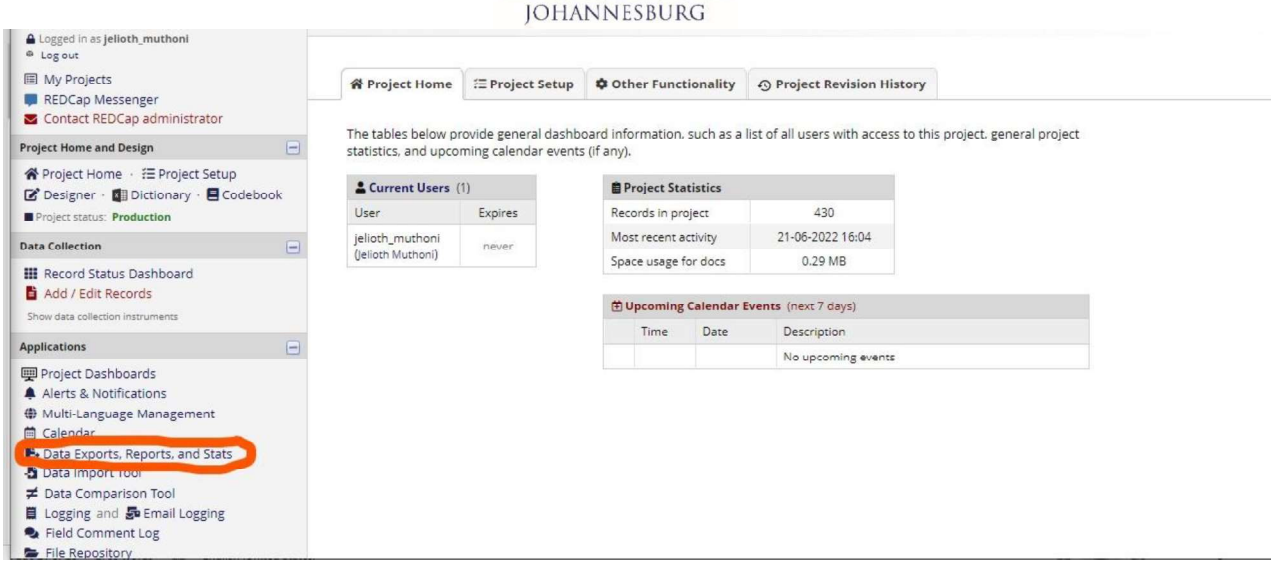


7.30 After sending data to server, click on Refresh Setup & Data, for the REDCap Mobile app to download the latest data dictionary from the server and delete all records on the Mobile app.

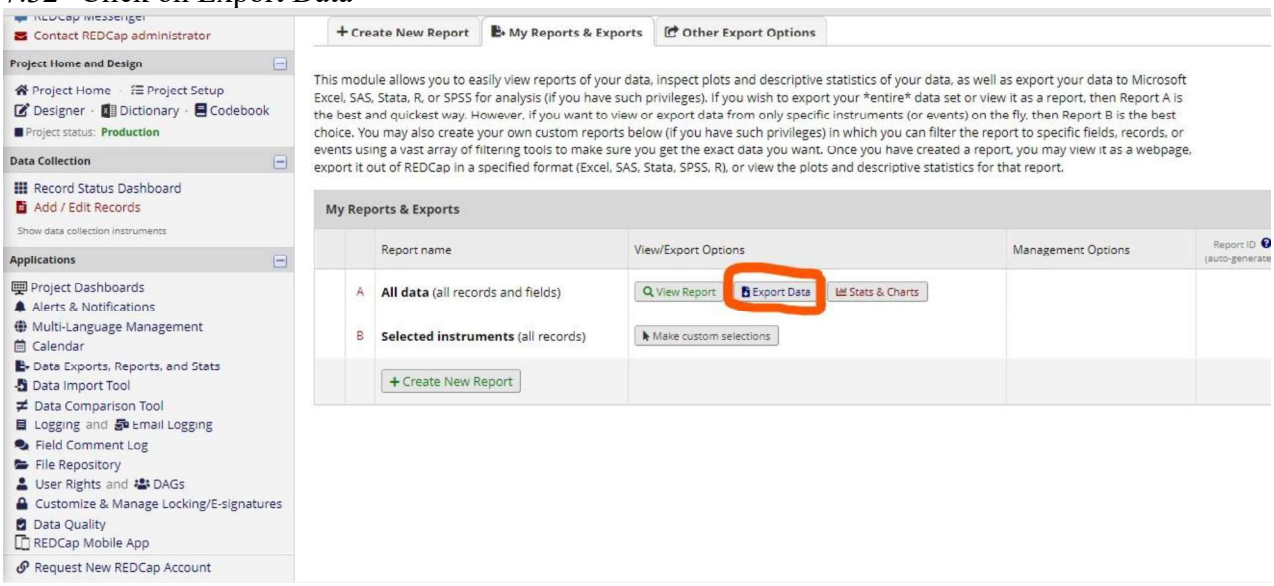
Exporting Data

We need data Export tool when you want to retrieve your data, for back-up or data analysis. REDCap is a data capture tool thus not used for data analysis.

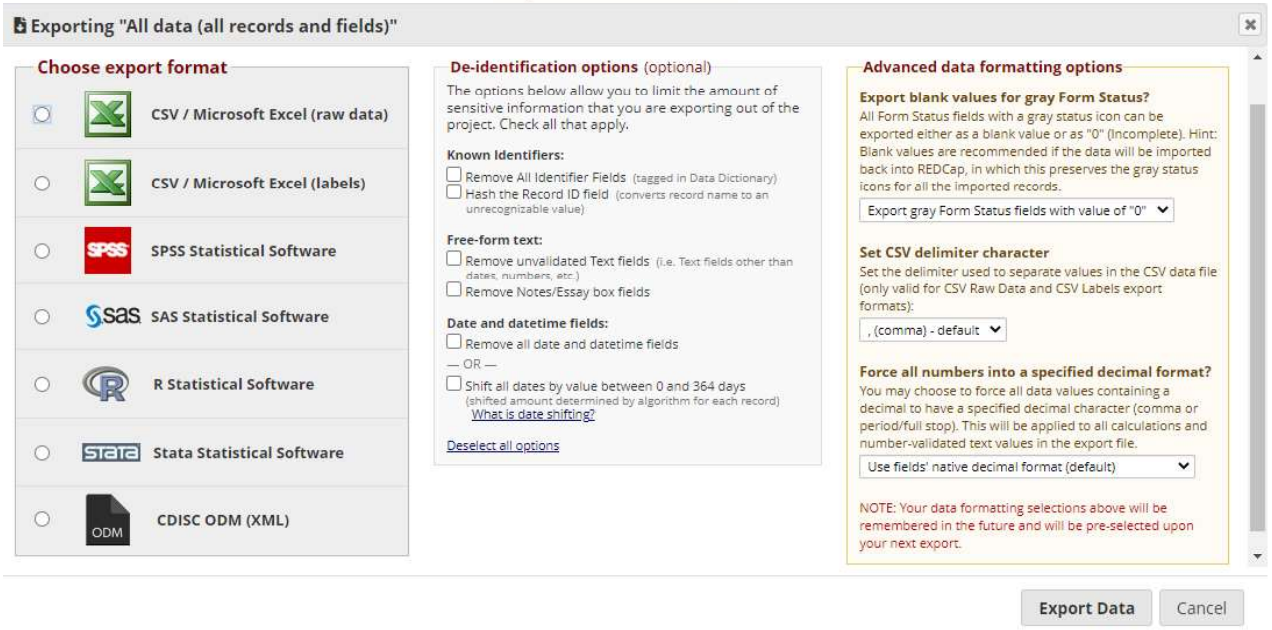
7.31 Click on the 'Data Exports, Reports, and Stats that is located on the left hand side



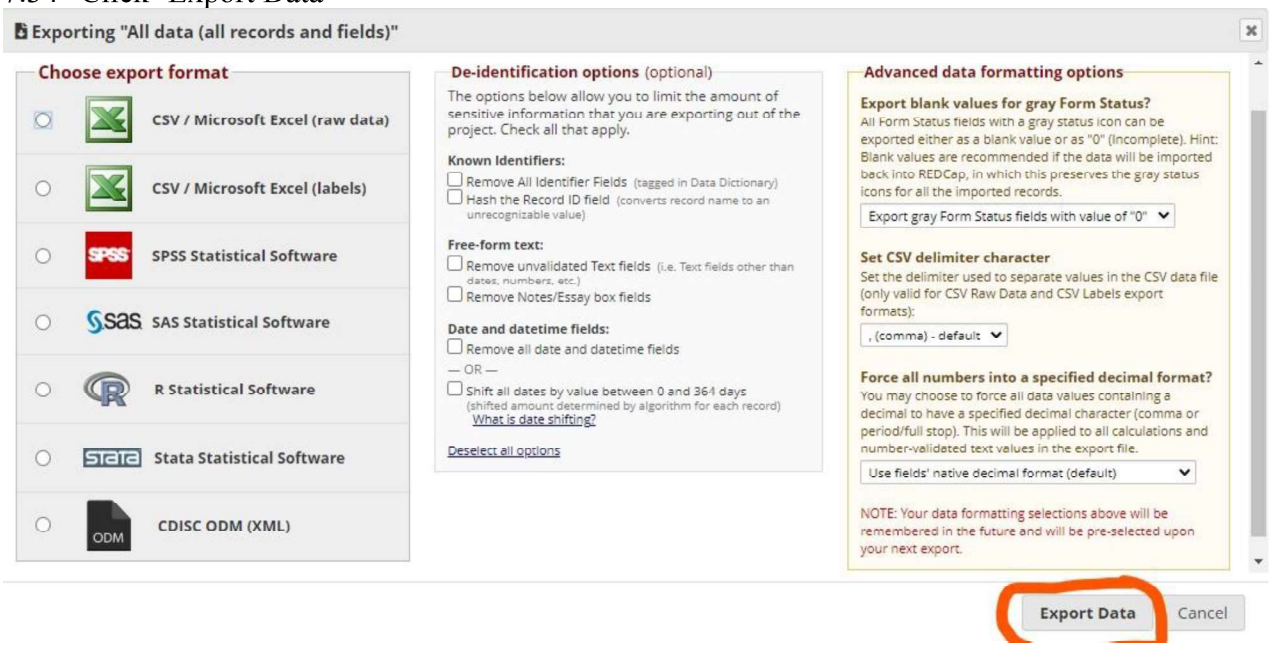
7.32 Click on Export Data



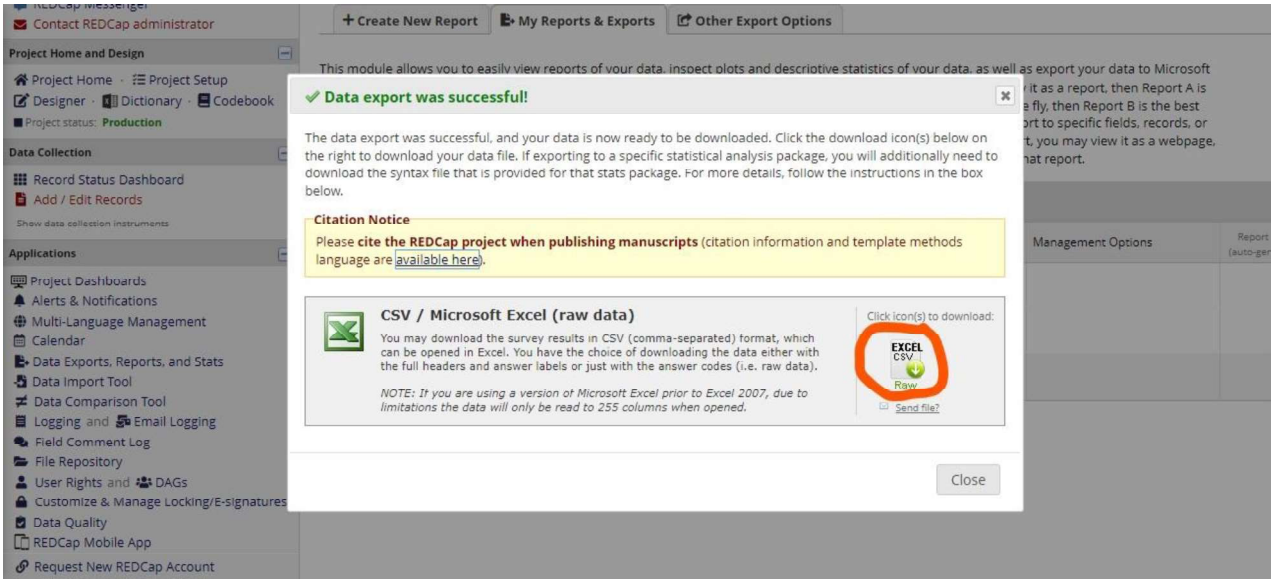
7.33 Choose the appropriate Export format



7.34 Click 'Export Data'



7.35 Click on the icon to download



7.36 Save the file in your desired destination (2)

8 **References**:

1. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, et al. The REDCap consortium: Building an international community of software platform partners. J Biomed Inform [Internet]. 2019;95(April):103208. Available from: https://doi.org/10.1016/j.jbi.2019.103208
2. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)-A metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform [Internet]. 2009;42(2):377–81. Available from: http://dx.doi.org/10.1016/j.jbi.2008.08.010

7. Forms and Appendices:

Form or Appendix Number	Title
Appendix I	Training Documentation Log for SOP

8. Version Table:

Version1: Title: **Investigating Knowledge Attitude and Perception of COVID-19 vaccines in Soweto, South Africa**	Dated: April 2022	No. Pages:29

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

TITLE: Investigating knowledge, attitudes and perceptions of COVID-19 vaccines of young people in Soweto, South Africa

APPENDIX: VIII

QUESTIONNAIRE

SECTION A

1. Cluster name:

- ☐ Soweto-Thembelihle
- ☐ Meadowlands Zone 4

Biographical information

2. Gender

- ☐ Male
- ☐ Female

3. Age in years…….

4. Ethnic group

- ☐ Zulu
- ☐ Xhosa
- ☐ Pedi
- ☐ Tsonga
- ☐ Venda
- ☐ Tswana
- ☐ Sesotho
- ☐ Coloured
- ☐ Other (specify)……

5. Highest level of education

- ☐ No formal education
- ☐ Primary education
- ☐ Some high school (did not complete)
- ☐ Grade 12/Matric
- ☐ Some tertiary (did not complete)
- ☐ Tertiary (college, university, tvet)

6. Current activity status (can choose more than one)

- ☐ Employment full-time
- ☐ Employed part-time
- ☐ Unemployed
- ☐ Self-employed
- ☐ Volunteer work

- Studying
- Other (specify)…….

7. Marital status

- Never married
- Once married
- Married
- Divorced
- Other (specify)……

8. Religion

- Roman Catholic Church
- Evangelic Charismatic
- African Independent Church (ZCC, Shembe, Apostolic)
- Christian protestant
- Muslim
- African traditional
- Other (specify)……

9. Have you spent the majority of the last 4 months residing here?

- Yes
- No

10. Are you currently pregnant

- Yes
- N**o**

11. Who is the head of the household?

- Myself
- My father
- My mother
- My brother
- My sister
- My aunt
- My uncle
- Other (specify)……

12. How many household members do you live with?

- 1-5
- 6-10

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TITLE: Investigating knowledge, attitudes and perceptions of COVID-19 vaccines of young people in Soweto, South Africa

- 11-15
- Other (specify)……

13. Do you have an elderly (above 60 years) person in the household?

- Yes
- No

14. What is your source of information?

- Friends
- Healthcare workers
- Radio
- TV
- Internet
- Family members
- Other (specify)…….

SECTION B (put X in the box or boxes you agree with)

1. Knowledge on COID-19 vaccines

		Strongly agree	Agree	Disagree	Strongly disagree
	General				
1.	I have heard about COVID-19				
2.	COVID-19 is a hoax				
3.	COVID-19 came from China				
4.	COVID-19 is caused by a bacteria				
5.	COVID-19 is caused by a virus				
6.	COVID-19 is a contagious disease				
7.	COVID-19 it's a flu				
8.	You can heal from COVID-19				

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	COVID-19 disease				
9.	COVID-19 disease should be confirmed by a test				
10.	Testing sites for COVID-19 are easily available				
11.	Fever is a symptom of COVID-19				
12.	Cough is NOT a symptom of COVID-19				
13.	Sore throat is a symptom of COVID-19				
14.	Body pain is a symptom of COVID-19				
15.	Diarrhoea or constipation is a symptom of COVID-19				
16.	Headache is a symptom of COVID-19				
17.	Loss of taste and smell is NOT associated with COVID-19				
18.	In suspecting infection with COVID-19, primarily I will measure fever				
19.	In suspecting infection with COVID-19, primarily I will visit a physician				
	Vulnerable group				
20.	Young people are at risk of COVID-19				
21.	Old people are at risk of COVID-19				
22.	I should avoid unnecessary daily activities when I have COVID-19				
23.	People with co-morbidities are at risk of COVID-19				

24.	People with disabilities are at risk of COVID-19				
25.	The disease is more dangerous in pregnant women				
	Transmission				
26.	The disease can be transmitted directly through cough				
27.	COVID-19 can be transmitted through saliva droplets				
28.	The disease can be transmitted directly through contact with infected surfaces				
29.	The disease can be transmitted directly through the consumption of contaminated dairy and meat				
	Prevention strategies				
30..	To avoid contracting COVID-19, I avoid contact with individuals suspected to be infected with COVID-19				
20.	Washing hands with water and soap can eliminate the disease cause				
31.	Wearing of mask prevents COVID-19				
32.	There is stigma if someone has COVID-19				
33.	Sanitizing of hands help prevent COVID-19				
34.	Opening windows thus keeping a room ventilated help in preventing transmission of CIVID-19				

35.	Home-made/traditional remedies help in the cure for COVID-19				
36.	Testing regularly is important in the prevention of COVID-19				
37.	Maintaining social distance is important in the prevention of COVID-19				
38.	Drinking alcohol is important in the prevention of COVID-19				
39.	Self-isolation distance is important in the prevention of COVID-19				
40.	Disclosing your COVID-19 status is important in the prevention of COVID-19				
	Vaccines				
41.	Currently there is cure for COVID-19				
42.	COVID-19 vaccine is NOT important				
43.	Vaccination sites are easily available				
44.	I would recommend someone to take a vaccine				
45.	Pfizer is better than Johnson and Johnson				
2. Perceptions on COID-19 vaccines					
	General				
47.	It is my opinion that early detection of COVID-19 can improve treatment and outcome				

48.	It is my opinion that COVID-19 can be treated at home				
49.	It is my opinion that health education can help prevent COVID-19				
50.	It is my opinion that COVID-19 is a serious disease				
51.	It is my opinion that COVID-19 can be avoided by proper percussion				
52.	I believe that COVID-19 is curable				
53.	I believe that the awareness of COVID-19 disease in society is sufficient.				
54.	Testing positive for COVID-19 will lead to some negative things happening to me				
55.	My friends are reluctant from getting tested for COVID-19 disease				
56.	I am concerned about my close family and friends getting COVID-19 from me.				
	COVID-19 information				
57.	Information on COVID-19 is NOT easily available				
58.	Information on COVID-19 is easily available BUT not easy to understand				
59.	I trust the information I receive about COVID-19 vaccines and COVID-19 disease				
	COVID-19 vaccine				

60.	I believe that the COVID-19 vaccine can stop me from being infected				
61.	I believe that the COVID-19 vaccine can stop me from getting the severe disease				
62.	COVID-19 vaccine has serious side effects				
63.	My friends are reluctant from receiving for COVID-19 vaccine				
64.	I would you be willing to have your family members (husband, wife, sisters, brothers, children, mother, father, grandparents) receive the vaccine against COVID-19				
65.	I would take a COVID-19 vaccine if I am required to get two shots, with the second shot some weeks after the first shot				
66.	I trust the pharmaceutical industry producing COVID-19 vaccines				
67.	When I get vaccinated I will protect other people in the community				
68.	When I get vaccinated I will protect other people in the community				
69.	COVID-19 is a punishment for immorality or sins in the past				
70.	Quarantining people with COVID-19 is the best way to prevent COVID-19 disease				
3. Attitudes					
71.	I think it's a shame to be COVID-19 positive				
72.	If one of my relatives is COVID-19 positive, I would be willing to take care of him/her				
73.	If my friend is COVID-19 positive, I will continue my friendship with him/her				

74.	If a shopkeeper is COVID-19 positive, I will buy items from him/her				
75.	If a student is COVID-19 positive they should be allowed to continue with their studies, while they are still positive				
76.	If a teacher is COVID-19 positive should be allowed to continue with their teaching, while they are still positive				
77.	I prefer to break contacts from people living with COVID-19 disease				
78.	Hugging or shaking hands with people who are COVID-19 is dangerous				
79.	'It is better to develop immunity by getting sick rather than by getting a vaccination				
80.	I believe that vaccinations prevent the disease they are supposed to prevent				

APPENDIX III: Coding List
Cluster name:

01 = Soweto-Thembelihle

02 = Meadowlands Zone 4

Biographical information

Gender

01 = Male
02 = Female

Age in years…….
Ethnic group

01 = Zulu
02 = Xhosa
03 = Pedi
04 = Tsonga
05 = Venda

06 = Tswana
07 = SeSotho
08 = Coloured
09 = Other (specify)……

Highest level of education

01 = Primary education
02 = Some high school (did not complete)
03 = Grade 12/Matric
04 = Some tertiary (did not complete)
05 = Tertiary

Current activity status (can chose more than one)

01 = Employment full-time
02 = Employed part-time
03 = Unemployed
04 = Self-employed
05 = Volunteer work
06 = Studying
07 = Other (specify)…….

Marital status

01 = Never married
02 = Once married
03 = Married
04 = Divorced
05 = Other (specify)……

Religion

01 = Roman Catholic Church
02 = Evangelic Charismatic
03 = African Independent Church (ZCC, Shembe, Apostolic)
04 = Christian protestant
05 = Muslim
06 = African traditional
07 = Other (specify)……

Have you spent majority of the last 4 months residing here?

01 = Yes
02 = No

Are you currently pregnant

01 = Yes

02 = No

Who is the head of household?

01 = Myself
02 = My father
03 = My mother
04 = My brother
05 = My sister
06 = My aunt
07 = My uncle
08 = Other (specify)……

How many household members do you live with?

01 = 1-5
02 = 6-10
03 = 11-15
04 = Other (specify)……

Do you have an elderly person (above 60 years) in the household?

01 = Yes
02 = No

What is your source of information?

01 = Friends
02 = Healthcare workers
03 = Radio
04 = TV
05 = Internet
06 = Family members
07 = Other (specify)…….

SECTION B (put X in the box or boxes you agree with)

01 = Strongly agree
02 = Agree
03 = Disagree
04 = Strongly disagree

APPENDIX IX

Investigating knowledge attitude and perceptions on COVID-19 vaccines among young people in Soweto, South Africa

DEMOGRAPHIC CHARACTERISTICS

Table 1: Social demographic characteristics

Variable		Frequency(%)
Cluster name	Soweto Thembelihle	180(50)
	Meadowlands	180(50)
Gender	Male	151(39.74)
	Female	229(60.26)
Ethnic group	Black	369(97.11)
	Colored	2(0.53)
	Non-South Africans	9(2.37)
Education	Primary or None	3(0.79)
	Secondary	324(85.26)
	Tertiary	53(13.95)
Marital Status	Not in union	365(96.05)
	In union	15(3.95)
Religion	Roman Catholic Church	21(5.53)
	Evangelic Charismatic	44(11.58)
	African Independent Church	73(19.21)
	Christian protestant	139(36.58)
	Muslim	8(2.11)
	African tradition	75(19.74)
	Other	20(5.26)

Table 2: Additional information on the population's demographic

Variable		**Frequency**
Pregnant	No	209(91.27)
	Yes	20(8.73)
Information source	Family members	64(17.20)
	Friends	9(2.42)
	Healthcare workers	12(3.23)
	Internet	184(49.46)
	Radio	13(3.49)
	TV	90(24.190

Data analysis based on vaccine hesitancy

Table 3: Distribution of responses on social demographic characteristics based on COVID-19 vaccine hesitancy

Variable		**Total**	**Non-hesitancy**	**Hesitancy**
Age	18-24 years	234(61.58)	55(69.62)	179(59.47)
	25-35 years	146(38.42)	24(30.38)	122(40.53)
Gender	Male	151(39.74)	37(46.84)	114(37.87)
	Female	229(60.26)	42(53.16)	187(62.13)
Ethnic group	Black	369(97.11)	79(100.00)	290(96.35)
	Colored	2(0.53)	0(0.00)	2(0.66)
	Non-South Africans	9(2.37)	0(0.00)	9(2.99)
Education	Primary or None	3(0.79)	0(0.00)	3(1.00)
	Secondary	324(85.26)	65(82.28)	259(86.05)
	Tertiary	53(13.95)	14(17.72)	39(12.96)
Marital Status	Not in union	365(96.05)	77(97.47)	288(95.68)
	In union	15(3.95)	2(2.53)	13(4.32)
Religion	Roman Catholic Church	21(5.53)	2(2.53)	19(6.31)
	Evangelic Charismatic	44(11.58)	8(10.13)	36(11.96)
	African Independent Church	73(19.21)	20(25.32)	53(17.61)
	Christian protestant	139(36.58)	27(34.18)	112(37.21)
	Muslim	8(2.11)	1(1.27)	7(2.33)
	African tradition	75(19.74)	18(22.78)	57(18.94)
	Other	20(5.26)	3(3.80)	17(5.65)

Table 2: Additional information on the population's demographic based on COVID-19 vaccine hesitancy

Variable		**Non-hesitancy**	**Hesitancy**	Total

Source of information	Family members	17(22.08)	47(15.93)	64(17.20)
	Friends	3(3.90)	6(2.03)	9(2.42)
	Healthcare workers	1(1.30)	11(3.73)	12(3.23)
	Internet	34(44.16)	150(50.85)	184(49.46)
	Radio	3(3.90)	10(3.39)	13(3.49)
	TV	19(24.68)	71(24.07)	90(24.19)

KNOWLEDGE

Table3: Distribution of knowledge based on COVID-19 vaccine hesitancy

Variable		**Total**	**Non-hesitancy**	**Hesitancy**	**P-value**
1. General					
Have you heard of COVID-19 disease	Strongly agree	103(27.11)	18(22.78)	85(28.24)	0.163
	Agree	250(65.79)	53(67.09)	197(65.79)	
	Disagree	26(6.84)	7(8.86)	19(6.31)	
	Strongly disagree	1(0.26)	1(1.27)	0(0.00)	
COVID-19 is a hoax	Strongly agree	36(9.47)	9(11.39)	27(8.97)	0.011
	Agree	142(37.37)	41(51.90)	101(33.5)	
	Disagree	190(50.00)	27(34.18)	163(54.15)	
	Strongly disagree	12(3.16)	2(2.53)	10(3.32)	
COVID-19 came from China	Strongly agree	93(24.47)	18(22.78)	75(24.92)	0.441
	Agree	215(56.58)	41(51.90)	174(57.81)	
	Disagree	69(18.16)	19(24.05)	50(16.61)	
	Strongly disagree	3(0.79)	1(1.27)	2(0.66)	
COVID-19 is caused by a bacteria	Strongly agree	11(2.89)	0(0.00)	11(3.65)	0.219
	Agree	104(27.37)	19(24.05)	85(28.24)	
	Disagree	246(64.74)	57(72.15)	189(62.79)	
	Strongly disagree	19(5.00)	3(3.80)	16(5.32)	
COVID-19 is caused by a virus	Strongly agree	56(14.74)	8(10.13)	48(15.95)	0.498
	Agree	267(70.26)	58(73.42)	209(69.44)	
	Disagree	55(14.47)	13(16.46)	42(13.95)	

	Strongly disagree	2(0.53)	0(0.00)	2(0.66)	
COVID-19 is a contagious disease	Strongly agree	102(26.84)	21(26.58)	81(26.91)	0.000
	Agree	243(63.95)	41(51.90)	202(67.11)	
	Disagree	31(8.16)	14(17.72)	17(5.65)	
	Strongly disagree	4(1.05)	3(3.80)	1(0.33)	
COVID-19 it's a flu	Strongly agree	73(19.21)	11(13.92)	62(20.60)	0.104
	Agree	262(68.95)	53(67.09)	209(69.44)	
	Disagree	43(11.32)	14(17.72)	29(9.63)	
	Strongly disagree	2(0.53)	1(1.27)	1(0.33)	
You can heal from COVID-19	Strongly agree	64(16.89)	15(18.99)	49(16.33)	0.014
	Agree	256(67.55)	43(54.43)	213(71.00)	
	Disagree	53(13.98)	19(24.05)	34(11.33)	
	Strongly disagree	6(1.58)	2(2.53)	4(1.33)	
2. COVID-19 disease					
COVID-19 disease should be confirmed by a test	Strongly agree	57(15.00)	10(12.66)	47(15.61)	0.020
	Agree	284(74.74)	54(68.35)	230(76.41)	
	Disagree	36(9.47)	13(16.46)	23(7.64)	
	Strongly disagree	3(0.79)	2(2.53)	1(0.33)	
Testing sites for COVID-19 are easily available	Strongly agree	43(11.32)	6(7.59)	37(12.29)	0.002
	Agree	233(61.32)	38(48.10)	195(64.78)	
	Disagree	95(25.00)	32(40.51)	63(20.93)	
	Strongly disagree	9(2.37)	3(3.80)	6(1.99)	
Fever is a symptom of COVID-19	Strongly agree	100(26.32)	18(22.78)	82(27.24)	0.318
	Agree	239(62.89)	48(60.76)	191(63.46)	
	Disagree	38(10.00)	12(15.19)	26(8.64)	
	Strongly disagree	3(0.79)	1(1.27)	2(0.66)	
Cough is a symptom of COVID-19	Strongly agree	107(28.16)	20(25.32)	87(28.90)	0.180
	Agree	228(60.00)	44(55.70)	184(61.13)	
	Disagree	42(11.05)	14(17.72)	28(9.30)	
	Strongly disagree	3(0.79)	1(1.27)	2(0.66)	

Sore throat is a symptom of COVID-19	Strongly agree	102(26.84)	19(24.05)	83(27.57)	0.622
	Agree	227(59.74)	46(58.23)	181(60.13)	
	Disagree	48(12.63)	13(16.46)	35(11.63)	
	Strongly disagree	3(0.79)	1(1.27)	2(0.66)	
Body pain is a symptom of COVID-19	Strongly agree	75(19.74)	11(13.92)	64(21.26)	0.524
	Agree	215(56.58)	49(62.03)	166(55.15)	
	Disagree	85(22.37)	18(22.78)	67(22.26)	
	Strongly disagree	5(1.32)	1(1.27)	4(1.33)	
Diarhoea is a symptom of COVID-19	Strongly agree	30(7.89)	1(1.27)	29(9.63)	0.002
	Agree	104(27.37)	15(18.99)	89(29.57)	
	Disagree	230960.53)	56(70.89)	174(57.81)	
	Strongly disagree	16(4.21)	7(8.86)	9(2.99)	
Headache is a symptom of COVID-19	Strongly agree	81(21.32)	12(15.19)	69(22.92)	0.064
	Agree	238(62.63)	47(59.49)	191(63.46)	
	Disagree	58(15.26)	19(24.05)	39(12.96)	
	Strongly disagree	3(0.790	1(1.27)	2(0.66)	
Loss of taste and smell is associated with COVID-19 disease	Strongly agree	90(23.68)	15(18.99)	75(24.92)	0.029
	Agree	213(56.05)	44(55.70)	169(56.15)	
	Disagree	75(19.74)	18(22.78)	57(18.94)	
	Strongly disagree	2(0.53)	2(2.53)	0(0.00)	
In suspecting infection with COVID-19 I primarily measure fever	Strongly agree	29(7.63)	1(1.27)	28(9.30)	0.000
	Agree	259(68.16)	45(56.96)	214(71.10)	
	Disagree	85(22.37)	30(37.97)	55(18.27)	
	Strongly disagree	7(1.84)	3(3.80)	4(1.33)	
In suspecting infection with COVID-19 I primarily visit a physician	Strongly agree	53(13.95)	2(2.53)	51(16.94)	0.000
	Agree	279(73.42)	55(69.62)	224(74.42)	
	Disagree	42(11.05)	19(24.05)	23(7.64)	
	Strongly disagree	6(1.58)	3(3.80)	3(1.00)	
3. Vulnerable group					
	Strongly agree	61(16.05)	8(10.13)	53(17.61)	0.030

Young people are at risk of COVID-19	Agree	197(51.84)	35(44.30)	162(53.82)	
	Disagree	111(29.21)	33(41.77)	78(25.91)	
	Strongly disagree	11(2.89)	3(3.80)	8(2.66)	
Old people are at risk of COVID-19	Strongly agree	131(34.47)	24(30.38)	107(35.55)	0.208
	Agree	219(57.63)	47(59.49)	172(57.14)	
	Disagree	29(7.63)	7(8.86)	22(7.31)	
	Strongly disagree	1(0.26)	1(1.27)	0(0.00)	
I should avoid unnecessary daily activities when I have COVID-19	Strongly agree	44(11.58)	3(3.80)	41(13.62)	0.024
	Agree	288(75.79)	64(81.01)	224(74.42)	
	Disagree	45(11.84)	10(12.66)	35(11.63)	
	Strongly disagree	3(0.79)	2(2.53)	1(0.33)	
People with comorbidities are more at risk of COVID-19	Strongly agree	92(24.21)	13(16.46)	79(26.25)	0.009
	Agree	238(62.63)	56(70.89)	182(60.47)	
	Disagree	46(12.11)	7(8.86)	39(12.96)	
	Strongly disagree	4(1.05)	3(3.80)	1(0.33)	
People with disability are more at risk of COVID-19	Strongly agree	51(13.42)	9(11.39)	42(13.95)	0.947
	Agree	190(50.00)	40(50.63)	150(49.83)	
	Disagree	130(34.21)	28(35.44)	102(33.89)	
	Strongly disagree	9(2.37)	2(2.53)	7(2.33)	
Pregnant women are more at risk of COVID-19	Strongly agree	72(18.95)	7(8.86)	65(21.59)	0.003
	Agree	231(60.79)	46(58.23)	185(61.46)	
	Disagree	75(19.74)	25(31.65)	50(16.61)	
	Strongly disagree	2(0.53)	1(1.27)	1(0.33)	
4. Transmission					
The disease can be transmitted through a cough	Strongly agree	92(24.21)	10(12.66)	82(27.24)	0.033
	Agree	263(69.21)	61(77.22)	202(67.11)	
	Disagree	23(6.05)	7(8.86)	16(5.32)	
	Strongly disagree	2(0.53)	1(1.27)	1(0.33)	
The disease can be transmitted	Strongly agree	68(17.89)	11(13.92)	57(18.94)	0.482
	Agree	258(67.89)	59(74.68)	199(66.11)	
	Disagree	52(1.68)	9(11.39)	43(14.29)	

through saliva droplets	Strongly disagree	2(0.53)	0(0.00)	2(0.66)	
The disease can be transmitted directly by touching infected surfaces	Strongly agree	83(21.84)	11(13.92)	72(23.92)	0.008
	Agree	260(68.42)	53(67.09)	207(68.77)	
	Disagree	33(8.68)	13(16.46)	20(6.64)	
	Strongly disagree	4(1.05)	2(2.53)	2(0.66)	
The disease can be transmitted directly through the consumption of contaminated dairy and meat	Strongly agree	25(6.58)	2(2.53)	23(7.64)	0.030
	Agree	116(30.53)	19(24.05)	97(32.23)	
	Disagree	199(52.37)	44(55.70)	155(51.50)	
	Strongly disagree	40(10.53)	14(17.72)	26(8.64)	
5. Prevention strategies					
To avoid contracting COVID-19, I avoid contact with individuals suspected to be infected with COVID-19	Strongly agree	64(16.84)	8(10.13)	56(18.60)	0.109
	Agree	255(67.11)	56(70.89)	199(66.11)	
	Disagree	49(12.89)	10(12.66)	39(12.96)	
	Strongly disagree	12(3.16)	5(6.33)	7(2.33)	
Washing hands with water and soap can eliminate the disease cause	Strongly agree	100(26.63)	15(18.99)	85(28.24)	0.017
	Agree	250(65.79)	52(65.82)	198(65.78)	
	Disagree	27(7.11)	10(12.66)	17(5.65)	
	Strongly disagree	3(0.79)	2(2.53)	1(0.33)	
Wearing of mask prevents COVID-19	Strongly agree	103(27.110	15(18.99)	88(29.24)	0.001
	Agree	240(63.16)	47(59.49)	193(64.12)	
	Disagree	30(7.89)	13(16.46)	17(5.65)	
	Strongly disagree	7(1.84)	4(5.06)	3(1.00)	
Sanitizing of hands help prevent COVID-19	Strongly agree	111(29.21)	15(18.99)	96(31.89)	0.001
	Agree	243(63.95)	51(64.56)	192(63.79)	
	Disagree	23(6.05)	11(13.92)	12(3.99)	
	Strongly disagree	3(0.79)	2(2.53)	1(0.33)	
Opening windows thus keeping a room ventilated help in	Strongly agree	103(27.11)	15(18.99)	88(29.24)	0.002
	Agree	239(62.89)	49(62.03)	190(63.12)	
	Disagree	36(9.47)	13(16.46)	23(7.64)	

preventing transmission of COVID-19	Strongly disagree	2(0.53)	2(2.53)	0(0.00)	
Home-made/traditional remedies help in the cure for COVID-19	Strongly agree	75(19.74)	20(25.32)	55(18.77)	0.284
	Agree	170(44.74)	35(44.30)	135(44.85)	
	Disagree	122(32.11)	20(25.32)	102(33.89)	
	Strongly disagree	13(3.42)	4(5.06)	9(2.99)	
Testing regularly is important in the prevention of COVID-19	Strongly agree	58(15.26)	5(6.33)	53(17.61)	0.000
	Agree	234(61.58)	34(43.04)	200(66.45)	
	Disagree	82(21.58)	38(48.10)	44(14.62)	
	Strongly disagree	6(1.58)	2(2.53)	4(1.33)	
Maintaining social distance is important in the prevention of COVID-19	Strongly agree	88(23.16)	9(11.39)	79(26.25)	0.001
	Agree	264(69.47)	59(74.68)	205(68.11)	
	Disagree	26(6.84)	9(11.39)	17(5.65)	
	Strongly disagree	2(0.53)	2(2.53)	0(0.00)	
Drinking alcohol is important in the prevention of COVID-19	Strongly agree	37(9.74)	10(12.66)	27(8.97)	0.096
	Agree	44(11.58)	8(10.13)	36(11.96)	
	Disagree	198(52.11)	48(60.76)	150(49.83)	
	Strongly disagree	101(26.58)	13(16.46)	88(29.24)	
Self-isolation is important in the prevention of COVID-19	Strongly agree	63(16.58)	6(7.59)	57(18.94)	0.024
	Agree	289(76.05)	66(83.54)	223(74.09)	
	Disagree	25(6.58)	5(6.33)	20(6.64)	
	Strongly disagree	3(0.79)	2(2.53)	1(0.33)	
Disclosing your COVID-19 status is important in the prevention of COVID-19	Strongly agree	75(19.74)	9(11.39)	66(21.93)	0.015
	Agree	245(64.47)	50(63.29)	195(64.78)	
	Disagree	54(14.21)	17(21.52)	37(12.29)	
	Strongly disagree	6(1.58)	3(3.80)	3(1.00)	
Their is stigma if someone has COVID-19	Strongly agree	40(10.53)	9(11.39)	31(10.30)	0.222
	Agree	168(44.21)	27(34.18)	141(46.84)	
	Disagree	153(40.26)	39(49.37)	114(37.87)	
	Strongly disagree	19(5.00)	9(16.45)	10(15.29)	

6. Vaccines					
Currently their is cure for COVID-19	Strongly agree	14(3.68)	1(1.27)	13(4.32)	0.005
	Agree	159(41.85)	21(26.58)	138(45.85)	
	Disagree	176(46.32)	48(60.76)	128(42.52)	
	Strongly disagree	31(8.16)	9(11.39)	22(7.31)	
Vaccination sites are easily available	Strongly agree	47(12.37)	3(3.80)	44(14.62)	0.000
	Agree	250(65.79)	41(51.90)	209(69.44)	
	Disagree	72(18.95)	30(37.97)	42(13.95)	
	Strongly disagree	11(2.89)	5(6.33)	6(1.99)	
I would recommend someone to take a vaccine	Strongly agree	51(13.42)	0(0.00)	51(16.94)	0.000
	Agree	243(63.95)	27(34.18)	216(71.76)	
	Disagree	69(18.16)	40(50.63)	29(9.63)	
	Strongly disagree	17(4.47)	12(15.19)	5(1.66)	
Pfizer is better than Johnson and Johnson	Strongly agree	24(6.32)	1(1.27)	23(7.64)	0.000
	Agree	98(25.79)	8(10.13)	90(29.90)	
	Disagree	208(54.74)	55(69.62)	153(50.83)	
	Strongly disagree	50(13.16)	15(18.99)	35(11.63)	

ATTITUDES

Table 4: Distribution of attitudes based on COVID-19 vaccine hesitancy

Variable		**Total**	**Non-hesitancy**	**Hesitancy**	**P-value**
I think it's a shame to be COVID-19 positive	Strongly agree	8(2.11)	2(2.53)	6(1.99)	0.717
	Agree	48(12.63)	7(8.86)	41(13.62)	
	Disagree	281(73.95)	61(77.22)	220(73.09)	
	Strongly disagree	43(11.32)	9(11.39)	34(11.30)	
If one of my relatives is COVID-19	Strongly agree	92(24.21)	24(30.38)	68(22.59)	0.228
	Agree	232(61.05)	48(60.76)	184(61.13)	

positive, I would be willing to take care of him/her	Disagree	41(10.79)	6(7.59)	35(11.63)	
	Strongly disagree	15(3.95)	1(1.27)	14(4.65)	
If my friend is COVID-19 positive, I will continue my friendship with him/her	Strongly agree	85(22.37)	18(22.78)	67(22.26)	0.128
	Agree	222(58.42)	46(58.23)	176(58.47)	
	Disagree	56(14.74)	15(18.99)	41(13.62)	
	Strongly disagree	17(4.47)	0(0.00)	17(5.65)	
If a shopkeeper is COVID-19 positive, I will buy items from him/her	Strongly agree	20(5.26)	6(7.59)	14(4.65)	0.030
	Agree	133(35.00)	35(44.30)	98(32.56)	
	Disagree	129(33.95)	27(34.18)	102(33.89)	
	Strongly disagree	98(25.79)	11(13.92)	87(28.9)	
If a student is COVID-19 positive they should be allowed to continue with their studies, while they are still positive	Strongly agree	10(2.63)	2(2.53)	8(2.66)	0.024
	Agree	59(15.53)	18(22.78)	41(13.62)	
	Disagree	151(39.74)	37(46.84)	114(37.87)	
	Strongly disagree	160(42.11)	22(27.85)	138(45.85)	
If a teacher is COVID-19 positive should be allowed to continue with their teaching, while they are still positive	Strongly agree	8(2.11)	2(2.53)	6(1.99)	0.009
	Agree	43(11.32)	15(18.99)	28(9.30)	
	Disagree	161(42.37)	39(49.37)	122(40.53)	
	Strongly disagree	168(44.37)	23(29.11)	145(48.17)	
I prefer to break contacts from people living with COVID-19 disease	Strongly agree	41(10.79)	2(2.53)	39(12.96)	0.045
	Agree	239(62.89)	51(64.56)	188(62.46)	
	Disagree	87(22.89)	23(29.11)	64(21.26)	
	Strongly disagree	13(3.42)	3(3.80)	10(3.32)	
Hugging or shaking hands with people who are COVID-19 is dangerous	Strongly agree	92(24.21)	8(10.13)	84(27.91)	0.000
	Agree	229(60.26)	48(60.76)	181(60.13)	
	Disagree	53(13.95)	19(24.05)	34(11.30)	
	Strongly disagree	6(1.58)	4(5.06)	2(0.66)	
'It is better to develop immunity by	Strongly agree	31(8.16)	7(8.86)	24(7.97)	0.000
	Agree	86(22.63)	35(44.30)	51(16.94)	

getting sick rather than by getting a vaccination	Disagree	214(56.32)	34(43.04)	180(59.80)	
	Strongly disagree	49(12.89)	3(3.80)	46(15.28)	
I believe that vaccinations prevent the disease they are supposed to prevent	Strongly agree	31(8.16)	2(2.53)	29(9.63)	0.000
	Agree	238(62.63)	32(40.51)	206(68.44)	
	Disagree	96(25.26)	41(51.90)	55(18.27)	
	Strongly disagree	15(3.95)	4(5.06)	11(3.65)	

PERCEPTIONS

Table 5: Distribution of perceptions based on COVID-19 vaccine hesitancy

1. General					
Variable		**Total**	**Non-hesitancy**	**Hesitancy**	**P-value**
It is my opinion that early detection of COVID-19 can improve treatment and outcome	Strongly agree	52(13.68)	6(7.59)	46(15.28)	0.012
	Agree	303(79.74)	62(78.48)	241(80.07)	
	Disagree	21(5.53)	9(11.39)	12(3.99)	
	Strongly disagree	4(1.05)	2(2.53)	2(0.66)	
It is my opinion health education can help prevent COVID-19	Strongly agree	86(22.63)	12(15.19)	74(24.58)	0.006
	Agree	272(71.58)	58(73.42)	214(71.10)	
	Disagree	20(5.26)	7(8.86)	13(4.32)	
	Strongly disagree	2(0.53)	2(2.53)	0(0.00)	
It is my opinion COVID-19 is a serious disease	Strongly agree	146(38.42)	16(20.25)	130(43.19)	0.000
	Agree	169(44.47)	27(34.18)	142(47.18)	
	Disagree	52(13.68)	25(31.65)	27(8.97)	
	Strongly disagree	13(3.42)	11(13.92)	2(0.66)	
It is my opinion COVID-19 can be avoided by	Strongly agree	68(17.89)	4(5.06)	64(21.26)	0.000
	Agree	287(75.53)	64(81.01)	223(74.09)	
	Disagree	22(5.79)	8(10.13)	14(4.65)	

proper percussion	Strongly disagree	3(0.79)	3(3.80)	0(0.00)	
I believe that COVID-19 is curable	Strongly agree	49(12.89)	6(7.59)	43(14.29)	0.030
	Agree	210(55.26)	39(49.37)	171(56.81)	
	Disagree	110(28.95)	29(36.71)	81(26.91)	
	Strongly disagree	11(2.89)	5(6.33)	6(1.99)	
I believe that the awareness of COVID-19 disease is sufficient in society	Strongly agree	45(11.84)	4(5.06)	41(13.62)	0.009
	Agree	209(55.00)	40(50.63)	169(56.15)	
	Disagree	108(28.42)	27(34.18)	81(26.91)	
	Strongly disagree	18(4.74)	8(10.13)	10(3.32)	
Testing positive for COVID-19 will lead to some negative things happening to me	Strongly agree	37(9.74)	7(8.86)	30(9.97)	0.116
	Agree	192(50.53)	33(41.77)	159(52.82)	
	Disagree	139(36.58)	34(43.04)	105(34.88)	
	Strongly disagree	12(3.16)	5(6.33)	7(2.33)	
My friends are reluctant from getting tested for COVID-19 disease	Strongly agree	44(11.58)	7(8.86)	37(12.29)	0.109
	Agree	190(50.00)	43(54.43)	147(48.84)	
	Disagree	125(32.89)	21(26.58)	104(34.55)	
	Strongly disagree	21(5.53)	8(10.13)	13(4.32)	
I am concerned about my close family and friends getting COVID-19 from me.	Strongly agree	67(17.68)	5(6.33)	62(20.67)	0.000
	Agree	219(57.78)	36(45.57)	183(61.00)	
	Disagree	84(22.16)	33(41.77)	51(17.00)	
	Strongly disagree	9(2.37)	5(6.33)	4(1.33)	
2. COVID-19 information					
Information on COVID-19 is NOT easily available	Strongly agree	77(20.26)	5(6.33)	72(23.92)	0.000
	Agree	227(59.74)	47(59.49)	180(59.80)	
	Disagree	61(16.05)	22(27.85)	39(12.96)	
	Strongly disagree	15(3.95)	5(6.33)	10(3.32)	
Information on COVID-19 is easily available BUT not easy to understand	Strongly agree	76(20.00)	8(10.13)	68(22.59)	0.000
	Agree	262(68.95)	52(65.82)	210(69.77)	
	Disagree	34(8.95)	14(17.72)	20(6.64)	
	Strongly disagree	8(2.11)	5(6.33)	3(1.00)	

I trust the information I receive about COVID-19 vaccines and COVID-19 disease	Strongly agree	61(16.05)	4(5.06)	57(18.94)	0.000
	Agree	205(53.95)	21(26.58)	184(61.13)	
	Disagree	85(22.37)	40(50.63)	45(14.95)	
	Strongly disagree	29(7.63)	14(17.72)	15(4.98)	
3. COVID-19 vaccines					
I believe that the COVID-19 vaccine can stop me from being infected	Strongly agree	21(5.53)	2(2.53)	19(6.31)	0.000
	Agree	143(37.63)	11(13.92)	132(43.85)	
	Disagree	185(48.68)	53(67.09)	132(43.85)	
	Strongly disagree	31(8.16)	13(16.46)	18(5.98)	
I believe that the COVID-19 vaccine can stop me from getting the severe disease	Strongly agree	34(8.95)	2(2.53)	32(10.63)	0.000
	Agree	159(41.84)	17(21.52)	142(47.18)	
	Disagree	141(37.11)	44(55.70)	97(32.23)	
	Strongly disagree	46(12.11)	16(20.25)	30(9.97)	
COVID-19 vaccine has serious side effects	Strongly agree	116(30.53)	20(25.32)	96(31.89)	0.000
	Agree	168(44.21)	28(35.44)	140(46.51)	
	Disagree	82(21.58)	22(27.85)	60(19.93)	
	Strongly disagree	14(3.68)	9(11.39)	5(1.66)	
My friends are reluctant from receiving for COVID-19 vaccine	Strongly agree	61(16.05)	13(16.46)	48(15.95)	0.624
	Agree	177(46.58)	35(44.30)	142(47.18)	
	Disagree	116(30.53)	23(29.11)	93(30.90)	
	Strongly disagree	26(6.84)	8(10.13)	18(5.98)	
I would you be willing to have your family members (husband, wife, sisters, brothers, children, mother, father, grandparents) receive the vaccine against COVID-19	Strongly agree	54(14.21)	4(5.06)	50(16.61)	0.000
	Agree	222(58.42)	32(40.51)	190(63.12)	
	Disagree	92(24.21)	35(44.30)	57(18.94)	
	Strongly disagree	12(3.16)	8(10.13)	4(1.33)	
I would take a COVID-19	Strongly agree	43(11.32)	3(3.80)	40(13.29)	0.000

vaccine if I am required to get two shots, with the second shot some weeks after the first shot	Agree	179(47.11)	19(24.05)	160(53.16)	
	Disagree	129(33.95)	45(56.96)	84(27.91)	
	Strongly disagree	29(7.63)	12(15.19)	17(5.65)	
I trust the pharmaceutical industry producing COVID-19 vaccines	Strongly agree	24(6.320	2(2.53)	22(7.31)	0.000
	Agree	171(45.00)	15(18.99)	156(51.83)	
	Disagree	124(32.630	43(54.430	81(26.91)	
	Strongly disagree	61(16.050	19(24.05)	42(13.95)	
When I get vaccinated, I will protect other people in the community	Strongly agree	41(10.79)	1(1.27)	40(13.29)	0.000
	Agree	258(67.89)	41(51.90)	217(72.09)	
	Disagree	64(16.84)	29(36.71)	35(11.63)	
	Strongly disagree	17(4.47)	8(10.13)	9(2.99)	
COVID-19 is a punishment for immorality or sins in the past	Strongly agree	34(8.95)	8(10.13)	26(8.64)	0.564
	Agree	93(24.47)	21(26.58)	72(23.92)	
	Disagree	166(43.68)	29(36.71)	137(45.51)	
	Strongly disagree	87(22.89)	21(26.58)	66(21.93)	
Quarantining people with COVID-19 is the best way to prevent COVID-19 disease	Strongly agree	59(15.53)	4(5.06)	55(18.27)	0.000
	Agree	268(70.53)	51(64.56)	217(72.09)	
	Disagree	38(10.00)	17(21.52)	21(6.98)	
	Strongly disagree	15(3.95)	7(8.86)	8(2.66)	

Data analysis based on age

Table 6: Social Demographic characteristics based on age

Variable		Total	18-24 years	≥25-35 years	P-value
Gender	Male	151(39.74)	102(43.59)	49(33.56)	0.052
	Female	229(60.26)	132(56.41)	97(66.26)	
Cluster name	Soweto Thembelile	190(50.00)	127(54.27)	63(43.15)	0.035
	Meadowlands	190(50.00)	107(45.73)	83(56.85)	
Ethnic group	Zulu	160(42.11)	107(45.73)	53(36.30)	0.162

	Xhosa	35(9.21)	19(8.12)	16(10.96)	
	Pedi	15(3.95)	9(3.85)	6(4.11)	
	Tsonga	23(6.05)	17(7.26)	6(4.11)	
	Venda	3(0.79)	0(0)	3(2.05)	
	Tswana	74(19.47)	41(17.52)	33(22.60)	
	Sesotho	59(15.53)	33(14.10)	26(17.81)	
	Coloured	2(0.53)	1(0.43)	1(0.68)	
	Other(specify)	9(2.37)	7(2.99)	2(1.37)	
Education	No formal education	2(0.53)	2(0.85)	0(0.00)	0.012
	Primary education	1(0.26)	0(0.00)	1(0.68)	
	Some high school (did not complete)	152(40.00)	100(42.74)	52(35.62)	
	Grade 12/Matrix	172(45.26)	108(46.15)	64(43.84)	
	Some tertiary (did not complete)	20(5.26)	9(3.85)	11(7.53)	
	Tertiary	33(8.68)	15(6.41)	18(12.33)	
Current activity status	Employed	32(8.42)	10(4.27)	22(15.07)	0.000
	Part time	20(5.26)	10(4.27)	10(0.68)	
	Self employed	24(6.32)	8(3.42)	16(10.96)	
	Volunteer	30(7.89)	4(1.71)	26(17.81)	
	Not working	147(38.68)	86(36.75)	61(41.78)	
	Study	121(31.84)	111(47.44)	10(6.85)	
	Other	6(1.58)	5(2.14)	1(0.68)	
Marital status	Never married	363(95.53)	227(97.01)	136(93.15)	0.091
	Once married	2(0.53)	2(0.85)	0(0.00)	
	Married	14(3.68)	4(1.71)	10(6.85)	
	Other(specify)	1(0.26)	1(0.43)	0(0.00)	
Religion	Roman Catholic Church	21(5.53)	14(5.98)	7(4.79)	0.431
	Evangelic Charismatic	44(11.58)	25(10.68)	19(13.01)	
	African Independent	73(19.21)	41(17.52)	32(21.92)	
	Christian protestant	139(36.58)	88(37.61)	51(34.93)	
	Muslim	8(2.11)	5(2.14)	3(2.05)	
	African tradition	75(19.74)	47(20.09)	28(19.18)	
	Other(specify)	20(5.26)	14(5.98)	6(4.11)	
Spent the majority of the	No	52(13.68)	33(14.10)	19(13.0)	0.764
	Yes	328(86.32)	201(85.90)	127(86.99)	

last 4 months residing here?					
Are you currently pregnant	No	209(91.27)	123(93.18)	86(88.66)	0.231
	Yes	20(8.73)	9(6.82)	11(11.34)	
Who is the head of the household?	Myself	72(18.95)	19(8.12)	53(36.30)	0.854
	My father	74(19.47)	60(25.64)	14(9.59)	
	My mother	140(36.84)	108(46.15)	32(21.92)	
	My brother	11(2.89)	1(0.43)	10(6.85)	
	My sister	13(3.42)	7(2.99)	6(4.11)	
	My aunt	12(3.16)	8(3.42)	4(2.74)	
	My uncle	10(2.63)	9(3.85)	1(0.68)	
	Other (specify)	48(12.63)	22(9.40)	26(17.81)	
How many household members do you live with?	1-5	274(72.11)	161(68.80)	113(77.40)	0.095
	6-10	101(26.58)	70(29.91)	31(21.23)	
	11-15	5(1.32)	3(1.28)	2(1.37)	
Do you have an elderly (above 60 years) person in the household?	No	306(80.53)	191(81.62)	115(78.77)	0.494
	Yes	74(19.47)	43(18.38)	31(21.23)	
What is your source of information?	Family members	64(17.20)	45(19.57)	19(13.38)	0.106
	Friends	9(2.42)	4(1.74)	5(3.52)	
	Healthcare workers	12(3.23)	11(4.78)	1(0.70)	
	Internet	184(49.46)	112(48.70)	72(50.70)	
	Radio	13(3.49)	7(3.04)	6(4.23)	
	TV	90(24.19)	51(22.17)	39(27.46)	

Objective 1: To describe the knowledge of COVID-19 vaccines among young people in Soweto, South Africa

Table 7: Distribution of responses based on knowledge levels of COVID-19 disease and vaccines on age

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Variable		**Total**	**18-24 years**	**≥25-35 years**	**P-value**
7. General					
Have you heard of COVID-19 disease	Strongly agree	103(27.11)	71(30.34)	32(21.92)	0.273
	Agree	250(65.79)	145(61.97)	105(71.92)	
	Disagree	26(6.84)	17(7.26)	9(6.16)	

	Strongly disagree	1(0.26)	1(0.43)	0(0.00)	
COVID-19 is a hoax	Strongly agree	36(9.47)	28(11.97)	8(5.48)	0.084
	Agree	142(37.37)	89(38.03)	53(36.30)	
	Disagree	190(50.00)	108(46.15)	82(56.16)	
	Strongly disagree	12(3.16)	9(3.85)	3(2.05)	
COVID-19 came from China	Strongly agree	93(24.47)	66(28.21)	27(18.49)	0.005
	Agree	215(56.58)	133(56.84)	82(56.16)	
	Disagree	69(18.16)	33(14.10)	36(24.66)	
	Strongly disagree	3(0.79)	2(0.85)	1(0.68)	
COVID-19 is caused by a bacteria	Strongly agree	11(2.89)	6(2.56)	5(3.42)	0.002
	Agree	104(27.37)	52(22.22)	52(35.62)	
	Disagree	246(64.74)	160(68.38)	86(58.90)	
	Strongly disagree	19(5.00)	16(6.84)	3(2.05)	
COVID-19 is caused by a virus	Strongly agree	56(14.74)	41(17.52)	15(10.27)	0.005
	Agree	267(70.26)	165(70.51)	102(69.86)	
	Disagree	55(14.47)	28(11.97)	27(18.49)	
	Strongly disagree	2(0.53)	0(0.00)	2(1.37)	
COVID-19 is a contagious disease	Strongly agree	102(26.84)	74(31.62)	28(19.18)	0.033
	Agree	243(63.95)	140(59.83)	103(70.55)	
	Disagree	31(8.16)	17(7.26)	14(9.59)	
	Strongly disagree	4(1.05)	3(1.28)	1(0.68)	
COVID-19 it's a flu	Strongly agree	73(19.21)	50(21.37)	23(15.75)	0.851
	Agree	262(68.95)	151(64.53)	111(76.03)	
	Disagree	43(11032)	31(13.25)	12(8.22)	
	Strongly disagree	2(0.53)	2(0.85)	0(0.00)	
You can heal from COVID-19	Strongly agree	64(16.89)	45(19.31)	19(13.01)	0.333
	Agree	256(67.55)	151(64.81)	105(71.92)	
	Disagree	53(13.98)	34(14.59)	19(13.01)	
	Strongly disagree	6(1.58)	3(1.29)	3(2.05)	
8. COVID-19 disease					
COVID-19 disease should be confirmed by a test	Strongly agree	57(15.00)	38(16.24)	19(13.01)	0.962
	Agree	284(74.740	170(72.65)	114(78.08)	
	Disagree	36(9.47)	23(9.83)	13(8.90)	
	Strongly disagree	3(0.79)	3(1.28)	0(0.00)	
Testing sites for COVID-19 are easily available	Strongly agree	43(11.32)	27(11.54)	16(10.96)	0.429
	Agree	233(61.32)	138(58.97)	95(65.07)	
	Disagree	95(25.00)	63(26.92)	32(21.92)	

	Strongly disagree	9(2.37)	6(2.56)	3(2.05	
Fever is a symptom of COVID-19	Strongly agree	100(26.32)	70(29.91)	30(20.55)	0.142
	Agree	239(62.89)	140(59.83)	99(67.81)	
	Disagree	38(10.00)	21(8.97)	17(11.64)	
	Strongly disagree	3(0.79)	3(1.28)	0(0.00)	
Cough is a symptom of COVID-19	Strongly agree	107(28.16)	81(34.62)	26(17.81)	0.001
	Agree	228(60.00)	132(56.41)	96(65.75)	
	Disagree	42(11.05)	18(7.69)	24(16.44)	
	Strongly disagree	3(0.79)	3(1.28)	0(0.00)	
Sore throat is a symptom of COVID-19	Strongly agree	102(26.84)	74(31.62)	28(19.18)	0.041
	Agree	227(59.740	131(55.98)	96(65.75)	
	Disagree	48(12.63)	26(11.11)	22(15.07)	
	Strongly disagree	3(0.79)	3(1.28)	0(0.00)	
Body pain is a symptom of COVID-19	Strongly agree	75(19.74)	51(21.79)	24(16.44)	0.917
	Agree	215(56.58)	123(52.56)	92(63.01)	
	Disagree	85(22.37)	56(23.93)	29(19.86)	
	Strongly disagree	5(1.32)	4(1.71)	1(0.68)	
Diarhoea is a symptom of COVID-19	Strongly agree	30(7.89)	16(6.84)	14(9.59)	0.031
	Agree	104(27.37)	60(25.64)	44(30.14)	
	Disagree	230960.53)	143(61.11)	87(59.59)	
	Strongly disagree	16(4.21)	15(6.41)	1(0.68)	
Headache is a symptom of COVID-19	Strongly agree	81(21.32)	56(23.93)	25(17.12)	0.110
	Agree	238(62.63)	145(61.97)	93(63.70)	
	Disagree	58(15.26)	30((12.82)	28(19.18)	
	Strongly disagree	3(0.790	3(1.28)	0(0.00)	
Loss of taste and smell is associated with COVID-19 disease	Strongly agree	90(23.68)	63(26.92)	27(18.49)	0.782
	Agree	213(56.05)	115(49.15)	98(67.12)	
	Disagree	75(19.74)	54(23.08)	21(14.38)	
	Strongly disagree	2(0.53)	2(0.85)	0(0.00)	
In suspecting infection with COVID-19 I primarily measure fever	Strongly agree	29(7.63)	22(9.40)	7(4.79)	0.357
	Agree	259(68.16)	158(67.52)	101(69.18)	
	Disagree	85(22.37)	48(20.51)	37(25.34)	
	Strongly disagree	7(1.84)	6(2.56)	1(0.68)	
In suspecting infection with COVID-19 I primarily visit a physician	Strongly agree	53(13.95)	33(14.10)	20(13.70)	0.654
	Agree	279(73.42)	169(72.22)	110(75.34)	
	Disagree	42(11.05)	28(11.97)	14(9.59)	
	Strongly disagree	6(1.58)	4(1.71)	2(1.37)	

Level of significance was at p value less than 0.05

9. Vulnerable group					
Young people are at risk of COVID-19	Strongly agree	61(16.05)	42(17.95)	19(13.01)	0.701
	Agree	197(51.84)	113(48.29)	84(57.53)	
	Disagree	111(29.21)	69(29.49)	42(28.77)	
	Strongly disagree	11(2.890	10(4.27)	1(0.68)	
Old people are at risk of COVID-19	Strongly agree	131(34.47)	84(35.90)	47(32.19	0.919
	Agree	219(57.63)	128(54.70)	91(62.33)	
	Disagree	29(7.63)	21(8.97)	8(5.48)	
	Strongly disagree	190.26)	1(0.43)	0(0.00)	
I should avoid unnecessary daily activities when I have COVID-19	Strongly agree	44(11.58)	25(10.68)	19(13.01)	0.017
	Agree	288(75.79)	171(73.08)	117(80.14)	
	Disagree	45(11.84)	35(14.96)	10(6.85)	
	Strongly disagree	3(0.79)	3(1.28)	0(0.00)	
People with comorbidities are more at risk of COVID-19	Strongly agree	92(24.21)	59(25.21)	33(22.60)	0.570
	Agree	238(62.63)	140(59.83)	98(67.12)	
	Disagree	46(12.11)	31(13.25)	15(10.27)	
	Strongly disagree	4(1.05)	4(1.71)	0(0.00)	
People with disability are more at risk of COVID-19	Strongly agree	51(13.42)	34(14.53)	17(11.64)	0.914
	Agree	190(50.00)	111(47.44)	79(54.11)	
	Disagree	130(34.21)	85(36.32)	45(30.82)	
	Strongly disagree	9(2.37)	4(1.71)	5(3.42)	
Pregnant women are more at risk of COVID-19	Strongly agree	72(18.95)	47(20.09)	25(17.12)	0.781
	Agree	231(60.79)	135(57.69)	96(65.75)	
	Disagree	75(19.74)	51(21.79)	24(16.44)	
	Strongly disagree	2(0.53)	1(0.43)	1(0.68)	
10. Transmission					
The disease can be transmitted through a cough	Strongly agree	92(24.21)	64(27.35)	28(19.18)	0.564
	Agree	263(69.21)	151(64.53)	112(76.71)	
	Disagree	23(6.05)	17(7.26)	6(4.11)	
	Strongly disagree	2(0.53)	2(0.85)	0(0.00)	
The disease can be transmitted through saliva droplets	Strongly agree	68(17.89)	47(20.09)	21(14.38)	0.912
	Agree	258(67.89)	149(63.68)	109(74.66)	
	Disagree	52(1.68)	37(15.81)	15(10.27)	
	Strongly disagree	2(0.53)	1(0.43)	1(0.68)	
The disease can be transmitted directly by	Strongly agree	83(21.84)	63(26.92)	20(13.70)	0.003
	Agree	260(68.42)	153(65.38)	107(73.29)	
	Disagree	33(8.68)	15(6.41)	18(12.33)	

touching infected surfaces	Strongly disagree	4(1.05)	3(1.28)	1(0.68)	
The disease can be transmitted directly through the consumption of contaminated dairy and meat	Strongly agree	25(6.58)	12(5.13)	13(8.90)	0.057
	Agree	116(30.53)	71(30.34)	45(30.82)	
	Disagree	199(52.37)	120(51.28)	79(54.11)	
	Strongly disagree	40(10.53)	31(13.25)	9(6.16)	
11. Prevention strategies					
To avoid contracting COVID-19, I avoid contact with individuals suspected to be infected with COVID-19	Strongly agree	64(16.84)	42(17.95)	22(15.07)	0.576
	Agree	255(67.11)	152(64.96)	103(70.55)	
	Disagree	49(12.89)	29(12.39)	20(13.70)	
	Strongly disagree	12(3.16)	11(4.70)	1(0.68)	
Washing hands with water and soap can eliminate the disease cause	Strongly agree	100(26.63)	67(28.63)	33(22.60)	0.752
	Agree	250(65.79)	146(62.39)	104(71.23)	
	Disagree	27(7.11)	18(7.69)	9(6.16)	
	Strongly disagree	3(0.79)	3(1.28)	0(0.00)	
Wearing of mask prevents COVID-19	Strongly agree	103(27.11)	69(29.49)	34(23.29)	0.911
	Agree	240(63.16)	139(59.40)	101(69.18)	
	Disagree	30(7.89)	20(8.55)	10(6.85)	
	Strongly disagree	7(1.84)	6(2.56)	1(0.68)	
Sanitizing of hands help prevent COVID-19	Strongly agree	111(29.21)	74(31.62)	37(25.34)	0.650
	Agree	243(63.95)	142(60.68)	101(69.18)	
	Disagree	23(6.05)	15(6.41)	8(5.48)	
	Strongly disagree	3(0.79)	3(1.28)	0(0.00)	
Opening windows thus keeping a room ventilated help in preventing transmission of COVID-19	Strongly agree	103(27.11)	66(28.21)	37(37.25)	0.171
	Agree	239(62.89)	135(57.69)	104(71.23)	
	Disagree	36(9.47)	31(13.25)	5(3.42)	
	Strongly disagree	2(0.53)	2(0.85)	0(0.00)	
Home-made/traditional remedies help in the cure for COVID-19	Strongly agree	75(19.74)	54(23.08)	21(14.38)	0.083
	Agree	170(44.74)	104(44.44)	66(45.21)	
	Disagree	122(32.11)	66(28.21)	56(38.36)	
	Strongly disagree	13(3.42)	10(4.27)	3(2.05)	
Testing regularly is important in the prevention of COVID-19	Strongly agree	58(15.26)	43(18.38)	15(10.27)	0.246
	Agree	234(61.58)	139(59.40)	95(65.07)	
	Disagree	82(21.58)	46(19.66)	36(24.66)	
	Strongly disagree	6(1.58)	6(2.56)	0(0.00)	

Maintaining social distance is important in the prevention of COVID-19	Strongly agree	88(23.16)	65(27.78)	23(15.75)	0.160
	Agree	264(69.47)	149(63.68)	115(78.77)	
	Disagree	26(6.84)	18(7.69)	8(5.48)	
	Strongly disagree	2(0.53)	2(0.85)	0(0.00)	
Drinking alcohol is important in the prevention of COVID-19	Strongly agree	37(9.74)	21(8.79)	16(10.96)	0.169
	Agree	44(11.58)	27(11.54)	17(11.64)	
	Disagree	198(52.11)	116(49.57)	82(56.16)	
	Strongly disagree	101(26.58)	70(29.91)	31(21.23)	
Self-isolation is important in the prevention of COVID-19	Strongly agree	63916.58)	43(18.38)	20(13.70)	0.788
	Agree	289(76.05)	171(73.08)	118(80.82)	
	Disagree	25(6.58)	18(7.69)	7(4.79)	
	Strongly disagree	3(0.79)	2(0.85)	1(0.68)	
Disclosing your COVID-19 status is important in the prevention of COVID-19	Strongly agree	75(19.74)	50(21.37)	25(17.12)	0.557
	Agree	245(64.47)	141(60.26)	104(71.23)	
	Disagree	54(14.21)	38(16.24)	16(10.96)	
	Strongly disagree	6(1.58)	5(2.14)	1(0.68)	
Their is stigma if someone has COVID-19	Strongly agree	40(1053)	28(11.97)	12(8.22)	0.889
	Agree	168(44.21)	100(42.74)	68(46.58)	
	Disagree	153(40.26)	92(39.32)	61(41.78)	
	Strongly disagree	19(5.00)	14(5.98)	5(3.42)	
12. Vaccines					
Currently their is cure for COVID-19	Strongly agree	14(3.68)	9(3.85)	5(3.42)	0.227
	Agree	159(41.85)	107(45.73)	52(35.62)	
	Disagree	176(46.32)	97(41.45)	79(54.11)	
	Strongly disagree	31(8.16)	21(8.97)	10(6.85)	
COVID-19 vaccine is NOT important	Strongly agree	64(16.84)	43(18.38)	21(14.38)	0.619
	Agree	237(62.37)	136(58.12)	101(69.18)	
	Disagree	73(19.21)	51(21.79)	22(15.07)	
	Strongly disagree	6(1.58)	4(1.71))	2(1.37)	
Vaccination sites are easily available	Strongly agree	47(12.37)	32(13.68)	15(10.27)	0.863
	Agree	250(65.79)	147(62.82)	103(70.55)	
	Disagree	72(18.95)	48(20.51)	24(16.44)	
	Strongly disagree	11(2.89)	7(2.99)	4(2.74)	
I would recommend someone to take a vaccine	Strongly agree	51(13.42)	35(14.96)	16(10.96)	0.094
	Agree	243(63.95)	135(57.69)	108(73.97)	
	Disagree	69(18.16)	50(21.37)	19(13.01)	
	Strongly disagree	17(4.47)	14(5.98)	3(2.05)	
	Strongly agree	24(6.32)	17(7.26)	7(4.79)	0.667

Pfizer is better than Johnson and Johnson	Agree	98(25.79)	56(23.93)	42(28.77)	
	Disagree	208(54.74)	127(54.27)	81(55.48)	
	Strongly disagree	50(13.16)	34(14.53)	16(10.96)	

Objective 2: To investigate the perceptions of COVID-19 vaccines among young people in Soweto, South Africa

Table 8: Distribution of responses based on perception levels of COVID-19 disease and vaccines on age

4. General					
Variable		**Total**	**18-24 years**	**≥25-35 years**	**P-value**
It is my opinion that early detection of COVID-19 can improve treatment and outcome	Strongly agree	52(13.68)	34(14.53)	18(12.33)	0.362
	Agree	303(79.74)	179(76.50)	124(84.93)	
	Disagree	21(5.53)	18(7.69)	3(2.05)	
	Strongly disagree	4(1.05)	3(1.28)	1(0.68)	
It is my opinion health education can help prevent COVID-19	Strongly agree	86(22.63)	59(25.21)	27(18.49)	0.170
	Agree	272(71.58)	162(69.23)	110(75.34)	
	Disagree	20(5.26)	12(5.13)	8(5.48)	
	Strongly disagree	2(0.53)	1(0.43)	1(0.68)	
It is my opinion COVID-19 is a serious disease	Strongly agree	146(38.42)	94(40.17)	52(35.62)	0.778
	Agree	169(44.47)	99(42.31)	70(47.95)	
	Disagree	52(13.68)	32(13.68)	20(13.70)	
	Strongly disagree	13(3.42)	9(3.85)	4(2.74)	
It is my opinion COVID-19 can be avoided by proper percussion	Strongly agree	68(17.89)	45(19.23)	23(15.75)	0.485
	Agree	287(75.53)	174(74.36)	113(77.40)	
	Disagree	22(5.79)	13(5.56)	9(6.16)	
	Strongly disagree	3(0.79)	2(0.85)	1(0.68)	
I believe that COVID-19 is curable	Strongly agree	49(12.89)	35(14.96)	14(9.59)	0.180
	Agree	210(55.26)	113(48.29)	97(66.44)	
	Disagree	110(28.95)	77(32.91)	33(22.60)	
	Strongly disagree	11(2.89)	9(3.85)	2(1.37)	
I believe that the awareness of COVID-19 disease is sufficient in society	Strongly agree	45(11.84)	29(12.39)	16(10.96)	0.108
	Agree	209(55.00)	119(50.85)	90(61.64)	
	Disagree	108(28.42)	71(30.34)	37(25.34)	
	Strongly disagree	18(4.74)	15(6.41)	3(2.05)	
Testing positive for COVID-19 will lead	Strongly agree	37(9.74)	29(12.39)	8(5.48)	0.055
	Agree	192(50.53)	121(51.71)	71(48.63)	

to some negative things happening to me	Disagree	139(36.58)	74(31.62)	65(44.52)	
	Strongly disagree	12(3.16)	10(4.27)	2(1.37)	
My friends are reluctant from getting tested for COVID-19 disease	Strongly agree	44(11.58)	26(11.11)	18(12.33)	0.085
	Agree	190(50.00)	111(47.44)	79(54.11)	
	Disagree	125(32.89)	80(34.19)	45(30.82)	
	Strongly disagree	21(5.53)	17(7.26)	4(2.74)	
I am concerned about my close family and friends getting COVID-19 from me.	Strongly agree	67(17.68)	42(18.03)	25(17.12)	0.199
	Agree	219(57.78)	126(54.08)	93(63.70)	
	Disagree	84(22.16)	58(24.89)	26(17.81)	
	Strongly disagree	9(2.37)	7(3.00)	2(1.37)	
5. COVID-19 information					
Information on COVID-19 is NOT easily available	Strongly agree	77(20.26)	49(20.94)	28(19.18)	0.070
	Agree	227(59.74)	126(53.85)	101(69.18)	
	Disagree	61(16.05)	48(20.51)	13(8.90)	
	Strongly disagree	15(3.95)	11(4.70)	4(2.74)	
Information on COVID-19 is easily available BUT not easy to understand	Strongly agree	76(20.00)	54(23.08)	22(15.07)	0.388
	Agree	262(68.95)	152(64.96)	110(75.34)	
	Disagree	34(8.95)	23(9.83)	11(7.53)	
	Strongly disagree	8(2.11)	5(2.14)	3(2.05)	
I trust the information I receive about COVID-19 vaccines and COVID-19 disease	Strongly agree	61(16.05)	41(17.52)	20(13.70)	0.325
	Agree	205(53.95)	113(48.29)	92(63.01)	
	Disagree	85(22.37)	61(26.07)	24(16.44)	
	Strongly disagree	29(7.63)	19(8.12)	10(6.85)	
6. COVID-19 vaccines					
I believe that the COVID-19 vaccine can stop me from being infected	Strongly agree	21(5.53)	13(5.56)	8(5.48)	0.864
	Agree	143(37.63)	91(38.89)	52(35.62)	
	Disagree	185(48.68)	109(46.58)	76(52.08)	
	Strongly disagree	31(8.16)	21(9.97)	10(6.85)	
I believe that the COVID-19 vaccine can stop me from getting the severe disease	Strongly agree	34(8.95)	22(9.40)	12(8.22)	0.277
	Agree	159(41.84)	91(38.89)	68(46.58)	
	Disagree	141(37.11)	89(38.03)	52(35.62)	
	Strongly disagree	46(12.11)	32(13.68)	14(9.59)	
COVID-19 vaccine has serious side effects	Strongly agree	116(30.53)	80(34.19)	36(24.66)	0.185
	Agree	168(44.21)	98(41.88))	70(47.95)	
	Disagree	82(21.58)	46(19.66)	36(24.66)	
	Strongly disagree	14(3.68)	10(4.27)	4(2.74)	
	Strongly agree	61(16.05)	48(20.51)	13(8.90)	0.307

My friends are reluctant from receiving for COVID-19 vaccine	Agree	177(46.58)	98(41.88)	79(54.11)	
	Disagree	116(30.53)	70(29.91)	46(31.51)	
	Strongly disagree	26(6.84)	18(7.69)	8(5.48)	
I would you be willing to have your family members (husband, wife, sisters, brothers, children, mother, father, grandparents) receive the vaccine against COVID-19	Strongly agree	54(14.21)	39(16.67)	15(10.27)	0.528
	Agree	222(58.42)	131(55.98)	91(62.33)	
	Disagree	92(24.21)	55(23.50)	37(25.34)	
	Strongly disagree	12(3.16)	9(3.85)	3(2.05)	
I would take a COVID-19 vaccine if I am required to get two shots, with the second shot some weeks after the first shot	Strongly agree	43(11.32)	30(12.82)	13(8.90)	0.325
	Agree	179(47.11)	101(43.16)	78(53.42)	
	Disagree	129(33.95)	80(34.19)	49(33.56)	
	Strongly disagree	29(7.63)	23(9.83)	6(4.11)	
I trust the pharmaceutical industry producing COVID-19 vaccines	Strongly agree	24(63.20	20(8.55)	4(2.74)	0.192
	Agree	171(45.00)	88(37.61)	83(56.85)	
	Disagree	124(32.63)	85(63.32)	39(26.71)	
	Strongly disagree	61(16.05)	41(17.52)	20(13.70)	
When I get vaccinated, I will protect other people in the community	Strongly agree	41(10.79)	29(12.39)	12(8.22)	0.113
	Agree	258(67.89)	144(61.54)	114(78.08)	
	Disagree	64(16.84)	48(20.51)	16(10.96)	
	Strongly disagree	17(4.47)	13(5.56)	4(2.74)	
COVID-19 is a punishment for immorality or sins in the past	Strongly agree	34(8.95)	22(9.40)	12(8.22)	0.258
	Agree	93(24.47)	55(23.50)	38(26.03)	
	Disagree	166(43.68)	94(40.17)	72(49.32)	
	Strongly disagree	87(22.89)	63(26.92)	24(16.44)	
Quarantining people with COVID-19 is the best way to prevent COVID-19 disease	Strongly agree	59(15.53)	36(15.38)	23(15.75)	0.571
	Agree	268(70.53)	164(70.09)	104(71.23)	
	Disagree	38(10.00)	23(9.83)	15(10.27)	
	Strongly disagree	15(3.95)	11(4.70)	4(2.74)	

Objective 3: To investigate the attitudes of COVID-19 vaccines among young people in Soweto, South Africa

Table 9: Distribution of responses based on attitudes levels of COVID-19 disease and vaccines on age

Variable		Total	18-24 years	≥25-35 years	P-value
I think it's a shame to be COVID-19 positive	Strongly agree	8(2.11)	5(2.14)	3(2.05)	0.624
	Agree	48(12.63)	29(12.39)	19(13.01)	
	Disagree	281(73.95)	168(71.79)	113(77.40)	
	Strongly disagree	43(11.32)	32(13.68)	11(7.53)	
If one of my relatives is COVID-19 positive, I would be willing to take care of him/her	Strongly agree	92(24.21)	59(25.21)	33(22.60)	0.465
	Agree	232(61.05)	136(58.12)	96(65.75)	
	Disagree	41(10.79)	27(11.54)	14(9.59)	
	Strongly disagree	15(3.95)	12(5.13)	3(2.05)	
If my friend is COVID-19 positive, I will continue my friendship with him/her	Strongly agree	85(22.37)	61(26.07)	24(16.44)	0.679
	Agree	222(58.42)	117(50.00)	105(71.92)	
	Disagree	56(14.74)	45(19.23)	11(7.53)	
	Strongly disagree	17(4.47)	11(4.70)	6(4.11)	
If a shopkeeper is COVID-19 positive, I will buy items from him/her	Strongly agree	20(5.26)	14(5.96)	6(4.11)	0.011
	Agree	133(35.000	68(29.06)	65(44.52)	
	Disagree	129(33.95)	81(34.62)	48(32.88)	
	Strongly disagree	98(25.79)	71(30.34)	27(18.49)	
If a student is COVID-19 positive they should be allowed to continue with their studies, while they are still positive	Strongly agree	10(2.63)	7(2.99)	3(2.05)	0.062
	Agree	59(15.53)	28(11.97)	31(21.23)	
	Disagree	151(39.74)	93(39.74)	58(39.73)	
	Strongly disagree	160(42.11)	106(45.30)	54(36.99)	
If a teacher is COVID-19 positive should be allowed to continue with their teaching, while they are still positive	Strongly agree	8(2.11)	6(2.56)	2(1.37)	0.094
	Agree	43(11.320	19(8.12)	24(16.44)	
	Disagree	161(42.37)	99(42.31)	62(42.47)	
	Strongly disagree	168(44.37)	110(47.01)	58(39.37)	
I prefer to break contacts from people living with COVID-19 disease	Strongly agree	41(10.79)	33(14.10)	8(5.48)	0.049
	Agree	239(62.89)	142(60.68)	97(66.44)	
	Disagree	87(22.89)	53(22.65)	34(23.29)	
	Strongly disagree	13(3.42)	6(2.56)	7(4.79)	

Level of significance was at p value less than 0.05

Hugging or shaking hands with people who are COVID-19 is dangerous	Strongly agree	92(24.21)	62(26.50)	30(20.55)	0.242
	Agree	229(60.26)	136(58.12)	93(63.70)	
	Disagree	53(13.95)	34(14.53)	19(13.01)	
	Strongly disagree	6(1.58)	2(0.85)	4(2.74)	
'It is better to develop immunity by getting sick rather than by getting a vaccination	Strongly agree	31(8.16)	23(9.83)	8(5.48)	0.178
	Agree	86(22.63)	57(24.36)	29(19.86)	
	Disagree	214(56.32)	122(52.14)	92(63.01)	
	Strongly disagree	49(12.89)	32(13.68)	17(11.64)	
I believe that vaccinations prevent the disease they are supposed to prevent	Strongly agree	31(8.16)	18(7.69)	13(8.90)	0.127
	Agree	238(62.63)	141(60.26)	97(66.44)	
	Disagree	96(25.26)	64(27.35)	32(21.92)	
	Strongly disagree	15(3.95)	11(4.70)	4(2.74)	

Data analysis based on gender

Objective 1: To describe the knowledge of COVID-19 vaccines among young people in Soweto, South Africa

Table 10: Social Demographic characteristics based on gender

Variable		**Total**	**Male**	**Female**	**P-value**
Age	18-24	234(61.58)	102(67.55)	132(57.64)	0.052
	25-34	146(38.42)	49(32.45)	97(42.36)	
Cluster name	Soweto Thembelile	190(50.00)	74(49.01)	116(50.66)	0.754
	Meadowlands	190(50.00)	77(50.99)	113(49.34)	
Ethnic group	Zulu	160(42.11)	76(50.33)	84(36.68)	0.022
	Xhosa	35(9.21)	9(5.96)	26(2.62)	
	Pedi	15(3.95)	9(5.96)	6(40.00)	
	Tsonga	23(6.05)	8(5.30)	15(6.55)	
	Venda	3(0.79)	0(0.00)	3(1.31)	
	Tswana	74(19.47)	29(19.21)	45(19.65)	
	Sesotho	59(15.53)	16(10.60)	43(18.78)	
	Colored	2(0.53)	1(0.66)	1(0.44)	
	Other(specify)	9(2.37)	3(1.99)	6(2.62)	
Education level	No formal education	2(0.53)	0(0.00)	2(0.87)	0.447
	Primary education	1(0.26)	1(0.66)	0(0.00)	
	Some high school (did not complete)	152(40.00)	65(43.05)	87(37.99)	

	Grade 12/Matrix	172(45.26)	65(43.05)	107(46.72)	
	Some tertiary (did not complete)	20(5.26)	9(5.96)	11(4.80)	
	Tertiary	33(8.68)	11(7.28)	22(9.61)	
Current activity	Employed	32(8.42)	10(6.62)	22(9.61)	0.000
	Not working	147(38.68)	43(28.48)	104(45.41)	
	Other	6(1.58)	4(2.65)	2(0.87)	
	Part time	20(5.26)	14(9.27)	6(2.62)	
	Self employed	24(6.32)	17(11.26)	7(3.06)	
	Study	121(31.84)	57(37.75)	64(27.95)	
	Volunteer	30(7.89)	6(3.97)	24(10.48)	
Marital status	Never married	363(95.53)	147(97.35)	216(94.32)	0.115
	Once married	2(0.53)	1(0.66)	1(0.44)	
	Married	14(3.68)	3(1.99)	11(4.80)	
	Other(specify)	1(0.26)	0(0.00)	1(0.44)	
Religion	Roman Catholic Church	21(5.53)	6(3.97)	15(6.55)	0.012
	Evangelic Charismatic	44(11.58)	19(12.58)	25(10.92)	
	African Independent	73(19.21)	28(18.54)	45(19.65)	
	Christian protestant	139(36.58)	42(27.81)	97(42.36)	
	Muslim	8(2.11)	5(3.31)	3(1.31)	
	African traditional	75(19.74)	39(25.83)	36(15.72)	
	Other (specify)	20(5.26)	12(7.95)	8(3.49)	
Resided here in the last 4 months	No	52(13.68)	14(9.27)	38(16.59)	0.042
	Yes	328(86.32)	137(90.73)	191(83.41)	
Are you pregnant	No	209(91.27)			
	Yes	20(8.73)			
Head of the house	The respondent	72(18.95)	31(20.53)	41(17.90)	0.038
	My father	74(19.47)	35(23.18)	39(17.03)	
	My mother	140(36.84)	55(36.42)	85(37.12)	
	My brother	11(2.89)	4(2.65)	7(3.06)	
	My sister	13(3.42)	6(3.97)	7(3.06)	
	My aunt	12(3.16)	2(1.32)	10(4.37)	
	My uncle	10(2.63)	5(3.31)	5(2.18)	
	Other (specify)	48(12.63)	13(8.61)	35(15.28)	
Number of people per household	1-5	274(72.11)	115(76.16)	159(69.43)	0.123
	6-10	101(26.58)	35(23.18)	66(28.82)	
	11-15	5(1.32)	1(0.66)	4(1.75)	
	No	306(80.53)	127(84.11)	179(78.17)	0.152

People living with the elderly	Yes	74(19.47)	24(15.89)	50(21.83)	
Source of information	Family members	64(17.20)	30(20.55)	34(15.04)	0.000
	Friends	9(2.42)	5(3.42)	4(1.77)	
	Healthcare workers	12(3.23)	2(1.37)	10(4.42)	
	Internet	184(49.46)	75(51.37)	109(48.23)	
	Radio	13(3.49)	9(6.16)	4(1.77)	
	TV	90(24.19)	25(17.12)	65(28.76)	

Objective 1: To describe the knowledge of COVID-19 vaccines among young people in Soweto, South Africa

Table 11: Distribution of responses based on knowledge levels of COVID-19 disease and vaccines on gender

Variable		**Total**	**Male**	**Female**	**P-value**
1. General questions					
I have heard about COVID-19 disease	Strongly agree	103(27.11)	49(32.45)	54(23.58)	0.022
	Agree	250(65.79)	96(63.58)	154(67.25)	
	Disagree	26(6.84)	5(3.31)	21(9.17)	
	Strongly disagree	1(0.26)	1(0.66)	0(0.00)	
COVID-19 is a hoax	Strongly agree	36(9.47)	23(15.23)	13(5.68)	0.000
	Agree	142(37.37)	67(44.37)	75(32.75)	
	Disagree	190(50.00)	54(35.76)	136(59.39)	
	Strongly disagree	12(3.16)	7(4.64)	5(2.18)	
COVID-19 came from China	Strongly agree	93(24.47)	36(23.84)	57(24.89)	0.268
	Agree	215(56.58)	81(53.64)	134(58.52)	
	Disagree	69(18.16)	32(21.19)	37(16.16)	
	Strongly disagree	3(0.79)	2(1.32)	1(0.44)	
COVID-19 is caused by a bacteria	Strongly agree	11(2.89)	5(3.31)	6(2.62)	0.933
	Agree	104(27.37)	39(25.83)	65(28.38)	
	Disagree	246(64.74)	101(66.89)	145(63.32)	
	Strongly disagree	19(5.00)	6(3.97)	13(5.68)	
COVID-19 is caused by a virus	Strongly agree	56(14.74)	22(14.57)	34(14.85)	0.824
	Agree	267(70.26)	107(70.86)	160(69.87)	
	Disagree	55(14.47)	22(14.57)	33(14.41)	
	Strongly disagree	2(0.53)	0(0.00)	2(0.87)	
	Strongly agree	102(26.84)	48(31.79)	54(23.58)	0.084

COVID-19 is a contagious disease	Agree	243(63.26)	91(60.26)	152(66.38)	
	Disagree	31(8.16)	11(7.28)	20(8.73)	
	Strongly disagree	4(1.05)	1(0.66)	3(1.31)	
COVID-19 is a flu-like disease	Strongly agree	73(19.21)	31(20.53)	42(18.34)	0.326
	Agree	262(68.95)	96(63.58)	166(72.49)	
	Disagree	43(11.32)	22(14.57)	21(9.17)	
	Strongly disagree	2(0.53)	2(1.32)	0(0.00)	
You can heal from COVID-19	Strongly agree	64(16.89)	29(19.21)	35(15.35)	0.946
	Agree	256(67.55)	96(63.58)	160(70.18)	
	Disagree	53(13.98)	23(15.23)	30(13.16)	
	Strongly disagree	6(1.58)	3(1.99)	3(1.32)	
2. COVID-19 Disease					
COVID-19 should be confirmed by a test	Strongly agree	57(15.00)	24(15.89)	33(14.41)	0.684
	Agree	284(74.74)	112(74.17)	172(75.11)	
	Disagree	36(9.47)	14(9.27)	22(9.61)	
	Strongly disagree	3(0.79)	1(0.66)	2(0.87)	
Testing sites for COVID-19 are easily available	Strongly agree	43(11.32)	20(13.25)	23(10.04)	0.849
	Agree	233(61.32)	85(56.29)	148(64.63)	
	Disagree	95(25.00)	43(28.48)	52(22.71)	
	Strongly disagree	9(2.37)	3(1.99)	6(2.62)	
Fever is a symptom of COVID-19	Strongly agree	100(26.32)	43(28.48)	57(24.89)	0.638
	Agree	239(62.89)	91(60.26)	148(64.63)	
	Disagree	38(10.00)	16(10.60)	22(9.61)	
	Strongly disagree	3(0.79)	1(0.66)	2(0.87)	
Cough is a symptom of COVID-19	Strongly agree	107(28.16)	49(32.45)	58(25.33)	0.927
	Agree	228(60.00)	80(52.98)	148(64.63)	
	Disagree	42(11.05)	19(12.58)	23(10.04)	
	Strongly disagree	3(0.79)	3(1.99)	0(0.00)	
Sore throat is a symptom of COVID-19	Strongly agree	102(26.84)	40(26.49)	62(27.07)	0.070
	Agree	227(59.74)	82(54.30)	145(63.32)	
	Disagree	48(12.63)	26(17.22)	22(9.61)	
	Strongly disagree	3(0.79)	3(1.99)	0(0.00)	
Body pain is a symptom of COVID-19	Strongly agree	75(19.74)	32(21.19)	43(18.78)	0.021
	Agree	215(56.58)	68(45.03)	147(64.19)	
	Disagree	85(22.37)	47(31.13)	38(16.59)	
	Strongly disagree	5(1.32)	4(2.65)	1(0.44)	

Diarrhoea is a symptom of COVID-19	Strongly agree	30(7.89)	15(6.55)	15(9.93)	0.977
	Agree	104(27.37)	38(25.17)	66(28.82)	
	Disagree	230(60.53)	89(58.94)	141(61.57)	
	Strongly disagree	16(4.21)	9(5.96)	7(3.06)	
Headache is a symptom of COVID-19	Strongly agree	81(21.32)	33(21.85)	48(20.96)	0.104
	Agree	238(62.63)	85(56.29)	153(66.81)	
	Disagree	58(15.26)	30(19.87)	28(12.23)	
	Strongly disagree	3(0.79)	3(1.99)	0(0.00)	
Loss of taste smell is a symptom of COVID-19	Strongly agree	90(23.68)	30(19.87)	60(26.20)	0.077
	Agree	213(56.05)	85(56.29)	128(55.90)	
	Disagree	75(19.74)	35(23.18)	40(17.47)	
	Strongly disagree	2(0.53)	1(0.66)	1(0.44)	
In suspecting COVID-19 I primarily measure fever	Strongly agree	29(7.63)	18(11.92)	11(4.80)	0.614
	Agree	259(68.16)	94(62.25)	165(72.05)	
	Disagree	85(22.37)	35(23.18)	50(21.83)	
	Strongly disagree	7(1.84)	4(2.65)	3(1.31)	
In suspecting COVID-19 I primarily see a doctor	Strongly agree	53(13.95)	24(15.89)	29(12.66)	0.390
	Agree	279(73.42)	101(66.89)	178(77.73)	
	Disagree	42(11.05)	23(15.23)	19(45.24)	
	Strongly disagree	6(1.58)	3(1.99)	3(1.31)	
3. Vulnerable group					
Young people are at risk of COVID-19	Strongly agree	61(16.05)	33(21.85)	28(12.23)	0.344
	Agree	197(51.84)	68(45.03)	129(56.33)	
	Disagree	111(29.21)	45(29.80)	66(28.82)	
	Strongly disagree	11(2.89)	5(3.31)	6(2.62)	
Old people are at risk of COVID-19	Strongly agree	131(34.47)	64(42.38)	67(29.26)	0.151
	Agree	219(57.63)	72(47.68)	147(64.19)	
	Disagree	29(7.63)	14(9.27)	15(6.55)	
	Strongly disagree	1(0.26)	1(0.66)	0(0.00)	
I should avoid unnecessary daily activities when I have COVID-19	Strongly agree	44(11.58)	18(11.92)	26(11.35)	0.965
	Agree	288(75.79)	115(76.16)	173(75.55)	
	Disagree	45(11.84)	15(9.93)	30(13.10)	
	Strongly disagree	3(0.79)	3(1.99)	0(0.00)	
People with comorbidities are more at risk of COVID-19	Strongly agree	92(24.21)	49(32.45)	43(18.78)	0.008
	Agree	238(62.63)	88(58.28)	150(65.50)	
	Disagree	46(12.11)	10(6.62)	36(15.72)	
	Strongly disagree	4(1.05)	4(2.65)	0(0.00)	
	Strongly agree	51(13.42)	27(17.88)	24(10.48)	0.065

People with disability are more at risk of COVID-19	Agree	190(50.00)	75(49.67)	115(50.22)	
	Disagree	130(34.21)	45(29.80)	85(37.12)	
	Strongly disagree	9(2.37)	4(2.65)	5(2.18)	
Pregnant women are more at risk of COVID-19	Strongly agree	72(18.95)	38(25.17)	34(14.85)	0.109
	Agree	231(60.79)	83(54.97)	148(64.63)	
	Disagree	75(19.74)	29(19.21)	46(20.09)	
	Strongly disagree	2(0.53)	1(0.66)	1(0.44)	
4. Transmission					
The disease can be transmitted through a cough	Strongly agree	92(24.21)	43(28.48)	49(21.40)	0.422
	Agree	263(69.21)	97(64.24)	166(72.49)	
	Disagree	23(6.05)	9(5.96)	14(6.11)	
	Strongly disagree	2(0.53)	2(1.32)	0(0.00)	
The disease can be transmitted through saliva droplets	Strongly agree	68(17.89)	31(20.53)	37(16.16)	0.192
	Agree	258(67.89)	102(67.55)	156(68.12)	
	Disagree	52(13.68)	17(11.26)	35(15.28)	
	Strongly disagree	2(0.53)	1(0.66)	1(0.44)	
The disease can be transmitted directly by touching infected surfaces	Strongly agree	83(21.84)	36(23.84)	47(20.52)	0.187
	Agree	260(68.42)	105(69.54)	155(67.69)	
	Disagree	33(8.68)	8(5.30)	25(10.92)	
	Strongly disagree	4(1.05)	2(1.32)	2(0.87)	
The disease can be transmitted directly through the consumption of contaminated dairy and meat	Strongly agree	25(6.58)	10(6.62)	15(6.55)	0.584
	Agree	116(30.53)	47(31.13)	69(30.13)	
	Disagree	199(52.37)	81(53.64)	118(51.53)	
	Strongly disagree	40(10.53)	13(8.61)	27(11.79)	
5. Prevention strategies					
To avoid contracting COVID-19, I avoid contact with individuals suspected to be infected with COVID-19	Strongly agree	64(16.84)	26(17.22)	38(16.59)	0.066
	Agree	255(67.11)	90(59.60)	165(72.05)	
	Disagree	49(12.89)	29(19.21)	20(8.73)	
	Strongly disagree	12(3.16)	6(3.97)	6(2.62)	
Washing hands with water and soap can eliminate the disease cause	Strongly agree	100(26.32)	45(29.80)	55(24.02)	0.182
	Agree	250(65.79)	96(63.58)	154(67.25)	
	Disagree	27(7.11)	9(5.96)	18(7.86)	
	Strongly disagree	3(0.79)	1(0.66)	2(0.87)	
Wearing of mask prevents COVID-19	Strongly agree	103(27.11)	45(29.80)	58(25.33)	0.462
	Agree	240(63.16)	84(55.63)	156(68.12)	
	Disagree	30(7.89)	18(11.92)	12(5.24)	

	Strongly disagree	7(1.84)	4(2.65)	3(1.31)	
Sanitizing of hands help prevent COVID-19	Strongly agree	111(29.21)	47(31.13)	64(27.95)	0.799
	Agree	243(63.95)	92(60.93)	151(65.94)	
	Disagree	23(6.05)	11(7.28)	12(5.24)	
	Strongly disagree	3(0.79)	1(0.66)	2(0.87)	
Opening windows thus keeping a room ventilated help in preventing transmission of CIVID-19	Strongly agree	103(27.11)	44(29.14)	59(25.76)	0.597
	Agree	239(62.89)	86(56.95)	153(66.81)	
	Disagree	36(9.47)	20(13.25)	16(6.99)	
	Strongly disagree	2(0.53)	1(0.66)	1(0.44)	
Home-made/traditional remedies help in the cure for COVID-19	Strongly agree	75(19.74)	30(19.87)	45(19.74)	0.143
	Agree	170(44.74)	77(50.99)	93(40.61)	
	Disagree	122(32.11)	40(26.49)	82(35.81)	
	Strongly disagree	13(3.42)	4(2.65)	9(3.93)	
Testing regularly is important in the prevention of COVID-19	Strongly agree	58(15.26)	26(17.22)	32(13.97)	0.216
	Agree	234(61.58)	80(52.98)	154(67.25)	
	Disagree	82(21.58)	42(27.81)	40(17.47)	
	Strongly disagree	6(1.58)	3(1.99)	3(1.31)	
Maintaining social distance is important in the prevention of COVID-19	Strongly agree	88(23.16)	34(22.52)	54(23.58)	0.246
	Agree	264(69.47)	101(66.89)	163(71.18)	
	Disagree	26(6.84)	15(9.93)	11(4.80)	
	Strongly disagree	2(0.53)	1(0.66)	1(0.44)	
Drinking alcohol is important in the prevention of COVID-19	Strongly agree	37(9.74)	22(14.57)	15(6.55)	0.021
	Agree	44(11.58)	19(12.58)	25(10.92)	
	Disagree	198(52.11)	73(48.34)	125(54.59)	
	Strongly disagree	101(26.58)	37(24.50)	64(27.95)	
Self-isolation distance is important in the prevention of COVID-19	Strongly agree	63(16.58)	30(19.87)	33(14.41)	0.791
	Agree	289(76.05)	107(70.86)	182(79.48)	
	Disagree	25(6.58)	12(7.95)	13(5.68)	
	Strongly disagree	3(0.79)	2(1.32)	1(0.44)	
Disclosing your COVID-19 status is important in the prevention of COVID-19	Strongly agree	75(19.74)	34(22.52)	41(17.90)	0.221
	Agree	245(64.47)	96(63.58)	149(65.07)	
	Disagree	54(14.21)	19(12.58)	35(15.28)	
	Strongly disagree	6(1.58)	2(1.32)	4(1.75)	
There is stigma if someone has COVID-19	Strongly agree	40(10.53)	22(14.57)	18(7.86)	0.048
	Agree	168(44.21)	67(44.37)	101(44.10)	
	Disagree	153(40.26)	56(37.09)	97(42.36)	

	Strongly disagree	19 (5.00)	6(3.97)	13(5.68)	
6.Vaccines					
Currently there is cure for COVID-19	Strongly agree	14(3.68)	6(3.97)	8(3.49)	0.999
	Agree	159(41.84)	64(42.38)	95(41.48)	
	Disagree	176(46.32)	67(44.37)	109(47.60)	
	Strongly disagree	31(8.16)	14(9.27)	17(7.42)	
COVID19 is not important	Strongly agree	64(16.84)	28(18.54)	36(15.72)	0.453
	Agree	237(62.37)	86(56.95)	151(65.94)	
	Disagree	73(19.21)	33(21.85)	40(17.47)	
	Strongly disagree	6(1.58)	4(2.65)	2(0.87)	
Vaccination sites are easily available	Strongly agree	47(12.37)	19(12.58)	28(12.23)	0.304
	Agree	250(65.79)	92(60.93)	158(69.00)	
	Disagree	72(18.95)	36(23.84)	36(15.72)	
	Strongly disagree	11(2.89)	4(2.65)	7(3.06)	
I would recommend someone to take a vaccine	Strongly agree	51(13.42)	18(11.92)	33(14.41)	0.061
	Agree	243(63.95)	89(58.94)	154(67.25)	
	Disagree	69(18.16)	37(24.50)	32(13.97)	
	Strongly disagree	17(4.47)	7(4.64)	10(4.37)	
Pfizer is better than Johnson and Johnson	Strongly agree	24(6.32)	6(3.97)	18(7.86)	0.094
	Agree	98(25.79)	33(21.85)	65(28.38)	
	Disagree	208(54.74)	93(61.59)	115(50.22)	
	Strongly disagree	50(13.16)	19 (12.58)	31(13.54)	

Objective 2: To investigate the perceptions of COVID-19 vaccines among young people in Soweto, South Africa

Table 12: Distribution of responses based on perception levels of COVID-19 disease and vaccines on gender

	1. General perceptions of COVID-19 vaccines				
Variable		**Total**	**Male**	**Female**	**P-value**
It is my opinion that early detection of COVID-19 can improve treatment and outcome	Strongly agree	52(13.68)	20(13.25)	32(13.97)	0.367
	Agree	303(79.74)	118(78.15)	185(80.79)	
	Disagree	21(5.53)	11(7.28)	10(4.37)	
	Strongly disagree	4(1.05)	2(1.32)	2(0.87)	
It is my opinion health education is important in the	Strongly agree	86(22.63)	33(21.85)	53(23.14)	0.467
	Agree	272(71.58)	107(70.86)	165(72.05)	
	Disagree	20(5.26)	10(6.62)	10(4.37)	

prevention of COVID-19	Strongly disagree	2(0.53)	1(0.66)	1(0.44)	
In my opinion COVID-19 is a serious disease	Strongly agree	146(38.42)	59(39.07)	87(37.99)	0.790
	Agree	169(44.47)	63(41.72)	106(46.29)	
	Disagree	52(13.68)	24(15.89)	28(12.23)	
	Strongly disagree	13(3.42)	5(3.31)	8(3.49)	
In my opinion COVID-19 can be avoided by proper precaution	Strongly agree	68(17.89)	34(22.52)	34(14.85)	0.522
	Agree	287(75.53)	103(68.21)	184(80.35)	
	Disagree	22(5.79)	13(8.61)	9(3.93)	
	Strongly disagree	3(0.79)	1(0.66)	2(0.87)	
It is my opinion COVID-19 is curable	Strongly agree	49(12.89)	21(13.91)	28(12.23)	0.551
	Agree	210(55.26)	84(55.63)	126(55.02)	
	Disagree	110(28.95)	42(27.81)	68(29.69)	
	Strongly disagree	11(2.89)	4(2.65)	7(3.06)	
I believe that the awareness of COVID-19 disease in society is sufficient.	Strongly agree	45(11.84)	19(12.58)	26(11.35)	0.961
	Agree	209(55.00)	82(54.30)	127(55.46)	
	Disagree	108(28.42)	42(27.81)	66(28.82)	
	Strongly disagree	18(4.74)	8(5.30)	10(4.37)	
Testing positive will lead to some negative things happening to me	Strongly agree	37(9.74)	20(13.25)	17(7.42)	0.128
	Agree	192(50.53)	76(50.53)	116(50.66)	
	Disagree	139(36.58)	50(33.11)	89(38.86)	
	Strongly disagree	12(3.16)	5(3.31)	7(3.06)	
My friends are reluctant from getting tested for COVID-19 disease	Strongly agree	44(11.58)	19(12.58)	25(10.92)	0.875
	Agree	190(50.00)	73(48.34)	117(51.09)	
	Disagree	125(32.89)	49(32.45)	76(33.19)	
	Strongly disagree	21(5.53)	10(6.62)	11(4.80)	
Am concerned of my family members getting COVID-19 from me	Strongly agree	67(17.68)	27(17.88)	40(17.54)	0.887
	Agree	219(57.78)	90(59.60)	129(56.58)	
	Disagree	84(22.16)	28(18.54)	56(24.56)	
	Strongly disagree	9(2.37)	6(3.97)	3(1.32)	
	2. COVID-19 information				
Information on COVID-19 is easily available	Strongly agree	77(20.26)	33(21.85)	44(19.21)	0.520
	Agree	227(59.74)	82(54.30)	145(63.32)	
	Disagree	61(16.05)	29(19.21)	32(13.97)	
	Strongly disagree	15(3.95)	7(4.64)	8(3.49)	
Information on COVID 19 is not easy to understand	Strongly agree	76(20.00)	38(25.07)	38(16.59)	0.187
	Agree	262(68.95)	96(63.58)	166(72.49)	
	Disagree	34(8.95)	14(9.27)	20(8.73)	

	Strongly disagree	8(2.11)	3(1.99)	5(2.18)	
I trust the information I receive about COVID-19 disease and COVID-19 disease	Strongly agree	61(16.05)	27(17.88)	34(14.85)	0.219
	Agree	205(53.95)	69(45.70)	136(59.39)	
	Disagree	85(22.37)	41(27.15)	44(19.21)	
	Strongly disagree	29(7.63)	14(9.27)	15(6.55)	
	3. COVID-19 vaccines				
I believe COVID-19 can stop me from being infected	Strongly agree	21(5.53)	8(5.30)	13(5.68)	0.137
	Agree	143(37.63)	51(33.77)	92(40.17)	
	Disagree	185(48.68)	76(50.33)	109(47.60)	
	Strongly disagree	31(8.16)	16(10.60)	15(6.55)	
I believe COVID-19 vaccine can stop me from getting severe disease	Strongly agree	34(8.95)	16(10.60)	18(7.86)	0.450
	Agree	159(41.54)	58(38.41)	101(44.10)	
	Disagree	141(37.11)	53(35.10)	88(38.43)	
	Strongly disagree	46(12.11)	24(15.89)	22(9.61)	
COVID-19 vaccine has serious side effects	Strongly agree	116(30.53)	42(27.81)	74(32.31)	0.283
	Agree	168(44.21)	67(44.37)	101(44.10)	
	Disagree	82(21.58)	36(23.84)	46(20.09)	
	Strongly disagree	14(3.68)	6(3.97)	8(3.49)	
My friends are reluctant from receiving COVID-19 vaccine	Strongly agree	61(16.05)	30(19.87)	31(13.54)	0.402
	Agree	177(46.58)	69(45.70)	108(47.16)	
	Disagree	116(30.53)	38(25.17)	78(34.06)	
	Strongly disagree	26(6.84)	14(9.27)	12(5.24)	
I would be willing to have my family members vaccinate first before I vaccinate	Strongly agree	54(14.21)	16(10.60)	38(16.59)	0.001
	Agree	222(58.42)	82(54.30)	140(61.14)	
	Disagree	92(24.21)	43(28.48)	49(21.40)	
	Strongly disagree	12(3.16)	10(6.62)	2(0.87)	
I would be willing to take a COVID-19 vaccine if am required to take two shots, with the second shot two weeks after the first shot	Strongly agree	43(11.32)	11(7.28)	32(13.97)	0.000
	Agree	179(47.11)	63(41.71)	116(50.66)	
	Disagree	129(33.95)	57(37.75)	72(31.44)	
	Strongly disagree	29(7.63)	20(13.25)	9(3.93)	
I trust the pharmaceutical industry producing COVID-19 vaccine	Strongly agree	24(6.32)	13(8.61)	11(4.80)	0.009
	Agree	171(45.00)	53(35.10)	118(51.53)	
	Disagree	124(32.63)	48(31.79)	76(33.19)	
	Strongly disagree	61(16.05)	37(24.50)	24(10.48)	
	Strongly agree	41(10.79)	17(11.26)	24(10.48)	0.001

When I get vaccinated, I protect people in my community	Agree	258(67.89)	88(58.28)	170(74.24)	
	Disagree	64(16.84)	32(21.19)	32(13.97)	
	Strongly disagree	17(4.47)	14(9.27)	3(1.31)	
COVID-19 is a punishment for our immorality and sins in the past	Strongly agree	34(8.95)	11(7.28)	23(10.04)	0.001
	Agree	93(24.47)	28(18.54)	65(28.38)	
	Disagree	166(43.68)	63(41.72)	103(44.98)	
	Strongly disagree	87(22.89)	49(32.45)	38(16.59)	
Quarantining people is the best way to prevent COVID-19 disease	Strongly agree	59(15.53)	21(13.91)	38(16.59)	0.227
	Agree	268(70.53)	104(68.87)	164(71.62)	
	Disagree	38(10.00)	20(13.25)	18(7.86)	
	Strongly disagree	15(3.95)	6(3.97)	9(3.93)	

Objective 3: To investigate the attitudes of COVID-19 vaccines among young people in Soweto, South Africa.

Table 13: Distribution of responses based on attitude levels of COVID-19 disease and vaccines on gender

Variable		Overall	Male	Female	P-value
	1. Attitudes of COVID-19 vaccines				
I think it's shame to be COVID-19 positive	Strongly agree	8(2.11)	5(3.31)	3(1.31)	0.624
	Agree	48(12.63)	23(15.23)	25(10.92)	
	Disagree	281(73.95)	101(66.89)	180(78.60)	
	Strongly disagree	43(11.32)	22(14.57)	21(9.17)	
If one of my relatives is positive for COVID-19 I would be willing to take care of him/her	Strongly agree	92(24.21)	46(30.46)	46(20.09)	0.001
	Agree	232(61.05)	92(60.93)	140(61.14)	
	Disagree	41(10.79)	10(6.62)	31(13.54)	
	Strongly disagree	15(3.95)	3(1.99)	12(5.24)	
If my friend is COVID-19 positive, I would be willing to continue my friendship with him/her	Strongly agree	85(22.37)	38(25.17)	47(20.52)	0.205
	Agree	222(58.42)	88(58.28)	134(58.52)	
	Disagree	56(14.74)	19(12.58)	37(16.16)	
	Strongly disagree	17(4.47	6(3.97)	11(4.80)	
If a shopkeeper is COVID-19 positive I will buy items from him or her	Strongly agree	20(5.26)	11(7.28)	9(3.93)	0.055
	Agree	133(35.00)	60(39.74)	73(31.88)	
	Disagree	129(33.95)	44(29.14)	85(37.12)	
	Strongly disagree	98(25.79)	36(23.84)	62(27.07)	

If a student is COVID-19 positive they should be allowed to continue with their studies, while they are still positive	Strongly agree	10(2.63)	6(3.97)	4(1.75)	0.583
	Agree	59(15.53)	24(15.89)	35(15.28)	
	Disagree	151(39.74)	57(37.75)	94(41.05)	
	Strongly disagree	160(42.11)	64(42.38)	96(41.92)	
If a teacher is COVID-19 positive should be allowed to continue with their teaching, while they are still positive	Strongly agree	8(2.11)	4(2.65)	4(1.75)	0.965
	Agree	43(11.32)	17(11.26)	26(11.35)	
	Disagree	161(42.37)	62(41.06)	99(43.23)	
	Strongly disagree	168(44.21)	68(45.03)	100(43.67)	
I prefer to break physical contacts from people living with COVID-19 disease	Strongly agree	41(10.79)	15(9.93)	26(11.35)	0.826
	Agree	239(62.89)	96(63.58)	143(62.45)	
	Disagree	87(22.89)	35(23.18)	52(22.71)	
	Strongly disagree	13(3.42)	5(3.31)	8(3.49)	
Hugging or shaking hands with people who are COVID-19 is dangerous	Strongly agree	92(24.21)	29(19.21)	63(27.51)	0.223
	Agree	229(60.26)	99(65.56)	130(56.77)	
	Disagree	53(13.95)	20(13.25)	33(14.41)	
	Strongly disagree	6(1.58)	3(1.99)	3(1.31)	
It is better to develop immunity by getting sick rather than by getting a vaccination	Strongly agree	31(8.16)	16(10.60)	15(6.55)	0.050
	Agree	86(22.63)	48(31.79)	38(16.59)	
	Disagree	214(56.32)	69(45.70)	145(63.32)	
	Strongly disagree	49(12.89)	18(11.92)	31(13.54)	
I believe that vaccinations prevent the disease they are supposed to prevent	Strongly agree	31(8.16)	11(7.28)	20(8.73)	0.050
	Agree	238(62.63)	88(58.28)	150(65.50)	
	Disagree	96(25.26)	43(28.48)	53(23.14)	
	Strongly disagree	15(3.95)	9(5.96)	6(2.62)	