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COVID-19 Vaccine Demand and Hesitancy Among University Students in Malawi

Ørjan Berg
Master of Science in Economics

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Ø.B.

Abstract

To deal with the spread of the coronavirus and thereby the adverse consequences related to the pandemic, reaching high levels of vaccine uptake has been of utmost importance. As of January 1. 2022, only around 8% of the Malawian population has been vaccinated against the coronavirus, leaving the population highly exposed to potential forthcoming outbreaks. There is reason to believe that the low degree of COVID-19 vaccination in the country can be partially warranted by high levels of vaccine hesitancy, as well as unwillingness to seek out vaccination services. Consequently, investigating why individuals are unwilling to get vaccinated is of great importance. This study utilizes survey data gathered from a sample of 764 university students in Lilongwe, Malawi, to identify key factors associated with vaccine demand and hesitancy. Findings indicate that students are substantially more likely to seek out vaccination services than the general population in Malawi. Furthermore, individual perceptions about the effectiveness of vaccines and the risks posed by the coronavirus are identified as strong and significant drivers of vaccination decisions. Conspiracies and myths about the side effects of the vaccines do not seem to be widespread, however, there seems to be much uncertainty associated with the effectiveness and safety of the available vaccines. The study emphasizes the importance of utilizing knowledge about individual behavior, attitudes, and perceptions in development of vaccination strategies and public health communication.

Keywords

COVID-19, vaccination behavior, vaccine hesitancy, behavioral insights, risk perceptions

Table of contents

List of tables

List of figures

1 Introduction

Throughout the last couple of years, the COVID-19 pandemic has had detrimental impacts on human lives and livelihoods around the world. Both directly, related to the mortality of the virus, and indirectly, related to the adverse responses of governments and institutions. As of 1 February 2022, there have been over 5.6 million confirmed deaths from the virus, as well as around 376 million confirmed cases (WHO, 2022). To put these numbers into context, WHO (2018) estimates that deaths from seasonal influenzas range within the numbers of 290.000-650.000 cases annually. The pandemic has also led to massive socio-economic impacts throughout the world, with soaring unemployment rates and drastic reductions in income for businesses as well as households.

The only efficient long-term strategy to deal with the pandemic is to achieve large-scale immunization of populations around the world (Randolph & Barreiro, 2020). Therefore, the production and distribution of vaccines promptly became the main focus in tackling the pandemic. Through a remarkable mobilization of resources and vast collaborative networks, we now have several effective vaccines, with no higher potential risks than existing vaccines (Baeza-Rivera et al., 2021). However, several countries, especially in Africa, have struggled to successfully vaccinate their citizens. This could potentially imply comprehensive negative consequences, including high mortality rates from the virus, increased pressure on health services, and adverse restrictions and sanctions to limit the spread of the virus in other ways. Furthermore, it might also have detrimental effects on the global community since a low degree of vaccination enables the virus to spread and potentially mutate into new variants.

In most countries COVID-19 vaccination has not been mandatory; hence the vaccination decision itself relies highly on individuals' willingness to accept and seek out vaccines based on their own free will. Furthermore, unwillingness to accept vaccines, namely vaccine hesitancy, is a problem in most countries around the world (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015). Therefore, simply increasing the supply of access to vaccines might not be sufficient to successfully vaccinate a big enough share of the population. As a consequence, understanding why individuals may be unwilling to accept vaccines or seek out vaccination services could be crucial to designing effective vaccination programs.

This study seeks to investigate which factors may influence behavior and attitudes about COVID-19 vaccination. More explicitly, it seeks to examine how factors such as beliefs about the virus and vaccines, social norms, information sources, personal experiences, and religious beliefs are associated with vaccine demand and hesitancy. Furthermore, it also seeks to investigate how individual risk tolerance is related to vaccination decisions. To answer these questions, I utilize survey data and experimental data gathered from a sample of 764 students attending the Lilongwe University of Agriculture and Natural Resources (LUANAR) in Malawi. The data was collected between February and March 2022, shortly after the omicron wave had peaked in Malawi.

The thesis consists of 6 chapters. The first chapter provides a brief introduction to the background of COVID-19 vaccination in Malawi, as well as a preview of existing research on the topic. The second chapter presents relevant theories and hypotheses used to answer the research questions. The third part presents the data and sample, while chapter 4 presents the methods used to analyze the data. In chapter 5, the results are presented, while the last part entails a discussion of the findings, a conclusion, and policy recommendations.

1.1 Background

As one of the poorest countries in Africa, Malawi is highly exposed to external health shocks, such as a global pandemic. According to the IPC (2022), well above 1 million people in Malawi are currently experiencing high levels of acute food insecurity. Furthermore, it has been estimated that approximately 50% of the population is living below the poverty line, while around 25% is living in extreme poverty (IMF, 2017). Moreover, health systems in the region are ill-equipped to deal with high levels of infection, and widespread infection control measures are likely to increase pressure on already exposed lives and livelihoods.

Accordingly, reaching high vaccination coverage is of utmost importance for the welfare of Malawian citizens, and the society as a whole. Vaccines are generally perceived as a cost-effective intervention due to the ensuing reductions in morbidity and mortality, as well as savings in the reduced need for sick care and workplace absence (Brewer et al., 2018). In the case of COVID-19, this is even more true, because of the substantial costs resulting from the intrusive policy measures imposed by governments around the world, as well as from the lost GDP due to the reduction in economic activity (Lopez-Valcarcel & Vallejo-Torres, 2021). Accordingly, the benefits from increasing vaccination and reducing other types of infection control measures are most likely enormous, even though this depends on how effectively the vaccines can protect against potential new mutations of the virus.

As of 28th January 2022, there have been reported a total of 84,309 confirmed cases and 2,553 deaths of COVID-19 in Malawi (Ritchie, et al., 2022). As of 31st January, 4.1% of the Malawian population have been fully vaccinated, while 3.6% have been partly vaccinated (Ritchie, et al., 2022). This accounts for a total number of approximately 1,900,000 vaccine doses. Consequently, only a small proportion of the population has been vaccinated against COVID-19. In April 2021 Malawi became the first African nation to destroy expired vaccine doses, due to low uptake of vaccines. Almost 20.000 expired doses were incinerated in Malawi alone, and other African countries soon followed their example (BBC, 2021). The low uptake of vaccines has been attributed to inadequate preparations, limited financial resources, weak health services, and poor infrastructure.

However, a question that arises is whether low vaccine demand or vaccine hesitancy has contributed to this problem. A 15-country study issued by the Africa CDC (Centre for Disease Control and Prevention) (2021) investigated the COVID-19 vaccine perceptions among African nations. They find a reasonably high willingness to accept vaccines in Malawi, where 80% of respondents report that they would take the vaccine if offered. Nonetheless, despite the relatively high willingness to accept vaccines, a significant proportion of people express concerns about the safety of the vaccines (CDC, February 2021).

Kanyanda et al. (2021) using national phone surveys in six African nations (including Malawi) found that at least four in five people were willing to be vaccinated in all but one country. Nevertheless, they also identified a robust share of vaccine hesitancy, especially related to safety concerns about the vaccine and the side effects. Accordingly, there is reason to believe that unwillingness to accept vaccines is contributing to the low vaccine uptake in Malawi.

1.2 Existing literature on the topic

The behavioral determinants of vaccination behavior have been widely researched throughout the last decades. Though most people all over the world today have good access to vaccines and vaccination services, delay, rejection, and inadequate uptake of vaccines are big threats to global public health. The problem is so pressing that in 2019, the year before the corona pandemic hit, the WHO (2019) announced vaccine hesitancy as one of the ten biggest threats to global health. Consequently, understanding vaccination behavior has become a hot topic within the fields of psychology and health economics.

A wide range of factors associated with vaccination demand and hesitancy has been identified, building on several different theoretical models conceptualizing health decisions. The most utilized models have been the Theory of Planned Behavior (TPB) (Ajzen, 1985), and the Health Belief Model (HBM) (Rosenstock, 1974) which apply to most types of individual health behavior. More recent and vaccine-specific frameworks include the “3 Cs” model of vaccine hesitancy (Complacency, Confidence and Convenience) (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015), and the “5 As” of vaccine uptake (Access, Affordability, Awareness, Acceptance and Activation) (Thomson, et al., 2016).

However, the complex nature of vaccine demand and hesitancy implies that attitudes and decisions about vaccination can vary according to the specific context, time, and place (Kalam et al., 2021). Accordingly, previous studies on vaccine uptake might have limited external validity when it comes to predicting behavioral determinants of COVID-19 vaccine demand in a specific country at a given time. Furthermore, when it comes to the relationship between risk preferences and vaccination behavior there is clearly a literature gap. Theoretically, there is still an incomplete understanding of the directional effect of risk tolerance for vaccine demand, considering that there are subjective risks associated both with getting vaccinated and abstaining from it (Binder & Nuscheler, 2017).

2 Theory & hypotheses

2.1 Defining vaccine demand and hesitancy

Vaccine demand is a complex phenomenon, and separating between vaccine demand and acceptance is a challenging exercise. A problem is that passive demand like vaccination intent or vaccine acceptance does not directly imply that individuals will actually undertake the vaccination action itself. This could be referred to as the intention-action gap (Thomson et al., 2016). To overcome this issue, the UNICEF/World Health Organization Strategic Objective 2 informal Working Group on Vaccine Demand (iWGVD) has defined vaccination demand in terms of behavior rather than attitudes (Hickler et al., 2017). More precisely demand could be defined as the actions of individuals and communities to seek, support and/or advocate for vaccines.

Vaccine hesitancy can be defined as a delay in the acceptance of vaccines or a refusal of vaccines, despite the availability of vaccine services (MacDonald & Hesitancy, 2015). This is a broad term that covers delay in vaccine uptake and acceptance, but also outright refusal. Furthermore, it is important to note that even though high levels of hesitancy lead to low vaccine demand, this does not necessarily mean that low levels of hesitancy will lead to high vaccine demand (MacDonald & Hesitancy, 2015). Consequently, it is possible to have a low demand for vaccines without having a big problem with vaccine hesitancy.

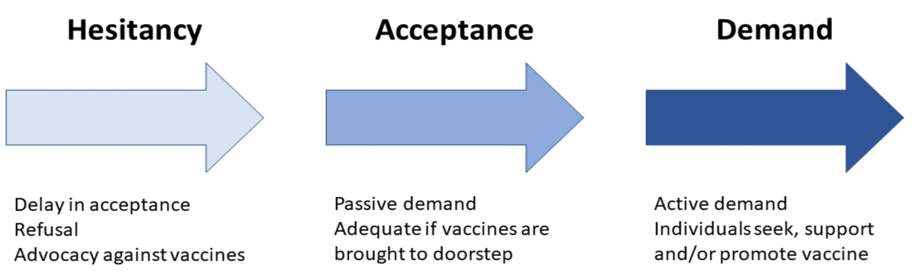

Figure 2.1. Defining vaccine demand, acceptance, and hesitancy. Based on definitions from Hickler, et al. (2017)

2.2 A conceptual framework for vaccination behavior

Several widely used theoretical models attempt to explain the conditions under which a person will engage in individual health behavior. One model that has received substantial empirical support, and that has been widely used to explain vaccination decisions, is the Health Belief Model (HBM) (Rosenstock, 1974). With a basis in psychological theory, the model attempts to predict why people will take action to prevent or control illness conditions (Glanz et al., 2008). Behavior is assumed to be influenced by some key variables, hereby the perceptions of susceptibility, the seriousness of the disease, the benefits of action, and the costs/barriers to action. Building on the HBM I have created a conceptual framework to help understand the factors that may influence individual behavior regarding COVID-19 vaccination. More precisely, why individuals are willing or unwilling to undertake the vaccination decision.

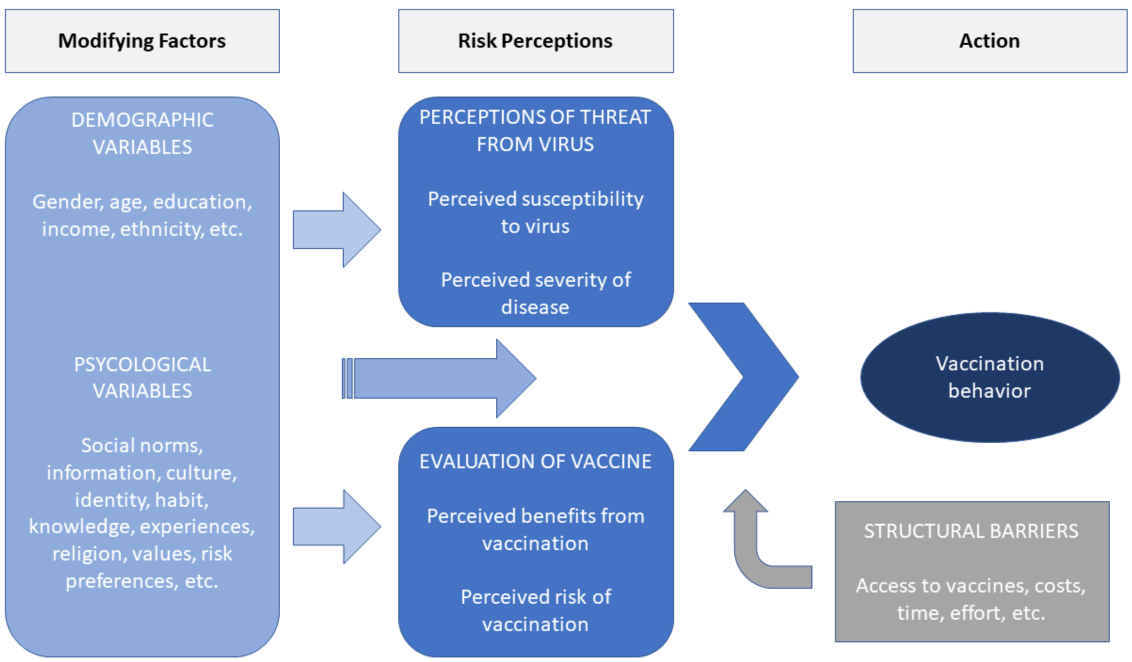

Figure 2.2. Conceptual framework, based on the Health Belief Model (HBM) and subsequent empirical work (Rosenstock, 1974; Ajzen, 1985; Janz & Becker, 1984; Betsch, et al., 2015).

The key idea is that the vaccination decision is governed by how individuals perceive the risks associated with contracting the virus, but also by the risks and benefits associated with injecting the vaccine. Hence, if people perceive that the virus itself poses a serious threat to their health, they are more likely to get vaccinated. On the other hand, if people perceive that the vaccine poses a risk, or that the benefits are minuscule, they are less likely to get vaccinated. Consequently, the vaccination decision depends highly on weighing these risks and benefits against each other. Some structural barriers may also interfere with a person's vaccination behavior, such as poor access to vaccines, inconvenience, transportation costs, and opportunity costs from taking time off work. Hence, some of the vaccine demand is likely to remain unfulfilled due to these barriers.

Table 2. 1. Determinants of vaccination behavior.

Perceived susceptibility	Beliefs about the likelihood of contracting the virus, for example through social activities, in the workplace or at school.
Perceived severity	Beliefs about the seriousness of the illness if you were to contract the virus. This includes both medical consequences (pain, disability, death) and social consequences (absence from work/school, family life and social relations).
Perceived vaccine benefits	Firstly, this includes perceptions about how effective the vaccine is for protection against virus infection and sickness. An individual who believes that the virus is highly infectious and dangerous is not likely to demand vaccines unless he thinks they will be effective in reducing the threat posed by the virus. In the case of COVID-19, there are also several other potential benefits from vaccination, such as reduced restrictions on mobility (travelling, events, etc.) and social recognition (avoiding shaming or distrust among your peers).
Perceived vaccine risks	Perceived dangers and/or costs associated with getting vaccinated. This is often related to beliefs about side effects and is triggered by emotions, feelings, information, social norms, personal experiences, and so on. Some people also find it uncomfortable or frightening to take vaccines, and fear of needles (trypanophobia) is one of the most common phobias around the world.

Structural barriers	Factors that limit the accessibility of vaccines and vaccination services. These can be supply-side issues, such as poor infrastructure and deficient access to health personnel. It can also be caused by a reluctance of individuals to undertake the costs and efforts associated with getting vaccinated. Few people get vaccines brought to their doorstep, thus locating and travelling to the nearest health clinic is often associated with some personal costs, be it time usage, travel expenditures or effort.
Demographic and psychological variables	Demographic, socio-economic, and psychological variables can have an indirect effect on vaccination behavior, by modifying the risk perceptions of individuals. For example, education may have an impact on perceptions about the riskiness of vaccines due to a better understanding of statistics and probability. Some of the psychological variables are also likely to have direct effects on vaccination behavior, such as social norms, habits, and identity.

2.2.1 Evaluating risk

Building on standard economic theory, the early models on vaccination behavior and motivation assumed people as rational agents, who carefully weigh the consequences of each alternative against each other to maximize their utility (choose the least risky option). However, thanks to insights from modern psychology and behavioral sciences, we now understand that people are often incapable of making completely rational decisions and are rather swayed by feelings and subjective perceptions. Consequently, there are several emotions and biases that may influence people's vaccination decisions.

One of humankind's main tools for dealing with uncertainty is the ability to make mental shortcuts, often called heuristics (Kahneman & Tversky, 1984). These are also useful when making judgements about the risks of vaccines and disease vulnerability, but they often lead us astray, forming the basis for many biases. The most prevalent of these might be loss aversion, which is the tendency for individuals to experience losses asymmetrically more severe than gains (Kahneman & Tversky, 1979). In the case of vaccination, this implies that avoiding the risks (losses) associated with vaccines might be perceived as more important than gaining protection from the vaccine, even though the gains outweigh the risks. A second mental shortcut that might lead to skewed risk perceptions is the affect heuristic. This implies that people are often guided by emotions when faced with uncertainty, rather than knowledge and statistics. For example, if a friend experiences serious implications from the corona vaccine, people are more likely to perceive vaccines as risky, even though the statistics remain unchanged. Closely related to this is the availability bias, which is the tendency for individuals to make decisions based on recent events and examples that immediately come to mind (Tversky & Kahneman, 1973). Hence, there is reason to believe that personal experiences and exposure to information are important determinants of vaccination behavior.

2.2.2 Modifying factors

In addition to the risk perceptions themselves, several demographic and psychological factors are likely to affect the vaccination decision directly, or indirectly by modifying the risk perceptions (Betsch et al., 2015). One factor that has been attributed a direct relationship with vaccine decisions is personal identity or inherent attitudes toward vaccines (Sobo, 2015). This anti-vaccine identity can arise from several places, including religious beliefs and communities, ideologies, and distrust in authorities. Holding on to misinformation is often a rationale for maintaining a certain identity or fitting into a group or a community. Hence, rejecting or opposing vaccines can be a means of sending out a message of who you are, rather than an attempt to maximize health benefits. This is closely related to conspiracy theories and is often enhanced by confirmation bias, which is the tendency to accept information that matches your preconceived attitudes and disregard information that opposes it (Kahneman, 2011).

Another factor that is likely to affect vaccination decisions directly is social norms (Betsch et al., 2015). It is useful to separate between injunctive norms, which express how you should behave (e.g., people expect you to get vaccinated), and descriptive norms, which express what people usually do (e.g., other people getting vaccinated). Injunctive norms are often effective in altering behavior because non-adherence can be sanctioned through social "penalties", such as a loss of social status. Descriptive norms, on the other hand, is more related to conformity, which is best described as an adjustment in behavior to fit a group norm. It has been found that when the majority of people are vaccinated, people are likely to conform to this behavior (Hershey et al., 1994). However, this is not necessarily the case for all populations or in all situations.

Knowledge about the virus and the vaccines presumably also have some impact on vaccination behavior. However, this impact is likely to be distorted by misinformation and feelings about the vaccination risks, or by social norms and affiliations (Betsch, et al., 2015; Slovic & Peters, 2006). Hence, personal experiences might be a better predictor of vaccination behavior than information or knowledge, because they have a greater impact on our feelings (Betsch, et al., 2015). However, this impact can also work the other way around if people experience side effects from the vaccines, which might lead to higher hesitancy. There is also reason to believe that if you do not take the vaccine and still do not experience any repercussions, this might reinforce the non-vaccination decision (Brewer, et al., 2018).

Gender differences are also likely to be associated with vaccine decisions. Several studies have found that men are more likely to accept vaccines than women (Dror, et al., 2020; Tavolacci, et al., 2021; Zintel, et al., 2022) and there could be several reasons for this. Firstly, several studies have found that women are more risk-averse than men (Croson & Gneezy, 2009; Byrnes, et al., 1999), which could potentially lead to more scepticism about the safety of vaccines. However, this is highly dependent on the risk-taking topic and can vary between age groups (Byrnes, et al., 1999) Furthermore, men and women respond differently to vaccines, and often females report more adverse effects from vaccines due to higher antibody responses (Jensen, et al., 2022).

2.2.3 Determinants of vaccine hesitancy

Many factors might influence vaccine hesitancy, namely delay in vaccine acceptance or refusal of vaccination (SAGE Working Group, 2014). Thus, a framework for understanding these might be useful. The WHO Strategic Advisory Group of Experts on Immunization (SAGE) Working group (2015) have developed a model to better understand the drivers of vaccine hesitancy, namely the 3C model, where three main determinants are proposed.

The first of these is **confidence**, which concerns trust in the effectiveness and safety of vaccines, the health services and professionals that deliver them, and in the motivations of policymakers who propose the vaccines (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015, p. 2). The second, is **complacency**, an issue when the perceived risk of illness from the vaccine-preventable disease is low, hence vaccination is not seen as necessary (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015, p. 2). As previously argued, individuals weigh the risks of vaccination against the risks of disease, thus if the risks of infection and severity of illness are deemed low, they are more likely to suffer from complacency. Complacency is also influenced by several other factors, such as self-efficacy or prioritizing other important life decisions. It might also be fortified by the omission bias, which leads to the tendency to favor inaction over action (Brewer, et al., 2018). The third determinant, **convenience**, concerns the affordability, availability, accessibility, and willingness to pay for vaccines (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015, p. 3). This determinant resembles the "Structural Barriers" from the conceptual framework and is related to the intention-behavior gap that can explain why individuals with a positive intention to vaccinate still do not get vaccinated (Betsch et al., 2015). In other words, what separates vaccine demand from acceptance.

In addition to these three, there have been proposed an additional two "Cs" of vaccine hesitancy (Oduwole, et al., 2019). The first of these is **calculation**, in which individuals rationally assess the risks of vaccination to decide. Hence, individuals with no strong pre-conceived attitudes towards vaccines actively seek out and assess information to make the decision that maximizes their subjective expected utility. This, again, relates to the subjecting weighting of risks and benefits of vulnerability to the virus versus vaccination. The second proposal is that a sense of **collective responsibility** can influence vaccination hesitancy because individuals may feel a social responsibility to vaccinate themselves to protect others (Oduwole, et al., 2019). However, this is not likely to be a strong predictor of behavior during the corona pandemic, considering that the vaccines do not guarantee against asymptomatic infection (Morens & Giurgea, 2022).

2.2.4 Limitations of models

The purpose of the conceptual framework is to identify and predict which factors may influence vaccination decisions, thus informing the derivation of hypotheses. The HBM has been extensively used by behavior scientists for this purpose priorly and is one of the most commonly used models to understand vaccination behavior (Sulat, et al., 2018). The model has received substantial empirical support since its origin and meta-analyses have shown that perceived susceptibility and seriousness of illness are associated with vaccination behavior (Brewer et al., 2007). It has also been found as a useful model to understand COVID-19 vaccination intention (Wong, et al., 2020).

The model is especially useful because it can be used to derive explicit hypotheses than can be empirically tested, namely from the key constructs of the model, which are perceptions about threats from the virus and evaluation of risks and benefits from vaccination. However, as a result, the effectiveness of the model will depend on the devotion to the model constructs and the nature of the outcome variables (Jones, et al., 2013). Hence, the validity of the model will depend on how the data is gathered and how the key variables are defined. In the case of this study, these constructs and the dependent variable are not designed according to the HBM, hence the key constructs may not be as effective in predicting vaccination behavior.

Furthermore, the HBM poorly captures other potentially important factors associated with vaccination decisions, such as the effects of social norms and personal experiences. As a result, developing testable hypotheses for these factors is more challenging, as there are no clearly defined constructs related to these. Hence, complementing the model with the 3C model might provide a better understanding of these key determinants. In this way, the models combined can be used to identify important factors influencing vaccination decisions. There are some clear overlaps between the models, such as the importance of confidence in the effectiveness of vaccines and the perceived risk of illness or infection from the disease. This substantiates the hypotheses related to these variables. However, there is also some added value from the 3C model, especially through distinguishing between the categories of hesitancy, namely confidence, complacency, and convenience, which provides a better understanding of why individuals may be hesitant about vaccination.

There is also reason to believe that there are location-specific effects in the context of health decisions (Karl et al., 2022). These can be related to local cultural values and social norms. Hence, the drivers of vaccine demand and hesitancy can vary based on the country or population that is evaluated. A concern is whether it is applicable for the case of university students in Malawi, or whether location-specific effects dominate. Consequently, the framework based on the HBM has some obvious limitations, but there is good evidence in support of the main constructs of the model.

2.3 Research questions and hypotheses

Building on the conceptual framework and theoretical models specified in this chapter, I have formulated the following research questions and hypotheses. Hypotheses will be tested by using the survey data sampled from Malawian university students.

Research Question 1: What are the main factors associated with COVID-19 vaccination behavior among university students in Malawi?

From the first research question, several interesting hypotheses arise. One of the key constructs of the conceptual framework is perceptions of the threats posed by the virus (see Figure 2.2). People care about their wellbeing, hence individuals who view the virus as highly susceptible and dangerous should be more inclined to seek out vaccination services. Therefore, **H1.1** (Table 2.1) states that *individuals who perceive that the virus represents a serious risk to their personal health are more likely to demand vaccines and less likely to be hesitant.*

Another key construct from the conceptual framework is the perceived benefits of getting vaccinated. The most important benefit of getting vaccinated is protection against infection or serious sickness. Consequently, **H1.2** states *that individuals who believe that vaccines effectively protect against infection and/or sickness are more likely to demand vaccines and less likely to be hesitant.*

Thirdly, social norms are likely to induce individuals' attitudes and behavior regarding vaccination (Betsch, et al., 2015). In a highly homogeneous university environment, students often depend on following the campus norms to fit in. Hence, perceptions about other students´ vaccination decisions are likely to affect your own decisions. Accordingly, **H1.3** states that *individuals who believe that a large share of fellow students is getting vaccinated are more likely to demand vaccines and less likely to be hesitant.*

Moreover, personal experiences are likely to influence vaccination decisions. Especially, individuals who have witnessed other people getting seriously sick from the coronavirus, are more likely to perceive it as dangerous, which could induce them to seek vaccination to avoid the same fate. This effect could be even larger if the person who was seriously sick was someone close, such as a friend or a family member. Therefore, **H.1.4** states that *individuals who have friends or relatives who have been seriously sick are more likely to demand vaccines and less likely to be hesitant.*

Another key construct of the conceptual framework is perceptions about the risks associated with vaccination, also related to confidence in vaccines. One key factor in this regard is perceptions about the side effects of the vaccines, namely undesirable effects from the treatment, often triggered by feelings and subjective risk perceptions. Hence, **H1.5** states that *individuals who believe that the vaccine will lead to an increased chance of getting sick and/or dying are less likely to demand vaccination, as well as more likely to be hesitant.*

Furthermore, vaccination behavior is often related to moral convictions and religious beliefs (Dubé et al., 2013). There are several potential reasons for this, including a preference for the “natural” over the “artificial” and a strong belief in a predestined fate for all humans (Ruijs et al., 2012). Some religious communities are well-known for rejecting vaccinations based on religious motives, such as the Amish in the United States, and the Orthodox Protestants in The Netherlands (Dubé et al., 2013). Consequently, **H1.6** states that *individuals who are strongly committed to religious practices are more likely to be hesitant towards vaccines and less likely to demand vaccination.*

As proposed in the 3C model, confidence in health services and health providers is also likely to influence vaccination decisions (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015). These are the institutions and people that give health advice, provide health services, and finally inject the vaccine. A distrust in these is likely a major factor when it comes to confidence in the vaccines. Hence, **H1.7** states that *individuals who do not trust the advice of health personnel about the pandemic are more likely to be hesitant and less likely to demand vaccination.*

Lastly, there are likely some gender differences in COVID-19 vaccination behavior, with females often reporting a lower vaccination intent than males (Zintel, et al., 2022). The mechanism's underlying these results are not well known but could be related to both different risk perceptions and disproportionately adverse effects from vaccination. Thereby, **H1.8** states that *females are less likely to demand vaccines and more likely to be hesitant.*

Research Question 2: How is risk tolerance related to vaccination behavior?

As outlined in the conceptual framework, vaccine decisions are highly related to risk perceptions and subjective probability weighting (Oduwole, et al., 2019). Firstly, the virus itself can pose a risk to your health if you are not vaccinated, and secondly, there can be a risk associated with taking the vaccine, represented by side effects. How an individual or group perceive these risks and weighs them against each other is highly subjective. Intuitively, if individuals associate the disease with high levels of risk, they are more likely to get vaccinated. Similarly, if they associate vaccination with high levels of risk, they are less likely to get vaccinated. A question that is poorly researched in this context is how the general risk preferences of an individual are related to risk perceptions about vaccines and vaccination choices.

By utilizing a modified one-shot version of the risky investment game, first proposed by Gneezy et al. (2009), it is possible to produce a measure of respondents' risk tolerance, which is closely related to loss aversion. An interesting question is whether an individual's risk tolerance can affect their hesitancy towards taking COVID-19 vaccines. As previously argued, the vaccination decision involves a trade-off between two risky alternatives, that is, vulnerability and vaccination (Binder & Nuscheler, 2017). This implies that risk tolerance and loss aversion might work either way for a specific individual, depending on how risky these alternatives are perceived to be Hence, in theory, loss aversion could both be associated with higher and lower vaccine demand, thus making it an empirical question. Unfortunately, the empirical evidence is scarce and the little evidence available is likely unreliable, due to the lack of controlled experimental settings. However, the evidence suggests that there might be a positive relationship between risk aversion and vaccination demand (Tsutsui, et al., 2010; Tsutsui, et al., 2012; Nuscheler & Roeder, 2016). This may indicate that getting vaccinated represents the least risky option and that the perceived risk of getting sick or infected outweighs the perceived risk of side effects. Consequently, **H2.1** (Table 2.1) states that *safer choices in the risky investment game are positively correlated with vaccine demand and negatively correlated with vaccine hesitancy*.

Table 2.1. RQs & hypotheses

RQ.1	**What are the main factors associated with COVID-19 vaccination behavior among university students in Malawi?**
H1.1	Students who perceive that COVID-19 represents a serious risk to their personal health are more likely to demand vaccines and less likely to be hesitant.
H1.2	Students who believe that vaccines are effective against infection and sickness are more likely to demand vaccines and less likely to be hesitant.
H1.3	Students with friends and/or relatives that have been seriously sick are more likely to demand vaccines and less likely to be hesitant.
H1.4	Perceptions about the share of fellow students getting vaccinated against COVID-19 are positively correlated with individual vaccine demand and negatively correlated with vaccine hesitancy.
H1.5	Individuals who believe that the vaccine leads to a higher risk of getting sick and dying are less likely to demand vaccines and more likely to be hesitant.
H1.6	Individuals who rank religious activity as a main hobby are less likely to demand vaccines and more likely to be hesitant.
H1.7	Individuals who do not trust the advice of health personnel are less likely to demand vaccines and more likely to be hesitant.
H1.8	Females are less likely to demand vaccines and more likely to be hesitant.
RQ.2	**How is risk tolerance related to vaccination behavior?**
H3.1	Safer choices in the risky investment game are positively correlated with vaccine demand and negatively correlated with vaccine hesitancy.

Table 2.2. Hypotheses and expected effects on dependent variables.

Dep. variable	Hyp.	Explanatory variable	Hypothesized sign
Demand			
	H1.1	Virus perceived as dangerous	+
	H1.2	Vaccines perceived effective	+
	H1.3	Friends/relatives have been seriously sick	+
	H1.4	Beliefs about other students getting vaccinated	+
	H1.5	Vaccines perceived as dangerous	-
	H1.6	Religious activity as a main hobby	-
	H1.7	Trust in the advice of health personnel	+
	H1.8	Female	-
	H3.1	Risky investment choice	+
Hesitancy			
	H1.1	Virus perceived as dangerous	-
	H1.2	Vaccines perceived effective	-
	H1.3	Friends/relatives have been seriously sick	-
	H1.4	Beliefs about other students getting vaccinated	-
	H1.5	Vaccines perceived as dangerous	+
	H1.6	Religious activity as a main hobby	+
	H1.7	Trust in the advice of health personnel	-
	H1.8	Female	+
	H2.1	Risky investment choice	-

3 Data & sample

3.1 Population and sample

This study utilizes data gathered at the Lilongwe University of Agriculture and Natural Resources (LUANAR), in Malawi. The data was gathered in the period February to March 2022 and consists of responses from 764 students at LUANAR, sampled from a broad range of different study programs within the fields of Agriculture, Biology, Natural Resource Management, Gender and Development, and Economics. Some examples of study programs are Agribusiness Management, Veterinary Medicine, Biotechnology, Development Economics, Environmental Sciences, and Agricultural Economics. The responses were gathered from two different campuses in the Lilongwe region, with most students coming from the Bunda Campus (87%) and the rest from the City Campus (13%). The sample covers first to fourth-year BSc students and a small share of MSc students. However, the majority of the sample consists of first to third-year BSc students.

Initially, 16 students were randomly sampled from each study program and year of study, however with some exceptions due to low participation from a couple of study programs. The result is 48 different groups of students that were interviewed separately. The sample should be fairly representative of the total population of students at LUANAR, even though not all study programs were included in the sample (Holden et al., 2022). The sample is hardly representative of the Malawian population or any other populations, but the findings might give some important insight into vaccination behavior and attitudes, that can be useful for better understanding the case of Malawi. Health decisions often suffer from location-specific effects, such as cultural values and norms, hence the insights from this sample are not necessarily valid for other countries than Malawi (Karl et al., 2022).

Table 3.1 illustrates that around 62% of the sample are male, while the remaining 38% are female. This is close to the true gender distribution at LUANAR. Most of the students range from the ages of 18 to 29 years, while a small share of students is in their thirties or forties. The majority (64%) are between 20 and 24 years of age. Furthermore, 93.5% of the sample comes from rural areas, while only 6.5% comes from urban areas. Students originate from a wide range of different ethnicities and districts, with the largest represented ethnicities being the Lomwe (21.5%), Chewa (20.5%), Tumbuka (18.5%), and Ngoni (15.8%) tribes. The fact that so many districts and ethnicities are represented, and that the majority of the students come from rural areas, substantiate the claim that insight from the sample can provide useful knowledge for the population of Malawi, especially considering that Malawi is mainly a rural country. There is also a wide variety of religious affiliations, with the majority of the sample adhering to the Christian faith (86.1%). The largest Christian denominations include the Central African Presbyterians, the Roman Catholics, the Seventh Day Adventist/Baptist, and the Pentecostal. A small share (3.4%) identify themselves as Sunni Muslims, around 10% identify with other religions, and almost no one (0.8%) has no religious affiliation.

Table 3.1. Sample characteristics.

Variable		Distribution (%)
Sex		
	Male	62.2
	Female	37.8
Age		
	17-19	10.5
	20-24	64.1
	25-29	19.9
	>29	5.5
Year of study		
	1st year BSc	25.0
	2nd year BSc	27.0
	3rd year BSc	35.5
	4th year BSc	8.4
	1st year MSc	3.0
	2nd year MSc	1.2
Campus		
	Bunda	87.4
	City	12.6
Rural or Urban		
	Rural	93.5
	Urban	6.5
Ethnicity		
	Chewa	20.6
	Lomwe	21.5
	Ngoni	15.8
	Nkhonde	3.7
	Sena	4.2
	Tonga	3.3
	Tumbuka	18.5
	Yao	7.3
	Other	5.2
Religion		
	Anglican	1.7
	Central African Presbyterians	31.3
	Jehovah’s Witnesses	2.0
	Pentecostal	14.4
	Roman Catholic	21.1
	Seventh Day Adventist/Baptist	15.3
	Sunni Muslim	3.4
	Other	10.1
	No Religion	0.8

3.2 Survey design and approach

The data collection was organized as a part of the project Experiments for Development of Climate-Smart Agriculture (SMARTEX), which is a collaborative research and capacity-building program between the School of Economics and Business (SEB) at NMBU and LUANAR. The project is a part of the NORAD-funded initiative NORHED II, which aims to strengthen the capacity of higher education institutions in developing countries. I participated in the data collection as a member of the SMARTEX-team, together with the team of LUANAR researchers as well as researchers at NMBU, who remotely administered the data sampling. More precisely, my role in the team encompassed the responsibility for randomization and payouts in incentivized games. As a consequence, I had limited influence on the survey questionnaire as well as other aspects of the data collection, hence the focus of this study has been highly dependent on the data gathered.

Methods used in the data collection, as well as a description of the data collected, are illustrated in a working paper by Holden et al. (2022). Nevertheless, the most central aspects of the survey questionnaire were knowledge about the pandemic, perceptions about the pandemic and protective measures, vaccination and testing, personal behavior in response to the pandemic, and perceptions about other people's behavior. Moreover, there was a section on demographics and family situation, also providing information on religious affiliation and activity and main social activities. The complete survey instrument is assessable in Appendix III.

Respondents were interviewed in groups of 16 students in a classroom setting with free seating on numbered desks. The desks had sufficient distance between them to avoid peeking and excessive communication. Students were provided with a tablet where they could access and respond to the survey instrument confidentially. The insurance of confidentiality, by utilizing tablets, could lead to more honest answers, compared to face-to-face interviews. Students were encouraged not to communicate and to contact an enumerator if in need of help. Because the data collection was organized during the fourth wave of corona (omicron) in Malawi, several measures were put in place to avoid infection among respondents, as well as among the researchers. These measures included mandatory use of facemasks, disinfection of equipment (tablets, pens, etc.), and social distancing.

A pilot test of the survey and experimental design was conducted on two groups of 16 students. This enabled the team to test the quality and effectiveness of the experimental design and the survey questionnaire, as well as prepare the instructors and experimenters for the first real groups. As a result, the survey instrument was updated thanks to a better comprehension of how good the students understood the survey, and the experimental design was customized to make the experiments seem more real to respondents.

3.3 Experimental design and approach

In addition to the survey instrument, utilizing a withing-subject design, students were subject to a series of experiments, or games. This included a sharing game, a dictator game, a trust game, and a risky investment game. For the purpose of this thesis, the risky investment game is the only experiment I will use, given the problem statement. Hence, I will not explain the design of the other experiments, elaborate on their usefulness or present data from these.

The risky investment game was first proposed by Gneezy & Potters (1997) to test the presence of myopic loss aversion, namely the tendency for people to be more attracted to risky options with a positive expected return when the evaluation period is longer. However, in this study, we have utilized a simple one-shot version of the game, building on the version used by Gneezy et al. (2009) who used the experiment to measure risk aversion across gender groups. In this initial experiment by Gneezy et al. (2009), subjects were first endowed with a small amount of money, hence they were asked how much of this they were willing to invest given a 50% chance of getting their investment tripled and a 50% chance of losing the money invested. However, a recent study by Holden & Tilahun (2021) found that this design can produce a significant endowment effect. That is, subjects are more likely to retain the amount when they have already acquired it, compared to if they had not acquired it beforehand. This phenomenon is closely related to loss aversion and the finding that the loss in utility from giving up one good roams lager than the gain from acquiring the same good (Thaler, 1980). Nevertheless, this effect can lead to biased estimates, especially if the goal is to frame the results with Expected Utility Theory (EUT), which captures risk aversion as utility curvature (Holden & Tilahun, 2021).

The experiment used in this study was designed to avoid this endowment effect, hence getting a more reliable measure of risk tolerance. The experimental protocol is attached in Appendix III, but in brief, the procedure of the game was as follows. The game was divided into two stages, whereas the second stage is the only one that will result in a real payoff. In the first stage, subjects were given the choice between a risky and a safe option. The risky option is a 50% chance of winning 3000 Malawi Kwacha (MKW) and a 50% chance of winning nothing.

The safe option is a 100% chance of winning 1000 MKW. The result of the risky option was decided by tossing a 20-sided die. In the second stage, subjects had to choose between 6 alternative mixes of risky and safe amounts, ranging from the riskiest option (50% chance of winning 3000 MKW and no safe amount) to the safest option (100% chance of winning 1000 MKW and no risky amount). Also here, the outcome of the risky amount was decided by tossing a 20-sided die. Subjects were informed that their choices will lead to real payouts after the game is finished, and the game was only played once. In addition to filling their choices on the tablets, students also had to fill out a paper game sheet. The purpose of this was to simplify the randomization-and payout process, as well as for accounting purposes.

The purpose of the experiment is to measure and estimate risk tolerance among subjects, which relates to how much risk individuals are willing to take when faced with risky decisions. A key hypothesis in this study is that vaccination decisions are significantly correlated with general risk tolerance. For this study, choices in the risky investment game will serve as an instrument for individual risk tolerance. Hence risk tolerance is represented by the choice among the 6 alternative mixes of risky and safe options in the game, which means that choosing a relatively riskier option in the game indicates a relatively higher degree of risk tolerance.

3.3.1 Limitations

The one-shot version of the risky investment game is often preferred due to its simplicity and because it might be more easily understood compared to more complicated tools, such as the Holt & Laury (2002) (HL) Multiple Choice List approach. A literature review by Charness & Viceisza (2016) found that the risky investment game may be more suitable for subjects with limited education in developing countries and that the HL approach was not well understood among their sample in rural Senegal. A lack of understanding will lead to inconsistencies and measurement error, which is a major problem when measuring risk preferences. This is likely one of the reasons why there has historically been weak predictive power and weak correlation between different risk preference measures (Gillen, et al., 2019). In other words, the choice of measurement tool matters, and identifying a tool that minimizes measurement error is of great importance.

The risky investment game has many positive traits, including that it is easy to understand, it is incentivized, and it can easily and quickly be implemented and incorporated into larger surveys (Holden & Tilahun, 2021). For the sake of this study, where participants were subject to a series of experiments and a large survey, there was a need for a speedy design, thus the one-shot risky investment game presented a better choice compared to more complicated and time-consuming experiments. However, there are some major limitations of the game (Holden & Tilahun, 2021). Firstly, it cannot by itself separate the effects of utility curvature (EUT), probability weighting, and loss aversion. This means that the investment decision in the game could potentially depend on any one of these, and most likely a combination. Secondly, the design of the game cannot remove measurement error from the decision made in the game. However, as already argued, the simplicity of the game might imply that subjects have a better understanding of their decisions, hence reducing measurement error in the game.

Furthermore, one fundamental question is to what degree the decisions in the game are relatable to real-life risky decisions, such as getting vaccinated. Unfortunately, this subject has been poorly researched. A study by Dasgupta et al. (2019) utilized the risky investment game using a within-subject design and noted that decisions in the game were correlated with the willingness to participate in a subsequent game. However, as with most experimental measures on risk preferences, the predictive power of the risky investment game decisions is deemed to be low. One reason for this may be due to response errors in the game (Kimball, et al., 2008). Another study, by Holden & Tilahun (2021), used a within-subject design to test whether decisions in the risky investment game can predict real-world investments among young business group members in rural Ethiopia. They found a low correlation, supporting the claim that there is substantial measurement error in the game. Consequently, there is reason to believe that individuals´ decision in the game is only partially affected by their true risk tolerance, thus serving as a poor instrument for general risk tolerance.

4 Methodology

4.1 Measuring vaccine demand and hesitancy

As argued in chapter 2, defining vaccine demand, acceptance, and hesitancy is a challenging exercise, and there are some limitations associated with the data. However, building on the definitions from chapter 2, I have been able to construct some viable measures.

Vaccine demand could be defined as the active effort of individuals to seek, support, and/or advocate for vaccines (Hickler, et al., 2017). However, as of February 2022, the most burdensome waves of the corona pandemic have most likely already passed, and the largest campaigns to roll out vaccines are completed. Hence, a key assumption is that those who demanded vaccines have already tried to get vaccinated. Consequently, vaccine demand is measured as the share of students that have answered “Yes” to the question “Have you already been vaccinated against COVID-19?” in the survey, plus the share of students that have responded “Yes” to the question “If you are not vaccinated, have you tried to get vaccinated?” (see Appendix III).

One weakness of this measure on vaccine demand is that we do not know in what way these latter individuals have tried to get vaccinated, or the nature of the barriers that prevented them from getting vaccinated. Therefore, another key assumption is that these individuals would have already been vaccinated, had it not been for some supply-side barriers, such as limited health service capacities and poor vaccination infrastructure. Another problem is that around 16% of these individuals, who once tried to get vaccinated, are now reluctant to get vaccinated. In other words, they have changed their mind since the initial action. Nevertheless, given the assumption that all those who wanted to get vaccinated have already tried, these individuals may still be counted as vaccine-demanding, and not as vaccine-hesitant.

Vaccine acceptance is measured as the share of students who have responded “Yes” to the question “Would you like to get vaccinated against COVID19?”. Hence, vaccine acceptance is measured as the share of students who have not already gotten vaccinated or tried to get vaccinated, but who would still like to get vaccinated. Vaccine hesitancy can be seen as the counterpart to vaccine acceptance, measured as the share of students who have not answered “Yes” to any of the questions “Have you already been vaccinated against COVID-19?”, “If you are not vaccinated, have you tried to get vaccinated?”, or “Would you like to get vaccinated against COVID19?". However, a limitation of the data is that there exists no good variable that can differentiate between those who actively oppose vaccination and those who simply experience a delay in acceptance.

4.1.1 Key variables of interest

To test the hypotheses formulated in chapter 2, I have utilized variables from the dataset to construct some viable measures of these factors. There are, of course, some limitations associated with these variables, and we have to acknowledge that there are some measurement errors associated with the survey design. Table 4.1 shows a description of the variables used to test my hypotheses, including the mean values, the standard deviation, and minimum and maximum values. The questions used to measure these variables are derived from the questionnaire, as shown in Appendix III.

Perceptions about the risks related to the virus and the vaccines are measured through the question "Do you perceive COVID-19 represents a serious risk to your personal health?". Similarly, the perceived benefits of the vaccines are measured through the questions "Does vaccination against COVID-19 protect persons against being infected by the virus?" and "Does vaccination against COVID-19 protect persons from getting seriously sick?". In other words, respondents were asked directly about the perceived threats from the virus and the perceived benefits of the vaccines. Sickness among friends and family is measured through the questions "if you have friends who have been infected, have any of these been seriously sick?" and "if you have relatives who have been infected, have any of these been seriously sick?".

To measure social influence, respondents were asked to enter the share (%) of students at the university they believe have been vaccinated against COVID-19. However, some respondents (45) seem to have misunderstood this question, entering non-percentage numbers. Because of the theoretical importance of normative social norms for vaccination behavior, I have chosen to drop these observations from the models. However, dropping these might introduce attrition bias if these dropped individuals have some common characteristics that have caused them to answer wrongly in the first place. One could for example imagine that individuals with lower numeracy skills are more likely to type void numbers on such questions, although, I have no available measures on numeracy skills. Nonetheless, I have run tests to check for attrition bias, checking if the dropped observations share some observed demographic characteristics, and I find no evidence for attrition bias (Appendix II). Hence, I assume that dropping these observations will not induce biased results.

When it comes to the perceived risks associated with the vaccines, respondents were asked to rank the top three negative effects from the question “What do you think the main negative effects of vaccination against COVID-19 are?”, where “Higher risk of getting sick and or die” was an alternative. Since most of the students who ranked this as a top-three negative effect have ranked it as either number 1 or number 2, I have created a dummy variable, taking the value 1 if ranked and 0 if not ranked (see Table 4.1). Hence, I assume that simply selecting it as an option in the questionnaire can be seen as a belief that the vaccine leads to a higher chance of sickness and death. Perceptions about the share of students who believe that vaccine is more dangerous than the virus itself are measured through the question “How big share of the students believe that the vaccine is more dangerous than the coronavirus itself?”, where alternatives were represented by five brackets (1-20%, 21-40%, etc).

Religious commitment is measured through the question “Rank your three most important social activities/hobbies”, where respondents rank religious activity by importance, compared to other generally important social activities, such as sports and spending time with friends as a dummy variable. It has been transformed into a dummy variable, taking the value of 1 if religious activity is among the top three hobbies, and 0 if not. The reason this variable has been transformed into a dummy is that we cannot assume that the rank unit effect is linear. Rather, there are likely some essential differences between those who have listed it as a top 3 hobby and those who have not. This is also supported by the data, where we can see that the majority of those who ranked it also frequently go to church or play an active role in the church.

The same logic is applied to trust in health personnel which is measured as a dummy, taking the value 1 if ranked among the top three categories from the question “Who do you respect/trust the most and follow the advice of in relation to the pandemic?”, and 0 otherwise. In other words, I assume that those who have ranked it among the top 3 most trusted information sources have an elementary higher trust in health personnel, compared to those who did not.

Table 4.1. Description of key variables and hypotheses.

Variable	Hyp.	Description	Obs.	Mean	Std. Dev.	Min	Max
vac_demand		1 if vaccinated or tried to get vaccinated, 0 otherwise	764	.461	.499	0	1
vac_hes		1 if neither tried to get vaccinated nor want to get vaccinated, 0 otherwise	764	.386	.487	0	1
risk_percep	H1.1	1 if believe COVID-19 poses risk to personal health, 0 otherwise	764	.804	.397	0	1
vacprot_inf	H1.2	1 if believe vaccine protect against infection, 0 otherwise	764	.329	.47	0	1
vacprot_sick	H1.2	1 if believe vaccine protect against sickness, 0 otherwise	764	.719	.45	0	1
sick_friend	H1.3	1 if had friend who has been seriously sick, 0 otherwise	764	.323	.468	0	1
sick_relative	H1.3	1 if had relative who has been seriously sick, 0 otherwise	764	.39	.488	0	1
student_vac	H1.4	Perceived % of students vaccinated	719	38.135	21.686	0	100
vac_sick	H1.5	1 if believe vaccine leads to higher chance of sickness, 0 otherwise	764	.073	.261	0	1
rel_act	H1.6	1 if religious activity is ranked among top 3 hobbies, 0 otherwise	764	.487	.5	0	1
trust_health	H1.7	1 if health personnel is among top 3 respected information sources in relation to pandemic, 0 otherwise	764	.893	.31	0	1
female	H1.8	1 if female, 0 otherwise	764	.378	.485	0	1
riskyinv	H2.1	Choice in risky investment game (1=full risk, 6=safe)	764	2.995	1.866	1	6

4.1.2 Endogeneity problems with explanatory variables

As conceptualized in chapter 2, some of these explanatory variables are most likely endogenous, namely dependent on other variables in the model. Decisions and perceptions are rarely independent but rather determined by other factors. This is also likely the case with many of the key explanatory variables in this case, which could potentially infer some endogeneity problems with the models. This again could give biased estimates from the models, violating the fundamental assumption for consistency of least-squares estimators that the error term is unrelated to the regressors, i.e., $E(u|x) \neq 0$ (Cameron & Trivedi, 2010).

As argued in chapter 2, perceptions about the threats posed by the virus and about the risks and benefits of the vaccines depend on a wide range of psychological and demographic factors, such as culture, norms, experiences, and gender. In other words, they are dependent on other variables in the models. Furthermore, this is also the case with perceptions about the share of fellow students that are vaccinated and trust in health personnel, which are likely to be dependent on social affiliation and personal experiences. Lastly, choices in the risky investment game are likely to interact with other types of perceptions, such as perceptions about the risks posed by the virus. Choices in the game are also positively correlated with being female, as well as negatively correlated with age. Nonetheless, I have no good instruments for these variables, hence endogeneity problems have to be assessed in the regression models following this chapter.

Nevertheless, some of the variables are also likely to be exogenous. Because of the random sampling of students within the classes, gender is likely random. The same is true for other demographic variables, such as age, religion, and marital status. Furthermore, religious activity, represented by self-stated importance as a social activity, is likely independent of other variables in the data set. Having friends or family that has been seriously sick is also likely to be random, as these events are independent of beliefs and perceptions. They could, however, interact with some demographic variables, such as family size or the number of close friends.

4.1.3 Control variables

To account for potential confounding factors that might influence vaccination decisions I have also included some control variables. These are demographic variables that ought to be associated with vaccination behavior, more precisely age, marital status, and whether the respondents are rural or urban. The purpose of including these variables is to assess the robustness of the findings and isolate the effects of the key explanatory variables, making sure that the effects are not due to some unobservable variables. Table 4.2 presents an overview of the control variables included in the regression models. The robustness of the findings is discussed later in this chapter.

Table 4.2. Description of control variables.

Variable	Description	Obs.	Mean	Std. Dev.	Min	Max
Age	Age of respondents	764	23.1	3.66	17	48
rural	1 if rural, 0 otherwise	764	.935	.247	0	1
married	1 if married, 0 otherwise	764	.058	.233	0	1

4.2 Empirical strategy

Panel data is often associated with longitudinal data, where the same individual is observed at different points in time. However, panel data methods can also be useful when working with cross-sectional data where each individual observed belongs to some distinct unit, such as a household, or in this case a class in a study program. It is probable that students who study in the same study program share some common characteristics. They are likely to share some background characteristics, such as similar interests, and they are frequently exposed to the same teachers and classroom environment, possibly even infecting each other with the virus. Hence, even though students are randomly drawn from each class, we cannot assume that students are independent observations within these classes. Effectively, this leads to a violation of the i.i.d. assumption, stating that random variables are independent and identically distributed. Consequently, we cannot use normal heteroskedasticity robust standard errors, but rather we need to correct the standard errors for clustering on classes. In addition, there are several other advantages of utilizing panel data methods. Firstly, it can model both the common and individual behavior within units (i.e. both students and classes), and secondly, it enables me to measure statistical effects that pure cross-sectional data cannot, such as the presence of correlated individual effects. As a result, panel data methods provide a data set containing more information and variability, and that takes the potential unobserved individual effects into account.

Given unobserved individual effects, the general class-individual panel model can be specified as:

$$y_{ic} = \alpha_i + x_i' \beta_{i1} + x_{ic}' \beta_{ic2} + u_{ic} \tag{4.1.}$$

where y_{ic} is the dependent individual-level variable, x_i' are class-level (individual-invariant) regressors, x_{ic} are class-individual-level regressors, α_i are class-specific effects, and u_{ic} is the idiosyncratic error. In this case, class-specific effects could be due to academic culture, while class-individual effects could be due to social interactions within the class.

This gives the following population-averaged (pooled) OLS models:

(4.2)

$$\begin{aligned} y_{ic} = \alpha_i &+ \beta_1 risk\_percep_{ic} + \beta_2 vacprot\_inf_{ic} + \beta_3 vacprot\_sick_{ic} + \beta_4 sick\_friend_{ic} \\ &+ \beta_5 sick\_relative_{ic} + \beta_6 student\_vac_{ic} + \beta_7 vac\_sick_{ic} + \beta_8 rel\_act_{ic} \\ &+ \beta_9 res\_health_{ic} + \beta_{10} female_{ic} + \beta_{11} riskyinv_{ic} + u_{ic} \end{aligned}$$

where y_{ic} is vaccination behavior, α_i is the intercept, u_{ic} is the measurement error, and β_1 through β_{11} are the parameters for key regressors. In addition, control variables for Age, rural, and married are included in some of the models to assess the robustness of key right-hand-side variables. The robustness of these models is elaborated on later in this chapter.

4.2.1 Considering linear probability models

When working with a binary dependent variable, there are some potential limitations of using a linear probability model (LMP), such as an OLS model (Wooldridge, 2016). Firstly, LPMs can produce predicted probabilities that are greater than 1 or less than 0, which is not possible. The second problem is that a LPM does not initially model nonlinear relationships between the dependent variable and the regressors. A linear model implies that the partial effects of any given explanatory variable are constant, which is not necessarily the case. A solution to these problems is to apply a logistic probability model using maximum likelihood estimation (MLE). A logistic model, such as a logit or probit, can capture nonlinear probability into a normal distribution and ensures that the predicted probability of the dependent variable ranges between 0-1 for all values of the regressors. However, this does not guarantee that the distribution is correct or that the regressors are linearly related to these distributions. The primary goal of such binary response models is to calculate the effects of the regressors x_{ic} on the response probability, namely the likelihood that the dependent variable will obtain the value 1, given by the function:

$$(4.3) \quad P(y = 1|x) = G(\alpha_i + \beta_1 x_{11} + \cdots + \beta_{ic} x_{ic}) = G(\alpha_i + x\beta)$$

where G is a function taking up values strictly between zero and one for all real numbers. However, logit and probit models are derived from an underlying latent variable y^*, which rarely has a well-defined unit of measurement. Therefore the coefficients are not useful in answering the question of interest, which is the effect of x_{ic} on the probability of success $P(y = 1|x)$. Fortunately, it is possible to calculate the marginal effects on the response probability from this model, which is easily done using statistical software, such as STATA. These effects are comparable to those from a linear model and can be used to assess the reliability of the effects from the LPM.

However, it is not given that the logistic probability model is a better fit than the linear model. Furthermore, the linear model is easier to interpret, seeing as you will get the marginal effects directly from the model. Therefore, a linear model is often preferred if the logistic model does not provide a substantially better fit, and often the linear and logistic models can give practically indistinguishable results (Hellevik, 2007). This is also the case with the data utilized in this study, where the marginal effects from the probit model are practically identical to those from the OLS model (see chapter 5). Moreover, as I am only interested in the average marginal effects, and no other aspects of the logistic function, utilizing a linear fit should not imply any problems.

4.2.2 Random versus fixed effects

The simple pooled OLS regression model does not deal with the unobserved class-specific factors that may interfere with the results, thus it can be regarded as a naïve model. However, several models can incorporate these unobserved confounding factors. We usually separate between Random Effects (RE) and Fixed Effects (FE) models. FE models assume that the class-specific effects (α_i) are correlated with the regressors (x_{ic}) in the model, resulting in inconsistent estimates on these independent variables. The FE model takes these confounding factors into account, providing consistent estimates of the regressors even though they are endogenous (dependent on class-specific effects). Thereby, we can view the error term from equation (4.2) as:

$$(4.4) \qquad u_{ic} = \alpha_i + \varepsilon_{ic}$$

where x_{ic} is allowed to be correlated with the individual-invariant error component α_i.

RE models, on the other hand, assume that the class-specific effects (α_i) are uncorrelated with the included regressors, thus individual effects are purely random. Hence there is no bias in ignoring the unobserved effects – they effectively become a part of the residual (u_{ic}). A consequence of this is that the residuals in a RE model are correlated across units, thus RE models can be estimated using Generalized Least Squares (GLS), which promises to provide more asymptotic efficiency than OLS, given that the RE assumptions are satisfied. However, the GLS assumptions are stricter than for OLS, and the efficacy gains are likely to be modest (Angrist & Pischke, 2009). Therefore, the costs of applying an RE model with finite sample properties might be bigger than the potential efficacy gains.

So which of these specifications is a better fit? Given that there exists some correlation between the unobserved class-specific factors and the explanatory variables, the pooled OLS and RE estimates are inconsistent. On the other hand, the FE estimator is less efficient than the RE estimator and is not able to estimate class-invariant regressors, such as for study programs or years of study. The choice of model should be well-founded in theory and intuition, but it is also possible to assess empirically using statistical tests. I have run Hausman tests to assess whether the RE and FE estimates are significantly different from each other, given both the simple models including only key exogenous regressors, as well as including all regressors and control variables. Test results are presented in Table II.4-II.7 in Appendix II. I was not able to reject the null hypothesis on the 5% level given any of the model specifications and conclude that the estimates are not significantly different, which indicates that the RE estimator is consistent and thus preferred. I have also run Breusch and Pagan Lagrangian multiplier tests for random effects given the same model specifications and found no evidence for random class-level effects. This indicates that the pooled OLS model could be just as good a fit as the RE model.

However, statistical tests are not by themselves a sufficient tool to override the choice of model; the decision also has to be founded on sound intuition and economic theory. Even though I found no evidence for correlated individual effects in the sample, there is reason to believe that the regressors in the model could be correlated with some unobserved class-specific factors. Perceptions about the coronavirus and the vaccines are likely dependent on academic culture, information sources, and social influence, which are all likely to vary between classes.

Classmates are influenced by each other, and they are exposed to much of the same inputs in their daily lives, hence it is very plausible that some unobserved class-specific factors influence beliefs, perceptions, and behavior related to the vaccine. In addition, a class environment is a place where diseases can easily spread among students, hence students may have been exposed to coronavirus outbreaks within the representative class. Therefore, we cannot discard the existence of correlated individual effects, thus FE models might be preferred to RE models or naïve pooled OLS models.

4.2.3 Causality or correlation

Separating between causal and correlational relationships can often be challenging, and in many cases impossible. Causality can be seen as the effect of a cause or a treatment on specific units or outcomes. The problem is that it is not possible to observe the counterfactual (what would have happened without the treatment) in the treatment group, hence we cannot say for sure that the effect is purely caused by the treatment. This has been referred to as the Fundamental Problem of Causal Inference (Holland, 1986).

In addition, there are multiple ways that causation can work other than the event A causing outcome B. For instance, the relationship can be reversed, there can be a confounding factor C, or there can be a chain reaction leading to outcome B. To establish causality, the following three conditions have to be met (Shadish, et al., 2002). Firstly, the cause must precede the effect. Secondly, the two variables need to be correlated, and this correlation cannot be due to chance (spurious). Thirdly, the correlational relationship cannot be due to some other confounding variable.

Consequently, claiming causality without observing a natural experiment, or under a controlled experimental setting, is close to impossible. Survey data does generally not satisfy these conditions, unless it captures some random shock that precedes the effect of interest, in this way creating a natural experiment. Consequently, claims about causality based on the data utilized in this study are likely implausible. However, a question that arises is whether experiences with the coronavirus, such as witnessing severe sickness or death among close friends or family members, can cause individuals to get vaccinated, hence representing a random shock.

One problem is that I do not have data on when this random shock took place, thus I cannot say for sure that it preceded the act of getting vaccinated. Another problem is that a random shock does not guarantee random assignment (Engel, 2016). It is imaginable that some individuals are more exposed to such events, due to social habits, family size, number of close relations, and so on. Hence, the data does not identify random exposure to the treatment of interest, only the reaction from it. Therefore, I cannot possibly test for causality using this data, the best I can do is correlation.

4.2.4 Robustness checks

To examine how robust the findings are, I have conducted several sensitivity analyses (robustness checks) to assess the reliability of the coefficients. A common exercise in econometrics is to examine how the regression coefficients behave when the model specifications change, namely by adding or removing explanatory variables. The core idea is that fragile regression coefficients are an indicator of misspecification and that such an analysis should be conducted to control for this (Leamer, 1983). The assumptions of any model are subject to uncertainty, and there is always uncertainty associated with the “true” values of coefficients, which could potentially change as the model specifications alter. This is especially true since the model has problems with endogenous regressors, as discussed in chapter 4.1.2.

To assess the robustness of key explanatory variables, I have started with simple models in the first stage, only containing exogenous right-hand-side variables. Afterwards, potentially endogenous regressors are added to the models, and lastly the control variables. The output is presented in Table II.1 and II.2 in Appendix II. We can observe that key variable coefficients are sensitive to alterations in the model specifications, both when using vaccine demand and vaccine hesitancy as dependent variables. Both in the case of demand and hesitancy, the effects from the variables “religious activity” and “relative has been seriously sick” are slightly reduced as the endogenous regressors are included. The effect of “female” is reduced as the control variable “Age” is included, likely due to the high correlation between the two. Inclusion of the other control variables, “rural” and “married”, does not seem to affect the key regressors much. Ultimately, the sensitivity to specific model changes indicates that the models suffer from some endogeneity problems. However, I do not have any good instruments for the potentially endogenous variables, hence I only have to acknowledge that there is substantial uncertainty associated with the true values of the coefficients

Nonetheless, how much can we trust this type of sensitivity analysis? The traditional idea in econometrics is that there exists one perfect model and that given the correct specifications, with robust coefficients, this model will provide structural validity. Conducting a robustness check of this nature is one way of determining this. However, there are numerous pitfalls when conducting this type of analysis, and the results could potentially be misleading (Lu & White, 2014). Claiming structural validity (and thusly reliable coefficients) solely based on this analysis could be fallacious. Rather, using the findings as an indicator of uncertainty in the model is more useful. Ultimately, the selection of core variables and structural specifications should be founded on sound theory and intuition, not statistical validity.

I have also tested for multicollinearity in the models, calculating the variance inflation factor (VIF), which measures the correlation and correlational strength between the explanatory variables in the regression model. The results indicate that I have no problems with multicollinearity in the models, with Age serving as the most highly correlated variable with a VIF value of 1.34 (Appendix II). This indicates that there is a low correlation between the explanatory variables. However, explanatory variables are likely to be correlated with omitted variables, potentially leading to omitted variable bias.

5 Results

5.1 Descriptive statistics

5.1.1 Vaccination decisions and attitudes

From Table 5.1 we can see that a relatively large share of the students in the sample has already been vaccinated with at least one dose (27.6%). This is a substantially larger share than the general population in Malawi, which was around 8% of the population going into February 2022 (Ritchie, et al., 2022). Out of the 211 vaccinated students, around 68% have received 1 dose of COVID-19 vaccine, around 31% have received 2 doses, and only one student (0.48%) has received 3 doses.

Table 5.1. Vaccination behavior and attitudes.

Variable	% Yes of 764 students
Have you already been vaccinated against COVID-19?	27.6
Have you tried to get vaccinated? (% Yes of 553 - those who are not already vaccinated)	25.5
Would you like to get vaccinated against COVID-19? (% Yes of 553 - those who are not already vaccinated)	42.5
Do you recommend all adults to get vaccinated?	80.1
Would you like to advise people to not take the vaccine?	15.7

Among those who are not already vaccinated, there is also a large share of students who state that they have tried to get vaccinated but failed. The nature of this attempt or the reasons why they were unsuccessful is not known, but as previously argued there are likely some structural barriers that limit the accessibility of vaccines. Plausible factors here include poor infrastructure, weak health service capacities, limited doses of vaccines available for distribution, and limited financial resources. Consequently, we are left with a majority (61%) of respondents who report that they have either already been vaccinated, have tried to get vaccinated, or would like to get vaccinated. This relates to the willingness to accept vaccines in the sample. Moreover, this means that we are left with a share of 39% who could be classified as vaccine-hesitant.

Put in perspective, this is a significantly lower willingness to accept COVID-19 vaccines than has been found in earlier studies from Malawi, where there has been found a willingness to accept vaccines above 80% (CDC Africa, 2021; Kanyanda, et al., 2021). Given the measurement tools specified in chapter 4, the distribution of vaccine demand, acceptance and hesitancy is illustrated in Figure 5.1, also illustrating the share of demanders who have successfully been vaccinated and the share who has tried, but not succeeded.

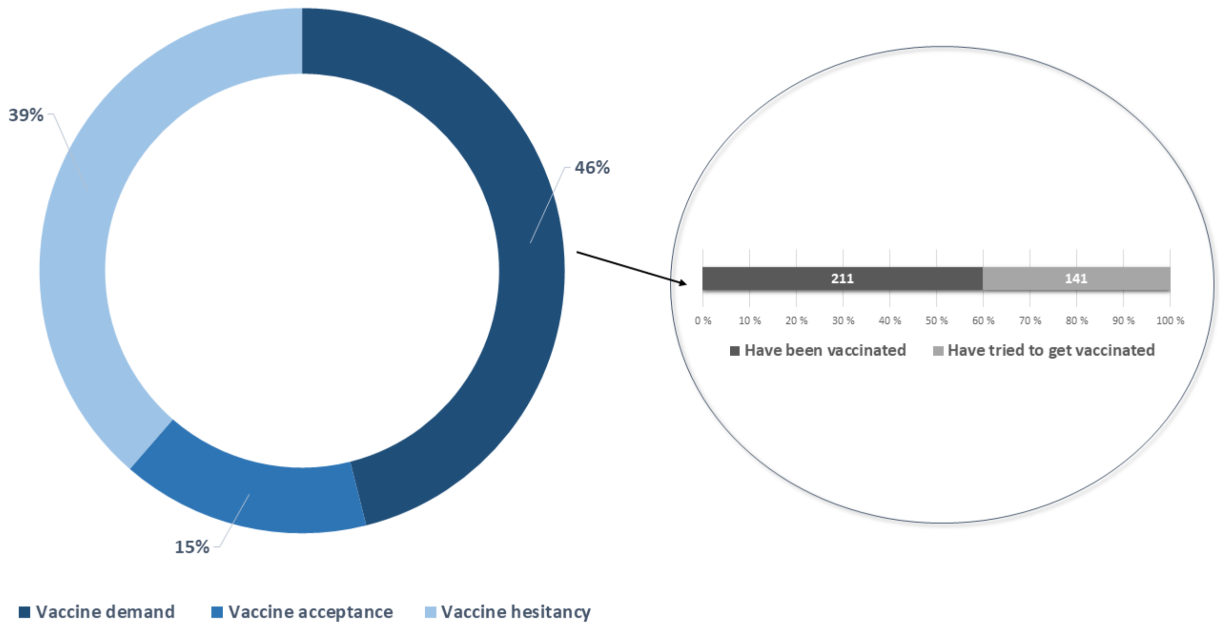

Figure 5.1. Distribution of vaccine demand, acceptance, and hesitancy.

Nevertheless, four in five students still recommend all adults to get vaccinated, which indicates that most students are in general positive towards the vaccines, even though they do not wish to inject the shot themselves. Furthermore, there is also a significant share of students (15.7%) who state that they would like to advise people not to get vaccinated. This could imply that we have a substantial share of anti-vaccinators in the sample, who outright oppose vaccination.

These respondents were also asked to elaborate on why they would like to advise people not to take the vaccine. The comments reveal that the most important reasons why students would like to advise people not to get vaccinated are because they believe that the vaccines are ineffective or because there is too much uncertainty associated with the vaccines (for instance due to inadequate testing). However, around 60% of these respondents seem to have misunderstood the question, indicating that they do not wish to advise people against vaccination after all. Moreover, very few express concerns about dangers or side effects associated with vaccination.

From Table 5.2 we can see that most students have a good or high trust in vaccines. However, there is also a notable share of students that report low or very low trust in vaccines. In total, around 29% of students report a distrust in vaccines, which is highly disturbing.

Table 5.2. Trust in vaccines.

How much trust do you have that vaccination is good for you?	Freq.	Percent	Cum.
Very low	104	13.6	13.6
Low	117	15.3	28.9
Good	278	36.4	65.3
High	134	17.5	82.9
Very high	131	17.2	100.0
Total	764	100.0	

5.1.2 Perceptions about positive/negative vaccine effects

From Table 5.3 we can see that the majority of respondents perceive that COVID-19 represents a serious risk to their health and perceive it as important for their health to get vaccinated. Paradoxically, these shares are higher than the willingness to accept vaccination, which might indicate that people can be hesitant towards vaccines even though they perceive the virus as a threat to their health and think that vaccination is important for their wellbeing. Furthermore, the majority of students think that vaccination protects against serious illness, while only a third think that it protects against infection. The latter might be explained by the realization that most COVID-19 vaccines do not guarantee against asymptomatic infection *(Morens & Giurgea, 2022)*.

Table 5.3. Perceptions about the effectiveness of vaccines

Variable	% Yes of 764 students
Do you perceive COVID-19 represents a serious risk to your personal health?	80.4
Do you perceive it as important for your own health to vaccinate yourself against COVID-19?	75.4
Does vaccination against COVID-19 protect persons against being infected by the virus?	32.9
Does vaccination against COVID-19 protect persons from getting seriously sick?	71.9

Students were also asked to rank the main positive and negative effects of the vaccines (Table 5.4). Following the questions above, we can observe that also here students report that the main positive effect of the vaccine is to reduce the risk of getting seriously sick. A large share also thinks that it gives a reduced risk of infection, but this is less important than the aforementioned. A significant share of respondents also states that it depends on how the individual reacts to the vaccine, which might relate to the view that vaccination can be more effective for some people, compared to others.

Table 5.4. Main positive and negative effects of vaccines.

Main positive effects of COVID-19 vaccination	Ranked importance (% of 764 students)			
	1	2	3	Not
Reduced risk of getting infected	45.4	10.1	1.3	43.2
Reduced risk of getting seriously sick or die	39.8	24.9	2.5	32.9
Depends on the type of vaccine	1.6	3.7	8.0	86.8
Depends on how the individual reacts to the vaccine	8.4	11.3	11.1	69.2
Depends on the type of coronavirus	1.7	2.5	5.9	89.9
No effect	2.9	0.3	0.4	96.5
Main negative effects of COVID-19 vaccination				
Higher risk of getting infected	3.8	0.8	0.5	94.8
Higher risk of getting sick and or die	3.7	3.1	0.5	92.7
Depends on the type of vaccine	13.9	18.7	12.3	55.1
Depends on how the individual reacts to the vaccine	60.9	9.8	4.2	24.9
Depends on the type of coronavirus	6.2	8.0	8.3	77.6
No effect	10.1	0.9	0.4	88.6

From Table 5.4 we can see that only a small share of students believe that vaccines will give a higher risk of getting infected or sick. This might indicate that few students believe the vaccines to be dangerous or see them as an irrefutable threat to their health. However, many report that they think it depends on the type of vaccine or on how the individual reacts to the vaccine. This indicates that some vaccines are regarded as more dangerous than others and that certain people are perceived as more exposed to negative effects than others. In general, only around 11% believe that there are no negative effects related to vaccines. One explanation for these results might be that there exists a lot of ambiguity about vaccines. People do not necessarily see vaccines as directly dangerous, but very few see them as entirely safe. This could potentially be one reason why vaccine hesitancy is so prevalent among students.

5.1.3 Perceptions about other students' behavior

From Figure 5.2 we can observe that there are widely separated opinions about how large a share of the students at the university has been vaccinated. The majority believe that below 60% of the student population has been vaccinated, but there is also a substantial number of respondents who believe that more than 60% have been vaccinated. This widely disbursed distribution might indicate that many students have little knowledge about the vaccination decisions of the general population at the university. Another interesting observation is that students who have either already been vaccinated or who have tried to get vaccinated (vaccine demand) generally seem to believe that a higher share of students has been vaccinated, compared to those who are hesitant about vaccines (Figure I.1, Appendix I).

Moreover, there is no consensus about the share of students who oppose vaccination (Table I.1, Appendix I). Few respondents think that above 80% of the students oppose vaccination, but there is a rather even distribution among the remaining brackets. However, the comments in the questionnaire reveal that there seems to be some misunderstanding of this question, possibly due to the framing. When it comes to beliefs about the share of students who think the vaccine is more dangerous than the virus itself, there is a somewhat more skewed distribution (Table I.2, Appendix I). The majority of respondents believe that this only applies to 40% of the students or less, while a smaller, but still substantial, share think that it applies to above 60% of students. In general, it might seem like beliefs about hesitancy and vaccine risks among fellow students are widespread. The majority of respondents believe that a sizeable share of fellow students opposes or fear vaccination against COVID-19.

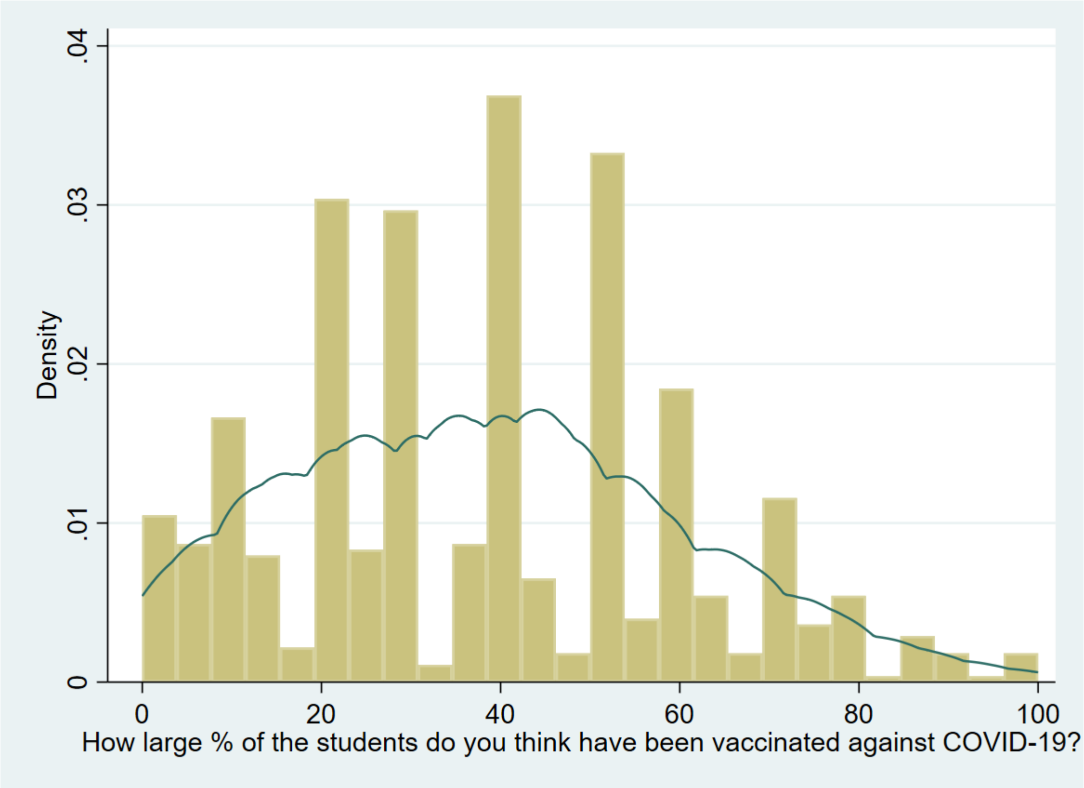

Figure 5.2. Perceptions about other students' behavior (45 missing observations due to entry errors by respondents).

5.1.4 Experiences with the virus

Out of the 764 respondents in the sample, most have encountered the virus in some way or another, either through getting infected themselves or by knowing someone else who has been infected (Table 5.5). Most of the respondents either have a friend or a relative who has been seriously sick, and the bulk of students also know somebody who has died from the virus. Nevertheless, it can seem like few respondents have experienced serious illness themselves, because the majority of those who have been infected from the sample did not get seriously sick (Table I.3, Appendix I). This could potentially be one reason why many students condone the perception that "the virus is only dangerous for other people, but not for me".

Table 5.5. Experiences with COVID-19.

Variable	% Yes of 764 students
Have you been infected by the virus at some point?	17.5
Do you have relatives who have been seriously sick from the virus? (% yes of 447 (58.51%))	66.7
Do you have friends who have been seriously sick from the virus (% yes of 525 (68.72%))	47.1
Do you know anybody who have died from COVID-19?	87.8
Have you lived with a person that have been infected?	31.9

5.1.5 Religion and social activities

The role of religion in Malawi is paramount, and this is also evident from the data. Almost 80% of the respondents go to church at least once a week, and over 70% state that they are active members of a religious group (Table 5.6 and 5.7).

Table 5.6. Religious activity.

Variable	% Yes of 764 students
Are you an active member of a religious group?	71.7
Do you have a church position? (% yes of 549 (71.86%))	39.2

Table 5.7. Frequency of Church visits.

How frequently do you go to Church/religious building?	Freq.	Percent	Cum.
Daily	29	3.80	3.80
More than once per week	272	35.60	39.40
Once a week	304	39.79	79.19
1-3 times per month	92	12.04	91.23
1-10 times per year	53	6.94	98.17
Less than one time per year	5	0.65	98.82
Never	9	1.18	100.00
Total	764	100.00	

To appreciate the crucial role that religion plays in the life of the average Malawian student, it is useful to compare the time spent on religious activities with other social activities, such as sports, reading, and spending time with friends. From Table 5.8 we can observe that religious activity is ranked as one of the most important social activities, even more important than sports. Consequently, this means that for many students, religious activity and commitment serve as one of the most important components of their lives. This could very well also influence their behavior in terms of vaccination decisions.

However, how reliable is this ranked importance as a measure of religious commitment? In Table I.4 (Appendix I), we can see that out of those ranking religious activity as one of their top hobbies, almost everyone (94.4%) visits the church at least once a week. In addition, the majority of these (87.1%) also state that they are an active member of their religious group. Consequently, this consistency leads us to believe that most of these respondents are indeed passionate about their religious faith and are not overstating or giving up untruthful responses.

Furthermore, it can seem like no specific religious belief is particularly overrepresented in terms of the religious commitment of its members (Figure I.2, Appendix I). From all the biggest religions, except Anglican, we can find a significant number of members that rank religious activity as one of their main social activities. Hence, it is not a religion-specific phenomenon, it applies to most religious communities at the university.

Table 5.8. Main social activities.

Main social activities/hobbies	Ranked importance (% of 764 students)			
	1	2	3	Not
Sports	26.1	8.4	7.6	58.0
Religious activity	24.6	15.6	8.5	51.3
Stay with friends	5.8	12.4	15.7	66.1
Computer games	3.3	3.9	4.6	88.2
Reading	14.0	15.1	14.0	56.9
Music	19.8	19.1	16.4	44.8
Spending time with family	6.0	9.3	15.1	69.6

5.1.6 Trust in information sources

As previously argued, a key determinant of vaccine hesitancy is often confidence, or trust, in the systems and professionals that provide vaccines, namely health personnel. We can see that most of the respondents perceive health personnel as highly respected and trustworthy (Table 5.9). However, there is also a significant share of respondents who state that they do not respect health personnel. A key hypothesis is that these individuals are more likely to be hesitant about vaccines. From Figure I.3 in Appendix I, we can see that there is a much higher share of hesitant individuals among those who do not trust health personnel, and vice versa. Another interesting remark is that there seems to be a severe lack of trust in political leaders, with only a handful of respondents ranking it as the most trusted information source. Furthermore, trust in health personnel seems to be very correlated with trust in vaccines, where only a few of those who do not trust health personnel also have high or very high trust in vaccines (Table I.5, Appendix I). This might indicate that trust in vaccines and trust in health personnel may be integrated.

Table 5.9. Respect/trust in information sources.

Who do you respect/trust the most and follow the advice of in relation to the pandemic?	Ranked respect/trust (% of 764 students)			
	1	2	3	Not
Religious leader	11.1	8.8	10.6	69.5
Political leaders	0.7	3.1	4.2	92.0
Health personnel	72.6	12.8	3.8	10.7
University leaders	1.4	13.2	15.5	69.9
Best friends	0.0	2.0	6.7	91.4
Parents	13.0	21.2	13.2	52.6
Others	1.2	1.1	3.1	94.6

5.1.7 The risky investment game

From the first stage in the risky investment game, we can see that only a small share of respondents prefer the safe option over the risky option (Table 5.10).

Table 5.10. Stage 1: Corner solution.

Risky or safe amount	Freq.	Percent	Cum.
Safe amount	170	22.3	22.3
Risky amount	594	77.8	100.0
Total	764	100.0	

The second stage of the game should be a much better tool for measuring risk tolerance among respondents, as this stage was incentivized, and students should now have a better understanding of the implications of their choice. However, we can see that the riskiest option is still the best-preferred choice among respondents, being selected by around one-third of students (Table 5.11). Nevertheless, a large share of respondents also chose a mix between the risky and safe amounts, leading to the conclusion that there exists a wide variety of risk tolerance levels within the sample.

Table 5.11. Stage 2: Combinations of risky and safe amounts.

Risky investment choice	Freq.	Percent	Cum.
1. 50% chance of Risky amount = 3000 + Safe amount = 0 (full risk)	256	33.5	33.5
2. 50% chance of Risky amount = 2400 + Safe amount = 200	121	15.8	49.4
3. 50% chance of Risky amount = 1800 + Safe amount = 400	80	10.5	59.8
4. 50% chance of Risky amount = 1200 + Safe amount = 600	105	13.7	73.6
5. 50% chance of Risky amount = 600 + Safe amount = 800	82	10.7	84.3
6. Risky amount = 0 + Safe amount = 1000 (no risk)	120	15.7	100.0
Total	764	100.0	

One indicator of the level of measurement error in the game is to look for inconsistencies between choices in the first and second stages of the game. For an individual who has successfully understood the game, risk tolerance should be somewhat stable throughout the game. However, from Table I.7 (Appendix I) we can observe that 47 respondents (7.9%) chose the risky amount in stage 1 and subsequently chose the safest option in stage 2. Furthermore, 17 (10%) of those who chose the safe amount in stage 1 selected the riskiest option in stage 2. Some of these inconsistencies could be due to respondents misunderstanding the game, although the fact that the first stage was not incentivized (no potential payout) could also have induced respondents to choose the risky option (since they had nothing to lose). Nevertheless, we have to recognize that there exists significant measurement error in the game from misunderstandings and inconsistent responses.

5.2 Econometric models

To answer the research questions and hypotheses formulated in chapter 2, I have estimated a series of regression models, as specified in chapter 4. Since vaccine demand and hesitancy are represented by two different equations (different outcome variables), different models have been estimated for the two variables. As argued in chapter 4, class FE models might be the most reliable estimation method given the data and model specifications. However, to assess the robustness of the findings, I have compared the findings to those from standard OLS, class RE, and Probit models. Furthermore, to additionally assess the robustness of the findings I start, in stage 1, with simple models only containing the exogenous right-hand-side variables. Thereby, the potentially endogenous variables, as discussed in chapter 4, are left out. In stage 2, I add the endogenous variables and assess the validity of the key variable coefficients.

5.2.1 Stage 1: simple models for vaccine demand

Table 5.12 presents the results from the simple models, using vaccine demand as the outcome variable and only key exogenous variables as regressors. The results from the probit models are represented by the average marginal effect, thus comparable to the output from the linear models. All models are applied with cluster-robust standard errors, with clustering on classes.

Table 5.12. Vaccine demand regressed on key exogenous variables.

Variables	Pooled OLS	Class RE	Class FE	Probit (Average Marginal Effects)
friend has been seriously sick	0.030 (0.039)	0.030 (0.042)	0.028 (0.043)	0.030 (0.041)
relative has been seriously sick	0.17^{***} (0.042)	0.17^{***} (0.040)	0.17^{***} (0.041)	0.17^{***} (0.039)
religious activity among top 3 hobbies	-0.085^{*} (0.039)	-0.085^{*} (0.036)	-0.085^{*} (0.037)	-0.085^{*} (0.035)
female	-0.10^{*} (0.044)	-0.11^{**} (0.037)	-0.13^{***} (0.039)	-0.11^{**} (0.037)
Constant	0.46^{***} (0.034)	0.47^{***} (0.033)	0.48^{***} (0.032)	
Observations	764	764	764	764
R^2	0.046		0.050	
Adjusted R^2	0.041		-0.018	

Cluster-robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

From these simple models, we can observe that having a relative that has been seriously sick is the strongest predictor of vaccine demand, significant on the 1% level. Having religious activity as a top hobby and being female are also important factors associated with vaccine demand, both negatively correlated. Having a friend that has been seriously sick is not significantly associated with vaccine demand. Coefficient values are fairly stable between the different models, indicating that the results are valid across model specifications. However, the female dummy seems to be a significantly stronger predictor when utilizing class FE.

5.2.2 Stage 1: simple models for vaccine hesitancy

As with the models above, Table 5.13 presents the results from the simple models, using vaccine hesitancy as the outcome variable and only key exogenous variables as regressors.

Table 5.13. Vaccine hesitancy regressed on key exogenous variables.

Variables	Pooled OLS	Class RE	Class FE	Probit (Average Marginal Effects)
friend has been seriously sick	-0.022 (0.042)	-0.023 (0.041)	-0.029 (0.042)	-0.022 (0.041)
relative has been seriously sick	-0.13^{**} (0.043)	-0.13^{**} (0.039)	-0.13^{**} (0.040)	-0.13^{***} (0.039)
religious activity among top 3 hobbies	0.14^{***} (0.036)	0.14^{***} (0.035)	0.14^{***} (0.036)	0.14^{***} (0.033)
female	0.11^{**} (0.039)	0.12^{**} (0.036)	0.13^{***} (0.038)	0.11^{**} (0.036)
Constant	0.33^{***} (0.031)	0.33^{***} (0.032)	0.33^{***} (0.032)	
Observations	764	764	764	764
R^2	0.052		0.056	
Adjusted R^2	0.047		-0.012	

Cluster-robust standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Also here, we can observe that having a relative that has been seriously sick is a strong predictor of vaccine hesitancy. Having religious activity as a top hobby is also strongly positively correlated with vaccine hesitancy, and the same applies to being female. Similarly, as for vaccine demand, coefficients are quite stable across model specifications, except for the dummy for female, which seems to be stronger when utilizing class FE.

5.2.3 Stage 2: models for vaccine demand including all regressors

In stage 2, I have included the potentially endogenous variables, as well as the control variables “Age”, “rural”, and “married”. The endogenous variables include perceptions about the virus and the vaccines, perceptions about behavior of others, trust in health personnel, and choices in the risky investment game. Also here, different model specifications are included to assess the robustness of the findings. Table 5.14 presents the regression models using vaccine demand as the outcome variable, with all regressors included.

Table 5.14. Vaccine demand regressed on all key variables and control variables.

Variables	Pooled OLS	Class RE	Class FE	Probit (Average Marginal Effects)
COVID-19 poses a risk to personal health	0.078	0.078	0.077	0.080
	(0.043)	(0.044)	(0.045)	(0.044)
vaccines protect against infection	0.12^{**}	0.12^{**}	0.11^{**}	0.12^{**}
	(0.036)	(0.038)	(0.039)	(0.036)
vaccines protect against sickness	0.17^{***}	0.16^{***}	0.15^{***}	0.17^{***}
	(0.039)	(0.040)	(0.041)	(0.039)
friend has been seriously sick	0.00084	0.0014	0.0036	0.00072
	(0.032)	(0.041)	(0.043)	(0.040)
relative has been seriously sick	0.16^{***}	0.16^{***}	0.15^{***}	0.16^{***}
	(0.037)	(0.040)	(0.041)	(0.038)
perceived % of students vaccinated	0.0049^{***}	0.0049^{***}	0.0048^{***}	0.0049^{***}
	(0.00071)	(0.00083)	(0.00086)	(0.00078)
vaccine leads to sickness	0.0015	0.00021	-0.0033	-0.012
	(0.054)	(0.068)	(0.070)	(0.071)
religious activity among top 3 hobbies	-0.087^{*}	-0.087^{*}	-0.087^{*}	-0.088^{*}
	(0.036)	(0.035)	(0.036)	(0.035)
health personnel respected	0.069	0.061	0.045	0.069
	(0.051)	(0.058)	(0.060)	(0.059)
female	-0.084	-0.092^{*}	-0.11^{**}	-0.091^{*}
	(0.042)	(0.039)	(0.040)	(0.038)
Risky investment choice	0.013	0.014	0.015	0.014
	(0.010)	(0.0094)	(0.0096)	(0.0093)
Constant	-0.39^{**}	-0.41^{*}	-0.43^{*}	
	(0.13)	(0.16)	(0.18)	
Observations	719	719	719	719
R^2	0.152		0.147	
Adjusted R^2	0.135		0.068	

Cluster-robust standard errors in parentheses
“Age”, “rural” and “married” are included as control variables
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Compared to the simple model from chapter 5.2.1, we can observe that the effects of the exogenous regressors are slightly reduced. Given class FE, the effects of having a relative that has been seriously sick are reduced from 17% to 15%, and being female is reduced from 13% to 11%. The change in the female dummy coefficient seems to be entirely due to the inclusion of the control variable “Age”, which is highly correlated with the female dummy. Furthermore, we can observe from Table 5.14 that the coefficient values also differ depending on the model specifications, indicating uncertainty about the true effects of the independent variables on the response probability. Following the hypotheses questioned in chapter 2, the coefficients indicate the following effects of the model.

5.2.4 Stage 2: models for vaccine hesitancy including all regressors

Table 5.15 presents regression models using vaccine hesitancy as the dependent variable, including all regressors and the control variables “Age”, “rural”, and “married”.

Table 5.15. Vaccine hesitancy regressed on all key variables and control variables.

Variables	Pooled OLS	Class RE	Class FE	Probit (Average Marginal Effects)
COVID-19 poses a risk to personal health	-0.15^{***}	-0.15^{***}	-0.14^{**}	-0.14^{***}
	(0.039)	(0.042)	(0.043)	(0.040)
vaccines protect against infection	-0.12^{***}	-0.12^{**}	-0.11^{**}	-0.11^{**}
	(0.033)	(0.036)	(0.037)	(0.036)
vaccines protect against sickness	-0.15^{***}	-0.15^{***}	-0.13^{***}	-0.14^{***}
	(0.040)	(0.038)	(0.039)	(0.036)
friend has been seriously sick	0.0064	0.0047	-0.0023	0.0021
	(0.040)	(0.040)	(0.041)	(0.039)
relative has been seriously sick	-0.12^{**}	-0.12^{**}	-0.12^{**}	-0.11^{**}
	(0.042)	(0.038)	(0.040)	(0.038)
perceived % of students vaccinated	-0.0043^{***}	-0.0042^{***}	-0.0040^{***}	-0.0043^{***}
	(0.00077)	(0.00079)	(0.00083)	(0.00077)
vaccine leads to sickness	0.12^{*}	0.12	0.11	0.13^{*}
	(0.056)	(0.065)	(0.067)	(0.066)
religious activity among top 3 hobbies	0.13^{***}	0.13^{***}	0.13^{***}	0.12^{***}
	(0.033)	(0.034)	(0.035)	(0.033)
health personnel respected	-0.17^{***}	-0.17^{**}	-0.16^{**}	-0.17^{**}
	(0.048)	(0.056)	(0.058)	(0.053)
female	0.090^{*}	0.093^{*}	0.10^{**}	0.091^{*}
	(0.038)	(0.037)	(0.038)	(0.036)
Risky investment choice	-0.0039	-0.0043	-0.0048	-0.0042
	(0.0097)	(0.0090)	(0.0092)	(0.0089)
Constant	1.22^{***}	1.24^{***}	1.33^{***}	
	(0.12)	(0.16)	(0.17)	
Observations	719	719	719	719
R^2	0.174		0.173	
Adjusted R^2	0.158		0.096	

Cluster-robust standard errors in parentheses
“Age”, “rural” and “married” are included as control variables
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As with the models for vaccine demand, the coefficient values of key exogenous variables are slightly affected by including the potentially endogenous right-hand-side variables and the control variables. The dummy variable for female is the variable that is most affected, with a reduction from 13% to 10%, given FE. It is also slightly less significant. Also here, this change is mainly due to the inclusion of the control variable “Age”. Furthermore, there is also some alterations in coefficient values and p-values between the model specifications, even though these are not major differences. Ultimately, this implies that there is some uncertainty associated with the coefficient values.

Table 5.16. Hypothesized effects versus results from regression models.

Dep. variable	Hyp.	Explanatory variable	Hypothesized sign	Class RE	Class FE	Probit
Demand						
	H1.1	Virus perceived as dangerous	+	n.s.	n.s.	n.s.
	H1.2	Vaccines protect against infection	+	$+^{**}$	$+^{**}$	$+^{**}$
	H1.2	Vaccines protect against sickness		$+^{***}$	$+^{***}$	$+^{***}$
	H1.3	Friends have been seriously sick	+	n.s.	n.s.	n.s.
	H1.3	Relatives have been seriously sick		$+^{***}$	$+^{***}$	$+^{***}$
	H1.4	Beliefs about other students getting vaccinated	+	$+^{***}$	$+^{***}$	$+^{***}$
	H1.5	Vaccines perceived as dangerous	-	n.s.	n.s.	n.s.
	H1.6	Religious activity as a main hobby	-	$-^{*}$	$-^{*}$	$-^{*}$
	H1.7	Trust in the advice of health personnel	+	n.s.	n.s.	n.s.
	H1.8	Female	-	$-^{*}$	$-^{**}$	$-^{*}$
	H3.1	Risky investment choice	+	n.s.	n.s.	n.s.
Hesitancy						
	H1.1	Virus perceived as dangerous	-	$-^{***}$	$-^{**}$	$-^{***}$
	H1.2	Vaccines protect against infection	-	$-^{**}$	$-^{**}$	$-^{**}$
	H1.2	Vaccines protect against sickness		$-^{***}$	$-^{***}$	$-^{***}$
	H1.3	Friends have been seriously sick	-	n.s.	n.s.	n.s.
	H1.3	Relatives have been seriously sick		$-^{**}$	$-^{**}$	$-^{**}$
	H1.4	Beliefs about other students getting vaccinated	-	$-^{***}$	$-^{***}$	$-^{***}$
	H1.5	Vaccines perceived as dangerous	+	n.s.	n.s.	$+^{*}$
	H1.6	Religious activity as a main hobby	+	$+^{***}$	$+^{***}$	$+^{***}$
	H1.7	Trust in the advice of health personnel	-	$-^{**}$	$-^{**}$	$-^{**}$
	H1.8	Female	+	$+^{*}$	$+^{**}$	$+^{*}$
	H2.1	Risky investment choice	-	n.s.	n.s.	n.s.

n.s.: not significant
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6 Discussion & conclusion

6.1 Research questions and hypotheses

The results show that vaccine demand is relatively prevalent among the population, compared to other populations in the country. A total of 27.6% of the sample is already vaccinated against the coronavirus and around 18.5% have tried to get vaccinated. In comparison, around 8% of the Malawian population had been vaccinated as of 1. February 2022. Consequently, after controlling for supply-side constraints, students at LUANAR probably have a significantly higher demand for vaccines than the general population in Malawi. Furthermore, an additional 15% of the population could be counted as vaccine acceptors, implying that they would accept the vaccine if provided effortlessly. Ultimately, this means that 39% can be counted as vaccine-hesitant, covering everything from delay in acceptance to anti-vaccine attitudes.

However, the survey data suggests that the number of people who oppose vaccination is fairly low. Among the students who state that they would like to advise people against vaccination, around 60% have misunderstood the question and only a small proportion advocate against the vaccines. Furthermore, beliefs about side effects do not seem to be widespread and very few respondents are concerned with the safety of vaccines. Rather, it can seem like the great majority of hesitant respondents simply do not see the benefits of getting vaccinated, either because they do not see the virus as a big threat to their health or because they do not believe that the vaccines are effective in protecting against it. Consequently, the hesitancy is likely due to a combination of complacency and lack of confidence in vaccines.

In the following section, I will discuss each hypothesis based on the findings from chapter 5.

RQ.1: What are the main factors associated with COVID-19 vaccination behavior among university students in Malawi?

The first research question posed in this study was concerned with identifying the key factors associated with COVID-19 vaccination decisions among university students in Malawi. Vaccine demand and hesitancy can be seen as natural counterparts. However, since hesitancy is not the counterpart to vaccine demand, but rather to vaccine acceptance, there may be divergent determinants for the different outcome variables. Consequently, another closely related question is what separates acceptance from demand. Building on the results presented in chapter 5, the hypotheses associated with RQ.1 will now be discussed.

H1.1 stated that *students who perceive that COVID-19 represents a serious risk to their personal health are more likely to demand vaccines and less likely to be hesitant.* However, contrary to the framework defined in chapter 2, the results from the regression models reveal that perceiving the virus as a serious risk to one's health does not imply a higher likelihood of seeking vaccination. Nonetheless, this does not mean that perceptions about the risks posed by the virus are not important to vaccination decisions, it is just not a determining factor for vaccine demand. The results show that those who do not perceive that the virus represents a serious risk are considerably more likely to be vaccine-hesitant, indicated by a 14-15% higher probability in the models. Hence, perceiving the virus as risky can be seen as a prerequisite for willingness to accept vaccines. However, it does not seem to motivate from passive to active demand, meaning that perceiving the virus as dangerous is not enough to induce individuals to seek out vaccination services.

H1.2 stated that *students who believe that vaccines are effective against infection and sickness are more likely to demand vaccines and less likely to be hesitant.* This hypothesis is well supported by the data, as both perceived protection against infection and serious sickness are two of the strongest predictors of both vaccine demand and hesitancy. According to the regression models, perceiving that the vaccines are effective in protecting against infection is associated with an 11-12% higher probability of demanding vaccines and an 11-12% lower probability of being hesitant. Similarly, perceiving that the vaccines protect against serious sickness is associated with a 15-17% higher probability of demanding vaccines and a 13-15% lower probability of being hesitant. These findings indicate that confidence in the effectiveness of vaccines is one of the main factors associated with vaccination behavior, which is in support of the theoretical framework outlined in chapter 2.

H1.3 stated that *students with friends and/or relatives that have been seriously sick are more likely to demand vaccines and less likely to be hesitant.* According to the findings, serious sickness among friends is not significantly related to either vaccine demand or hesitancy. However, serious sickness among relatives is strongly related to vaccination decisions, indicating a 15-16% higher likelihood of seeking out vaccination and an 11-12% lower likelihood of being hesitant, according to the regression models. Consequently, this implies that experiences with the virus do matter, but some experiences seem to be more important than others. One potential reason for these results could be that death and sickness within the family leave a stronger impression than it would among friends. Relatives usually reside in the same household and often care for each other in sickness. Some relatives are also older, leaving them more exposed to sickness from the virus. Ultimately, there are several reasons why sickness within the family could be a stronger motivational force than sickness among friends.

H1.4 stated that *perceptions about the share of fellow students getting vaccinated against COVID-19 are positively correlated with individual vaccine demand and negatively correlated with vaccine hesitancy.* The regression results confirm this hypothesis, indicating that a 1% increase in the perceived share of students vaccinated is associated with a 0.48-0.49% higher likelihood of demanding vaccines and a 0.40-0.43% lower likelihood of being hesitant. However, the linearity of this relationship is questionable, thus one should be careful interpreting these numbers as linear marginal effects.

Nevertheless, the numbers give a good indication of the importance of descriptive norms for vaccine demand. For example, if linearity is assumed and holding other things constant, an increase in perceived vaccination degree by 10% would imply a 4.9% higher chance of demanding vaccines for a given individual, which is quite impactful. However, there is a lot of uncertainty associated with this relationship and the explanatory variable. Nonetheless, there seems to be an important relationship between perceptions about the share of fellow students vaccinated and vaccination decisions.

H1.5 stated that *individuals who believe that the vaccine leads to a higher risk of getting sick and dying are less likely to demand vaccines and more likely to be hesitant.* The data reveals that very few believe that the vaccine leads to higher risks of sickness or death, represented by only 56 individuals in the sample stating this belief. Furthermore, only 28 out of these state that this is the main negative effect of the vaccines. This view is also supported by the comments sections in the survey, where respondents wrote why they are against the vaccine. Only around a dozen respondents express concerns about side effects or unsafe vaccines as the reason for their hesitancy.

Ultimately, these findings are also supported by the regression models, where the variable is not a significant predictor of vaccine demand. Furthermore, using vaccine hesitancy as the dependent variable, the regressor is not significant at the 5% level across all models, although it is significant in the probit model and the naïve OLS model with an impact on the response probability of 12-13%. However, one should be careful to accept these results, as these effects could be due to too few observations. Ultimately, it might seem like perceptions about the negative effects of vaccines are not among the main factors associated with vaccination decisions.

H1.6 stated that *individuals who rank religious activity as a main hobby are less likely to demand vaccines and more likely to be hesitant.* Results from the regression models indicate that this is a strong and significant predictor of vaccine hesitancy. In other words, being religiously active is associated with an increased likelihood of being hesitant, approximately 12-13%. Furthermore, it is also associated with an approximate 0.87% higher probability of demanding vaccines, from the models. I also tested for religion-specific effects (Table II.8, Appendix II) and found that being a Seventh Day Adventist/Baptist is also highly associated with being vaccine-hesitant. However, this effect is not related to religious activity as a hobby, seeing as the Seventh Day Adventists/Baptists are not abnormally religiously active.

Rather, this effect might be traced back to one of the cornerstones within the church, which is a focus on a healthy and “natural” lifestyle, treating the body as a “temple” (Kolodziejska, 2022). Consequently, even though the church, in general, encourages immunization through vaccination, some members might still find vaccines “unnatural” or contradictory to the initial health message inherent to the faith. Similar beliefs could potentially also be motivational for members of other religions. Other reasons why high religious commitment is associated with vaccine hesitancy could be identity-related or due to social influence within the religious communities. Generally, this is an important relationship that should be further investigated.

H1.7 states that *individuals who do not trust the advice of health personnel are less likely to demand vaccines and more likely to be hesitant.* Results from the regression models are consistent with the second hypothesis, indicating that lack of trust in health personnel is one of the strongest predictors of hesitancy, associated with a 16-17% lower likelihood of being hesitant. However, the variable is not significantly correlated with vaccine demand. Intuitively, this could make sense, as trust in health personnel may not motivate from passive to active demand. Rather, it can seem like the few people who do not have trust in these entities are very likely to be hesitant. This finding is also supported by the correlation between distrust in vaccines and distrust in health personnel in the data (Table I.5, Appendix I). Nevertheless, most respondents state that health personnel is one of the most trusted information sources, thus general distrust against health personnel does not seem to be prevalent in the population. Moreover, trust or distrust in other information sources, such as political or religious leaders, does not predict vaccination behavior.

H1.8 states that *females are less likely to demand vaccines and more likely to be hesitant.* The results from the regression models are consistent with this hypothesis, indicating that females have a 9-11% lower likelihood of vaccine demand and around 9-10% higher likelihood of hesitancy. As argued in chapter 2, it is difficult to justify gender differences in vaccination behavior. However, it could be related to confidence in vaccines. From the data, there seem to be significant gender differences in vaccine trust, indicating that women have less trust in COVID-19 vaccines than men (Table I.6, Appendix I). Only around 29% of women in the sample have high or very high trust in vaccines, while around 38% of men do. Therefore, it is plausible that women to a greater degree are hesitant due to circumspection of risk, or lack of confidence in vaccines, while men are more prone to complacency.

RQ 2: How is risk tolerance related to vaccination behavior?

The second research question posed in this thesis is concerned with how risk tolerance is related to vaccination behavior. To answer this question, choices in the risky investment game (as described in chapter 3) served as an instrument for individual risk tolerance.

More precisely, **H2.1** stated that *safer choices in the risky investment game are positively correlated with vaccine demand and negatively correlated with vaccine hesitancy*. Results from the regression models reveal that choices in the game are neither correlated with vaccine demand nor hesitancy, thus not associated with vaccination behavior. However, this does not necessarily imply that risk tolerance is not a predictor of vaccination behavior, rather it means that choices in the game serve as a bad instrument for risk tolerance. As previously argued, there is likely significant measurement error in the game, due to misunderstandings and misentries. Furthermore, there are also some serious limitations to the game's ability to predict real-life decisions (Holden & Tilahun, 2021). As a result, I cannot conclude on the importance of individual risk tolerance for vaccination behavior based on the findings. I can only conclude that this one-shot version of the risky investment game is an insufficient method when it comes to predicting real-life vaccination decisions.

6.2 Limitations of study

6.2.1 Reliability

Reliability is related to the consistency or reproducibility of the results. Is it feasible that we would achieve the same results given the same methods and circumstances as in this study? The results from the survey suggest that there is substantial measurement error involved in the responses of respondents. One way of determining this is to look at the consistency of outcomes between questions that are interested in more or less the same thing. Students were asked about whether vaccination protects against being infected or against serious sickness. Later, they were asked to rank the main positive effects of vaccination.

The results indicate that many respondents who replied that vaccination protects against infection or serious sickness do not see this as a positive effect of the vaccine. In the case of serious sickness, as many as 21% gave ambiguous responses. This implies that some of the results from the survey are highly dependent on the framing of the question, and possibly also due to random entries. Another problem is misunderstandings or false entries. By assessing the comments, I estimate that around 60% of those who replied they would like to advise people not to take the vaccine have misunderstood the question. This is just one example, and there are likely many more throughout the survey.

Consequently, the results from the survey have limited reliability, and given another test, I have to assume that the results could be very different. As a consequence, the results from the regression models have to be accepted with great care. Nevertheless, the general trend given by the responses should reveal a somewhat truthful image. To my knowledge, individuals have no major incentives to lie about vaccination decisions and attitudes in a survey, hence we can assume that the results display a good representation of the big picture. The general insights are therefore useful, even though we must be careful to accept specific results as the truth. Furthermore, the reliability of the estimates depends on the sample size, as measurement error decreases when the sample size increases. Therefore, increasing the sample size could be one way of increasing reliability.

6.2.2 Validity

Validity refers to how accurately the method measures real-world properties and variations. In other words, it is concerned with how much we can trust these results to represent the true relationships regarding vaccination behavior. One way of determining the validity of the findings is to assess the construct validity, namely the adherence to existing theory and literature of the measurements. As presented in Table 5.16, and as discussed earlier in this chapter, several of the coefficient signs correspond well to the theoretical framework and thusly the hypotheses posed. The strongest determinants of vaccination behavior were much as expected, strengthening the theoretical validity of the study. However, some inconsistencies were found, such as the lack of effect from perceived vaccination risks. Nonetheless, as argued in chapter 2, there are likely some location-specific effects concerning vaccination behavior, and given the overall findings, this discrepancy is likely due to the unique characteristics of the population.

Another useful concept is content validity, which concerns whether the measurements included cover all aspects of vaccination behavior. In other words, whether the questions in the survey are measuring what they are supposed to. As argued in chapter 4, the measures on vaccine demand, acceptance, and hesitancy are likely uncertain and depend on a series of assumptions. Furthermore, several of the explanatory variables could potentially be poor measures of the variables of interest. Examples are whether the stated importance of religious activity is a good measure of religious commitment, or whether ranked negative effects of vaccines is a good measure of perceived vaccine risks. Consequently, the content validity of this study is highly questionable, and there is reason to believe that some measurements have limited validity.

As argued in chapter 4, I am not able to establish causal relationships from the survey data. There are likely many confounding factors influencing the regression results, as well as potential omitted variable bias. In general, it is impossible to determine whether the effects on the dependent variables are solely due to a certain explanatory variable, or rather some confounding factor. Therefore the internal validity of the results is likely to be very limited.

Furthermore, the external validity is probably also very limited. As argued in chapter 3, thanks to a representative number of classes included in the sample, as well as random sampling within the classes, the results should be fairly representative of the total population of students at LUANAR. However, they can hardly be applied to any other population or situation. Generally, it is plausible that students have higher vaccination intent and a more rational attitude towards vaccines, compared to the general population in Malawi. This is illustrated through the relatively high share of people vaccinated among the sample.

6.3 Conclusion

Utilizing a classroom survey among university students in Malawi, this study has assessed what factors are associated with COVID-19 vaccine demand and hesitancy. A total of 764 students participated in the survey, stating personal behavior, attitudes, and perceptions about the corona pandemic. Results indicate that approximately 28% of students have already been vaccinated, and another 25% have unsuccessfully attempted to get vaccinated. A total of 39% could be counted as vaccine-hesitant, demonstrating a reluctance to get vaccinated. This is a substantially higher share than compared to previous findings in the country (CDC Africa, 2021). However, in general, trust in vaccines and vaccine providers is high and few people justify their vaccine reluctance by fear of vaccine side effects. Rather, perceiving that the vaccines are ineffective in protecting against infection or sickness, or that the virus does not pose a serious threat to one’s health, seem to be more important determinants of vaccine hesitancy.

Panel regression models were estimated to assess the key determinants of vaccine demand and hesitancy. The findings are consistent with the hypothesis that perceptions about the vaccine's ability to protect against infection and serious sickness are among the most important factors associated with vaccine demand and hesitancy. However, perceptions about the risks posed to individual health by the coronavirus do not seem to be associated with vaccine demand but are rather associated with vaccine hesitancy. This implies that individuals who do not perceive the virus as a risk to their health, are significantly more likely to be hesitant.

Furthermore, beliefs about side effects of the vaccines do not seem to predict either vaccine demand or hesitancy. This deviates from the theoretical framework and thus the initial hypothesis. Other important factors influencing vaccination decisions are social influence, negative experiences with the virus, and gender. Furthermore, vaccine hesitancy is positively correlated with religious activity and negatively correlated with trust in health personnel.

The thesis has also investigated the relationship between risk tolerance and vaccination behavior, however, the nature of this relationship is still ambiguous. Risk tolerance was measured through a simple one-shot version of the risky investment game, building on the experiment first proposed by Gneezy et al. (2009). From the regression models, I found no correlation between vaccination decisions and behavior in the risky investment game. However, this does not necessarily imply that risk tolerance is not associated with vaccination decisions, rather it conveys the weakness in predicting vaccination behavior from this simple experiment. Moreover, the low correlation with the outcome variables could also be due to respondents misunderstanding the game. Consequently, I was not able to neither support nor reject the null hypothesis that lower risk tolerance is positively correlated with vaccine demand and negatively correlated with vaccine hesitancy.

6.3.1 Policy recommendations

Achieving high vaccination rates could potentially be crucial to successfully dealing with the direct and indirect repercussions of a pandemic. Furthermore, many studies primarily focus on the supply side of vaccines, even though many of the problems with vaccination can be accounted to the demand side. This thesis emphasizes the importance of individual behavior, perceptions, and attitudes that influence the demand for vaccination. Health professionals and policymakers should utilize these insights when designing vaccine programs and when communicating health advice, to nudge people in the right direction.

Results from the survey data can indicate that the low vaccine uptake among university students in Malawi can be warranted by both complacency and a lack of confidence in the vaccines. Potential strategies to deal with complacency issues are to emphasize the risks posed by the virus to individuals and society, highlight the social benefits of vaccination, and incorporate vaccination as the social norm. Effective public communication aimed at raising awareness about vaccination decisions and correcting misinformation could potentially lead to stronger positive attitudes towards vaccination (Betsch, et al., 2015). Furthermore, the data suggest that the advice of political leaders is not trusted in relation to the pandemic (Table 5.9). Therefore, these recommendations may be more reliable if communicated by well-respected health personnel, such as acknowledged physicians and doctors. If trustworthy sources are devoted to debunking myths and misinformation associated with the vaccines, this could potentially also mitigate some of the problems associated with lack of confidence in vaccines.

As a consequence, we could potentially end up with societies where people make health decisions that benefit both themselves and society as a whole. However, there is still much uncertainty as to how people make vaccination decisions, leaving much room for further research. Especially, there is a need for research investigating how to best incentivize citizens in making rational health decisions, that can improve lives as well as social welfare.

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APPENDICES

I. Appendix: Descriptive statistics

Table I.1. Perceptions about other students' behavior I.

How big share of the students are against getting vaccinated against COVID-19?

% of students	Freq.	Percent	Cum.
1-20%	175	22.91	22.91
21-40%	180	23.56	46.47
41-60%,	198	25.92	72.38
61-80%,	167	21.86	94.24
81-100%	44	5.76	100.00
Total	764	100.00	

Table I.2. Perceptions about other students' behavior II.

How big share of the students believe that the vaccine is more dangerous than the coronavirus itself?

% of students	Freq.	Percent	Cum.
1-20%	290	37.96	37.96
21-40%	166	21.73	59.69
41-60%,	139	18.19	77.88
61-80%,	111	14.53	92.41
81-100%	58	7.59	100.00
Total	764	100.00	

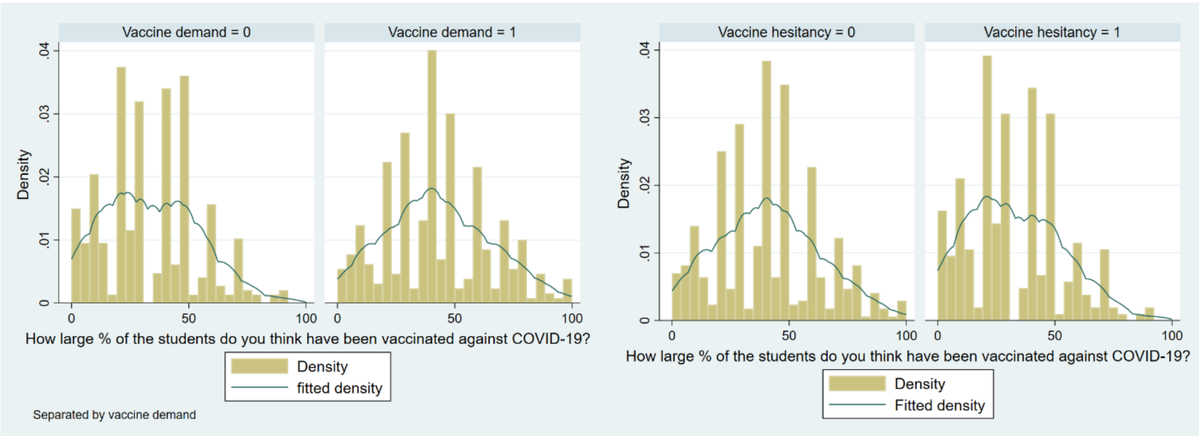

Figure I.1. Beliefs about other students' behavior, separated by vaccine attitudes.

Table I.3. How sick did you get?

How sick did you get while infected by COVID-19?	Freq.	Percent	Cum.
I did not feel any effect	3	2.24	2.24
I felt only mild symptoms	55	41.04	43.28
I felt ill and uncomfortable	43	32.09	75.37
I got seriously sick but did not go to the hospital	29	21.64	97.01
I got very sick and was hospitalized	4	2.99	100.00
Total	134	100.00	

Table I.4. Frequency of church visits divided by religion as a social activity.

Frequency of church visits	Religion ranked as top 3 social activity		
	no	yes	Total
Daily	8	21	29
More than once per week	55	217	272
Once a week	191	113	304
1-3 times per month	75	17	92
1-10 times per year	49	4	53
Less than one time per year	5	0	5
Never	9	0	9
Total	392	372	764

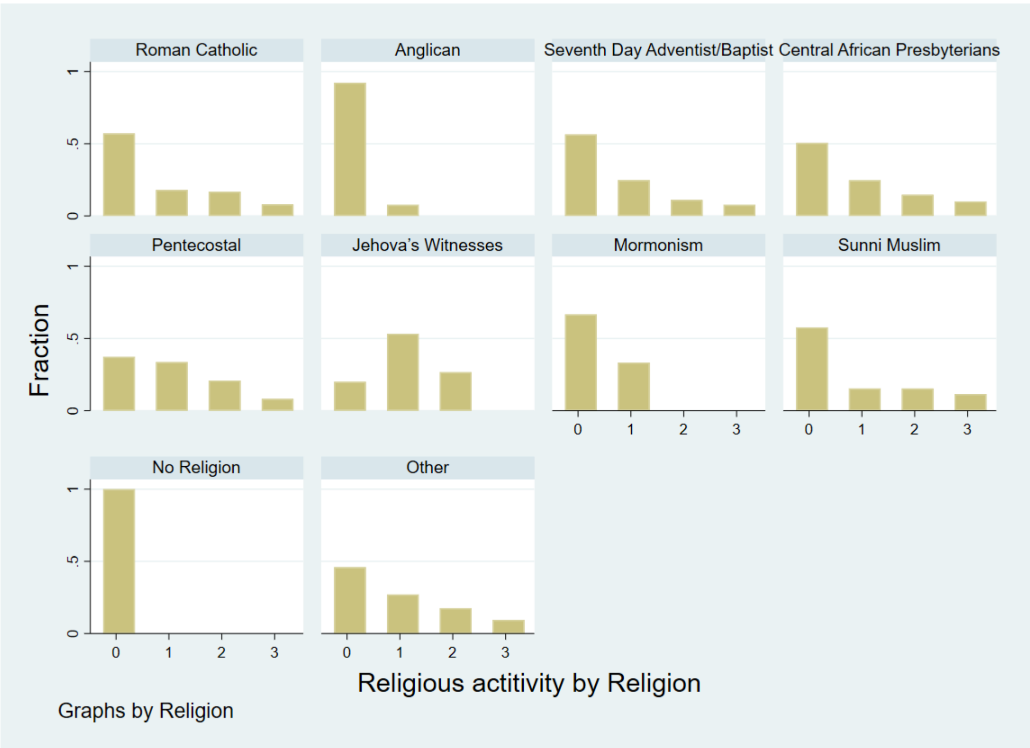

Figure I.2. Religious activity as a main social activity, divided by Religion.

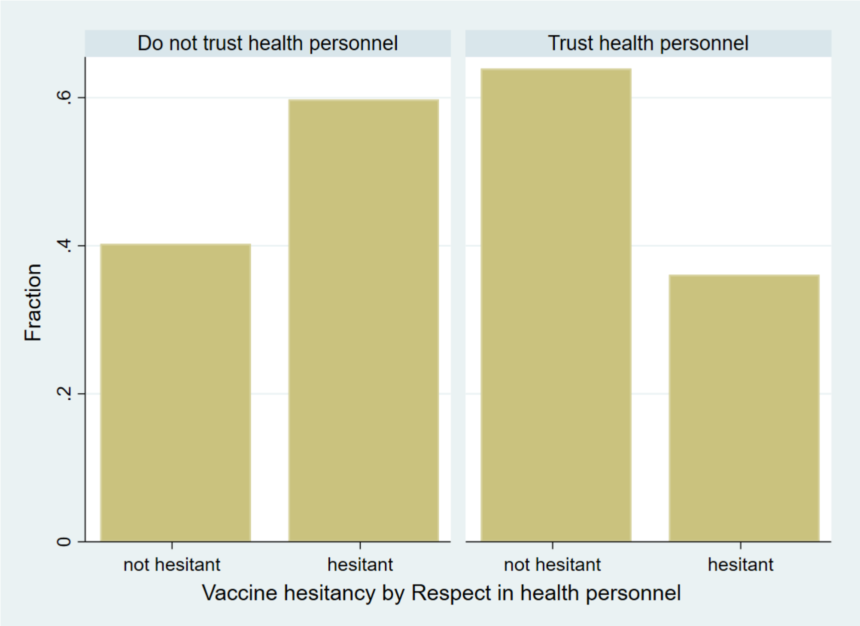

Figure I.3. Vaccine hesitancy divided by trust in health personnel.

Table I.5. Trust in vaccines divided by trust in health personnel.

	health personnel respected		
Trust in vaccine	0	1	Total
Very low	22	82	104
Low	18	99	117
Good	31	247	278
High	5	129	134
Very high	6	125	131
Total	82	682	764

Table I.6. Trust in vaccines divided by gender

	Gender		
Trust in vaccine	Male	Female	Total
Very low	56	48	104
Low	67	50	117
Good	171	107	278
High	87	47	134
Very high	94	37	131
Total	475	289	764

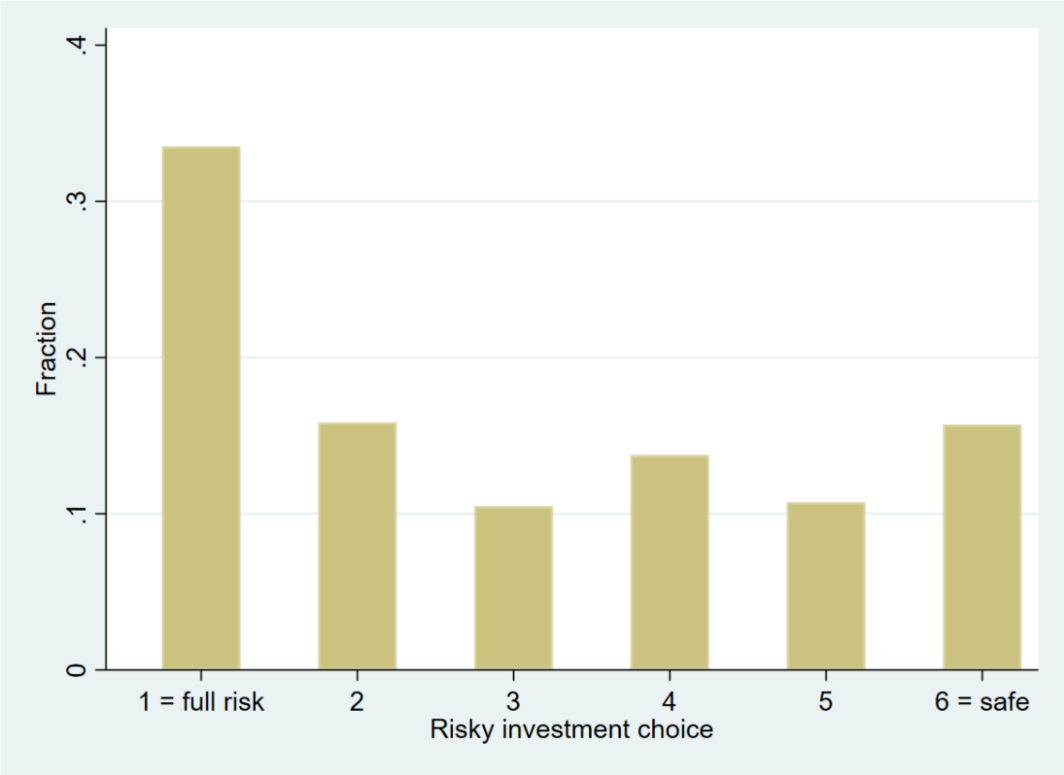

Figure I.4. The risky investment game decision.

Table I.7. Inconsistencies between stages 1 and 2 in the risky investment game.

Stage 2: Risky investment choice	Stage 1: Risky or safe amount		
	Safe amount	Risky amount	Total
1. 50% chance of Risky amount = 3000 + Safe amount = 0 (full risk)	17	239	256
2. 50% chance of Risky amount = 2400 + Safe amount = 200	9	112	121
3. 50% chance of Risky amount = 1800 + Safe amount = 400	12	68	80
4. 50% chance of Risky amount = 1200 + Safe amount = 600	28	77	105
5. 50% chance of Risky amount = 600 + Safe amount = 800	31	51	82
6. Risky amount = 0 + Safe amount = 1000 (no risk)	73	47	120
Total	170	594	764

II. Appendix: Regression models and robustness checks

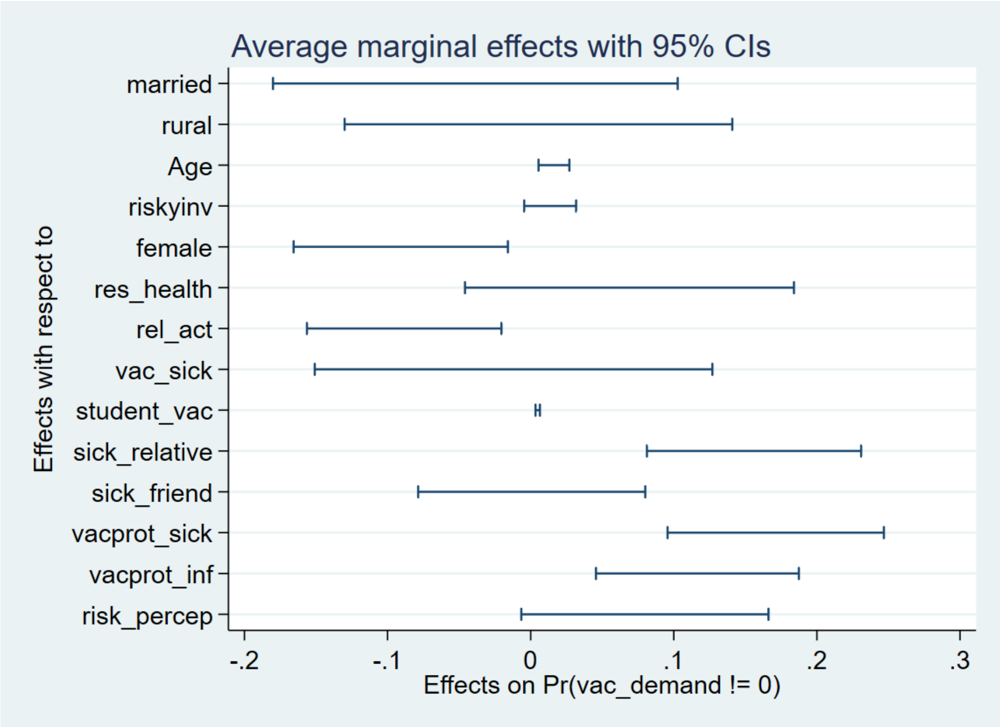

Figure II.1. Marginal effects on vaccine demand.

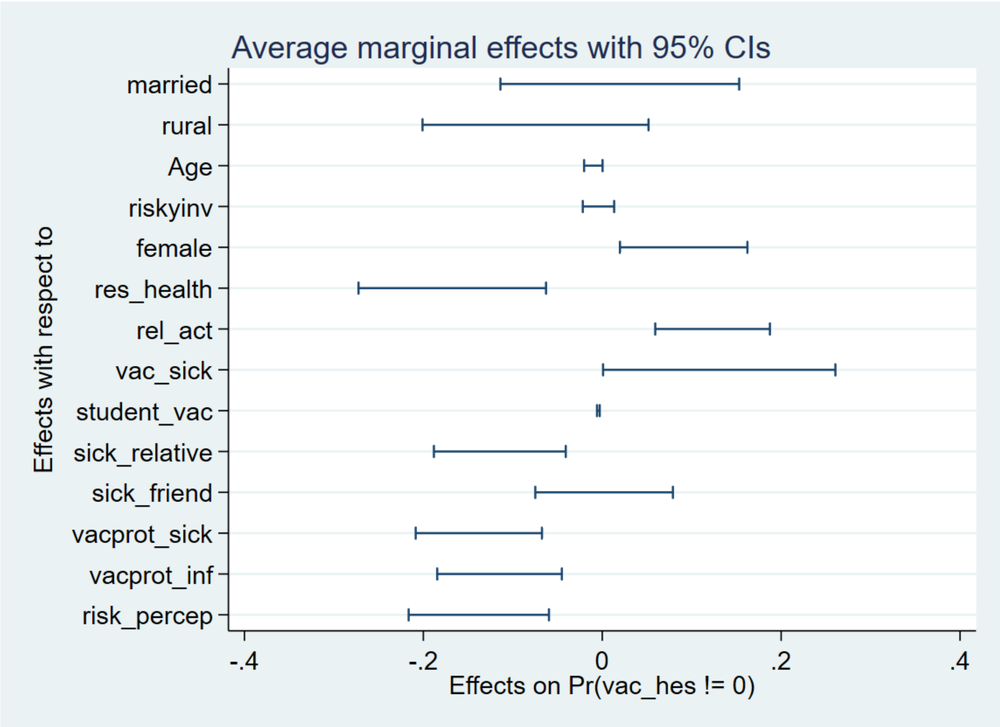

Figure II.2. Marginal effects on vaccine hesitancy.

Table II.1. Robustness check with vaccine demand as dependent variable.

	Class FE		
Variables	Key exogenous var	+ endogenous var	+ control var
friend has been seriously sick	0.028	0.0061	0.0036
	(0.043)	(0.043)	(0.043)
relative has been seriously sick	0.17^{***}	0.15^{***}	0.15^{***}
	(0.041)	(0.041)	(0.041)
religious activity among top 3 hobbies	-0.085^{*}	-0.072^{*}	-0.087^{*}
	(0.037)	(0.036)	(0.036)
Female	-0.13^{***}	-0.13^{***}	-0.11^{**}
	(0.039)	(0.039)	(0.040)
COVID-19 poses a risk to personal health		0.083	0.077
		(0.045)	(0.045)
vaccines protect against infection		0.11^{**}	0.11^{**}
		(0.039)	(0.039)
vaccines protect against sickness		0.16^{***}	0.15^{***}
		(0.041)	(0.041)
perceived % of students vaccinated		0.0047^{***}	0.0048^{***}
		(0.00086)	(0.00086)
vaccines leads to sickness		0.0092	-0.0033
		(0.070)	(0.070)
health personnel respected		0.055	0.045
		(0.060)	(0.060)
Risky investment choice		0.013	0.015
		(0.0096)	(0.0096)
Age			0.019^{**}
			(0.0062)
rural			0.012
			(0.071)
married			-0.035
			(0.073)
Constant	0.48^{***}	0.011	-0.43^{*}
	(0.032)	(0.087)	(0.18)
Observations	764	719	719
R^2	0.050	0.134	0.147
Adjusted R^2	-0.018	0.058	0.068

Cluster-robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table II.2. Robustness check with vaccine hesitancy as dependent variable.

	Class FE		
Variables	Key exogenous var	+ endogenous var	+ control var
Friend has been seriously sick	-0.0289	-0.00586	-0.00233
	(0.042)	(0.041)	(0.041)
relative has been seriously sick	-0.129**	-0.115**	-0.119**
	(0.040)	(0.040)	(0.040)
religious activity among top 3 hobbies	0.138***	0.119***	0.131***
	(0.036)	(0.035)	(0.035)
Female	0.134***	0.121**	0.101**
	(0.038)	(0.038)	(0.038)
COVID-19 poses a risk to personal health		-0.147***	-0.143**
		(0.044)	(0.043)
vaccines protect against infection		-0.110**	-0.115**
		(0.037)	(0.037)
vaccines protect against sickness		-0.143***	-0.133***
		(0.039)	(0.039)
perceived % of students vaccinated		-0.00397***	-0.00397***
		(0.00083)	(0.00083)
vaccines leads to sickness		0.102	0.115
		(0.067)	(0.067)
health personnel respected		-0.168**	-0.157**
		(0.058)	(0.058)
Risky investment choice		-0.00274	-0.00476
		(0.0092)	(0.0092)
Age			-0.0157**
			(0.0060)
rural			-0.100
			(0.068)
married			0.0207
			(0.070)
Constant	0.328***	0.882***	1.325***
	(0.032)	(0.084)	(0.17)
Observations	764	719	719
R^2	0.056	0.160	0.173
Adjusted R^2	-0.012	0.086	0.096

Cluster-robust standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table II.3. VIF for vaccine demand and hesitancy models

Variable	VIF	1/VIF
age	1.340	0.747
sick_relative	1.280	0.783
married	1.250	0.801
sick_friend	1.240	0.805
female	1.180	0.847
student_vac	1.070	0.935
vacprot_sick	1.060	0.946
rel_act	1.060	0.946
vacprot_inf	1.050	0.952
vac_sick	1.050	0.953
risk_percep	1.050	0.956
riskyinv	1.040	0.957
res_health	1.030	0.973
rural	1.020	0.977
Mean VIF	1.120	

Table II.4. Hausman test for vaccine demand, given only key exogenous variables.

	Coef.
Chi-square test value	7.825
P-value	.098

Table II.5. Hausman test for vaccine demand, given all key variables and controls.

	Coef.
Chi-square test value	9.92
P-value	.768

Table II.6. Hausman test for vaccine hesitancy, given only key exogenous variables.

	Coef.
Chi-square test value	3.777
P-value	.437

Table II.7. Hausman test for vaccine hesitancy, given all key variables and controls.

	Coef.
Chi-square test value	7.871
P-value	.896

Table II.8. Test for religion-specific effects with vaccine hesitancy as dependent variable.

Variables	Class FE
COVID-19 pose risk to personal health	-0.13**
	(0.044)
vaccines protect against infection	-0.11**
	(0.038)
vaccines protect against sickness	-0.12**
	(0.040)
Friend has been seriously sick	-0.00080
	(0.041)
relative has been seriously sick	-0.12**
	(0.040)
perceived % of students vaccinated	-0.0036***
	(0.00083)
vaccine leads to sickness	0.11
	(0.067)
religious activity among top 3 hobbies	0.14***
	(0.035)
health personnel respected	-0.16**
	(0.058)
female	0.091*
	(0.038)
Risky investment choice	-0.0047
	(0.0092)
Religion	
Anglican	0.20
	(0.14)
Seventh Day Adventist/Baptist	0.17**
	(0.058)
Central African Presbyterians	0.034
	(0.049)
Pentecostal	0.088
	(0.059)
Jehovah's Witnesses	-0.21
	(0.13)
Mormonism (Church of Jesus Christ of Latter-Day Saints)	0.35
	(0.27)
Sunni Muslim	0.0040
	(0.10)
No Religion	-0.091
	(0.19)
Other	0.013
	(0.066)
Constant	1.24***
	(0.18)
Observations	719
R^2	0.195
Adjusted R^2	0.108

Cluster-robust standard errors in parentheses
"Age", "rural", and "married" included as control variables
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

III. Appendix: Survey and experimental instrument

Demographics

DEMOGRAPHICS

E `IsAnswered(Consent)`

Interview Date	DATE — Date ________________________________
01a.Given unique Class ID, prepared in the stratification(CID Writen on your desk) E `IsAnswered(Date)` V1 `self.InRange(1,60)` M1 Class ID out of range	NUMERIC: INTEGER — ClassID ________________________________
01b. Given unique student ID (SID Writen on your desk) E `IsAnswered(ClassID)` V1 `self.InRange(1,16)` M1 ID out of range	NUMERIC: INTEGER — StudentID ________________________________
01. Name of student E `IsAnswered(StudentID)`	TEXT — Name ________________________________
02.Age E `IsAnswered(Name)` V1 `self.InRange(15,55)` M1 Age out of range	NUMERIC: INTEGER — Age ________________________________
03.Sex E `IsAnswered(Age)`	SINGLE-SELECT — Sex 01 ○ Female 00 ○ Male
04.Ethnic group E `IsAnswered(Sex)`	SINGLE-SELECT — Ethnic_group 01 ○ Chewa 02 ○ Nyanja 03 ○ Yao 04 ○ Tumbuka 05 ○ Lomwe 06 ○ Nkhonde 07 ○ Ngoni 08 ○ Sena 09 ○ Nyakyusa 10 ○ Tonga 11 ○ Lambya 12 ○ Senga 13 ○ Sukwa 14 ○ English 15 ○ Other
If others Specify E `Ethnic_group==15`	TEXT — specify_Ethnic ________________________________

05.Religion E IsAnswered(Ethnic_group)	SINGLE-SELECT Religion 01 ○ Roman Catholic 02 ○ Anglican 03 ○ Seventh Day Adventist/Baptist 04 ○ Central African Presbyterians 05 ○ Pentecostal 06 ○ Jehova's Witnesses 07 ○ Mormonism (Church of Jesus Christ of Latter-Day Saints) 08 ○ Greek/Other Orthodox 09 ○ Sunni Muslim 10 ○ Buddhism 11 ○ Hinduism 12 ○ No Religion 13 ○ Other
if others specify E Religion==13	TEXT specify_religion --------------------------------
06.District of origin in Malawi E IsAnswered(Religion)	SINGLE-SELECT District 101 ○ Chitipa 102 ○ Karonga 103 ○ Nkhata Bay 104 ○ Rumphi 105 ○ Mzimba 106 ○ Likoma 201 ○ Kasungu 202 ○ Nkhotakota 203 ○ Ntchisi 204 ○ Dowa 205 ○ Salima 206 ○ Lilongwe 207 ○ Mchinji 208 ○ Dedza 209 ○ Ntcheu 301 ○ Mangochi And 12 other symbols [1]
07.Village name E IsAnswered(District)	TEXT Village_name --------------------------------
08.Traditional Authority name E IsAnswered(Village_name)	TEXT TA --------------------------------
09. Is village rural or urban? E IsAnswered(TA)	SINGLE-SELECT Rural_Urban 01 ○ rural 00 ○ urban
10. What year did you start as a student at LUANAR?(e.g 2019 0r 2020) E IsAnswered(Rural_Urban) V1 self.InRange(2015,2022) M1 Entry out of range	NUMERIC: INTEGER Start_student --------------------------------
11.Mobile phone number(Start with 265........) E IsAnswered(Start_student) V1 self.InRange(265000000000,265999999999) M1 Mobile number out of range	NUMERIC: DECIMAL Phone_number --------------------------------

	12.LUANAR Student Identification Number(Student Reg Number eg 180100200)	NUMERIC: INTEGER ID_number _.
E	IsAnswered(Phone_number)	
V1	self.InRange(100000000,2999999999)	
M1	Entry out of range	
	13.Year of study	SINGLE-SELECT Year_of_study 01 First year Diploma 02 Second year Diploma 03 First year BSc 04 Second year BSc 05 Third year BSc 06 Fourth year BSc 07 First year MSc 08 Second year MSc 09 First year PHD 10 Second year PHD 11 Third year PHD 12 Fourh year PHD
E	IsAnswered(ID_number)	
V1	self.InRange(1,7)	
M1	Entry out of range	
	14.Type of program	SINGLE-SELECT Program_Type 01 BSc 02 Diploma 03 MSc 04 PhD 05 Others
E	IsAnswered(Year_of_study)	
	If other specify	TEXT Specify_Type _.
E	Program_Type==5	
	15.Which LUANAR Campus do you belong to?	SINGLE-SELECT Campus 01 Bunda 02 City 03 NRC 04 ODL
E	IsAnswered(Program_Type)	

15A. If Bunda Campus, What is the name of your study program? E campus==1	SINGLE-SELECT campus_1 01 ○ Bachelor of Veterinary Medicine 02 ○ Bachelor of Science in Agribusiness Management 03 ○ Bachelor of Science in Agricultural Development Communication 04 ○ Bachelor of Science in Agricultural Economics 05 ○ Bachelor of Science in Agricultural Education 07 ○ Bachelor of Science in Agricultural Engineering 08 ○ Bachelor of Science in Agricultural Enterprise Development And Microfinance 09 ○ Bachelor of Science in Agricultural Extension 10 ○ Bachelor of Science in Agricultural innovations 11 ○ Bachelor of Science in Agriculture 12 ○ Bachelor of Science in Agriculture Education 13 ○ Bachelor of Science in Agroforestry 14 ○ Bachelor of Science in Agro-Forestry 15 ○ Bachelor of Science in Agronomy 16 ○ Bachelor of Science in Animal Science 17 ○ Bachelor of Science in Aquaculture And Fisheries Science And 40 other symbols [2]
15B. If City Campus, What is the name of your study program? E campus==2	SINGLE-SELECT campus_2 01 ○ BSc. in Agribusiness Management 02 ○ BSc. in Agriculture Economics 03 ○ BSc. in Agricultural Development Communication 04 ○ BSc. in Agricultural Education 05 ○ BSc. in Agricultural Enterprise Development and Microfinance 06 ○ BSc. in Agricultural Extension 07 ○ BSc. in Development Economics 08 ○ Diploma in Youth and Development 09 ○ Diploma in Gender and Development 10 ○ BSc. in Gender and Development 11 ○ Master of Science in Agricultural and Applied Economics 12 ○ Master of Science in Gender and Development

15C. If NRC Campus, What is the name of your study program? E `campus==3`	SINGLE-SELECT `campus_3` 01 ○ Bachelor of Veterinary Medicine 02 ○ Bachelor of Science in Food Technology 03 ○ Certificate in Basic Studies 04 ○ Diploma in Agriculture 05 ○ Diploma in Agriculture Education 06 ○ Diploma in Agro Food Processing 07 ○ Diploma in Animal Health and Production 08 ○ Diploma in Environmental Management 09 ○ Diploma in Food, Nutrition and Livelihood Security 10 ○ Diploma in Horticulture 11 ○ Diploma in Irrigation Technology 12 ○ Diploma in Land Administration 13 ○ Foundation in Veterinary Medicine
15D. If ODL Campus, What is the name of your study program? E `campus==4`	SINGLE-SELECT `campus_4` 01 ○ BSc. in Agribusiness Management 02 ○ BSc. in Agriculture Economics 03 ○ BSc. in Agricultural Development Communication 04 ○ BSc. in Agricultural Education 05 ○ BSc. in Agricultural Enterprise Development and Microfinance 06 ○ BSc. in Agricultural Extension 07 ○ BSc. in Development Economics 08 ○ Diploma in Youth and Development 09 ○ Diploma in Gender and Development 10 ○ BSc. in Gender and Development 11 ○ BSc. in Food Science and Technology 12 ○ BSc. in Human Nutrition and Food Science 13 ○ BSc. in Human Sciences and Community Services 14 ○ BSc. in Agroforestry 15 ○ BSc. in Aquaculture and Fisheries Science 16 ○ BSc. in Forestry And 3 other symbols [3]

FAMILY SITUATION

Family_situation

13.Marital status	SINGLE-SELECT Marital_status 01 ○ Single 02 ○ Married 03 ○ Separated 04 ○ Divorced 05 ○ Widowed
14.Number of children you have (Your own children) E IsAnswered(Marital_status) V1 self.InRange(0,20) M1 Number out of Range	NUMERIC: INTEGER Number_of_children ________________________________
15.Are your parents alive? E IsAnswered(Number_of_children)	SINGLE-SELECT Parents 01 ○ Yes, both are alive, 02 ○ Father is dead but my mother is alive, 03 ○ Mother has died but my father is alive, 04 ○ Both are dead
16.Number of siblings E IsAnswered(Parents)	NUMERIC: INTEGER siblings ________________________________
17.Number of brothers E IsAnswered(siblings)	NUMERIC: INTEGER brothers ________________________________
18.Birth rank(First born =1, Second born =2, Third born=3,.) E IsAnswered(brothers) V1 self.InRange(0,20) M1 Out of range	NUMERIC: INTEGER birth_rank ________________________________
19.What is the primary source of income for your parents/guardian? E IsAnswered(birth_rank)	SINGLE-SELECT income 01 ○ Farming 02 ○ Government employment 03 ○ Private employment 04 ○ Private business 05 ○ Pension/Retired 06 ○ Skilled worker 07 ○ Priest /religious leader 08 ○ Chief 09 ○ Other
If others Specify E income==9	TEXT SpecifyInc ________________________________
20.Are your parents/guardians farmland owners? F IsAnswered(income) E IsAnswered(income)	SINGLE-SELECT parent_land 01 ○ Yes 00 ○ No
21.If yes to Q20, farmland ownership holding size of parents/guardians(acres) E parent_land==1	NUMERIC: INTEGER parents_farmland_size ________________________________

22.How do you fund your studies? E IsAnswered(parent_land)	MULTI-SELECT stdy_funds 01 ☐ Help from parents/guardians 02 ☐ Own job and income 03 ☐ Scholarship/Loan 04 ☐ Others
23 Rank your three most important social activity/hobby E IsAnswered(stdy_funds)	MULTI-SELECT: ORDERED activity_hobby 01 ☐ Sports 02 ☐ Religious Activity 03 ☐ Stay with friends 04 ☐ Computer games 05 ☐ Reading 06 ☐ Music 07 ☐ Spending time with Family 08 ☐ None
24. Do you have any other important social activities? E IsAnswered(activity_hobby)	SINGLE-SELECT other_social_act 01 ○ Yes 00 ○ No
If others Specify E other_social_act==1	TEXT Q24Specify ________________________________
25. How frequently do you go to Church/religious building: E IsAnswered(other_social_act)	SINGLE-SELECT Religious_activity 01 ○ Daily 02 ○ More than once per week 03 ○ Once a week 04 ○ 1-3 times per month 05 ○ 1-10 times per year 06 ○ Less than one time per year 07 ○ Never
26. Are you an active member of a religious group? E IsAnswered(Religious_activity)	SINGLE-SELECT relig_active_memb 01 ○ Yes 00 ○ no
27.If yes to Q26, do you have a church position? E relig_active_memb==1	SINGLE-SELECT church_position 01 ○ Yes 00 ○ No
27B. what is your position E church_position==1	TEXT church_duty ________________________________

KNOWLEDGE ABOUT THE CORONA PANDEMIC

	K1. In which town was the virus causing COVID-19 first discovered?	TEXT Corona_town _ .
	K1B. In which country was the virus causing COVID-19 first discovered?	TEXT Corona_country _ .
E	K2.How many waves of the virus have you had in Malawi since 2019? IsAnswered(Corona_country)	NUMERIC: INTEGER number_of_waves _ .
E	K3.Do you know COVID19 variants by name? IsAnswered(number_of_waves)	SINGLE-SELECT know_COVID19_variants 01 ○ Yes 00 ○ No
E	K3A. Mention the 1st COVID19 variant by name know_COVID19_variants==1	TEXT COVID19_variant1 _ .
E	K3B. Mention the 2nd COVID19 variant by name know_COVID19_variants==1	TEXT COVID19_variant2 _ .
E	K3B. Mention the 3rd COVID19 variant by name know_COVID19_variants==1	TEXT COVID19_variant3 _ .
	K4A.How many (Exact number) are known to have died from COVID-19 in Malawi up to January 2022?	NUMERIC: INTEGER CVD_DEATH_Exact _ .
E	K4B.How many (Minimum) are known to have died from COVID-19 in Malawi up to January 2022? IsAnswered(CVD_DEATH_Exact)	NUMERIC: INTEGER CVD_DEATH_Min _ .
E	K4B.How many (Maxmum) are known to have died from COVID-19 in Malawi up to January 2022? IsAnswered(CVD_DEATH_Min)	NUMERIC: INTEGER CVD_DEATH_Max _ .
E	K5.How many are known to have been infected by the corona virus in Malawi up to January 2022? IsAnswered(CVD_DEATH_Max)	NUMERIC: INTEGER CVDinfectjan22 _ .
E	K6. How many of the staff at LUANAR have died from COVID-19 up to January 2022? IsAnswered(CVDinfectjan22)	NUMERIC: INTEGER COVstaffdeathjan22 _ .
E	K7.How many of the students at LUANAR do you know have been sick from COVID-19 since the beginning of the pandemic? IsAnswered(COVstaffdeathjan22)	NUMERIC: INTEGER COVstud_sick _ .
E	K8.How large % of the staff at LUANAR do you think have been vaccinated against COVID-19? IsAnswered(COVstud_sick)	NUMERIC: INTEGER COVstaffvac _ .

K9.How large % of the students at LUANAR do you think have been vaccinated against COVID-19? E IsAnswered(COVstaffvac)	NUMERIC: INTEGER COVstudentvac ________________
K10.What have been the main sources of information on LUANAR COVID-19 status and update? E IsAnswered(COVstudentvac)	SINGLE-SELECT COVinfo 01 ○ University Administration public announcement 02 ○ University staff personal info 03 ○ Fellow students 04 ○ Newpaper 05 ○ Radio 06 ○ Internet: University webpage 07 ○ Rumors 08 ○ Others
If others Specify E COVinfo==8	TEXT COVinfo_other ________________
K11.Does vaccination against COVID-19 protect persons against being infected by the virus? E IsAnswered(COVinfo)	SINGLE-SELECT vacprotinf 01 ○ Yes 00 ○ No 02 ○ Don't know
K12.Does vaccination against COVID-19 protect persons from getting seriously sick? E IsAnswered(vacprotinf)	SINGLE-SELECT vac_prot_sick 01 ○ Yes 00 ○ No 02 ○ Don't know
K13.Do you know any vaccines that work against COVID-19? E IsAnswered(vac_prot_sick)	SINGLE-SELECT vaccines_that_work 01 ○ Yes 00 ○ No
K13A.Which vaccines do you know about that work against COVID-19? (Give 1st name of vaccine) E vaccines_that_work==1	TEXT Vaccine_1 ________________
K13B.Which vaccines do you know about that work against COVID-19? (Give 2nd name of vaccine) E vaccines_that_work==1	TEXT Vaccine_2 ________________
K13C.Which vaccines do you know about that work against COVID-19? (Give 3rd name of vaccine) E vaccines_that_work==1	TEXT Vaccine_3 ________________

PERCEPTION QUESTIONS RELATED TO THE PANDEMIC

P1.Do you perceive COVID-19 represents a serious risk to your personal health?	SINGLE-SELECT COVriskpercep 01 ○ Yes 00 ○ No 02 ○ Don't know
P2. If yes to P1, why, explain E COVriskpercep==1	TEXT COVriskexplainperc ________________________________
P3. If no to P1, explain E COVriskpercep==0	TEXT COVnoriskexplainperc ________________________________
P4.Do you perceive it as important for your own health to vaccinate yourself against COVID-19? E IsAnswered(COVriskpercep)	SINGLE-SELECT vac_perceive_impnt 01 ○ Yes 00 ○ No 02 ○ Don't know
P5. Rank the three most important methods you consider protect against getting infected by the corona virus? (Select inorder of importance)	MULTI-SELECT: ORDERED protection_methods 01 ☐ Used facemask 02 ☐ Kept >1 meter distance to people in public spaces 03 ☐ Reduced the number of contact persons 04 ☐ Washed my hands many times per day 05 ☐ Avoided handshakes 06 ☐ Avoided crowded places 07 ☐ Used disinfectants regularly 08 ☐ Prayed to God to not get infected 09 ☐ Traditional medicine 10 ☐ None 11 ☐ Others
P6.Specify if you consider other methods E protection_methods.Contains(11)	TEXT SpecifyMethods ________________________________
P7A.What do you think are the main positive effects of vaccination against COVID-19 are?	MULTI-SELECT: ORDERED vacmain_eff 01 ☐ Reduced risk of getting infected 02 ☐ Reduced risk of getting seriously sick or die 03 ☐ Depends on the type of vaccine Uncertain 04 ☐ Depends on how the individual reacts to the vaccine (age and health condition) 05 ☐ Depends on the type of the vaccine 06 ☐ Depends on the type of corona virus 07 ☐ No effect 08 ☐ Others
If yes specify E vacmain_eff.Contains(8)	TEXT Specify_effct ________________________________

P7B.What do you think are the main negative effects of vaccination against COVID-19 are? E IsAnswered(vacmain_eff)	MULTI-SELECT: ORDERED vacmain_effnegtv 01 ☐ Higher risk of getting infected 02 ☐ Higher risk of getting sick and or die 03 ☐ Depends on the type of vaccine Uncertain 04 ☐ Depends on how the individual reacts to the vaccine (age and health condition) 05 ☐ Depends on the type of the vaccine 06 ☐ Depends on the type of corona virus 07 ☐ No effect 08 ☐ Others
If yes specify E vacmain_effnegtv.Contains(8)	TEXT Specifyeffcts ________________________________
P8. Rank three most vulnerable groups if infected by the corona virus? Considering if not vaccinated. (Rank based on vunerability) E IsAnswered (vacmain_effnegtv)	MULTI-SELECT: ORDERED vulnerable_grps 01 ☐ People elder than 80 years 02 ☐ People 60-80 years old 03 ☐ People 40-60 years old 04 ☐ People 20-40 years old 05 ☐ People 0-20 years old 06 ☐ People that are overweight 07 ☐ People with other diseases 08 ☐ Anybody can get seriously sick 09 ☐ Dont know

VACCINATION AGAINST COVID-19 AND INFECTIONS/SICKNESS

	V1.Have you already been vaccinated against COVID-19?	SINGLE-SELECT vac_cov19 01 ○ Yes 00 ○ No
E	V2. If yes to V1, what type of vaccine? vac_cov19==1	MULTI-SELECT COVvac_type 01 ☐ Astra Zeneca 02 ☐ Johnson&Johnson 03 ☐ Pfizer
E	V3.If yes to V1, how many doses have you received? vac_cov19==1	NUMERIC: INTEGER COVvac_doses ________________________________
E	V4A. If yes to V1, when were you vaccinated first time? vac_cov19==1	DATE COVvac_date_first ________________________________
E	V4B. If yes to V1, when were you vaccinated Second time? COVvac_doses>=2	DATE COVvac_date_second ________________________________
E	V4C. If yes to V1, when were you vaccinated Third time? COVvac_doses>=3	DATE COVvac_date_third ________________________________
E	V5. If yes to V1, where were you vaccinated? vac_cov19==1	SINGLE-SELECT COVvac_location_first 01 ○ At LUANAR 02 ○ At my home place 03 ○ Other
E	If others Specify COVvac_location_first==3	TEXT COVvacSpecifyplace ________________________________
E	V6. If you are not vaccinated, have you tried to get vaccinated? vac_cov19==0	SINGLE-SELECT COV_vac_tried 01 ○ Yes 00 ○ No
E	V7.Would you like to get vaccinated against COVID-19? vac_cov19==0	SINGLE-SELECT liketoget_vac 01 ○ Yes 00 ○ No 02 ○ Don't know
E	V8. Does your answer to V7 depend on the type of vaccine you get access to? vac_cov19==0	SINGLE-SELECT vcn_vs_type 01 ○ Yes 00 ○ No
E	V8a. If Yes to question V7, explain: vcn_vs_type==1	TEXT COVvac_explain ________________________________
	V9.Do you recommend all adults to get vaccinated?	SINGLE-SELECT COVvacrecom 01 ○ Yes 02 ○ No

V10. Would you like to advise people to not take the vaccine? E `IsAnswered(COVvacrecom)`	SINGLE-SELECT `COVvacwarning` 01 ○ Yes 00 ○ No
V11. If yes to V10, explain why: E `COVvacwarning==1`	TEXT `why_COVvac_warn` _.
V12A.How much trust do you have that vaccination is good for you? E `IsAnswered(COVvacwarning)`	SINGLE-SELECT `vactrust` 05 ○ Very high 04 ○ High 03 ○ Good 02 ○ Low 01 ○ Very low
V12B.Should vaccines be reserved for only some groups that should be given first priority? E `IsAnswered(vactrust)`	SINGLE-SELECT `COVvac_priority` 01 ○ Yes 00 ○ No
V13. If yes to V12B, who should be given priority? E `COVvac_priority==1`	MULTI-SELECT: ORDERED `COVvacprigroups` 01 ☐ People elder than 80 years 02 ☐ People 60-80 years old 03 ☐ People 40-60 years old 04 ☐ People 20-40 years old 05 ☐ People 0-20 years old 06 ☐ People that are overweight 07 ☐ People with other diseases 08 ☐ Anybody can get seriously sick
V14.Have you been infected by the corona virus at some point as far as you know? E `IsAnswered(COVvac_priority)`	SINGLE-SELECT `CoronaInfected` 01 ○ Yes 00 ○ No
V14a.If yes to V14, how did the infection affect your body? E `CoronaInfected==1`	SINGLE-SELECT `Vac_gainst_Covid` 00 ○ I did not feel any effect 01 ○ I felt only mild symptoms 02 ○ I felt ill and uncomfortable 03 ○ I got seriously sick but did not go to hospital 04 ○ I got very sick and was hospitalized
V15.If yes to V14, when was this? E `CoronaInfected==1`	DATE `MonthInfected` _.
V16.Have you at some points in time tested yourself for being infected?	SINGLE-SELECT `Coronatested` 01 ○ Yes 00 ○ No
V17.If yes to V16, where was this? E `Coronatested==1`	TEXT `Coronatestplace` _.
V18.If yes to V16, how many times? E `Coronatested==1`	SINGLE-SELECT `Coronatesttimes` 01 ○ Once 02 ○ Twice 03 ○ Thrice 04 ○ More than thrice

V20.If you have been infected, did you get sick and how sick? E CoronaInfected==1	SINGLE-SELECT how_sick 01 ○ Mild symptoms only 02 ○ Unpleasant illness but no breathing problems 03 ○ Unpleasant illness with breathing problems 04 ○ Other
If others Specify E how_sick==4	TEXT specifyhowsick ________________________________
V21.If you have been sick with COVID-19, did you go to/stay in hospital? E CoronaInfected==1	SINGLE-SELECT stay_in_hospital 01 ○ yes 00 ○ no
V22.Do you have any friends who have been infected by corona?	SINGLE-SELECT COVsickfriend 01 ○ Yes 00 ○ No
V23.If yes to V22, have any of these been seriously sick? E COVsickfriend==1	SINGLE-SELECT COVsickfriendsserious 01 ○ Yes 00 ○ No
V24. Do you have any relatives who have been infected?	SINGLE-SELECT COVsickrelatives 01 ○ Yes 00 ○ No
V25.If yes to V24, have any of these been seriously sick? E COVsickrelatives==1	SINGLE-SELECT COVsickreativserious 01 ○ Yes 00 ○ No
V26. Do you know anybody who have died from COVID-19?	SINGLE-SELECT COVdied_know 01 ○ Yes 00 ○ No
V27. Have you lived with a person that have been infected by the corona virus? E IsAnswered(COVdied_know)	SINGLE-SELECT coronainfcohabit 01 ○ Yes 00 ○ No

PERSONAL BEHAVIOR IN RESPONSE TO THE PANDEMIC

B1.Have you tried avoiding getting infected by the corona virus during the most recent wave of the pandemic?	SINGLE-SELECT Corona_protection_rank 01 ○ Yes 02 ○ No
B2.Tick the three most important items or ways you have used E Corona_protection_rank==1	MULTI-SELECT: ORDERED Protection1 01 ☐ facemask 02 ☐ Kept >1 meter distance to people in public spaces 03 ☐ Reduced the number of contact persons 04 ☐ Washed my hands many times per day 05 ☐ Avoided handshakes 06 ☐ Avoided crowded places 07 ☐ Avoided visiting old people/family 08 ☐ Prayed to God to not get infected 09 ☐ Used traditional medicine 10 ☐ Other
If others Specify E Protection1.Contains(10)	TEXT spcimport _ .
B3. If you used facemask regularly during the peak of the last wave of the pandemic, how many times did you use such a mask before you disposed it? E IsAnswered(Protection1)	SINGLE-SELECT facemaskchange 01 ○ 1-5 times 02 ○ 6-10 times 03 ○ 11-20 times 04 ○ >20 times 05 ○ Changed mask daily 06 ○ Other 07 ○ Never
B4. What kind of facemask did you use? E IsAnswered(facemaskchange)	SINGLE-SELECT facemasktype 01 ○ Purchased paper mask 02 ○ Washable cloth mask 03 ○ Homemade mask from cotton 04 ○ Other 05 ○ None
If others Specify E facemasktype==4	TEXT facemasktypesp _ .
B5.What are the main benefits of using facemask?	MULTI-SELECT facemaskbenefit 01 ☐ Protect yourself from being infected by others 02 ☐ Protecting others from being infected by you 03 ☐ You are safe when you go to crowded places 04 ☐ You do not need to think about social distancing 05 ☐ Others 06 ☐ None
If others Specify E facemaskbenefit.Contains(5)	TEXT facemaskbenefitspec _ .

B6. If you used a washable facemask that you used many times, how often did you wash it during the peak of the pandemic? E IsAnswered(facemaskbenefit)	SINGLE-SELECT facemaskwash 01 ○ Daily 02 ○ Twice per week 03 ○ Once per week 04 ○ Rarely 05 ○ Never

PERSONAL BEHAVIOR IN RESPONSE TO THE PANDEMIC

Roster: B7. HOW COMMONLY DO YOU USE A FACEMASK - %ROSTERTITLE%

generated by fixed list facemaskuse

01 In stores/shops
02 At friends home
03 In the street
04 In the bus
05 In the market
06 At home
07 In the university
08 In the classroom
09 In church

Select frequency on use of face mask in the question shown above	SINGLE-SELECT Measures_of_avoiding_Covid 01 ○ Always 02 ○ Never 03 ○ Sometimes
B8. Have you made any adjustments in your behavior to reduce the risk that you will infect others in case you are infected without knowing it?	SINGLE-SELECT adjustments 01 ○ Yes 02 ○ No
B9A.what are your three most important behavioral activities you did during the height of the most recent wave of the pandemic to protect others E IsAnswered(adjustments)	MULTI-SELECT: ORDERED rankprotectact1 01 ☐ Used facemask 02 ☐ Kept >1 meter distance to people in public spaces 03 ☐ Reduced the number of contact persons 04 ☐ Washed my hands many times per day 05 ☐ Avoided all handshakes 06 ☐ Avoided crowded places 07 ☐ Used disinfectants regularly 08 ☐ Avoided visiting parents and grandparents to not infect them 09 ☐ Avoided visiting other old or sick people 10 ☐ Avoided going to church
B9B.Do you think it is necessary for you to adjust your behavior due to the corona pandemic? E IsAnswered(rankprotectact1)	SINGLE-SELECT B9 01 ○ Yes 00 ○ No

B10A.If No to B9B, what are the reasons? select your three most important reasons E B9==0	MULTI-SELECT: ORDERED ranknoadjustreasons1 01 ☐ Very low or no risk of getting infected 02 ☐ Very low or no risk of getting sick if infected 03 ☐ No or very low risk of infecting others 04 ☐ I do not want to adjust my behavior as I should be free to do whatever I want 05 ☐ I do not think I am at risk myself and others should take care of themselves, that is not my responsibility
If others specify E IsAnswered(ranknoadjustreasons1)	TEXT others_reasns _________________________________
B11.How frequently did you update yourself on the pandemic situation in the country during the last wave? If yes, how often?	SINGLE-SELECT B11 01 ○ Daily 02 ○ Weekly 03 ○ Monthly 04 ○ I do not make any special efforts to be updated on this 05 ○ I expect others to inform me or warn me if important
B12B.Do you update yourself regarding the pandemic?	SINGLE-SELECT pandemicUpdate 01 ○ Yes 02 ○ No
B12C.If you update yourself regarding the pandemic, select the three most important sources of information? E pandemicUpdate==1	MULTI-SELECT: ORDERED pandemicinfosrc 01 ☐ Radio 02 ☐ TV 03 ☐ Newspapers 04 ☐ Internet 05 ☐ Religious leaders 06 ☐ Political leaders 07 ☐ Health personnel 08 ☐ Others
B13.Is internet an important source of information?	SINGLE-SELECT pandem_internetsources 01 ○ Yes 02 ○ No
B13B.If internet is an important source of information, which websites are your main sources of information? Websites: E pandem_internetsources==1	TEXT pandem_internetsources2 _________________________________
B14.Who do you respect/trust the most and follow the advice of in relation to the pandemic?(Select your three most respected on list) E IsAnswered(pandem_internetsources)	MULTI-SELECT: ORDERED Respect_info 01 ☐ Religious leader 02 ☐ Political leaders 03 ☐ Health Personnel 04 ☐ University Leaders 05 ☐ Best friends 06 ☐ Parents 07 ☐ Others

PERCEPTION ABOUT THE BEHAVIOR OF OTHERS RELATED TO THE PANDEMIC

O1. Do you think that other students behave in a responsible way in relation to the pandemic?	SINGLE-SELECT o1_othstudbehav 01 ○ Yes 00 ○ No
O2.how big share of the students at LUANAR do you think are too careless and can therefore contribute to the spread of the virus? E IsAnswered(O1_othstudbehav)	SINGLE-SELECT o2_careless_stud 01 ○ 1-20% 02 ○ 21-40% 03 ○ 41-60%, 04 ○ 61-80%, 05 ○ 81-100%
O3.How big share of the students are against the recommended protective measures? E IsAnswered(O2_careless_stud)	SINGLE-SELECT o3_studagainstprotact 01 ○ 1-20% 02 ○ 21-40% 03 ○ 41-60%, 04 ○ 61-80%, 05 ○ 81-100%
O4.How big share of the students are against getting vaccinated against COVID-19? E IsAnswered(O3_studagainstprotact)	SINGLE-SELECT o4_sharestudantivac 01 ○ 1-20% 02 ○ 21-40% 03 ○ 41-60%, 04 ○ 61-80%, 05 ○ 81-100%
O5.How big share of the students are believing that their religion/God protects them against the pandemic E IsAnswered(O4_sharestudantivac)	SINGLE-SELECT o5_studreligprot 01 ○ 1-20% 02 ○ 21-40% 03 ○ 41-60%, 04 ○ 61-80%, 05 ○ 81-100%
O6.How big share of the students believe that the vaccine is more dangerous than the corona virus itself? E IsAnswered(O5_studreligprot)	SINGLE-SELECT o6_COVvacriskiercorona 01 ○ 1-20% 02 ○ 21-40% 03 ○ 41-60%, 04 ○ 61-80%, 05 ○ 81-100%
O7.How big share of the students believe that the corona virus is no serious threat to them and therefore ignore it?	SINGLE-SELECT o7corona_NOthreat 01 ○ 1-20% 02 ○ 21-40% 03 ○ 41-60%, 04 ○ 61-80%, 05 ○ 81-100%
O8.How big share of the students believe that traditional medicines are better at protecting against corona infection/COVID-19 than the vaccines? E IsAnswered(o7corona_NOthreat)	SINGLE-SELECT o8_sharestudtradmedicine 01 ○ 1-20% 02 ○ 21-40% 03 ○ 41-60%, 04 ○ 61-80%, 05 ○ 81-100%

O9.Are there some special events that have changed your opinion/attitudes/behavior about the corona pandemic/COVID-19 risk? E IsAnswered(O8_sharestudtradmedicine)	SINGLE-SELECT O9_specialeventseffect 01 ○ Yes 00 ○ No
O10.If yes to O9, what was this event or events that changed your attitudes/opinion/behavior? Explain E O9_specialeventseffect==1	TEXT O10_whatevents _
O11.Have students changed their behavior related to the latest corona variant (omicron) compared to earlier variants?	SINGLE-SELECT omicronbehavior 01 ○ Yes 00 ○ No
O12.If the students have changed their behavior related to the latest wave of the pandemic, explain what change in behavior you observe E omicronbehavior==1	TEXT omicronbehav2 _

GAME SET 4

Game_set_4

STATIC TEXT

Game 4. Instructions This game takes place in two steps. First you will choose between a risky and safe amount of money. Afterwards you choose between alternative mixes of safe and risky amounts, based on your preferences.

R1. Step 1. You have the choice between 1. a risky amount of 3000 MK with a 50% chance of winning this amount (determined by one coin toss). If the coin toss gives a "Head" you win. If the coin toss gives a "Tail" you lose and you receive nothing. 2. a safe amount of 1000 MK. State your preferred choice	SINGLE-SELECT GS4_1 01 ○ Risky amount 00 ○ Safe amount
R2. Step 2. Whether you preferred the risky or safe amount above, we give you an option to choose between an alternative mixture of risky and safe amounts. What is your preferred combination of risky and safe amount? Select your preferred combination of risky and safe amount among the six alternatives below E IsAnswered(GS4_1)	SINGLE-SELECT riskyinv 01 ○ 1. 50% chance of Risky amount = 3000 + Safe amount = 0 (full risk) 02 ○ 2. 50% chance of Risky amount = 2400 + Safe amount = 200 03 ○ 3. 50% chance of Risky amount = 1800 + Safe amount = 400 04 ○ 4. 50% chance of Risky amount = 1200 + Safe amount = 600 05 ○ 5. 50% chance of Risky amount = 600 + Safe amount = 800 06 ○ 6. Risky amount = 0 + Safe amount = 1000 (no risk)

STATIC TEXT

Thank you for participating in the games. We will finalize the lotteries and payout after you have filled in all your answers to the survey instrument on corona/COVID-19

STATIC TEXT

Wait for further instructions before proceeding to the Lottery

STATIC TEXT

The lottery will be implemented for your preferred risky amount level. Only in the case you prefer zero risky amount will there be no lottery.

STATIC TEXT

The experimenter tosses the die once in front on the desk of the student

R3. Outcome of lottery, 1=Win, 0=Loss E IsAnswered(riskyinv)	SINGLE-SELECT G4lottery 01 ○ Die outcome number 1-10 for 20-sided die=Loss 00 ○ Die outcome number 11-20 for 20-sided die=Win 02 ○ Safe amount

STATIC TEXT

The payout to the students is organized in an envelope for all the four games at the end.

Norges miljø- og biovitenskapelige universitet
Noregs miljø- og biovitskapelege universitet
Norwegian University of Life Sciences

Postboks 5003
NO-1432 Ås
Norway