UNIVERSITY OF KWAZULU-NATAL

Potential adoption of mHealth applications to induce healthy lifestyles among UKZN (PMB) students

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DECLARATION

I, Nompumelelo Cebisile Witness Mtshali declare that

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LIST OF ABBREVIATIONS

BI – Behaviour Intention

DOI – Diffusion of Innovation theory

EE – Effort Expectancy

FC- Facilitating Conditions

GPS – Global Positioning System

HTMT - Heterotrait-Monotrait Ratio

ICASA- Independent Communications Authority of South Africa

ICT- Information and Communication Technology

IoMT – Internet of Medical Things

IoT – Internet of Things

mHealth- Mobile health (the use of mobile technologies to provide healthcare services)

NCDs- Non-Communicable Diseases

PE – Performance Expectancy

PLS - Partial Least Square

PMB - Pietermaritzburg

PT – Persuasive Technology

RFID- Radio- Frequency Identification

SA – South Africa

SEM- Structured Equation Model

SI – Social Influence

SMS- Short Message Service

SPSS – Statistical Package for Social Science

SRMR- Standardized Root Mean Square Residual

TAM – Technology Acceptance Model

TPB – Theory of Planned Behaviour

UB – Use Behaviour

UKZN - University of KwaZulu-Natal

UTAUT – Unified Theory of Acceptance and Use of Technology

WHO - World Health Organisation

ABSTRACT

Over the years, the World Health Organization has reported an increasing number of young people affected by Non-Communicable Diseases (NCDs). There is also evidence that there is an increased prevalence of NCDs amongst the youth in South Africa. This surge in NCDs amongst the youth is often related to unhealthy lifestyles. It is also known that the rate of smartphone adoption among the youth in South Africa is high. This high rate of smartphone adoption presents an opportunity to devise mobile applications-driven interventions to induce healthy lifestyles amongst the youth. It is in this context that this study examined the potential adoption of mobile health applications to promote healthy lifestyles, that is, to monitor one's diet and physical exercise amongst the youth in South Africa. The study adopted the Unified Theory of Acceptance and Use of Technology (UTAUT) to explain the youth's intention to adopt mobile health applications that help induce healthy lifestyles. Data was collected from a convenient sample of 320 students registered at the University of KwaZulu-Natal, Pietermaritzburg campus using a survey questionnaire. The descriptive analysis was conducted to assess and understand the perceptions and awareness of students pertaining to the use of mobile health applications. The Partial Least Structured Equation Model was used to assess the proposed model for the adoption of mobile health applications that promote healthy lifestyles. The results revealed that effort expectancy (EE), performance expectancy (PE) and social influence (SI), and facilitating conditions are the factors that influence the adoption of mobile health applications that help to induce healthy lifestyles. In addition, the study found that there is limited awareness of mobile health applications among UKZN (PMB) students. The study recommended that there is a need for interventions to raise awareness on the use of mHealth applications that help induce healthy lifestyles amongst the youth. Furthermore, any interventions that seek to promote healthy lifestyles amongst the youth should consider the identified factors that significantly influence the adoption of mHealth applications that help induce healthy lifestyles.

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CHAPTER 1: INTRODUCTION TO THE STUDY

1.1 Introduction

This chapter introduces the study by outlining the background and the context of the study. Furthermore, the chapter provides an outline of the rationale of the study, the research problem, research objectives, and research questions that guide the study. The chapter further summarises the research methodology adopted in this study, the study's guiding framework, the significance and limitation of the study as well as an outline of the chapters covered in this study.

1.2 Background of the study

The World Health Organisation (2016) defines non-communicable diseases (NCDs) as chronic diseases that cannot be transferred from one person to another. Wang and Wang (2020) stated that NCDs encompasses cardiovascular diseases as well as chronic respiratory diseases, diabetes, and cancer. The burden of NCDs is a growing global health challenge in developing countries (Kassa and Grace, 2019). The increasing number of deaths due to NCDs has compelled the World Health Organisation to declare the surge in NCDs cases a global health crisis that needs to be prioritised (World Health Organisation, 2014). There is evidence that a high number of people affected by these diseases are from the low-middle income countries where there is a lack of effective prevention and management of these diseases (World Health Organisation, 2014). The literature has revealed some factors that contributed to getting NCDs, these factors include smoking tobacco, harmful use of alcohol, adopting an unhealthy diet, and lack of body/physical activity (Kassa and Grace, 2019).

Forouzanfar, Alexander, Anderson et al. (2015) argue that the major cause of NCDs is living an unhealthy lifestyle. World Health Organisation (2014) reported a high rate of young people who suffers from and succumb to non-communicable diseases. Previous studies have revealed that most people including the youth own smartphones through which they stay informed (Kormendi, 2015; Ahad and Anshari, 2017). Stephens and Allen, (2013) state that mobile technologies could be used as part of healthcare interventions to raise awareness about NCDs and promoting healthy living.

Globally, mobile phone subscribers are predicted to be over 4 billion (O'Dea, 2020). In addition, in 2019, South Africa's smartphone penetration rate had increased from 81.7% (2018) to 91.2% (Independent Communications Authority of South Africa, 2020). The significant adoption of mobile technologies provides an opportunity to explore the use of mobile applications to change people's behaviour and promote the awareness of healthy lifestyles (Tomlinson, Rotheram-Borus, Swartz and Tsai, 2013). Karageorgos et al., (2018) argue that the evolution of mHealth technologies could be a promising solution that will improve health outcomes.

Many studies have been conducted to demonstrate the effectiveness of using mobile technologies to improve healthy lifestyles. Some of these studies focused on diabetes and diet (Conway, Campbell, Forbes, Cunningham and Wake, 2016; Vandelanotte et al., 2016). On the other hand, several studies have investigated the use of mobile technologies to encourage physical exercises/activities routines (Dobbins and Rawassizadeh, 2015; Choi, Hyeon Lee, Vittinghoff and Fukuoka, 2016; Ndayizigamiye, Kante and Shingwenyana, 2020). In the context of this study, adopting a healthy lifestyle include adopting a physical exercise routine and adopting a healthy eating habit.

Previous studies have shown little evidence of people's adoption and use of mobile technologies to induce a healthy lifestyle (Bhuyan et al., 2016; Atallah, Khalifa, Metwally and Househ, 2018). In addition, McCarroll, Eyles, and Mhurchu, (2017) and Helbostad et al., (2017) have found that people view healthy lifestyles as just eating healthy other than adopting a combination of physical activity/exercise routine (such as jogging and other exercises) and a healthy diet. Thus, the aim of this study is to investigate the awareness of mobile applications that help induce healthy eating habits among the youth (UKZN PMB students) as well factors that may influence the adoption of such mobile applications.

1.3 Research Problem

In South Africa, there is evidence of an increase in diseases related to unhealthy lifestyles especially among the youth (UNICEF, 2016; Shisana et al., 2012). In the light of the current adoption of mobile applications by the youth in South Africa, which is estimated to be at 72% (UNICEF, 2012), there is a potential for using mobile applications to induce healthy lifestyles amongst the youth. However, in the context of South Africa, factors that may contribute to the adoption of such mobile applications and the awareness of such applications have not been widely investigated from the youth perspective. This means that the potential adoption of mobile applications that may induce healthy lifestyles by the youth remains largely unknown in the South African context. Identifying such factors may assist in devising adequate mHealth interventions that are specifically targeted to the youth. Moreover, it is anticipated that findings from this study will assist in the design of such mobile health applications taking into consideration the determinants and the awareness context. Such a user-centred design may contribute to the acceptance of the applications, which could lead to a reduction of health risks associated with the lack of a healthy lifestyle. In the context of this research, the term youth represent people between the age of 14 and 35 as defined by South Africa's National Youth Commission Act of 1996 (ICASA, 2020).

1.4 Research questions and objectives

1.4.1 Research questions:

- To what extent is the youth aware of mobile applications that help induce healthy lifestyles?
- What is the effect of performance expectancy on the behavioural intention to adopt mobile applications that help induce healthy lifestyles?
- What is the effect of effort expectancy on the behavioural intention to adopt mobile applications that help induce healthy lifestyles?
- What is the effect of social influence on the behavioural intention to adopt mobile applications that help induce healthy lifestyles?
- What is the effect of facilitating conditions on the use behaviour of mobile applications that help induce healthy lifestyles?
- What is the effect behavioural intention on the use behaviour of mobile applications that help induce healthy lifestyles?

1.4.2 Research objectives:

- To identify the current awareness of mobile applications that that help induce healthy lifestyles.
- To assess the effect of performance expectancy on the behavioural intention to adopt mobile applications that help induce healthy lifestyles.
- To assess the effect of effort expectancy on the behavioural intention to adopt mobile applications that help induce healthy lifestyles.
- To assess the effect of social influence on the behavioural intention to adopt mobile applications that help induce healthy lifestyles.
- To assess the effect of facilitating conditions on the use behaviour of mobile applications that help induce healthy lifestyles.
- To assess the effect behavioural intention on the use behaviour of mobile applications that help induce healthy lifestyles.

1.5 Theoretical framework

The study used the Unified Theory of Acceptance and Use of Technology (UTAUT) model as the guiding theoretical framework. The UTAUT model depicts the behavioural intention and use behaviour towards the use of a technology (Venkatesh et al, 2003). The UTAUT model has been used in previous studies to determine the factors that influence the adoption of mHealth technologies (Kijsanayotin et al., 2009; Hoque and Sorwar, 2017; Ndayizigamiye et al., 2020).Their findings depicted that performance expectancy, effort expectancy, facilitating conditions, and social influence are factors that influence the adoption of mHealth applications. In addition, Ndayizigamiye et al., (2020) identified awareness as an additional factor that also contributes to the adoption of mHealth applications. Other studies have also shown that having knowledge or being aware of technology may influence the adoption or non-adoption of the technology (Adegbehingbe, 2015; Ntshakala, 2016; Kayyali, Peletid, Ismail, Hashim, Bandeira, and Bonnah, 2017). In this study, the UTAUT framework was used to determine the factors influencing the adoption of mHealth applications that help induce healthy lifestyles within the sample frame.

1.6 Methodology overview

Saunders, Lewis and Thomhill (2016) developed a research onion framework that can be used to articulate the research methodology adopted in a research study. In this study, the research onion framework was adopted to explain the research methodology adopted in this study. The framework consists of six layers namely, research philosophy, research approach, research method research strategy, time horizon, research techniques, and procedures.

The study adopted positivism as the research philosophy and deduction as the research approach. The study adopted the quantitative method because it investigates the relationship between variables using numerical data and is analysed using quantitative statistical techniques and graphics (Saunders et al., 2016). The researcher chose the quantitative method to produce an in-depth understanding of the research problem and insights into the factors that affect the adoption of mHealth applications by the youth in South Africa's context. Furthermore, the study adopted a descriptive research design as it intends to depict and explain the relationships between variables based on hypothetically grounded assumptions regarding how the constructs within the UTAUT framework are related.

The target population for this research was the University of KwaZulu Natal, Pietermaritzburg (PMB) campus registered students that are between the age of 18 and 35 years. At the time of data collection in 2019, the Pietermaritzburg campus had 9500 registered students. De Morgan's sampling table (shown in Table 3.1) was used to determine the sample size for the study. The sample size for this research was 370 students.

This study used a questionnaire survey as a primary method to collect data. The Statistical Package for Social Sciences (SPSS) version 25 and the SMARTPLS 3.0 software were used to analyse data. Descriptive analysis was conducted using SPSS version 25 to assess the youth's perceptions of mHealth applications that promote physical activity as well as those that promote healthy eating habits. In addition, SMARTPLS 3.0 was used to perform the Partial Least Square (PLS) Structural Equation Modelling (SEM) to evaluate the UTAUT model in the context of the study's objectives. Structured Equation Model (SEM) has two different types of models namely: the measurement model and the structural model (Wong, 2019). For the measurement model, Internal Consistency Reliability, Indicator Reliability, Convergent Validity, and Discriminant Validity tests were run to determine the reliability and validity of the constructs. The structural model predicts how the endogenous constructs fit the model and Coefficient of Determination (R^2), Predictive Relevance (Q^2), Standardized Root Mean Square Residual (SRMR), and Path Coefficients were conducted to prove model validity.

1.7 Limitations of the study

This research used a sample of students registered at the University of KwaZulu-Natal (on the Pietermaritzburg campus) in South Africa. In addition, as depicted in the results section, the respondents were young people (between 18 and 35 years of age according to South Africa's classification of youth). Therefore, the generalizability of the findings can only be extended to the broader category of youth. However, caution should be taken when extending the results of this study to the broader category of youth as the term "youth" can denote a different set of people in a different context. Moreover, the study targeted 'educated' youth since all the respondents were enrolled at the University of KwaZulu-Natal. Thus, further research should be conducted to assess the adoption of mHealth applications that help induce healthy lifestyles to "uneducated youth" or youth who are not pursuing a formal qualification. Notwithstanding the limitations, this research is a stepping-stone towards assessing the adoption of mobile applications that help induce healthy lifestyles in South Africa's context and from the youth's perspectives, using structural equation modelling (PLS-SEM).

1.8 Dissertation Structure

Chapter 1: Introduction

The first chapter outlines the research problem, research objectives, and research methodology and provides a discussion of the framework used to meet the research objectives. The chapter further delineates the contribution as well as the limitations of the study.

Chapter 2: Literature Review

The second chapter focuses on previous literature relating to the adoption of mobile health applications to induce healthy lifestyles. The first section of the chapter gives an overview of the adoption of mobile applications for healthcare purposes (mHealth applications). In addition, the chapter discusses factors and challenges that influence the adoption of mHealth applications. The chapter further discusses various technology adoption frameworks used to examine behavioural change and adoption of new technologies.

Chapter 3: Research Methodology

The research methodology chapter discusses the methods used to conduct this study. The chapter discusses the research philosophy, the research approach, the research method, research design, the research strategy, and the time horizon adopted in this study. It further discusses the sampling design, data collection, and analysis methods applied in this study.

Chapter 4: Findings and discussion of the results

The chapter presents the results of the study using the quantitative research approach. The demographic results are presented first, followed by the descriptive analysis of youth awareness about the mHealth applications that help induce healthy lifestyles. Lastly, it presents the model (measurement and structural) assessment achieved using the Partial Least Squares Structural Equation Modelling (PLS-SEM). The study further discusses the findings in the light of the research questions.

Chapter 5: Conclusion and recommendations

The chapter concludes the study and provides practical recommendations in the light of the findings. The chapter further suggests future research endeavours to address the limitations and gaps of this study.

1.9 Chapter Summary

This chapter has introduced the study. The chapter discussed the background of the study, research problem, research objectives as well as the adopted research methods. Furthermore, this chapter discussed the research rationale, the significance of the study, limitations of the study, and the structure of the study's chapters. The next chapter provides the literature review.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Current mobile technology advancement has provided users with platforms where they can have access to personalised healthcare through mobile applications. McNaughton and Light (2013) note that advancement in mobile technologies has engendered various ways of delivering information to mobile users. Such features include amongst other global positioning systems (GPS), radio-frequency identification (RFID), enhanced mobile phone-mounted cameras, and biometrics sensors.

Mobile technologies are rapidly increasing with new designs and platforms that encourage new application development to enhance the current standard of living and to a certain extent, people's lives. Global trends reveal that people spend about 65% of their time on their phones (Quart, 2018). Through the usage of mobile phones, people can be educated and encouraged to adopt mobile applications that could enhance or induce healthy lifestyles. The World Health Organisation (2016) defines mHealth as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices". MHealth applications are mobile platforms that offer services such as emergency applications, ambulatory, and hospital care, clinical nursing, homecare, and personal healthcare (Akter and Ray, 2010).

South Africa, as a developing country has challenges pertaining to infrastructure development. In the healthcare sector, South Africa's challenges are exemplified by the current inadequate infrastructure in public hospitals, clinics, and the shortage of qualified healthcare professionals (Malelelo-Ndou, Ramathuba, and Netshisaulu, 2019). It has been argued that mHealth can help address some of the challenges pertaining to healthcare delivery particularly in the context of developing countries (Ndayizigamiye, 2016).

This literature review section discusses the current literature pertaining to the use of mobile technologies and mHealth applications. In addition, this literature review section highlights the factors that influence the adoption of mobile applications and the effects of these factors. Furthermore, the chapter reviews the common theories used in Information Systems (IS) research, followed by a justification of the choice of the most suitable theory for this study.

2.2 Mobile applications

The current increase in smartphones use globally has been triggered by the enhancement of mobile phone capabilities, capacious memories, and operating systems that are more efficient, hence encouraging mobile application development (Boulos et al, 2011). The 20th century has seen improvement in telecommunications and a vast amount of telecommunications innovation came with the adoption of mobile devices (Bock et al., 2015).

Mobile devices can facilitate the sharing of information between businesses, people, government entities, and many more, through the use of mobile applications (Boulos et al., 2011). Most smartphones have an Android Operating System (OS) which makes it easy for developers to develop new applications as there are a lot of open-source applications that are used to develop applications that are compatible with the Android operating system. According to Muessig et al., (2013), more than 500 million applications are developed every year and most of them are about health, fitness, and medical applications. Alam, Hoque, Hu and Barua (2018) projected that there would be approximately 6.95 billion mHealth applications by the year 2020. These applications help users to live healthy lifestyles and are known as mHealth Applications. The mHealth applications are considered to be an effective way of employing ICTs for personalised healthcare (Kratzke and Cox, 2012; Alazzam, Al-Sharo and Al-Azzam, 2018).

The World Health Organisation (WHO, 2014) states that each year, almost 38 million deaths are accounted for Non-Communicable Diseases (NCDs) and 42% (16 million) of these deaths are related to people below the age of 70 years. In addition, most of these deaths occur within Low and Middle-income countries (LMCs). Forouzanfar et al., (2015) argue that unhealthy eating is the major cause of NCDs worldwide. Although healthy eating education is mainly provided through face-to-face or focus group strategies, Karmali et al., (2014) contend that these methods require a significant number of resources and their uptake is generally low. Generally, in the context of inducing healthy eating habits through face-to-face or focus groups, a lot of information must be conveyed in a short timeframe. In addition, cost and location are significant hindrances to accessing such interventions (Kariuki et al., 2017). Thus, there is a need for alternative sustainable interventions for promoting healthy eating to reduce incidents of NCDs-related deaths.

The use of mobile technologies could be one of the potential alternative cost-effective solutions to curb the surge of NCDs (Stephens and Allen, 2013; Whittaker et al., 2016), especially in resource-limited settings. Currently, there is an increasing number of 6 billion mobile subscribers in the world (Statista, 2020) and about 477 million people in Sub-Saharan Africa are subscribed to mobile services (GSMA,2020). In addition, Ericson (2016) projected that the ownership of smartphones will rise to 6.4 billion in 2021.

There is evidence that mobile technologies can promote behavioural change (Tomlinson et al., 2013) either through mobile device applications or through text messages. In the context of inducing healthy eating habits, Burke et al., (2011) argue that mobile devices can be used to implement interventions geared toward monitoring one's food intake, physical activity or even sending text messages to encourage people to eat certain types of food and setting healthy eating plans. In the context of this study, healthy eating refers to a variety of eating behaviours associated with good health and consistent with dietary guidelines, such as increased consumption of foods (or foods containing nutrients) conducive to good health, e.g., fruits, vegetables, whole-grains, vitamins, and minerals. It also refers to "a decreased consumption of foods (or nutrients) which when consumed in excess are associated with poor health, e.g., fast food, sugar-sweetened beverages, saturated fat, sodium, sugar, and alcohol; reduced energy intakes (for overweight or obese people), decreased portion sizes of energy-dense foods; and adherence to dietary patterns which promote the intake of foods conducive to good health" (McCarrolla et al. 2017: p 157).

2.2.1. Mobile health applications

There are many types of mHealth applications. Some applications focus on specific illnesses like diabetes, HIV, tuberculosis (BT), and heart disease (Wei Peng et al., 2016). Other mHealth applications focus on keeping people healthy by helping them to adopt a healthy diet and engage in regular physical exercises (McKay, Wright, Shill, Stephens and Uccellini, 2019). According to Alazzam (2018), mHealth applications aim to provide quality of care. mHealth applications can provide useful data that could be accessed anywhere by different healthcare workers (Baldwin, Singh, Sittig and Giardina, 2017).

The adoption of mHealth applications is more pronounced in Western countries while African countries are still lurking (Alam et al., 2020). Previous studies reported that European countries have a large number of people suffering from non-communicable and chronic diseases and that cost the countries a sizeable amount that is around 115 billion euros every year (Klaus and Julio, 2011; Hoque et al., 2020). Thus, European countries have embraced mHealth applications that allow their citizens to self-manage their illnesses in an attempt to curb the surge in Non-Communicable diseases (Klaus and Julio, 2011). The adoption of self-health care management applications assists the national healthcare system by decreasing the burden (that is, infrastructure and costs) associated with monitoring and taking care of patients (Belisario, Huckvale et al., 2013).

MHealth applications can be embedded within other devices like smartwatches to monitor someone’s health or routine exercises and relay such information to smartphones (Li et al., 2020). These applications then assist patients with monitoring their vital signs, food intake, and can remind patients about taking medication Burke et al., (2011). Other mHealth applications allow patients to send SMSs to specialists and medical facilities to expedite the diagnosis process (Elamin et al., 2018). SMS system assists old ageing individuals by reminding them to take the medication in time and ensuring that they collect it in time (Vervloet et al., 2012). The SMS system can be more convenient (to the older generation), easy to use and cheaper compared to advanced mHealth applications (Vervloet et al., 2012). Mobile health systems can be used to share insights into people’s health and motivate other people to monitor their health while ensuring that data is secure (Elamin et al., 2018). Although mHealth applications can help monitor or enhance people's health, it is important to adopt applications that suit one's needs. It is important for people to be careful of the applications they download as some applications can claim to be helping people only to find out that they are misleading and putting people's lives in danger (Kumar, 2020).

2.3 Awareness of mobile health applications

Traditionally, mHealth applications were designed to ease the communication between healthcare providers and patients (Kayyali et al, 2017). However, that is now changing as mHealth applications are becoming the most useful tools to manage, monitor, and improve lifestyles. Kayyali et al. (2017) conducted a study in England to assess the general awareness of mHealth applications from diabetic patients using a questionnaire and semi-structured interviews. Their study concluded that the level of awareness and usage of mHealth applications by patients was significantly low and further suggested that there is a need to promote such applications in order to increase people's knowledge and awareness. In the context of South Africa, Ndayizigamiye et al (2020), revealed that awareness is also a factor that influence the adoption of mHealth applications. Pai and Alathur (2019) on the other hand recommend the need to improve people's awareness of and familiarity with mobile health applications to induce healthy lifestyles.

2.4 Adoption of mobile health applications

Smartphones popularity is now an avenue for devising mobile phones- enabled interventions to support health education and awareness programs. Lupse, Caprioru, and Stoleu Tivadar (2016) conducted a study that entailed designing a mobile application that would assist people to live a healthy lifestyle by encouraging them to eat healthy food and exercise frequently. The study revealed that most participants were living unhealthy lifestyles without noticing that they were at risk of contracting Non-Communicable Diseases (NCDs) and the study suggested interventions that will raise awareness and motivate people to live a healthy lifestyle.

Ndayizigamiye (2016) investigated the benefits and various determinants of the adoption of mobile health (mHealth) in the context of public healthcare in Burundi. The study found that the adoption of mobile health (mHealth) can assist in disease management and prevention and improve the healthcare services delivery in the country (Ndayizigamiye, 2016). Although mobile health technologies can bring positive changes in the healthcare system, Ndayizigamiye (2016) discovered that there is limited knowledge and information sharing about the mobile health capabilities within the Burundi's healthcare environment. These could be regarded as barriers toward adopting mHealth services.

Over a decade, there has been a rising number of patients that are using telehealth care and mHealth at their homes (Watterson, Walsh and Madeka, 2015). Patients with long-term diseases are becoming more familiar with the use of mHealth applications as they provide a portable monitoring system (Elamin et al., 2018). Moreover, mHealth interventions have the potential to help address overcrowding in hospitals and clinics and they can help monitor non-communicable and chronic diseases (Elamin et al., 2018).

Lopes, Rodrigues, and Ray (2011) discussed a mobile health application called SapoFitness for dietary evaluation. SapoFitness application suggests daily meals and exercises to individuals based on the goals they have set for themselves. They concluded that this application was very intuitive and easy to use. Miller et al., (2016) investigated how e- and m-Health interventions could encourage physical activity and a healthy diet in developing countries. The study focused on individuals who were at risk of diabetes or hypertension. The findings show that emerging technologies (smartphones, wearable activity tracker) will be more effective in monitoring diabetes and hypertension. Kante and Ndayizigamiye (2020) highlighted the importance of having policies that guide the implementation of the Internet of Medical Things (IoMTs). In the context of developing countries, Kante and Ndayizigamiye (2020) found that only one country (Senegal) had an eHealth strategy that invoked the use of IoMTs. As mHealth applications are increasingly being connected to other IoT devices, it is very important to have such policies that would provide guidelines on standards to be used to ensure interoperability of IoTs devices and mHealth applications, security, and privacy.

2.5 Adoption of mHealth to induce health behavioural change

Zhao, Freeman, and Li (2016) examined factors that influence people's health behaviour change via mobile phone applications using behaviour change theories. The study was conducted in high-income countries and the results revealed that users preferred user-friendly applications, which consume less time while providing detailed information. Dennison et al., (2018) investigated the youth's perspectives on a mobile application in relation to health behavioural change. The results depicted that well-developed applications with valuable feedback would be more effective to change youth behaviour and promote healthy lifestyles. However, they also found that there are challenges such as the unavailability of health professionals to assist patients with adhering to medication and inaccurate information that could limit the effectiveness of mobile applications to change behaviour.

Cho, Park et al., (2014) examined factors influencing the use of health applications. They found that health awareness is significantly correlated with the use of health applications. Bailey, O'conor et al., (2015) found disparities between age and health literacy in relation to technology access. They also found that elderly and less educated people are less inclined to own smartphones and utilize the internet for health-related reasons.

2.5.1 Effects of mHealth interventions on food and nutrient intake

Soureti, Murray, Cobain, Chinapaw, van Mechelen and Hurling (2011) assessed the effects of automated web-based planning tools coupled with mobile text reminders on healthy eating in England. The primary outcomes revealed that participants in the intervention group were more likely to report eating a balanced diet compared to others that did not partake in the intervention. Beasley et al., (2008) on the other hand evaluated the capability of a Personal Digital Assistant (PDS)-based self-monitoring diet program (Diet-MatePro) in the United States of America (Virginia). Participants in the control group were given a paper-based food diary to record their dietary intake while those in the intervention group were given the PDA-based program. The study recorded that participants in the DietMatePro group (43%) were more likely to adhere to diet compared to the paper-based diary group (28%) (p=0.039). Kerr et al., (2016) evaluated the effectiveness of text messaging for improving the intake of fruit, vegetables, and decreasing junk food (unhealthy food or drinks) over 6 months. The study used a Randomised Control Trial (RCT). Participants who were young adults (males and females) were required to take pictures of food and drinks taken over four days. Participants were randomly allocated to one of three groups.

The first group of participants received feedback on their diet. In addition, text messages were sent to them on a weekly basis. On the other hand, the second group of participants received feedback on their diet only while the last group did not receive any feedback at all. The study findings revealed that men who received dietary feedback only, significantly reduced their energy-dense nutrient-poor (EDNP) intake (mean= 1.4 intake/day, p=0.02) while females who received feedback on their diet only, were able to significantly reduce their intake of beverages with sugar content (mean=0.2 intake/day, p=0.04) compared with the participants in the control group. They concluded that the use of mobile technology has great potential for a healthy diet and healthy weight promotion amongst young adults.

Vakili et al., (2015) evaluated the impact of a short text messaging system on choosing a healthy diet amongst women in Iran. The main aim was to enhance women's consumption of dairy products, green leafy vegetables, vitamin A-rich fruits, and seafood. In this Randomized Controlled Trial (RCT) study, 100 menopausal Iranian women between the age of 40 and 60 were assigned into two groups. Women in the intervention group were sent 16 text messages that included information on healthy food choices and the associated benefits during a four-month period. The study revealed that women in the intervention group increased the intake of vitamin A-rich fruits and vegetables compared to those in control group ($P < 0.001$). Moreover, after the intervention, there were more women ($P = 0.02$) that incorporated fish as part of their diet. However, there was no significant increase in the consumption of dairy products within the intervention group. There was also a noticeable increase, although not significant, in the consumption of green leafy vegetables within the intervention group.

Atienza et al., (2008) conducted a randomized study to evaluate the efficacy of using a Personal Digital Assistant (PDA) to increase the intake of whole-grain and vegetable intake within an 8-week period. Twenty-seven healthy adults aged 50 and above were randomly recruited in the study. Those in the intervention cluster were firstly trained and then given a Personal Digital Assistant to monitor their consumption of fibre-rich food (whole-grain) and vegetables. Those in the control group (non-intervention cluster) were given standard, written nutrition-related education materials. The study revealed that vegetable intake significantly increased among the participants in the intervention cluster (1.5–2.5 intake/day; p=0.02). Furthermore, there was an increase in the consumption of fibre-rich food by the participants in the intervention cluster (3.7–4.5 intake/day; p=0.10).

2.5.2 Effects of mHealth interventions on weight loss

Fjeldsoe et al. (2016) evaluated the effect of a text message based (GHSH) intervention (as a follow-up strategy) on people who participated in an intensive lifestyle coaching intervention. Two hundred and twenty-eight participants were randomly selected to be either part of the intervention group or the control group. Then, the participants were sent text messages for a period of six months based on each participant's preference. The outcomes revealed that participants in the intervention group recorded significant body weight loss (-0.89 kg) than those in the control group.

Haapala, Barengo, Biggs, Surakka, and Manninen (2009) conducted a study on the effectiveness of a mobile phone-enabled weight loss programme among overweight adults. One hundred and twenty-five overweight (BMI= 26 to 36kg/m2) adults (25 to 44-year-old) were randomly assigned either to an intervention (experimental) group or a non-intervention group. Through text messages, participants in the intervention group (N=62) who were self-directed dieters, were instructed to report their weight on a daily basis and received immediate tailored feedback. The outcomes revealed that participants in the intervention group recorded significant weight loss compared to the control (non-intervention group).

Lin, Mahmooth, Dehia, Frutchey, Mercado, Epstein, Preston, Gibbons, Bowie, and Labrique (2015) investigated the effects of text messages to support a healthcare intervention for obese African Americans. The study used a randomized controlled trial of 124 adults of which 63 were assigned to the intervention while 61 were assigned to the control group. The intervention group received standard care and daily tailored text messages for 6 months while the control group received only standard care. They found that the degree of engagement with the text messages was correlated with weight loss. Participants in the intervention group recorded more weight loss (-2.5kg after 3 months and -3.4 kg after 6 months) than the control group.

2.5.3 Effect of mHealth intervention on physical activities/exercises

Al Ayubi, Parmanto, Branch and Ding (2014) conducted a study reviewing the fundamental characteristics of mHealth applications that encourage people to engage in physical activities. The study examined how the characteristics were fitting with users' needs. In addition, the study aimed to determine how the applications were changing people's lives. They used a qualitative approach and interviewed 18 participants within the age range of 24 to 45 and the body mass index ranging from 18.5 to 42.98. The results showed that participants were keen to use such applications to change their health behaviour. In addition, these applications provided them with effective and innovative interactions. Mateo, Granado, Ferre-Grau, Montana-Carreras (2015) on the other hand conducted a study that evaluated the efficacy of mobile-based applications in promoting weight loss and increasing physical activities. The study revealed that promoting the use of mobile applications could help induce healthy lifestyles.

2.6 Determinants and challenges to the adoption of mHealth to induce healthy lifestyles

Yu, Wu, Yu, and Xiao (2006) investigated factors associated with adopting mHealth. The results indicate that for mHealth solutions to be effective, certain infrastructure needs to be in place. This includes networking, hardware, and technical support (Yu et al., 2006). Yu et al., (2006) categorize factors related to the adoption of mHealth into broad categories such as processes, people, technology, mobile phone compatibility, sufficient security, and privacy when using mHealth systems. On the other hand, Jeon and Park (2015) investigated factors that affect the acceptance of smartphone applications that seek to induce healthy lifestyles. Using the theory acceptance model (TAM), the results depicted that technical support and training have a significant impact on the perceived ease of use of the applications. The findings implied that having the necessary infrastructure and support would encourage more adults to adopt mHealth interventions. Moreover, Klasnja et al., (2009) conducted a study to investigate the usage of mobile technologies to support health behaviour change. They discovered that effectiveness, ease of use, and available support boost people's confidence to use the applications.

Leon, Schneider, and Daviaud (2012) used the qualitative research approach in South Africa to assess challenges facing mobile health application adoption. The results indicated that the challenges include system complexity, financial issues, and the lack of technical support. Furthermore, a study conducted by Boulos, Wheeler, Tavares, and Jones (2011) showed that barriers to adopting mHealth applications include cost, network bandwidth, battery power efficiency, usability, and privacy. Alazza et al., (2011) stated that the lack of education and awareness of mHealth may detect the usage and acceptance of mHealth applications.

A study conducted by Kante and Ndayizigamiye (2020) revealed a number of challenges related to the adoption of IoT-based healthcare services (which includes mHealth services) in developing countries. The identified challenges can be classified as information related challenges, socioeconomic and individual challenges, technical and organisational challenges, systems design issues. On the other hand, Ndayizigamiye and Maharaj (2016) categorised challenges to the adoption of mHealth in Burundi as physical access to mobile technology; human capacity and training; political will and public support; budget and donors/partners funding; and organisational barriers.

Ndayizigamiye and Maharaj (2018) reviewed mHealth interventions used for public healthcare in the East African region. Their review indicated that public-private sectors collaboration; including content in local language; involving users in the design phase of the interventions; and improving telecommunications infrastructure contributed significantly to the success of the interventions. Orji and Mandryk (2014) conducted a study to determine factors that affect health behaviour. Their results showed that culturally relevant design of persuasive technology could encourage healthy eating behaviour.

2.7 Benefits of using mHealth applications to induce healthy lifestyles.

Alzazzam et al., (2018) evaluated the acceptance of mHealth applications by healthcare providers. The results depicted that mobile applications were easy to use and improved information sharing with patients. Further benefits included increase health care quality and accessibility; raising healthcare awareness for active patients; easy and safe transfer of information about primary care channels (Alzazzam et al., 2018).

Mobile health (mHealth) applications and wearable devices have the potential to help individuals adopt a healthy lifestyle such as adopting a healthy diet and exercise routines. mHealth technologies/ applications would effectively contribute to reducing the risk of being diagnosed with chronic diseases such as stroke, cancer, and diabetes. Furthermore, the use of mHealth applications could be one of the core strategies to introduce self-health care monitoring to induce healthy lifestyles. In this instance, the use of self-health care monitoring applications can help people improve their behaviour and attitude towards what they eat and exercise routines.

Dute et al., (2016) conducted a study with European adolescents and students to examine the use of mobile applications to promote a healthy lifestyle. They reported that these applications can enable users to set goals, monitor their behaviour, and increase awareness on how to live a healthy lifestyle without incurring more expenses. Watterson et al., (2017) conducted a study to assess how mobile applications could be used to improve adolescent confidence in living a healthy lifestyle (eating healthy and exercising daily). Watterson et al., (2017) found that adolescents would engage more with applications that are interactive to improve their healthy lifestyles. The results also suggest that factors such as family and friend's support increase the prospects of the adolescents’ meeting the minimum daily requirements of healthy eating and physical activity.

A study conducted by Lund et al. (2014) in Zanzibar found that the use of mHealth Applications for appointment reminders and education helps reduce perinatal mortality. The mHealth Applications can reach a wide number of people but the lack of internet connectivity is still a big factor that is halting the adoption of mHealth Applications. According to Lee et al., (2016), there is evidence that shows that there is an improvement in health delivery, health behaviour, and infant feeding for people that are using mHealth Applications. Even though mHealth helps improve health and infant feeding, there is no evidence of mortality or morbidity reduction (Swanson et al., 2019).

A study by Santero et al. (2018), showed that the two most important mHealth functionalities are the SMS functionality and the monitoring capability of patients with diabetes, the monitoring increases the primary care of the patients. Previous research has also shown that using SMS has improved the healthy lifestyles of patients with diabetes (Islam, 2016). The usage of mHealth applications for monitoring and self-management for children that had transplants has shown promising results as these applications provide the opportunity for the whole family to help monitor and assist children via video calls with their doctors (Lerret, 2019).

The self-monitoring of blood pressure is helpful when it comes to the improvement of Hypertension control (Lakshminarayan et al., 2018). According to Uhlig et al., (2013), a meta-analysis study has shown that patients that are using mHealth applications to self-monitor their blood pressure (BP) tend to have a lower BP compare to those that do not use the applications. In addition, using mHealth Applications improve blood pressure, fats profiles, and insulin sensitivity thus helping improve the life span of the patients (Ekelund et al., 2011; Shin et al., 2016).

Patients with schizophrenia are believed to have 20% lower life expectancy and they’re more likely to suffer from cardiovascular diseases (Hennekens et al., 2005). Patients suffering from schizophrenia are encouraged to use mHealth applications that help them with physical exercise as it might help with prolonging their life span (Shin et al., 2016).

Diabetes is one of the dangerous chronic disease known to man. According to Hou et al. (2016), the estimation of people that will suffer from diabetes in 2030 worldwide is approximately 500 million. The diabetes mHealth App is a promising platform that aims to help patients self-manage their diabetes. The diabetes mHealth app is defined as software that receives and transmits data that is manually entered, and the app automatically provides feedback to the patient or it provides feedback to the health care specialist (Hou et al., 2016). The diabetes mHealth applications are using a wireless network, data transmissions, and feedback data from the specialist. According to Hou et al., (2016), the diabetes mHealth Applications are much better than the telemedicine interventions as they are available on a global scale, they are affordable, easy to use, and they are interactive. The diabetes mHealth Applications are used for self-management for patients, they provide food intake suggestions, physical exercises, and blood glucose levels (Hou et al., 2016). The applications provide feedback from the specialist about how the patient's glucose level and suggest proper medication intake.

The HIV/AIDS mHealth Applications are used for tracking patients and facilitating test results notifications. The HIV/AIDS mHealth Applications uses an interactive tool, that makes the individual interaction personal and provides tailored information for the patient. The use of mHealth to manage HIV/AIDS has shown a great growth potential as it improves the monitoring and treatment of infected patients (Muessig et al., 2013).

Helbostad et al., (2017) stated that mHealth applications can be aimed to promote health behavioural change and disease management. According to Torrey (2020, p1), disease management is an approach to healthcare that teaches patients how to manage a chronic disease. With the advent of technology especially mobile applications, health awareness and management can now be done online using mobile phones. In this case, patients may not need to physically be present at a physical healthcare facility to receive such healthcare services (Helbostad et al., 2017). Imaja, Ndayizigamiye and Maharaj (2017) provided a user case design scenario for mHealth intervention to prevent and treat Cholera in the South Kivu province of the Democratic Repu blic of Congo (DRC). They suggested that stakeholders should be included in the design phase of the mHealth intervention to ensure its successful adoption. Ndayizigamiye, Hangulu, and Akintola (2017) made a similar suggestion in the context of home cares' disposal of medical waste in South Africa.

2.8 Theoretical Framework

This study investigates the potential adoption of mHealth applications that help induce healthy lifestyles using the UTAUT model as the theoretical lens. Other studies have used different theoretical frameworks to assess factors that influence the adoption of different technologies. The most used theories include the Diffusion of Innovation Theory (DOI), Technology Acceptance Model (TAM), Theory of Planned Behaviour (TPB), and UTAUT model. This section discusses these theories and how they have been used to assess factors that influence the intention to use and adopt mHealth applications.

Table 2. 1: Commonly used technology adoption framework in Information Systems (IS) research

Technology adoption framework	**Framework Constructs**	**Sources**
Technology Acceptance Model (TAM)	Perceived Usefulness Perceived Ease of Use	Wu, Li, and Fu (2011) Ajzen (1991)
Diffusion of Innovation Theory (DIT)	Compatibility Trialability Complexity Relative Advantage Observability	Roger (2003) Kavai et al (2014) Yi and Bae (2017)
Unified Theory of Acceptance and Use of Technology (UTAUT)	Effort expectancy Performance expectancy Social Influence Facilitating Conditions	Venkatesh et al (2003) Hossain (2016)
Theory of Planned Behaviour (TPB)	Attitudes Subject norms Perceived behavioural control	Wu, Li, and Fu (2011)

2.8.1 Diffusion of Innovation Theory

The Diffusion of Innovation (DOI) Theory is one of the most commonly used theories to examine and assess factors that affect the adoption of new technologies. The DOI theory uses various constructs to determine factors affecting the adoption of technology namely, relative advantage, compatibility, complexity, observability, and trialability.

Relative advantage refers to the benefits that can be drawn from the innovation compared to the previously known idea (Rogers,2003). Different measurements are used to determine the relative advantage including financial benefits, convenience, and gratification.

Compatibility refers to whether a technological innovation is compatible with existing beliefs, values and previous experience (Rogers, 2003).

Complexity refers to the extent to which an innovation is easy to understand and use (Rogers, 2003). When innovation is easy to use and understand, the level of adoption tends to be higher.
Trialability “is a degree to which an innovation may be experimented with on a limited basis” (Rogers, 2003, p. 16).
Observability “is the degree to which the results of an innovation are visible to others” (Rogers, 2003, p. 16).”

Studies have found that early adopters of the technology have different characteristics from the late adopters. Understanding the different users’ potential to adopt and use the new product/ideas plays a significant role in the adoption process. Kavai (2014) used the Diffusion of Innovation theory to investigate the determinants that influence the adoption of mobile eHealth in Kenya. The study found that the adoption and use of mHealth technologies in the country were still low as a result of inadequate health promotion and education about the new technological advancement of mHealth applications. Furthermore, the study showed that there was a lack of awareness of mHealth technologies from patients and health care providers, and they (patients and healthcare providers) also needed training on how to use mobile health technologies (Kavai, 2014). Yi and Bae (2017) conducted a survey with college students to assess whether relative advantages, complexity, trialability, and observability are the factors affecting the adoption and continuous use of health applications. The results depicted that there is a need for mHealth developers to improve the relative advantage associated with the use of mHealth applications and reduce their complexity to increase their adoption rate.

Ndayizigamiye and Maharaj (2017) investigated the determinants of the adoption of mobile health by healthcare professionals in Burundi using the Diffusion of Innovation Theory as the theoretical framework. They found that relative advantage, compatibility, trialability, and observability have a significant influence on mHealth adoption while complexity did not exert a significant influence. They then advocated for education and awareness interventions to encourage primary healthcare workers to adopt mHealth.

2.8.2 Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) was formulated in 1980 as the Theory of Reasoned Action and is used to predict an individual's intention to use and engage with new technology. The theory postulates that a combination of three factors namely: attitude towards the behaviour, subjective norms, and perceived behavioural control can be used to determine the behavioural intention.

Perceived Behavioural Control (PBC) is defined as "the degree to which the decision-maker is confident in performing the behaviour" (Weigel, Hazen, Cegielski and Hall, 2014, p5).

Subjective Norm (SN) is defined as "the degree to which a decision-maker feels it is necessary to behave in a manner consistent with the social environment" (Weigel et al., 2014, p5).

Attitude Towards the Behaviour (ATB) is defined as "the degree to which a decision-maker holds a positive attitude towards the adoption of the innovation" (Weigel et al., 2014, p5).

2.8.3 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is an Information Systems (IS) Theory formulated by Davis Fred in 1989. The theory was adapted from the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975) and it aims to assess the acceptance and the use of new technologies. TAM uses two constructs namely, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) to determine their effect on the use of an innovation.

Perceived Usefulness (PU) assesses the degree to which a person/user believes that using a system will improve his/her job performance (Davis et al., 1989, p 985). PU helps determine how a system can be used to improve productivity.

Perceived Ease of Use (PEOU) is the degree to which a person believes using a system will be effortless (Davis et al., 1989, p985).

2.8.4 Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) model was formulated in 2003 by Venkatesh et al., (2003). The UTAUT model is an extension of the TAM2 model which includes facilitating conditions as another construct that influence the behavioural intention to adopt a technology. Furthermore, the UTAUT model proposes gender, age, experience, and voluntariness as moderating factors within the model. The UTAUT constructs are Performance Expectancy (PE), Effort Expectancy (EE), and Social Influence (SI). In the UTAUT model, Performance Expectancy, Effort Expectancy, and Social Influence are theorised to have an effect on behavioural intention while facilitating conditions are predicted to have an effect on use behaviour.

Performance Expectancy (PE) refers to the extent to which users perceive that a system would increase their job performance (Venkatesh et al., 2003).
Effort Expectancy (EE) refers to an individual's perception of whether a system is easy to use and easy to learn how to use (Venkatesh et al., 2003).
Social Influence (SI) refers to whether people that influence one's behaviour believe one should adopt a system (Venkatesh et al., 2003).
Facilitating Conditions (FC) refers to people's beliefs that there is support (technical support and organisational infrastructure) for the use of a new system (Venkatesh et al., 2003).

Among all the above-mentioned frameworks, this study adopted the UTAUT model to determine factors influencing the potential adoption and use of mHealth applications to induce healthy lifestyles. UTAUT is a combination of the other eight known frameworks. Therefore, UTAUT can help ascertain many factors that affect the adoption of information systems (Chao, 2019). UTAUT is also appropriate when one intends the individual perspective on the adoption of information systems (Chao, 2019). *Figure 2.1* depicts the UTAUT constructs. In the context of this study, the constructs are defined as follows:

- Performance expectancy refers to the extent to which an individual perceives that mobile health applications could help them induce healthy lifestyles.
- Effort expectancy refers to the individual's perceptions of the ease of use of mobile health applications that help to induce healthy lifestyles.
- Social influence refers to how an individual is influenced by other people to use mobile applications that help induce healthy lifestyles.
- Facilitating conditions refer to the extent an individual believes that there are technical and organizational infrastructure to support the use of mobile applications that help to induce healthy lifestyles.

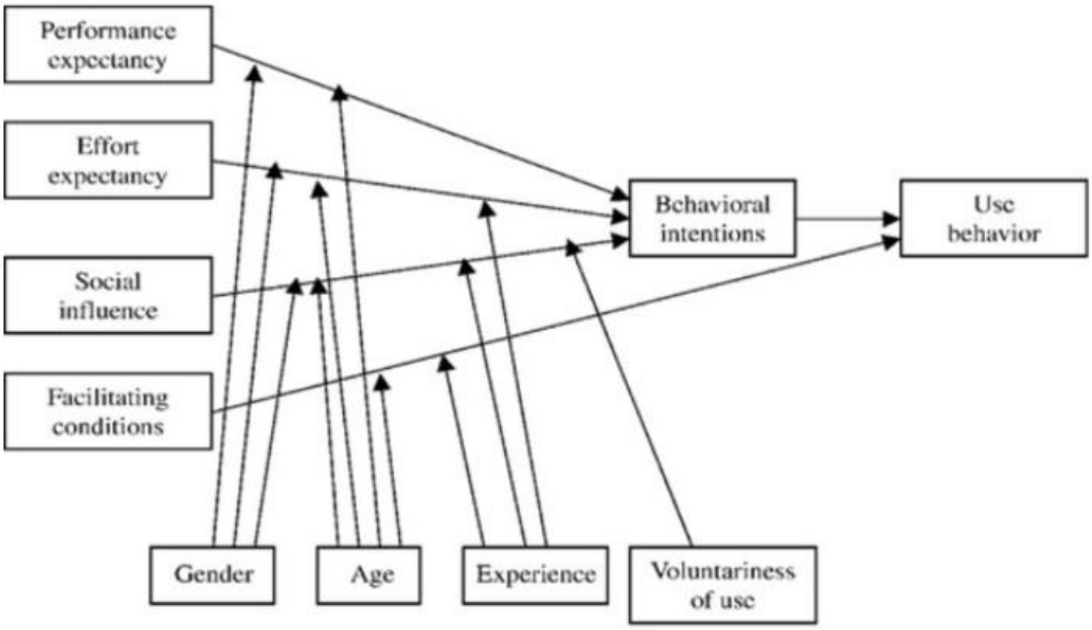

Figure 2. 1: UTAUT Framework

Source: Venkatesh et al., 2003

2.9 Application of Information Systems theories in mHealth adoption studies

Wu, Li, and Fu (2011) examined the adoption of mobile healthcare systems by healthcare professionals using the Technology Acceptance Model (TAM) and Theory of Planned Behaviour (TPB). Both frameworks were integrated to determine the factors that influence the adoption of mobile healthcare systems besides perceived ease of use, perceived usefulness, attitude, subjective norms, and perceived behaviour control. The study revealed that facilitating conditions is a determinant of the adoption of mHealth systems. Furthermore, Hoque and Sorwar (2015) conducted a similar study that investigated the factors influencing the acceptance of mHealth among elderly people in Bangladesh. The study made use of the UTAUT model to determine the elderly's behaviour to adopt and use mHealth. The results revealed that behavioural intention towards the adoption of mHealth by elderly people is influenced by facilitating conditions, performance expectancy, and effort expectancy.

In the context of Canada, Ifinedo (2012) examined factors that influence healthcare professionals to accept mHealth technologies. The survey was conducted among 227 healthcare professionals using the UTAUT model. The study posited that health professional's intention to use mHealth and usage behaviour was influenced by effort expectancy, social influence, and facilitating conditions. Hossain (2016) on the other hand, conducted a study using the UTAUT model to determine factors that influence the adoption of mHealth. Hossain (2016) used a cross-sectional survey questionnaire to a larger population in Bangladesh and found that performance expectancy, effort expectancy, social influence, facilitating conditions, and perceived reliability had a significant influence towards mHealth systems adoption. In addition, some challenges and barriers to mHealth adoption that were identified include human behaviour, minimal technological access, culture, and social issues. Furthermore, previous studies of technology adoption have shown that there is a strong effect size between behavioural intention and actual use behaviour (Venkatesh et al., 2003; Carlsson, 2006; Ami-Narh & Williams, 2012; Ifinedo, 2012;).

Schomakers et al., (2018), conducted a study using an extended UTAUT model to investigate factors that influence the adoption and acceptance of mHealth applications. Schomakers et al (2018) evaluated 165 internet users in Germany aged between 18 and 65 years. All participants were using a mobile application that monitors diabetes and 150 of them were using fitness applications. The results indicated that the intention to use diabetes and fitness mobile applications was significant. In the context of the fitness application, the intention to use was $F(1,164) = 38.93$, $p < .001$. However, the willingness to use both applications differs as users were more inclined to use diabetes applications when they were suffering from diabetes ($M = 4.13$, $SD = 0.93$) than to use a fitness application ($M = 3.60$, $SD = 1.11$). The study further found that another important factor that influenced the lack of adoption of mHealth is the fear of technology and the unwillingness to share personal data. Overall, Schomakers et al (2018) found that fitness applications were mostly used by young adults and elders who were using diabetes applications as their age increases.

In South Africa's context, Soni, Ndayizigamiye, and Kante (2019) found that performance and social influence are the highest predictors of behavioural intention to adopt mobile applications for self-health care monitoring purposes amongst the youth. In addition, another study by Ndayizigamiye, Soni, and Jere (2018) indicated that results demonstrability; performance expectancy; savings; social aspects; awareness; connectivity; accessibility; ease of use and access; privacy; user satisfaction, and affordability are factors that motivate South Africa's youth to adopt self-health care monitoring mobile applications.

2.10 Chapter summary

This chapter has reviewed the literature on mobile application adoption and its different use. Mobile health applications can be used for many reasons such as monitoring diet, improve/assist with physical activity, and other self-health care monitoring purposes. This chapter has also looked at different factors that may promote or impede the adoption and use of mobile health applications that help induce healthy lifestyles. Furthermore, different types of technology adoption frameworks/theories were reviewed. The following chapter will discuss the research methodology used in this study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

Research methodology denotes the collection of methods or rules by which a particular piece of research is undertaken in line with the principles, theories, and values that underpin a particular approach to the research (Somekh and Lewin, 2011, p346). This chapter delineates the methodology that was followed to answer the research objectives/questions. This chapter discusses the various sections that form the structure of the research methodology.

3.2 Nature of the Study

A research design provides guidelines to the researcher on the approach that needs to be followed to achieve the required results. According to Aljowaidi (2015), there are two types of research design methods that can be followed when conducting a study. These are the exploratory research design and the explanatory research design which is mostly known as the descriptive research design.

On one hand, the exploratory research design is used when little is known about the issue under investigation as it aims to explore the issue in more depth. On the other hand, the descriptive research design is mainly used when the study aims to understand how a certain phenomenon behaves and why that phenomenon occurs, and it is based on a model (framework) variable (Aljowaidi, 2015). Descriptive research seeks to describe, explain, and validate research findings based on the research objectives (Creswell, 2014). Other studies follow a hybrid approach by using both research design methods. In this case, such studies aim to explore and explain the research topic under investigation. The use of both research design methods usually occurs there is a new direction that the researcher aims to explore from a research topic that has been previously extensively explored. This study follows a descriptive research design as it intends to depict and explain the relationships between variables based on hypothetically grounded assumptions regarding how the variables are related.

In this chapter, the research onion framework (Saunders et al., 2016) is adopted to illustrate the process followed to conduct the study.

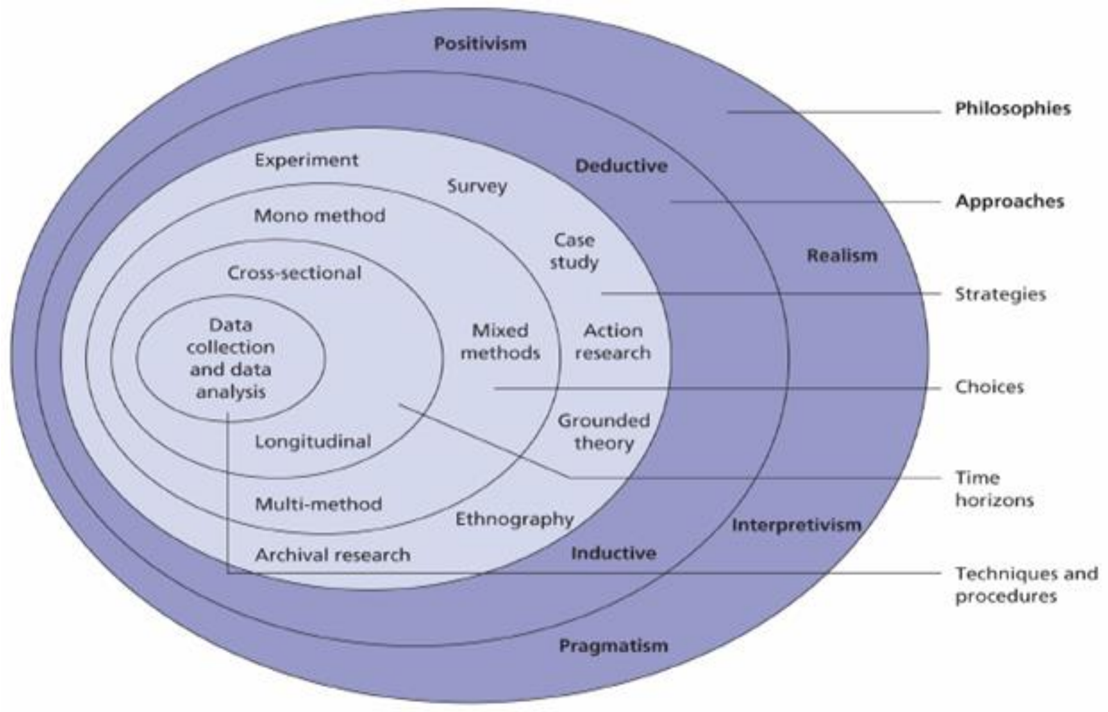

Figure 3. 1: Research Onion Framework

Source: Saunders et al. (2016)

3.3 Research Philosophy

Research philosophy is the first layer of the research onion framework and it is also known as the research paradigm. According to Khan (2014, p 214), a paradigm is “a set of values and techniques which is shared by members of a scientific community, which act as a guide or map, dictating the kinds of problems scientists should address and the types of explanations that are acceptable to them”. There are four main research philosophies namely “positivism, realism, interpretivism, and pragmatism” (Saunders et al., 2007, p 138).

3.3.1 Positivism

Positivism is based on the natural science philosophy and aims to test and explain measurable knowledge (Saunders et al., 2016). The knowledge is obtained through practical, data collection and analysis, and through observation of events. Positivists believe that in order to find “credible information” the researcher must prove the objective by observing, study social actors or atomic events and use empirical data to prove or disprove the set hypothesis or objective of the study (Schwaferts, 2015). This study adopted the positivism philosophy as it aims to unpack a phenomenon, that is, the adoption of mobile applications that help induce healthy lifestyles, using measurable constructs (UTAUT constructs).

3.3.2 Realism

Saunders et al., (2016) define realism as an approach based on critical reasoning. Realism postulates that the perception of sensations and imaginations are part of the real entities but not the real entities themselves. Sekaran and Bougies (2016) state that realism has the same beliefs and processes as the positivism philosophy.

3.3.3 Interpretivism

Interpretivism aims to understand the nature, social behaviour, and cultural lives of the participants (Saunders et al., 2016). The reality is made of social phenomena and it is constantly changing and therefore, facts and information are subjective and relative (Schwaferts, 2015). Interpretivism also postulates that it is important to understand a situation from a different point of view and such views should be interpreted individually as they may be influenced by society and culture.

3.3.4 Pragmatism

Sekaran and Bougie (2016) define pragmatism as an approach that evaluates beliefs or theories through practical applications. Pragmatism emphasizes the practical application of knowledge or an idea by action (Žukauskas et al., 2018). According to Saunders et al., (2015, p217) “if the research problems don’t suggest unambiguously that one particular type of knowledge or method should be adopted, this only confirms that pragmatist's view is perfectly possible to work with different types of knowledge and methods”.

3.4 Research approach

There are two main research approaches: the deductive and the inductive approaches.
A deductive approach entails that a study builds upon a theory and then tests the hypotheses or the research questions (Saunders et al., 2016). The results of a study that

follows deductive approach research may lead to the revision of the theory and the process of hypothesis testing may have to start all over again. Unlike the deductive approach, the inductive approach helps to build a theory from the findings of the study (Schwaferts, 2015). The inductive approach is largely used when there is little research that exists on the research topic. This study adopted a deductive approach as it was built from a well-established framework, that is, the Unified Theory of Acceptance and Use of Technology (UTAUT) framework.

3.5 Research methods

The third layer of the research onion process is a methodological choice (Saunders et al., 2016). A research study can either adopt a quantitative, qualitative, or mixed-method approach (Saunders, 2009). The quantitative approach is adopted mainly when a study aims to test predefined hypotheses or objectives to arrive at conclusions that can be generalised (Alshamaila, 2013). The qualitative approach is used when a study aims to explore a phenomenon in depth. The choice of either approach is based on the assumptions that are made by the researcher about the phenomenon under investigation.

3.5.1 Qualitative method

According to Denzin and Lincoln (2005), a qualitative research method investigates a phenomenon using interpretive and naturalistic perspectives. Qualitative research aims to reveal individual's views regarding the environment in which they live and operate. The qualitative approach is largely used when a researcher aims to understand people, social, and cultural situations where they reside. The qualitative method entails a critical understanding and analysis of the participant's meanings to establish connections between the participant's responses (Saunders and Lewis, 2012). A qualitative approach investigates the problem, issue, or situation in-depth in order to understand how or why it occurred. A qualitative approach is ideal when a study investigates a topic based on a small sample size.

3.5.2 Quantitative method

Quantitative research entails measuring the variables of a sample data to establish the relationship between the variables using statistical analysis techniques such as means, correlations, and frequency analysis. Quantitative research uses questionnaires for data collection (Saunders et al., 2016).

The study adopted the quantitative research method as the researcher had a clear understanding of independent and dependent variables and a specific model that depicts the expected relationship between the variables, which can be tested against observations of the phenomenon (Aljowaidi, 2015). The quantitative approach is effective when the researcher aims to collect data from a large sample by using a questionnaire that uses closed-ended questions (Alshamaila, 2013).

3.5.3 Mixed methods

Mixed methods are normally adopted in a study that requires the use of both the quantitative and qualitative research methods (Saunders et al., 2016; Johnson and Onwuegbzie, 2004). A quantitative approach is often adopted when the researcher aims to generalise the findings while the primary aim of a qualitative approach is to gain a much deeper meaning of a phenomenon under investigation. According to Saunders and Lewis (2012), the mixed-method approach takes advantage of the strengths of both approaches. The use of mixed methods also reduces the shortcomings associated with the use of a single method.

3.6 Research strategy

The research strategy is a road map that helps the researcher to answer the research questions (Saunders, 2011). There are different paths that a researcher can choose to achieve the research goals. According to Saunders (2011, p 136), the research onion presents seven strategies that may be used namely, “experiment, survey, case study, action research, grounded theory, ethnography, and archival research” strategies. Saunders (2011) states that surveys are mainly used when a study is descriptive or exploratory in nature. Thus, this study used the survey research strategy as it is descriptive in nature. Moreover, this study made use of the representative sample from a predefined population.

3.7 Time horizons

Time horizons are concerned about the time that it takes to conclude the research. Saunders (2011) states that research can be cross-sectional, or it can be longitudinal. A longitudinal study can take a long time to be completed as it can be continuous for many years while the cross-sectional study is short as it is constrained by time. In this study, the cross-sectional time horizon was adopted as the study had to be completed in the maximum prescribed time of two years.

3.8 Study site

The study was conducted at the University of KwaZulu-Natal on the Pietermaritzburg campus. The University of KwaZulu-Natal has five campuses, namely Howard College campus, Westville campus, Edgewood campus, Pietermaritzburg campus, and the medical school campus. The Pietermaritzburg campus has four colleges, i.e., the College of Law and Management studies, the College of Science and Agriculture, and the College of Humanities. The Pietermaritzburg campus was chosen because it was convenient for the researcher. The site was also chosen because the Pietermaritzburg campus has a diverse youth (students) population and easily accessible.

3.9 Techniques and procedures

The techniques and procedures layer of the research onion provides a detailed plan on how the data will be collected and analysed.

3.9.1 Research instrument design

The research instrument design is one of the most critical processes in research. It is important to design a research instrument properly for it to capture and measure what it is intended to measure. In this study, the research instrument used closed-ended questions that sought to capture information about mHealth awareness and mHealth adoption in the context of inducing healthy lifestyles (by promoting physical activity and a healthy diet). Most questions that were used in the questionnaire were based on the previous studies that have used the UTAUT model to investigate the adoption of new technologies (see Appendix B).

According to Sarantakos (1998), the structure of the questionnaire determines whether the respondents will be able to answer all questions in the questionnaire. It is important to structure a questionnaire in a manner that is appealing to the participants and the questionnaire must provide an estimate of the time it will take to fill it. Edwards et al. (2002) state that the length of the questionnaire determines the response rate as a longer questionnaire affects the response rate negatively. In addition, having a questionnaire that has long qualitative questions may hinder the response rate of the participants. It is also important to design a valid and reliable questionnaire so that participants' responses may answer the research questions/objectives. To achieve this, this study used the six steps depicted in Figure 3.2 below to construct the study's questionnaire as recommended by Saunders (2009).

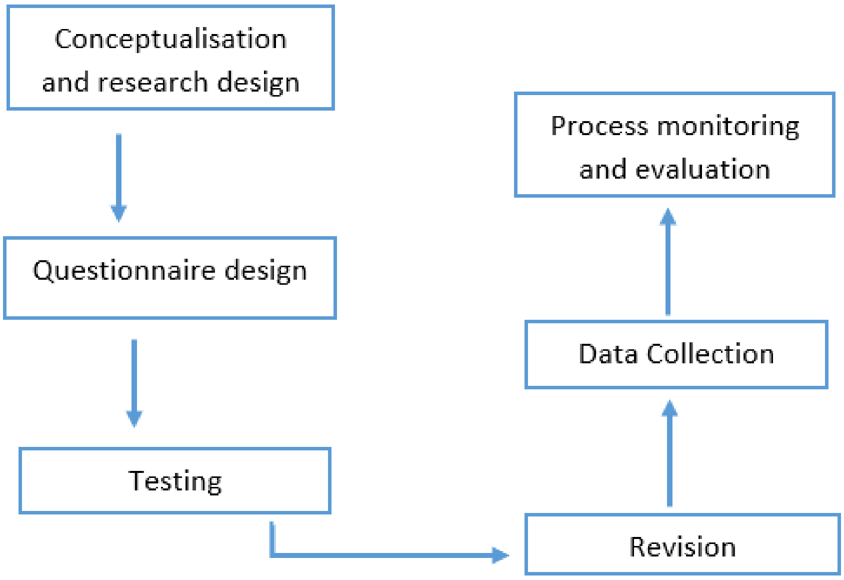

Figure 3. 2: Questionnaire design process

Source: Saunders (2009)

3.9.1.1 Conceptualisation and research design

According to Giesen, Meertens, Vis-Visschers and Beukenhorst (2012), the conceptualisation of a research instrument entails formulating the variables that the study aims to quantify. The quantifiable variables must aim to answer the research questions. In addition, the variables must be valid and reliable to capture the correct context. This study used the UTAUT framework constructs to formulate questions within the questionnaire. In addition, the questions within the questionnaire were adopted from previous studies.

3.9.1.2 Questionnaire design

During the process of questionnaire design, the questions were written down and they were formatted appropriately (Giesen et al., 2012). The researcher must construct the questionnaire in a simple understandable manner so that the respondents can understand it. This also means that the research must pay attention to the language used in the questionnaire as well as the readability of the questionnaire, that is, the font type and size must enhance the readability of the questionnaire. In case there are graphical images in the questionnaire, they must be clear. The questionnaire (see Appendix B) was structured as follows:

Section A: The aim of this section was to collect the demographic information of the participants. Participants were requested to specify their age, gender, level of study, and whether they own a smartphone or not. The last two questions in this section sought to find out how often the participants use fitness and diet-related mobile health applications. All questions in this section were designed in a nominal form.

Section B to section D of the questionnaire comprised Likert-scaled questions. A Likert scale is defined as an interval scale that aims to determine whether a respondent agrees or disagrees with statements pertaining to their beliefs or behavioural belief statements (Hair et al., 2010).

Section B: This section aimed to capture the extent to which participants are awareness of mobile applications that help induce healthy lifestyles. In addition, participants needed to choose the platform from which they heard about mobile health.

Section C: This section aimed to identify factors that may influence the adoption of mobile health applications that promote healthy lifestyles. The questions in this section were based on the constructs of the theoretical framework (UTAUT) underpinning the study. A Five-point Likert scale format (from 1= Strongly Disagree to 5=Strongly

Agree) was used to ascertain the extent to which the participants agreed or disagreed with each statement in section C.

Section D: This section also used the Likert scale format (from 1= Strongly Disagree to 5=Strongly Agree) to investigate the participants' intention to adopt mobile health applications that help induce healthy lifestyles as well as the use behaviour of these applications.

3.9.1.3 Testing

Testing of the questionnaire is important as errors are discovered in this phase. The researcher can do informal testing by going through the questionnaire looking for spelling errors and assessing whether the questions make sense. The formal testing is done by the supervisor or an experienced researcher who checks that the questions are consistent and error-free (Saunders and Lewis, 2012). The pilot study also helps to test for errors as it helps ascertain whether the participants understand the questions. The testing phase also helps identify whether the questions from the questionnaire measure what they are intended to measure Alshamaila (2013).

3.9.1.4 Pilot Study

A pilot test is an important part of research as it helps to discover errors within the instrument. In this study, a pilot test was conducted with ten respondents from the study's population. Any ambiguous words and grammar errors that were pointed out by the participants were addressed. The questionnaire was then given to a statistician for further validation. The statistician made suggestions that were attended to. For example, some questions seemed to measure similar constructs and therefore were merged. The statistician further suggested that the study should be separated into two sections, one that measures the adoption of mobile applications that promote physical exercise and the other that measures the adoption of mobile applications that promote healthy eating habits.

3.9.1.5 Revision

After the testing phase, the questionnaire is subjected to revision whereby all errors are corrected (Saunders and Lewis, 2012). Grammar and spelling errors are fixed during this process. In the context of this study, errors that were identified during the pilot phase were addressed. In addition, the statistician's suggestions were taken into account.

3.9.1.6 Data collection

Data collection can be done face to face, online, or through the mail. Data collection can occur through different channels such as hand-delivered surveys, email surveys, mail service, online surveys, and telephone surveys (Alshamaila, 2013). In this study, data was collected using hand-delivered questionnaires. This allowed the researcher to clarify any rising issues during the data collection process. The questionnaire was hand-delivered to potential participants at the University's library facilities, computer laboratories, student residences, and lecture venues. Questionnaires were collected as soon as the participants had finished filling them. Participants were given about 15 minutes to complete the questionnaire. However, other participants who requested more time to fill in the questionnaire were given two days to fill in the questionnaire. There were no incentives given to the participants. The participants were clearly advised that they had a right to refrain from participating in the study anytime they feel uncomfortable with the study.

3.9.1.7 Process monitoring and evaluation

Giesen et al. (2012) state that a questionnaire needs to be monitored and evaluated especially when a study relies on a newly designed questionnaire. A new questionnaire needs to go through rigorous testing.

3.10 Target population and sampling methods

The target population is defined as a collection of components where the sample is selected (Draugalis and Plaza, 2009). The target population for this study was defined as the total population of registered students at the University of KwaZulu-Natal on the

Pietermaritzburg (PMB) campus. At the time of data collection in 2019, the Pietermaritzburg campus had 9500 registered students (University of KwaZulu Natal Institutional Intelligence Reports, 2019). De Morgan's sampling table was used to determine the sample size of the study's participants. According to Morgan (1970), if the population size is 9500 at 5% margin error and 95% confidence, the sample size should be approximately 370.

Table 3. 1:De Morgan table for Determining Sample Size

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Note: "N" denotes the population size while "S" denotes the sample size

Source: Krejcie and Morgan, 1970.

3.11 Sampling strategy

Sampling is about selecting a subset of a total population i.e., a sampling frame (Taherdoost, 2016). The sample frame should have the same characteristics as the study's population (Saunders and Lewis, 2012). A sample frame can be chosen using either probability or non-probability sampling methods. Saunders et al. (2009) argue that the probability sampling method is used to increase the sample representability as it gives the potential participants an equal chance to participate in the study. In this study, it was not feasible to apply the probability sampling method as the participants (students) were situated in different places and were attending classes at different times. Therefore, the convenient sampling technique (non-probability sampling technique) was used. According to Suen, Haung and Lee (2014), convenience sampling is defined as a sampling technique that is used for a targeted population, that is easily accessible, within geographical proximity, has the will to participate, and available at a given time.

3.12 Data analysis

Data analysis entails organising and categorising the data in such a way that it reveals patterns and provides meaning from the data. The data analysis was conducted using the Statistical Package for Social Science (SPSS v25) and the SMARTPLS 3.0 software. The collected data were analysed based on the study's research questions.
SPSS v25 was used for descriptive analysis to describe the respondent's demographics. In addition, SMARTPLS 3.0 was used to perform the Partial Least Square (PLS) Structural Equation Modelling (SEM) to evaluate the UTAUT model and its constructs in the context of the study's objectives. Structured Equation Model (SEM) has two different types of models namely: the measurement model and the structural model. The measurement model, also known as the outer model, was evaluated through various statistical tests. These tests include Internal Consistency Reliability, Indicator Reliability, Convergent Validity, and Discriminant Validity. Table 3.2 below summarises the measurement model assessment.

Table 3. 2:Measurement Model Assessment

Validity type	**Criterion**	**Definition**	**Reference**
Indicator reliability	Indicator loading >0.600	Loadings measures how the indicator's variances are defined by the corresponding latent variable.	(Urbach and Ahlemann, 2010) (Garson, 2016, Henseler et al., 2015)
Internal consistency reliability	Cronbach's >0.6	Measures the degree to which MVs loads simultaneously when the LV increases.	(Urbach and Ahlemann, 2010)
Internal consistency reliability	Composite reliability >0.6	Attempts to measures the sum of LVs factors loadings relative to the sum of the factor loading plus error variance. Leads to values between 0 (completely unreliable) and 1 (perfectly reliable).	(Urbach and Ahlemann, 2010) (Henseler et al., 2015)
Content validity	Average Variance Extracted (AVE)>0.5	Attempts to measure the amount of variance that an LV component captures from its indicators relative to the amount due to measurement error.	(Urbach and Ahlemann, 2010) (Garson, 2016)
Discriminant validity	Heterotrait-Monotrait Ratio (HTMT) <1	HTMT is one of the reliable measures to evaluate the discriminant validity	(Garson, 2016)

Adopted from Hair et al. (2019) and Kante et al. (2018)

The structural model predicts how the endogenous constructs would fit in the model. This structural model (inner model) and shows the relationship between the constructs. Coefficient of Determination (R2), Predictive Relevance (Q2), Standardized Root Mean Square Residual (SRMR), and Path Coefficients were used to establish the model validity (Ndayizigamiye et al., 2020). Table 3.3 explains the assessment criteria for the structural model.

Table 3. 3:Structural Model Assessment

Validity type	Criterion	Definition	Reference
Model Predictability	Predictive relevance $Q^2>0.05$	Systematically it is assumed that a certain number of cases are missing for the sample and the model parameter would be used to predict omitted values.	(Urbach and Ahlemann, 2010) (Garson, 2016) (Henseler et al., 2015)
Model validity	Model fit SRMR <0.08	SRMR measures the approximate fit of the researcher's model.	(Garson, 2016, Urbach and Ahlemann, 2010)
Model validity	$R^2>0.100$	Coefficient of determination	(Urbach and Ahlemann, 2010)
Model validity	Path coefficients Critical t-values for two-tailed test are 1.65 (significance level=10 percent), 1.96 (significance level= 5 percent), and (significate level= 1 percent).	Attempts to measure the explained variance on an LV relative to its total var.	(Garson, 2016)

Adopted from Kante et al. (2018)

3.12.1 Reliability test

The reliability test assesses whether the results can be duplicated in a similar environment. The reliability test is mostly concerned with the internal consistency of the questions (Alshamaila, 2013), that is, whether questions within a construct are correlated. If the coefficient value is closed to 1 then the measured variables are correlated otherwise if it approaches 0 then there is no correlation (Young, 2015). The Cronbach alpha coefficient is widely used as a reliable measure to indicate how well various items within a construct are correlated (Sekaran and Bougie, 2016).

Some other methods can be applied in order to increase the reliability of the research instrument. There are guidelines on how to make the instrument that is used for data collection reliable and consistent. According to Neuman (2014), there are four procedures that can be applied to increase the reliability of a research instrument:

- Clearly conceptualise a research construct
- Choose an appropriate measurement level
- Use many measurement variables
- Conduct a pilot test

These procedures can assist the researcher to make sure that the research data is reliable, and it tests what it aims to test. This study made use of a pilot study to test the reliability of the research instrument. In addition, the Cronbach alpha test was ran to ascertain the internal consistency of items within each construct of the UTAUT framework.

3.12.2 Validity test

Establishing validity entails assessing whether the research instrument measures what it intends to measure (Bebli, 2012). To be valid, a questionnaire must measure the correct variables that are in line with the research objectives or the hypotheses. The validity test also assesses whether the research instrument is properly constructed in such a way that the wording of the questions is clear. According to Alshamaila (2013), there are two subcategories of validity namely, content validity and construct validity.

Content validity: checks that the theoretical framework's variables are aligned with the research questions/objectives. The content validity of this study's instrument was established through an extensive review of the literature on technology adoption and taking into consideration how the UTAUT constructs were used in previous similar studies.

Construct validity: can be established through convergent validity and discriminant validity. In order to establish the construct validity, the construct must withstand the discriminant validity and convergent validity tests. *Convergent validity* measures whether the construct items when grouped together can form a single construct. To validate the instrument, participants in the pilot test were given an opportunity to voice their opinions on the format and the wording of the statements.

Discriminant validity measures whether each construct is not highly correlated with other constructs. The discriminant validity is concerned with showing that the constructs are distinct. The convergent and discriminant validity were established in the data analysis phase using the SMARTPLS 3.0 software.

3.13 Ethical clearance considerations

In any formal research, there are ethical requirements that need to be followed. For instance, a researcher must report the findings of the research as they are, with a high standard of integrity. It is important that the researcher should not infringe on the rights of the participants and should always ensure that the participants are not humiliated or exposed to harmful situations.

In this study, the researcher applied for Ethical Clearance (EC) with the Ethics committee of the University of KwaZulu-Natal and followed all the ethics requirements as prescribed by the University. The EC reference number is (HSS/2166/018M), and the EC letter is attached in appendix C. The data that was collected was handled with confidentiality and integrity. Personal identifiable information of the participants was not published in the dissertation. The collected questionnaires will be stored in a safe environment and will be discarded after 5 years.

3.14 Chapter summary

This chapter provided information about the research methodology adopted in this study. The chapter provided information about the study population and the techniques that were used to select the sample size of the study. This chapter also gave detailed information about the process that was followed in the design of the research instrument, data collection procedures, and data analysis techniques that were performed in this study. The chapter further explained the tests that were used to measure the reliability and validity of the research questionnaire and how the study complied with the ethics requirements. The following chapter presents the findings of the study.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the findings of the study and the discussion thereof. Firstly, this chapter presents findings from the descriptive analysis. Then, the chapter presents the findings from inferential statistics that relate to the Structural Equation modelling approach that was adopted in this study. Lastly, the chapter discusses the research objectives of the study in the light of the findings of the study.

4.2 Descriptive Analysis

4.2.1 Demographics

The gender distribution of the respondents was almost balanced. Figure 4.1 depicts that 51.4% of the respondents were females, 48.1% were males and 0.5 % of the respondents did not disclose their gender. In addition, most of the respondents were below 30 years of age. Figure 4.2 depict that most respondents were between the age of 18 and 23 (51.9%) followed by those between 24 and 29 years (40.3%). One can deduce that all the respondents can be categorised as youth according to the South Africa's categorisation criteria (South Africa National Youth Policy, 2008). Moreover, as expected, all the respondents were registered students at the University of KwaZulu-Natal (Pietermaritzburg Campus) as data were collected on the Pietermaritzburg campus of the University of KwaZulu-Natal.

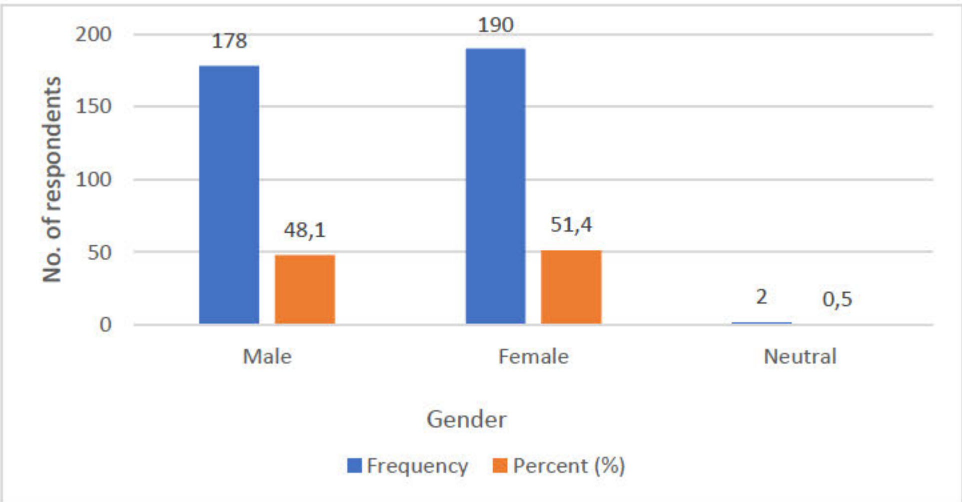

Figure 4. 1 Demographic Information:Gender

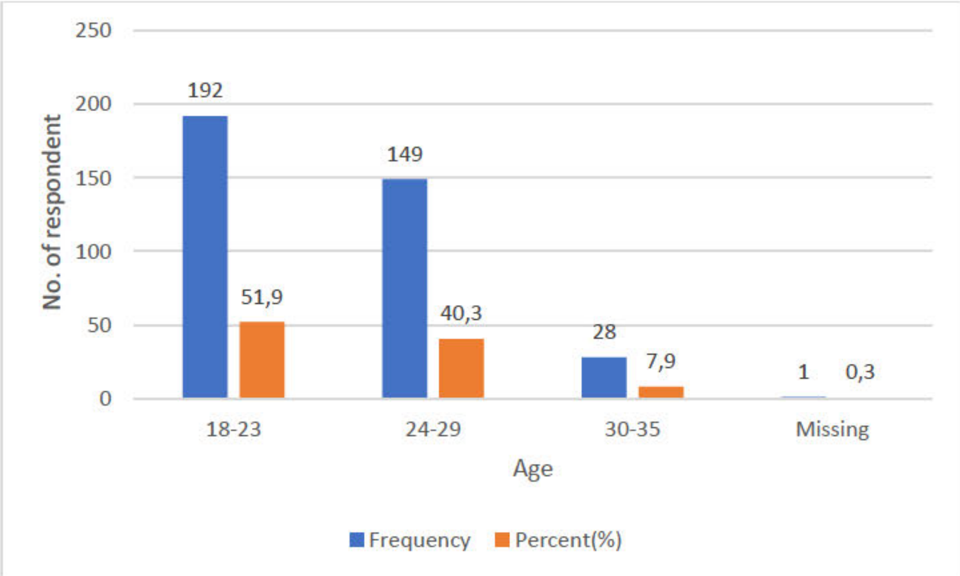

Figure 4. 2 Demographic Information: Age

The demographic distribution of the respondents also shows that most respondents were undergraduate students (54.30%), followed by those registered for an Honours degree (23.0%) and a Masters level qualification (17.6 %). Only a few respondents were registered for a Ph.D. qualification (5.1%).

Findings also show that 94.4% of respondents owned a smartphone and only 4.3% of the respondents did not. This is not surprising as the adoption rate of mobile phones by young people in South Africa has increased (Ndayizigamiye, Kante, and Shingwenyana, 2020). Thus, most respondents were acquainted with mobile applications and hence were able to answer the questions within the research instrument (questionnaire) based on their experience with using mobile phone applications.

The smartphone penetration rate in South Africa has increased from 45% in 2016 up to 90% in 2019 (ICASA, 2020). As depicted in Table 4.1, the findings reveal that 22.2% of the respondents often (Often% + Very often%) use fitness applications. In addition, 30.8% of the respondents sometimes use these applications while 21.1% of the respondents rarely use them. This implies that 74.1% of the respondents were aware of the fitness applications as they had used them before.

For diet-related applications, the findings reveal that 13.2% of the respondents often use (Often% + Very Often%) applications to manage their diets. Moreover, 22.2% of the respondents rarely use them while 24.3% of the respondents use them sometimes. As can be seen from table 4.1, there were more respondents (40.4%), who had not used diet applications than those who did not use fitness applications (25.9%).

Table 4. 1: Use of mHealth applications

	Never %	Rarely %	Sometimes %	Often %	Very often %
5.1. Fitness Applications (Runtastic, Home Workout, Pro Gym Workout, and others)	25.9 N=96	21.1 N=78	30.8 N=114	15.4 N=57	6.8 N=25
5.2. Diet Applications (Weight loss, Military Diet, Health Diet Guide, and others)	40.3 N=149	22.2 N=82	24.3 N=90	8.9 N=33	4.3 N=16

4.3 Awareness of mobile health applications that help induce healthy lifestyles

Table 4.2 depicts that 66.2%, N=245 (Strongly agree% + agree%) of the respondents had heard about mobile applications that help induce healthy lifestyles, and 53.7%, N= 199 (strongly agree + agree) had seen these applications. However, only 31.1%, N= 115 (strongly agree% + agree%) had used mobile applications that help induce healthy lifestyles and only 28.4%, N=68 (strongly agree% + agree%) were currently (at the time of data collection) using mobile health applications that help induce healthy lifestyles.

Table 4. 2: Awareness of mHealth applications

	Strongly disagree %	Disagree %	Neutral %	Agree %	Strongly agree %
6.1. I have heard about mobile applications that help induce healthy lifestyles.	10.0 N=37	10.0 N=37	13.8 N=51	48.1 N=178	18.1 N=67
6.2. I have seen mobile applications that help induce healthy lifestyles.	9.5 N=35	19.2 N=71	17.6 N=65	38.6 N=143	15.1 N=56

6.3. I have used mobile applications that help induce healthy lifestyles.	25.4 N=94	27.6 N=102	15.9 N=59	22.7 N=84	8.4 N=31
6.4. I am currently using mobile applications that help induce healthy lifestyles. **Missing values N=1 (0.3)**	34.1 N=126	34.6 N=128	12.7 N=47	14.3 N=53	4.1 N=15

Table 4.3 depicts the medium through which the respondents were made aware of the applications that help induce healthy lifestyles. Out of 370 individuals that participated in a survey, more than 120 respondents had seen mobile health applications from different sources such as a pamphlet, social media, and friend's phone. More specifically, 35.4% (N=131) of the respondents (strongly agree% + agree%) had seen these applications on peers' phone and 33.8% (N=125) of the respondents had seen them from a pamphlet. Interestingly, there were many more respondents (56.2%, N=208) who were made aware of these applications through social media.

Table 4. 3: How you become aware of mHealth applications

	Strongly disagree %	**Disagree %**	**Neutral %**	**Agree %**	**Strongly agree %**
7.1. I have come across mobile health applications that help induce healthy lifestyles on social media. **Missing value =1 (0.3%)**	8.9 N=33	17.3 N=64	17.3 N=64	43.0 N=159	13.2 N=49
7.2. I have seen mobile applications that help induce healthy lifestyles in a pamphlet. **Missing value =1 (0.3%)**	16.5 N=61	31.6 N=117	17.8 N=66	26.5 N=98	7.3 N=27
7.3. I have seen mobile applications that help to induce healthy lifestyles working on my peers' phone. **Missing value =1 (0.3%)**	17.6 N=65	28.4 N=105	18.4 N=68	25.9 N=96	9.5 N=35

Figure 4.3 below depicts that most of the respondents (39%, N=143) had heard about mHealth applications on social media. Approximately 9% (N=35) of the respondents heard about mHealth from other people (word of mouth). In addition, 6% (N=23) of the respondents had heard of mHealth applications from educational institutions. Moreover, 4% (N=14) of the respondents heard about mHealth on traditional media. Approximately 2% (N=6) of respondents discovered mHealth through healthcare providers. Interestingly, 12% (N=44) of respondents heard about mHealth applications from all the above mediums (social media, healthcare providers, educational institutions, traditional media, and word of mouth. There were only 10% (N=37) of respondents that have never heard about mHealth applications.

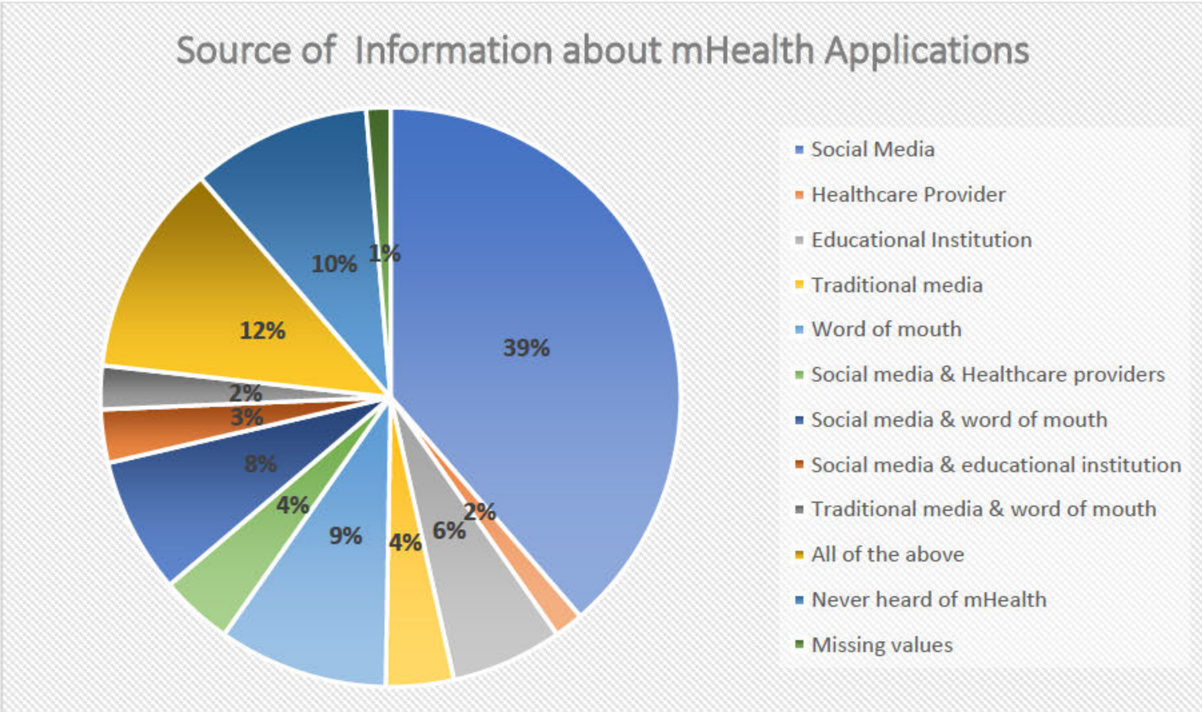

Figure 4. 3: Source of information about mHealth applications

4.4 Construct Validity Test

In PLS-SEM, convergent, and discriminant validity tests help determine whether a construct should be included in the actual model (Kante et al., 2018). In the context of this study, constructs that have passed the discriminant and convergent validity can be said to be the determinants of the adoption of a mobile application that helps induce healthy lifestyles.

4.4.1 Convergent Validity

According to Kline (2003), convergent validity measures the inter-correlation between variables of the same construct. Gregory (2007) states that a moderate or high correlation shows evidence of convergent validity. PLS-SEM uses different measurements to assess convergent validity. These are the Cronbach's Alpha coefficient, Composite Reliability (CR), and the Average Variance Extracted (AVE).

4.4.1.1 Cronbach's Alpha

Al-Qeisi (2009) defines Cronbach alpha as a coefficient that determines how well variables within a construct correlate with one another. Generally, a Cronbach's alpha value of 0.8 and above depicts a good internal consistency of items within a construct (Bebli, 2012).

4.4.1.2 Composite Reliability (CR)

Composite Reliability also measures the internal consistency of the scaled items (Ab Hamid et al., 2017). Fornell and Larker (1981, p.41) state that "composite reliability is an indicator of a shared variance among the observed variables used as an indicator of the latent construct". In addition, composite reliability differs from Cronbach's alpha, as it doesn't assume that indicators are equally reliable. The composite reliability value should be greater or equal to 0.6 for a construct to pass the convergent validity test (Kline, 2013; Hair, Ringle and Sarstedt 2011).

4.4.1.3 Average Variance Extracted (AVE)

Gefen, Straub, Boudreau (2000) state that AVE measures the variance of each construct. It depicts the sum of variance for each construct as a ratio. For a model to be adequate, the AVE value should be above 0.5 (Urbach and Ahlemann, 2010). As stated earlier in the previous chapters, mobile applications that help induce healthy lifestyles were grouped into two categories: mobile applications that promote physical activity and mobile applications that promote healthy eating habits. Hence, the analysis of the convergent validity was carried out within each category.

On one hand, as shown in table 4.4. The Composite reliability for each construct that has items related to mobile applications that promote physical activity was greater than 0.8 while the Average Variance Extracted was greater than 0.6 and the Cronbach's alpha coefficient was greater than 0.8. Therefore, the items in the questionnaire pertaining to the adoption of mobile applications that promote physical activity (the items that represent the UTAUT constructs) passed the convergent validity test.

Table 4. 4: Convergent Validity for Physical Activity

	Cronbach's Alpha	**Composite Reliability**	**Average Variance Extracted (AVE)**
Behavioural Intention (physical activity)	0.912	0.944	0.850
Effort Expectancy (physical activity)	0.907	0.935	0.781
Facilitating Conditions (physical activity)	0.816	0.878	0.645
Performance Expectancy (physical activity)	0.852	0.910	0.772
Social Influence (physical activity)	0.838	0.902	0.755
Use Behaviour (physical activity)	1.000	1.000	1.000

On the other hand, the Cronbach's alpha for each construct that has items related to promoting healthy eating habits (diet) was greater than 0.7, while the composite reliability was greater than 0.9 and the AVE was greater than 0.7 (see table 4.5). Hence, the items related to the adoption of mobile applications that help induce healthy eating habits (the items that represent the UTAUT constructs) also passed the convergent validity test.

Table 4. 5: Convergent Validity for Diet

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Behavioural Intention (Diet)	0.919	0.949	0.861
Effort Expectancy (Diet)	0.869	0.911	0.718
Facilitating Conditions (Diet)	0.797	0.904	0.825
Performance Expectancy (Diet)	0.850	0.909	0.769
Social Influence (Diet)	0.862	0.916	0.784
Use Behaviour (Diet)	1.000	1.000	1.000

4.4.2 Discriminant Validity

Hair et al., (2014) argue that discriminant validity represents the extent to which a construct is empirically distinct from other constructs, that is whether a construct measure only what it is intended to measure. Hair et al., (2014) further argued that the discriminant validity can be assessed through the Fornell-Larcker criterion, Cross loading criterion, and Heterotrait-Menotrait Ratio (HTMT). However, Hanseler (2014) argued that discriminant validity is best established through the Heterotrait-Menotrait Ratio (HTMT). Therefore, in this study, the Heterotrait-Monotrait Ratio (HTMT) was used to assess discriminant validity. For the Covariance-Based Structural Equation Modelling (CB-SEM), Hair et al. (2014) argues that the HTMT ratio should be less than 0.85. However, for PLS-SEM, the HTMT ratio should be less than1.0 (Henseler et al., 2014).

Table 4.6 shows that the HTMT for every construct related to the adoption of mobile applications that promote physical activity is less than 1.0. Thus, discriminant validity was established for all items in the UTAUT constructs that evaluated the effect of mobile applications that promote physical activity.

Table 4. 6: Discriminant Validity for Physical Activity

	Behavioural Intention PA	Effort Expectancy PA	Facilitating Conditions PA	Performance Expectancy PA	Social Influence PA	Use Behaviour PA
Behavioural Intention PA						
Effort Expectancy PA	0.520					
Facilitating Conditions PA	0.412	0.624				
Performance Expectancy PA	0.564	0.678	0.425			
Social Influence PA	0.603	0.512	0.381	0.614		
Use Behaviour PA	0.520	0.386	0.409	0.375	0.452	

Table 4.7 below shows that the HTMT for every construct related to the adoption of mobile applications that help induce healthy eating habits is also less than 1.0. Thus, discriminant validity was established.

Table 4. 7: Discriminant Validity for Diet

	Behavioural Intention Diet	Effort Expectancy Diet	Facilitating Conditions Diet	Performance Expectancy Diet	Social Influence Diet	Use Behaviour Diet
Behavioural Intention Diet						
Effort Expectancy Diet	0.560					
Facilitating Conditions Diet	0.249	0.557				
Performance Expectancy Diet	0.631	0.633	0.344			
Social Influence Diet	0.610	0.493	0.227	0.582		
Use Behaviour Diet	0.526	0.355	0.327	0.377	0.427	

4.5 Factor Loadings

Factor loading examines the relationship between each variable in the construct. Hair et al., (2017) stated that factor loading can be used to determine the construct reliability through the scores of square factor loadings. Furthermore, Schmitt and Sass (2011) explained factor loading as the correlation between the observed score and latent score.

Schmitt and Sass (2011) presented a rule of thumb that is used to determine whether the variable has a significant effect or not. Schmitt and Sass (2011) argue that the rotated factor loading should be at least 0.4 to be considered important. Hair et al. (2017) on the other hand, uses a stringent criterion of 0.7 as the cut-off for less important variables. In this study, variables with factor loadings less than 0.7 were eliminated as they were not showing a significant effect.

In this study, factor analysis was used to ensure the reliability of all variables and to unearth variables that are important in the measurement of variables pertaining to the adoption of mobile health applications that help induce healthy lifestyles.

The results of factor analysis for behavioural intention, social influence, performance expectancy, and effort expectancy constructs depicted in Table 4.8 below, show that items within each construct measure one and only one construct as all the factor loading values are greater than 0.7. However, for the facilitating conditions construct two variables showed a value that is less than 0.7. To ensure that all constructs measure one and the same factor, FCP3 (*access to a mobile device which allows you to download applications*) (0.51) and FCP4 (*access to people who can assist with difficulties while using mobile applications*) (0.55) were removed from further analysis.

Table 4. 8: Factor Loading for Physical Activity

	Items	Behavioural Intention PA	Factor loadings
Behavioural Intention	BIP1	0.92	0.85
	BIP2	0.917	0.84
	BIP3	0.929	0.86
Effort Expectancy	EEP1	0.89	0.79
	EEP2	0.879	0.77
	EEP3	0.91	0.83
	EEP4	0.856	0.73
Facilitating Conditions	FCP1	0.853	0.73
	FCP2	0.894	0.80
	FCP3	0.711	0.51
	FCP4	0.74	0.55
Performance Expectancy	PEP1	0.888	0.79
	PEP2	0.914	0.84
	PEP3	0.832	0.69
Social Influence	SIP1	0.87	0.76
	SIP2	0.879	0.77
	SIP3	0.858	0.74
Use Behaviour	UBP1	1	1

The factor loading for the adoption of mobile health applications that promote a healthy diet is positive and greater than 0.6. This indicates that variables within each construct (behavioural intention, social influence, performance expectancy, and effort expectancy) measure one and only construct. Similarly, to the factor loading for mHealth applications that promote physical activity, table 4.9 depicts that results and some facilitating conditions variables are less than 0.6 (for diet applications). According to Kante et al., (2018) for coefficient value to be significant it should be greater than 0.6 and FCD3 (*access to a mobile device that allows you to download applications*) (0.36) and FCD4 (*access to people who can assist with difficulties while using mobile applications*) (0.46) are below the range which means they may not be substantial to assess the adoption mobile adoptions that help induce healthy eating habits. The two variables (FCD3 and FCD4) were also removed from further analysis.

Table 4. 9: Factor Loading for Diet

Construct	Items	Behavioural Intention Diet	Factor loadings (loadings square)
Behavioural Intention	BID1	0.92	0.85
	BID2	0.93	0.86
	BID3	0.94	0.87
Effort Expectancy	EED1	0.86	0.74
	EED2	0.88	0.77
	EED3	0.85	0.73
	EED4	0.80	0.63
Facilitating Conditions	FCD1	0.80	0.64
	FCD2	0.86	0.73
	FCD3	0.60	0.36
	FCD4	0.68	0.46
Performance Expectancy	PED1	0.87	0.76
	PED2	0.90	0.81
	PED3	0.86	0.74
Social Influence	SCD1	0.90	0.80
	SCD2	0.90	0.80
	SCD3	0.86	0.74
Use Behaviour	UBD1	1	1

4.6 Hypothesis Validation

4.6.1 Path (Beta)

The bootstrapping functionality of SMARTPLS v3 was used to determine the path coefficient β. The path coefficient β helps determine the effect of an exogenous variable on the endogenous variable (Garson, 2010). Furthermore, the path coefficient determines the reliability of the latent variables (UTAUT variables) that are used in this study to determine the effect of the UTAUT constructs on the adoption of mobile health applications that help induce healthy lifestyles (physical activity and healthy diet).

To establish the path coefficients, the following hypotheses were formulated:

H_1: Performance expectancy has an effect on the behavioural intention to adopt mobile applications that help induce healthy lifestyles

H_2: Effort expectancy has an effect on the behavioural intention to adopt mobile applications that help induce healthy lifestyles

H_3: Social influence has an effect on the behavioural intention to adopt mobile applications that help induce healthy lifestyles

H_4: Facilitating conditions has an effect on the use behaviour of mobile applications that help induce healthy lifestyles

H_5: Behavioural intention influence the use behaviour of mobile applications that help induce healthy lifestyles

As depicted in table 4.10, social influence has the strongest effect (0.330) on behavioural intention to adopt mobile applications that promote physical activity followed by performance expectancy (0.208) and effort expectancy (0.202). In addition, behavioural intention has the strongest effect on use behaviour (0.425), followed by facilitating conditions (0.247). The path coefficients for all the model's constructs were greater than 0.1. Hence, all the hypotheses pertaining to the effect of the UTAUT constructs (variables) on the adoption of mobile applications that promote physical activity were supported.

Table 4. 10: Path Coeffients for Physical Activity

	Beta	T Statistics (|O/STDEV|)	Comment
Behavioural Intention Physical Activity -> Use Behaviour Physical Activity	0.425	10.666***	Supported
Effort Expectancy Physical Activity -> Behavioural Intention Physical Activity	0.202	3.516***	Supported
Facilitating Conditions Physical Activity -> Use Behaviour Physical Activity	0.247	5.489***	Supported
Performance Expectancy_ Physical Activity -> Behavioural Intention Physical Activity	0.208	3.457***	Supported
Social Influence Physical Activity -> Behavioural Intention Physical Activity	0.330	6.288***	Supported

Critical t-values for two tailed tests are 1.65* (significance level=10 percent), 1.96** (significance level=5 percent), 2.58*** (significance level=1 percent).

As depicted in table 4.11, just like in the case of mobile applications that promote physical activity, social influence also has the strongest effect (0.306) on behavioural intention to adopt mobile applications that help induce healthy eating habits followed by performance expectancy (0.289) and effort expectancy (0.214). In addition, behavioural Intention to adopt mobile applications that help induce healthy eating habits had a much stronger effect on use behaviour (0.460) than facilitating conditions (0.205). All path coefficients had a value greater than 0.1. Therefore, all the hypotheses pertaining to the effect of the UTAUT constructs (variables) on the adoption of mobile applications that help induce healthy eating habits were supported.

Table 4. 11: Path coefficients for Diet applications

	Beta	T Statistics (|O/STDEV|)	Comment
Behavioural Intention Diet -> Use Behaviour Diet	0.460	10.660***	Supported
Social Influence Diet -> Behavioural Intention Diet	0.306	5.527***	Supported
Performance Expectancy Diet -> Behavioural Intention Diet	0.289	4.909***	Supported
Facilitating Conditions Diet -> Use Behaviour Diet	0.205	4.489***	Supported
Effort Expectancy Diet -> Behavioural Intention Diet	0.214	4.172***	Supported

Critical t-values for two tailed tests are 1.65* (significance level=10 percent), 1.96** (significance level=5 percent), 2.58*** (significance level=1 percent).

4.7 Coefficient of Determination (R^2)

Coefficient of Determination (R2) measures the goodness of fit for the linear model and it can be any value between 0 and 1. Urbach and Ahlemann (2010) state that R2 measures the variance of the Latent variable relative to its total variance. These values are considered to be strong if they are at least 0.670, moderate if they are around 0.333, and weak when they around 0.190 (Urbach and Ahlemann, 2010). In this study, the coefficient of determination was used to determine the relationship between variables used to assess the effect of the UTAUT constructs on the adoption of mHealth applications that help induce healthy lifestyles.

4.7.1 Coefficient of Determination (R^2) for mobile applications that promote physical activity

Figure 4.4 shows the coefficients of determination (R^2) for the constructs related to the adoption of mobile applications that promote physical activity. The figure shows that the variance of the first endogenous variable (behavioural intention) is 0.375. This means that the three exogenous variables (performance expectancy, effort expectancy, and social influence) explain 37.5% of the variance in the behavioural intention to adopt mobile health applications that promote physical activity. Furthermore, behavioural intention and facilitating conditions explain 30.3% of the variance in the use behaviour of mobile applications that promote activity.

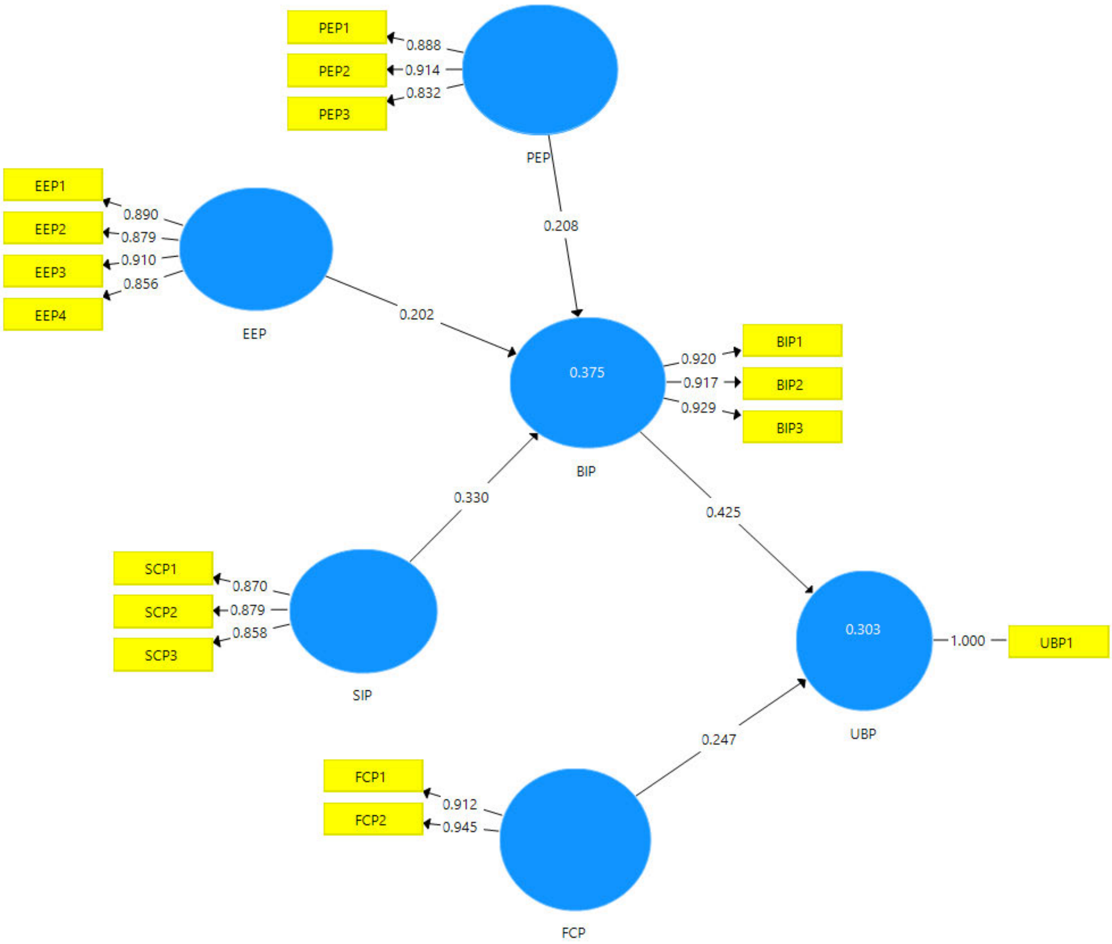

Figure 4. 4: Model Result for Physical Activity

4.7.2 Coefficient of Determination (R^2) for mobile applications that help induce healthy eating habits

Figure 4.5 shows the coefficients of determination (R^2) for the constructs related to the adoption of mobile applications that help induce healthy eating habits. The figure shows that the variance of the first endogenous variable (behavioural intention) is 0.436. This means that the exogenous variables (performance expectancy, effort expectancy, and social influence) explain 43.6% of the variance in the behavioural intention to adopt mobile health applications that help induce healthy eating habits. Furthermore, behavioural intention and facilitating conditions explain 29.5% of the variance in the latent variable (use behaviour).

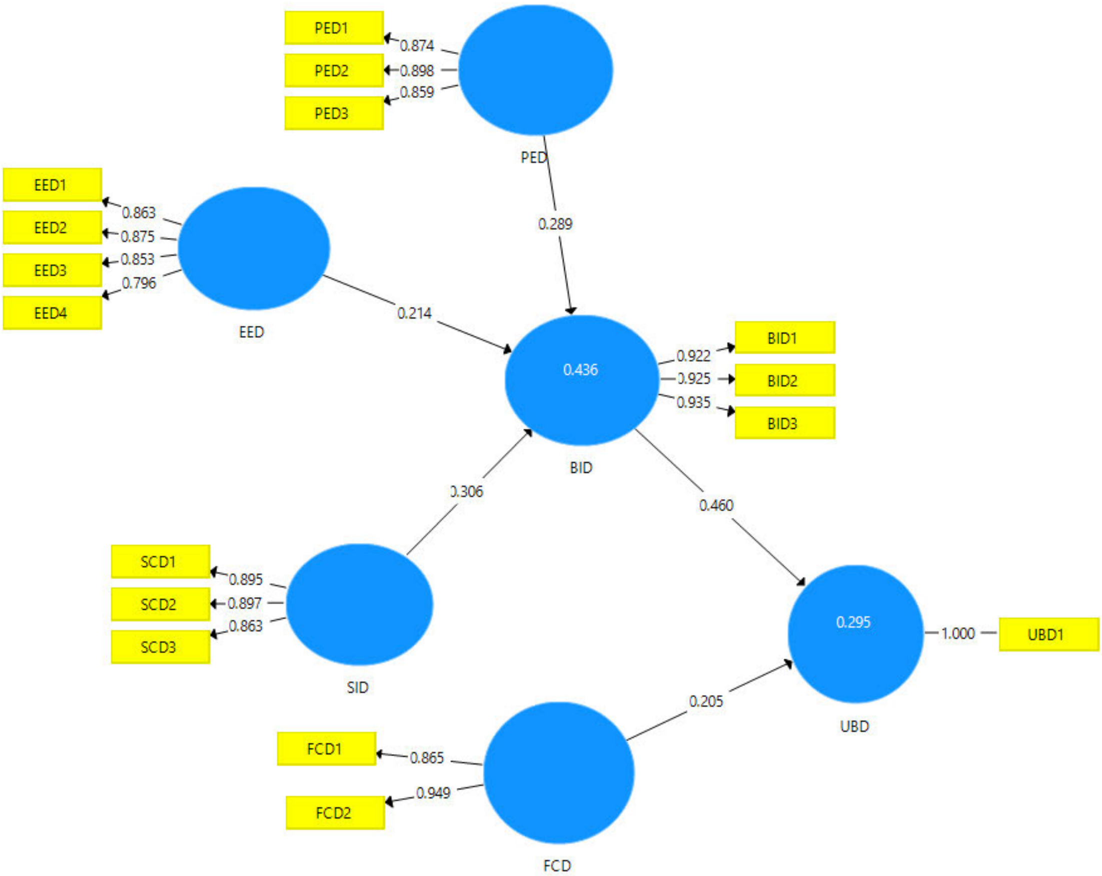

Figure 4. 5: Model Results for Diet

4.8 Model Fit (SRMR)

Model fit is used to assess and examine if the model fits the data and whether the model is valid (Barrett, 2007). The model fit was assessed using Standardised Root Means Squared Residual (SRMR) of the SMARTPLS version 3. A model is deemed acceptable if its value is less than 0.08 (Garson, 2016).

Table 4.12 below reports the Model fit for the adoption of mHealth applications that promote physical activity. As depicted in the table the SRMR value is 0.044. Hence, the proposed model for the adoption of mobile applications that promote physical activity is acceptable.

Table 4. 12: Model Fit for Physical Activity

	Saturated Model	Estimated Model
SRMR	0.044	0.048
d_ULS	0.265	0.313
d_G	0.235	0.241
Chi-Square	548.660	558.257
NFI	0.857	0.855

Table 4.13 below reports the Model fit for the adoption of mHealth applications used to monitor diet. The SRMR value is 0.049 and this means that the proposed model for the adoption of mobile applications that promote a healthy diet is acceptable.

Table 4. 13: Model Fit for Diet

	Saturated Model	Estimated Model
SRMR	0.049	0.051
d_ULS	0.320	0.353
d_G	0.241	0.246
Chi-square	568.632	577.456
NFI	0.843	0.841

4.9 Discussion of the findings

This section discusses the results of the data analysis in light of the study's research questions.

Research question 1: To what extent is the youth aware of mobile applications that help induce healthy lifestyles?

This study found that a large number (66.2%) of respondents had heard about mobile applications that help induce healthy lifestyles and a considerable number of respondents (53.7%) had seen these applications. However, the use of these applications is low as only 31.1% of respondents had used these applications. The study also revealed that very few respondents often use diet-related applications (13.2%). There are also very few respondents that often use (22.2%) fitness mobile applications. This means that fitness applications and diet-related applications are not popular choices of mobile applications amongst the surveyed youth although most of the respondents (94.4%) own a smartphone. However, this is not surprising as a recent survey (Statista,

2021) of the most popular mobile applications in South Africa did not feature and mHealth applications. Clement (2021) done a survey study featured WhatsApp, Uber, YouTube video, Facebook, Facebook Messenger as the most popular mobile applications (in descending order of popularity) in South Africa. It is important to notice that in this survey (Clement, 2021), three out of the 5 most popular mobile applications in South Africa are social media applications (WhatsApp, Facebook, Facebook Messenger). Thus, interventions geared towards inducing healthy lifestyles should prioritise social media platforms to attract the attention of a much wider audience. This study's findings also found that social influence has the highest effect size for both mobile applications that promote physical activity as well as those that promote healthy eating habits (see Section 4.3). This further corroborates the suggestion that the use of social media platforms to promote mobile applications that help induce healthy lifestyles could be effective especially in the context of South Africa's youth.

Awareness of mobile health applications to induce healthy lifestyles is one of the antecedents to their adoption (Kayyali et al., 2017; Ndayizigamiye et al., 2020). In fact, lack of awareness of mHealth applications has been identified as one of the impediments to their adoption (Krebs and Duncan, 2015; Kayyali et al., 2017). However, the awareness of these applications does not necessarily imply their adoption. Thus, interventions that promote the awareness of these applications should also promote their use. In addition, further assessments should be made to assess the effect of their adoption on youth's health outcomes.

4.9.2 The effect of the UTAUT constructs on the adoption of mHealth applications that help to induce healthy lifestyles

This section discusses the effect of the UTAUT constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) on the adoption of mobile applications that help induce healthy lifestyles.

Research question 2: What is the effect of performance expectancy on the behavioural intention to adopt mobile applications that help induce healthy lifestyles

This chapter has highlighted that the bootstrapping functionality was used to determine the path coefficient β. The path coefficient β helps determine the effect of an exogenous variable (in this case performance expectancy) on the endogenous variable (in this case adoption of mobile applications that help induce healthy lifestyles) (Garson, 2010). The results depicted that there is a significant effect size (effect size = 0.289 at 99% confidence level) between performance expectancy and behavioural intention to adopt mobile health applications that promote healthy eating habits. Similarly, there is a significant effect size (effect size = 0.208 at 99% confidence level) between performance expectancy and behavioural intention to adopt mobile health applications that promote physical activity. The study's results concur with other studies (Ndayizigamiye et al., 2020; Nunes et al., 2019; Alam et al., 2018; Hoque and Sorwar, 2017) which found that there is a significant effect between performance expectancy and behaviour intention towards the adoption of mobile health applications.

Research question 3: What is the effect of effort expectancy on the behavioural intention to adopt mobile applications that help induce healthy lifestyles?

In the context of this study, effort expectancy relates to the ease of use of mobile health applications that help induce healthy lifestyles. The effect of effort expectancy on behavioural intention was tested using the bootstrapping functionality on the SMARTPLS software version 3. The results have shown that the effect size for mobile applications that help induce healthy eating habits is 0.214 at 99 % confidence level which is similar to what Okunus et al., (2018) have found while the effect size for mobile applications that promote physical activity is 0.202 at 99 % confidence level, which concur with previous studies (Hoque and Sorwar, 2017; Ndayizigamiye et al., 2020).

In the context of Bangladesh, Alam et al., (2018) have found that effort expectancy has the strongest effect towards the adoption of mHealth services. However, in the case of this study, expectancy does not have the strongest effect although it does have a significant effect on the adoption of mobile applications that promote physical activity and those that promote healthy eating habits.

Research question 4: What is the effect of social influence on the behavioural intention to adopt mobile applications that help induce healthy lifestyles?

Conci et al., (2009) indicated that social influence is a key factor that determines the use intention and use behaviour of mobile phones. This study found a significant effect of social influence on the behavioural intention to adopt mobile health applications that promote healthy eating habits (effect size= 0.306 at 99% confidence level) and on behavioural intention to adopt mobile health applications that promote physical activity (effect size=0.330 at 99% confidence level). In addition, it was found that social influence is the highest predictor of the behavioural intention amongst the UTAUT constructs. A similar study by Ndayizigamiye et al, (2020) also found that social influence has the highest effect on behavioural intention to adopt mHealth applications that promote physical activity. This is not surprising because generally, peer influence is higher amongst the youth than in any population category (Martino, Ellickson, and McCaffrey, 2009). Past studies have also reported that lack of social influence (support and encouragement from the family) may become a barrier to the adoption of mHealth applications in South Africa (Petersen et al., 2019).

Research question 5: What is the effect of facilitating conditions on the use behaviour of mobile applications that help induce healthy lifestyles?

Venkatesh et al., (2000) define facilitating conditions as the technical infrastructure that exists to support the adoption/use of a system. Mohammand et al., (2017) argued that facilitating conditions as a moderating factor does not have an effect on use behaviour. In the context of this study, the facilitating condition has a direct effect on the adoption (use behaviour) of mobile health applications that help induce healthy lifestyles. The results indicated that facilitating conditions have an effect size of 0.205 (at 99% confidence level) on the use behaviour of mHealth applications that promote healthy eating habits and an effect size of 0.247 behaviour of mHealth applications that promote physical activity. The results concur with another study (Ndayizigamiye et al., 2020) that found that facilitating conditions, as a construct, have a significant positive effect on the use behaviour of mHealth applications that promote physical activity in South

Africa's context. In addition, Dwivedi et al., (2016) also found that facilitating conditions had an influence on the adoption of mHealth applications.

Research question 6: What is the effect of behavioural intention on the use behaviour of mobile applications that help induce healthy lifestyles?

In the UTAUT framework, the behaviour intention construct is a predictor of the actual use behaviour. The results from this study show that the effect size of the behavioural intention to adopt mobile applications that help induce healthy eating habits on the use behaviour is 0.460 (at 99% confidence level) while the effect size of the behavioural intention to adopt mobile applications that promote physical activity on the use behaviour is 0.425. The results concur with studies with similar results (Mohammand et al., 2018; Ndayizigamiye et al., 2020).

4.10 Chapter summary

This chapter presented the results of the study and outlined the model that best fit the adoption of mobile health applications to promote healthy lifestyles. This model was drawn based on the factors that have a significant effect size on the behavioural intention and the use behaviour of mobile applications that help induce healthy lifestyles. Firstly, the chapter articulated the demographics information of all respondents and depicted the respondents' level of awareness about mobile health applications that promote physical and those that promote healthy eating habits. The descriptive analysis was conducted through frequency analysis to determine the data distribution amongst all participants. Secondly, the chapter displayed the results on the constructs validity and how the proposed PLS-SEM model fits the data. The results showed two models that best fit data for the adoption of mobile health applications that promote healthy eating habits and those that promote physical activity respectively. The chapter further provided a discussion of the findings based on the research questions that guide this study. The following chapter concludes the study and provides recommendations based on the study's findings.

CHAPTER 5: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

The last chapter concludes the study. This chapter provides a summary of each chapter of this study and summarises the findings. It further provides practical recommendations for future studies. Furthermore, the chapter outlines the limitations and contributions of the study.

5.2 Summary of the study

The objective of this study was to investigate factors that influence the adoption of mHealth applications to induce healthy lifestyles among UKZN (PMB) students. The following research questions were articulated to investigate the research problem:

- To what extent is the youth aware of mobile applications that help induce healthy lifestyles?
- What is the effect of performance expectancy on the behavioural intention to adopt mobile applications that help induce healthy lifestyles?
- What is the effect of effort expectancy on the behavioural intention to adopt mobile applications that help induce healthy lifestyles?
- What is the effect of social influence on the behavioural intention to adopt mobile applications that help induce healthy lifestyles?
- What is the effect of facilitating conditions on the use behaviour of mobile applications that help induce healthy lifestyles?
- What is the effect of behavioural intention on the use behaviour of mobile applications that help induce healthy lifestyles?

The study was divided into five chapters. Chapter one introduced the study by delineating the research problem and research objectives. It further explained the theoretical framework adopted in the study and outlined the research methodology as well as the study limitations. Lastly, it provided an overview of the study's chapters.

The second chapter has provided a literature review on mobile health applications and how they are being used. It further discussed factors influencing the adoption of mobile health applications to induce healthy lifestyles and some challenges faced when using mHealth applications. Lastly, it provided a literature review on IT adoption theoretical frameworks and how they have been used in studies that investigated the adoption of mHealth applications.

Chapter three presented a detailed description of the research methodology adopted in this study to collect and analyse data based on the research onion framework (Saunders et al., 2016). The methodology chapter highlighted that the study was conducted at the University of KwaZulu-Natal (PMB) campus. The target population was students between the age of 18-35 years. Convenience sampling was used to collect data. Data were captured and analysed using SPSS v25 (descriptive analysis). Moreover, the SMARTPLS software version 3 was used to assess the measurement and structural models and to evaluate the relationship between constructs.

Chapter four presented, interpreted, and discussed the results of the analysis based on the study's research questions.

5.3 Summary of Major Findings

Major findings are presented below in relation to the research questions.

Regarding the awareness of mobile applications that help induce healthy lifestyles, the study found that most respondents were aware of these applications as they had heard (66.2%) about them or seen (53.7%) them. However, the use of such applications is very low (31.1%). In addition, it was found that the use of fitness applications and diet applications is not popular amongst the surveyed youth in this study.

As alluded to in chapter 4 a recent survey found that social three out of the 5 most popular mobile applications in south Africa are social media applications (WhatsApp, Facebook, Facebook Messenger) (Clement, 2021). Thus, it is not surprising that most of the respondents (39%, N=143) had heard about mHealth applications from social media. Thus, it is highly recommended that interventions that seek to increase the youth's awareness of mHealth applications that help induce healthy lifestyles (by promoting physical activity and healthy eating habits should use social media.

The study also found that all the UTAUT constructs have a significant effect on the behaviour intention towards the adoption of mobile applications that help induce healthy lifestyles with varied effect sizes. Most importantly, social influence had a strong effect size amongst all the constructs. This means that social influence is the highest predictor in the adoption of mobile applications that promote physical activity as well as those that promote healthy eating habits. This further corroborates the assertion made earlier that interventions that seek to promote mobile applications that help induce healthy lifestyles amongst the youth should make use of social media due to the youth's likely susceptibility to peer influence.

In addition, the research used the PLS-SEM to assess a proposed model for the adoption of mobile health applications that help to induce healthy lifestyles. The results revealed that effort expectancy (EE), performance expectancy (PE), and social influence (SI) explain 43.6% of the variance of the behavioural intention (BI) towards adopting mHealth applications that promote healthy eating habits among the youth. Furthermore, the results revealed that effort expectancy (EE), performance expectancy (PE), and social influence (SI) explain 37.5% of the variance of behavioural intention (BI) towards adopting mHealth applications that promote physical activity among the youth. In addition to factors that influence the adoption of mHealth applications, facilitating conditions also influence the use behaviour of these mobile applications. Facilitating conditions explain 29.5% of the variance in the use behaviour of diet-related applications and 30.3% of applications that promote physical activity.

5.4 Recommendations

In this study, the adoption of mobile applications that promote physical activity and the adoption of mobile applications that promote healthy eating habits were investigated separately. However, adoption of a healthy lifestyle entails adopting a healthy diet as well as adopting a physical activity/exercise routine. This implies that the promotion of healthy eating habits and the promotion of physical activity are complementary and not mutually exclusive. Therefore, it is highly recommended that mHealth interventions that seek to promote healthy lifestyles should promote both physical exercise and healthy eating concurrently.

Furthermore, there are other components of "healthy lifestyles" that were not investigated. Thus, this study does not imply that physical activity and healthy eating are the only components of a healthy lifestyle. It is therefore suggested that other studies should investigate other components of healthy lifestyles that were not addressed in this study.

Moreover, the study did not test the moderating effect of awareness on the adoption of mobile applications that promote physical activity as well as those that promote healthy eating habits. The study rather used 'awareness' to get an understanding of the extent to which the youth know about the mHealth applications. Therefore, it is suggested that further studies should investigate the moderating effect of awareness in the UTAUT framework and in the context of inducing healthy lifestyles.

On a practical level, this study recommends that interventions geared towards encouraging the youth to adopt mobile applications that help induce healthy lifestyles should make use of peers' influence or social media that instil peer's influence. This is in accordance with the results that show that social influence is the highest predictor in the adoption of these applications. Furthermore, this study recommends that any interventions that seek to promote healthy lifestyles amongst the youth should also consider the other factors (identified through this study) that significantly influence the adoption of mHealth applications that help induce healthy lifestyles.

5.5 Contribution of the Study

The significance of this study stems from the fact that it is situated within the broad arena of behavioural change research and investigates the determinants of the adoption of technologies that may help induce healthy lifestyles. Worldwide, there is an increase of young people being affected by chronic disease and obesity due to unhealthy eating and lack of physical exercise routines (Steyn and Damasceno, 2006). Based on an extensive literature review on the topic, it is apparent that not much research has been done on the topic within the context of South Africa in general. Thus, this research addresses the gap in the literature from a developing country's perspective. This research is needed to understand the enablers that should be in place in order to devise adequate strategies to induce healthy lifestyles among the youth in the context of South Africa using mobile technologies.

5.6 Limitations of the Study

This research used a sample of students registered at the University of KwaZulu-Natal (on the Pietermaritzburg campus) in South Africa. In addition, as depicted in the results section, the respondents were young people (between 18 and 35 years of age according to South Africa's classification of youth). Therefore, the findings can be only be extended to the broader category of youth. However, caution should be taken when extending the results of this study to the broader category of youth as the term 'youth' can denote a different set of people in a different context. Moreover, the study targeted 'educated' youth since all the respondents were enrolled at the University of KwaZulu-Natal. Thus, further research should be conducted to assess the adoption of mHealth applications that help induce healthy lifestyles to 'uneducated youth' or youth who are not pursuing a formal qualification. Notwithstanding the limitations, this research is a stepping-stone towards assessing the adoption of mobile applications that help induce healthy lifestyles in the South African context and from the youth's perspectives, using a structural equation modelling approach.

REFERENCES

Ab Hamid, M, Sami, W. and Sidek, M., 2017. Discriminant validity assessment: Use of Fornell & Larcker criterion versus HTMT criterion. *Journal of Physics: Conference Series*, IOP Publishing 890 (2017), 012163.

ABaldwin, J.L., Singh, H., Sittig, D.F. and Giardina, T.D., 2017. Patient portals and health applications: Pitfalls, promises, and what one might learn from the other. In Healthcare. *Elsevier,* 5(3), pp. 81-85

Ahad, A.D. and Anshari, M., 2017. Smartphone habits among youth: Uses and gratification theory. *International Journal of Cyber Behaviour, Psychology and Learning (IJCBPL),* 7(1), pp.65-75.

Ajzen, I., 1991. The theory of planned behaviour. *Organizational behaviour and human decision processes*, *50*(2), pp.179-211.

Al Ayubi, S. U., Parmanto, B., Branch, R. and Ding, D., 2014. A persuasive and social mHealth application for physical activity: a usability and feasibility study. JMIR mHealth and uHealth, 2(2), e25.

Alam, M.Z., Hoque, M.R., Hu, W. and Barua, Z., 2020. Factors influencing the adoption of mHealth services in a developing country: A patient-centric study. *International Journal of Information Management,* 50(2020), pp.128-143.

Alam, M.Z., Hu, W. and Barua, Z., 2018. Using the UTAUT model to determine factors affecting acceptance and use of mobile health (mHealth) services in Bangladesh. Journal of Studies in Social Sciences, 17(2).

Alazzam, M.B., Al-sharo, Y.M. and Al-azzam, M.K., 2018. Developing (UTAUT 2) model of adoption mobile health application in Jordan e-government. *Journal of Theoretical & Applied Information Technology*, *96*(12).

Aljowaidi, M., 2015. A study of e-commerce adoption using toe framework in saudi retailers: firm motivations, implementation and benefits.

Al-qeisi, K. I., 2009. *Analyzing the use of UTAUT model in explaining an online behaviour: Internet banking adoption.* Brunel University Brunel Business School PhD Theses.

Alshamaila, Y.Y., 2013. *An empirical investigation of factors affecting cloud computing adoption among SMEs in the North East of England* (Doctoral dissertation, Newcastle University).

Alzaza, N.S. and Yaakub, A.R., 2011. Students' awareness and requirements of mobile learning services in the higher education environment. *American Journal of Economics and Business Administration*, *3*(1), pp.95-100.

Angosto, S., García-Fernández, J., Valantine, I. and Grimaldi-Puyana, M., 2020. The Intention to Use Fitness and Physical Activity Applications: A Systematic Review. *Sustainability*, *12*(16), pp.6641.

Atallah, N., Khalifa, M., El Metwally, A. and Househ, M., 2018. The prevalence and usage of mobile health applications among mental health patients in Saudi Arabia. Computer methods and programs in biomedicine, 156 (2018), pp.163-168.

Bailey, S.C., O'conor, R., Bojarski, E.A., Mullen, R., Patzer, R.E., Vicencio, D., Jacobson, K.L., Parker, R.M. and Wolf, M.S., 2015. Literacy disparities in patient access and health-related use of Internet and mobile technologies. *Health Expectations*, *18*(6), pp.3079-3087.

Barrett, P., 2007. Structural equation modelling: Adjudging model fit. *Personality and Individual differences*, 42 (2007)**,** pp.815-824.

Bebli, R. S., 2012. *The impact of internet banking service quality on customer satisfaction in the banking sector of Ghana*., Blekinge Institute of Technology

Bhuyan, S.S., Lu, N., Chandak, A., Kim, H., Wyant, D., Bhatt, J., Kedia, S. and Chang, C.F., 2016. Use of mobile health applications for health-seeking behavior among US adults. Journal of medical systems, 40(6), p.153.

Bock, W., Candelon, F., Chai, S., Choi, E., Corwin, J., DiGrande, S., Gulshan, R., Michael, D., and Varas, A., 2015. The Mobile Revolution: How Mobile Technologies Drive aTrillion-Dollar Impact. Available online: https://www.bcg.com/publications/2015/telecommunications-technology-industries-the-mobile-revolution [Date accessed: 29 November 2020]

Boulos, M.N.K., Wheeler, S., Tavares, C. and Jones, R., 2011. How smartphones are changing the face of mobile and participatory healthcare: an overview, with example from eCAALYX. *Biomedical engineering online*, *10*(1), p.24.

Burke, L.M., Hawley, J.A., Wong, S.H. and Jeukendrup, A.E., 2011. Carbohydrates for training and competition. *Journal of sports sciences, 29(sup1)*, pp.17-27.

Cable, D.M. and DeRue, D.S., 2002. The convergent and discriminant validity of subjective fit perceptions. *Journal of applied psychology*, 87(5), pp.875.

Chao, C.M., 2019. Factors determining the behavioural intention to use mobile learning: An application and extension of the UTAUT model. *Frontiers in psychology*, 10 (1652), p.1-14.

Cho, J., Park, D. and Lee, H.E., 2014. Cognitive factors of using health applications: systematic analysis of relationships among health consciousness, health information orientation, eHealth literacy, and health app use efficacy. *Journal of medical Internet research*, *16*(5), p.125.

Choi, B., Lee, I., Kim, J. and Jeon, Y., 2005. A qualitative cross-national study of cultural influences on mobile data service design. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 661-670).

Clement, J., 2020. Most popular mobile apps used in South Africa as of February 2020, by reach. Available at https://www.statista.com/statistics/1103151/most-popular-mobile-apps-south-africa/ [Date accessed: 06 January 2021]

Conci, M., Pianesi, F. and Zancanaro, M., 2009. Useful, social and enjoyable: Mobile phone adoption by older people. *In IFIP Conference on Human-Computer Interaction (pp. 63-76)*. Springer, Berlin, Heidelberg.

Davais, F. D., Bagozzi, R. P. and Warshaw, P. R., 1989. User acceptance of computer technology: a comparison of two theoretical models. *Management science*, 35 (8)**,** pp.982-1003.

Denzin, N. and Lincoln, Y., 2005. Handbook of qualitative research second edition. *Sage publications, inc, thousand oaks*, p.1143.

Dobbins, C. and Rawassizadeh, R., 2015, October. Clustering of physical activities for quantified self and mhealth applications. *In 2015 IEEE International Conference on Computer and Information Technology; Ubiquitous Computing and Communications; Dependable, Autonomic and Secure Computing; Pervasive Intelligence and Computing* (pp. 1423-1428). IEEE.

Draugalis, J.R. and Plaza, C.M., 2009. Best practices for survey research reports revisited: implications of target population, probability sampling, and response rate. *American journal of pharmaceutical education*, 73(8).

Dute, D.J., Bemelmans, W.J.E. and Breda, J., 2016. Using mobile applications to promote a healthy lifestyle among adolescents and students: a review of the theoretical basis and lessons learned. *JMIR mHealth and uHealth*, *4*(2), pp. e39.

Dwivedi, Y. K., Shareef, M. A., Simintiras, A. C., Lal, B., & Weerakkody, V. (2016). A generalised adoption model for services: A cross-country comparison of mobile health (m-health). *Government Information Quarterly*, 33(1), pp.174–187.

Edwards, P., Roberts, I., Clarke, M., Diguiseppi, C., Pratap, S., Wentz, R. and Kwan, I., 2002. Increasing response rates to postal questionnaires: Systematic review. *BMJ,* 324 **(**1183), pp.1-9.

Ekelund, U., Besson, H., Luan, J.A., May, A.M., Sharp, S.J., Brage, S., Travier, N., Agudo, A., Slimani, N., Rinaldi, S. and Jenab, M., 2011. Physical activity and gain in abdominal adiposity and body weight: prospective cohort study in 288,498 men and women. *The American journal of clinical nutrition*, 93(4), pp.826-835.

Elamin, W., Hannis, D., Nnyanzi, L. and Ells, L., 2018. To study the impact of mHealth interventions on chronic diseases management: A systematic overview of systematic reviews protocol. *Clinical eHealth*, *1*(1), pp.17-20.

Ericsson Mobility Report, 2016. Ericsoon Mobility Report: Mobile World Congree Edition, viewed 20 June 2020

Fishbein, M., and Ajzen, I. 1975. *Belief, attitude, intention and behaviour: An introduction to theory and research*.

Fjeldsoe, B.S., Goode, A.D., Phongsavan, P., Bauman, A., Maher, G., Winkler, E. and Eakin, E.G., 2016. Evaluating the maintenance of lifestyle changes in a randomized controlled trial of the 'Get Healthy, Stay Healthy'program. *JMIR mHealth and uHealth*, 4(2), p.e42.

Fogg, B.J., 2002. Persuasive technology: using computers to change what we think and do. *Ubiquity*, *2002*(December), p.2.

Forouzanfar, M. H., Alexander, L., Anderson, H. R., Bachman, V. F., Biryukov, S., Brauer, M., Burnett, R., Casey, D., Coates, M. M. & Cohen, A. 2015. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990–2013: A systematic analysis for the Global Burden of Disease Study 2013. The Lancet, 386, 2287-2323

García-Peñalvo, F.J., Conde, M.Á. and Matellán-Olivera, V., 2014. Mobile applications for older users–The development of a mobile applications repository for older people. *In International Conference on Learning and Collaboration Technologies* (pp. 117-126). Springer, Cham.

Garson, G. D., 2016. Partial least squares: regression and structural equation models. *Asheboro, nc: Statistical Associates Publishers*.

Giesen, D., Meertens, V., Vis-Visschers, R. and Beukenhorst, D. 2012. Questionnaire development. *The hague, heerlen, Netherlands*.

Glbert, P., 2020. SA Smartphone numbers jump. Available at http://www.connectingafrica.com/author.asp?section_id=761&doc_id=761473#:~:text=South%20Africa's%20smartphone%20penetration%20was,while%20mobile%20users%20increased%20overall.&text=South%20Africa's%20smartphone%20penetration%20increased,of%20the%20ICT%20Sector%20report [Date accessed: 06 September 2020]

GMSA, 2020. The Mobile Economy Sub-Saharan African 202, Available at https://www.gsma.com/mobileeconomy/sub-saharan-africa/ [Date accessed 08 November 2020]

Hair J.F., H., Ringle C. M., and Sarstedt, M., 2014. Partial least squares structural equation modeling (PLS-SEM). *Sage Publisher*, vol. 26 (2)**,** pp. 106-121

Hair Jr, J. F., Matthews, I. M., Matthews, R.L. and Sarstedt, M., 2017. PLS-SEM or CB-SEM: updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, 1**,** pp.107-123.

Hair Jr, J.F., Sarstedt, M., Hopkins, L., and Kuppelwieser, V.G., 2014. Partial least squares structural equation modeling (PLS-SEM). *European business review*.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E., 2010. Multivariate data analysis: international version. *New jersey, pearson*.

Hair, J.F., Risher, J.J., Sarstedt, M., and Ringle, C.M., 2019. When to use and how to report the results of PLS-SEM. European Business Review, 31(1), pp.2–24.

Hartz, J., Yingling, L. and Powell-Wiley, T.M., 2016. Use of mobile health technology in the prevention and management of diabetes mellitus. Current cardiology reports, 18(12), p.130.

Helbostad, J.L., Vereijken, B., Becker, C., Todd, C., Taraldsen, K., Pijnappels, M., Aminian, K. and Mellone, S., 2017. Mobile health applications to promote active and healthy ageing. *Sensors*, *17*(3), p.622.

Hennekens, C.H., Hennekens, A.R., Hollar, D. andCasey, D.E., 2005. Schizophrenia and increased risks of cardiovascular disease. *American heart journal*, 150(6), pp.1115–1121.

Henseler, J., Dijkstra, T.K., Sarstedt, M., Ringle, C.M., Diamantopoulos, A., Straub, D.W., Ketchen Jr, D.J., Hair, J.F., Hult, G.T.M. and Calantone, R.J., 2014. Common beliefs and reality about PLS: Comments on Rönkkö and Evermann (2013). *Organizational research methods*, 17(2), pp.182-209.

Henseler, J., Ringle, C.M. and Sarstedt, M., 2015. A new criterion for assessing discriminant validity in variance-based structural equation modelling. *Journal of the academy of marketing science*, 43(1), pp.115-135.

Hills, A.P., King, N.A. and Armstrong, T.P., 2007. The contribution of physical activity and sedentary behaviours to the growth and development of children and adolescents. *Sports medicine*, *37*(6), pp.533-545.

Hoque, R. and Sorwar, G., 2017. Understanding factors influencing the adoption of mHealth by the elderly: An extension of the UTAUT model. *International journal of medical informatics*, 101 (2017), pp.75-84.

Hossain, M.A., 2016. Assessing m-Health success in Bangladesh. *Journal of Enterprise Information Management*.

Hou, C., Carter, B., Hewitt, J., Francisa, T. and Mayor, S., 2016. Do mobile phone applications improve glycemic control (HbA1c) in the self-management of diabetes? A systematic review, meta-analysis, and GRADE of 14 randomized trials. *Diabetes care*, *39*(11), pp.2089-2095.

Ifinedo, P., 2012, January. Technology acceptance by health professionals in Canada: An analysis with a modified UTAUT model. In *2012 45th Hawaii international conference on system sciences* (pp. 2937-2946). IEEE.

Imaja, I.M., Ndayizigamiye, P. and Maharaj, M., 2017. A design of a mobile health intervention for the prevention and treatment of Cholera in South Kivu in the Democratic Republic of Congo. In *2017 IEEE Global Humanitarian Technology Conference (GHTC)* (pp. 1-5). IEEE.

Islam, S., 2016. Effects of mobile phone SMS for prevention of cardiovascular risk factors among patients with type 2 diabetes in Bangladesh: A prospective, parallel group, randomized co ntrolled trial. *Journal of Hypertension, 34,* p.133.

Jacob, C., Sanchez-Vazquez, A. and Ivory, C., 2020. Understanding Clinicians' Adoption of Mobile Health: A Qualitative Review of the Most Used Frameworks. *JMIR mHealth uHealth*.

Jeon, E. and Park, H., 2015. Factors affecting acceptance of smartphone application for management of obesity. *Healthcare informatics research*, *21*(2), pp.74-82.

Johnson, R. B. and Onwuegbuzie, A. J. 2004. Mixed methods research: a research paradigm whose time has come. *Educational researcher*, 33**,** pp.14-26.

Kante, M. and Ndayizigamiye, P., 2020. A Systematic Mapping of Studies on the Adoption of Internet of Things to Provide Healthcare Services in Developing Countries. *Perspectives on ICT4D and Socio-Economic Growth Opportunities in Developing Countries*, p.99.

Kante, M. and Ndayizigamiye, P., 2020. An analysis of the current status of Internet of Medical Things policies in developing countries. *NPG Neurologie-Psychiatrie-Gériatrie*, 20 (119), pp.259-265.

Karageorgos, G., Andreadis, I., Psychas, K., Mourkousis, G., Kiourti, A., Lazzi, G. and Nikita, K.S., 2018. The promise of mobile technologies for the health care system in the developing world: a systematic review. IEEE reviews in biomedical engineering, 12, pp.100-122.

Kariuki, E.G. and Okanda, P., 2017, September. Adoption of m-health and usability challenges in m-health applications in Kenya: Case of Uzazi Poa m-health prototype application. In *2017 IEEE AFRICON* (pp. 530-535). IEEE.

Karmali, K.N., Goff, D.C., Ning, H. and Lloyd-Jones, D.M., 2014. A systematic examination of the 2013 ACC/AHA pooled cohort risk assessment tool for atherosclerotic cardiovascular disease. *Journal of the American College of Cardiology*, *64*(10), pp.959-968.

Kassa, M. and Grace, J., 2019. The Global Burden and Perspectives on Non-communicable Diseases (NCDs) and the Prevention, Data Availability and Systems Approach of NCDs in Low-resource Countries. *In Public Health in Developing Countries-Challenges and Opportunities*. IntechOpen.

Kavai, M.R., 2014. Mobile phone eHealth adoption in Kenya: Application of Diffusion of Innovation Theory. ADM No: P52/72666/2014

Kayyali, R., Peletidi, A., Ismail, M., Hashim, Z., Bandeira, P. and Bonnah, J., 2017. Awareness and use of mHealth applications: a study from England. *Pharmacy*, *5*(2), p.33.

Kharrazi, H., Faiola, A. and Defazio, J., 2009, July. Healthcare game design: behavioural modelling of serious gaming design for children with chronic diseases. In *International Conference on Human-Computer Interaction* (pp. 335-344). Springer, Berlin, Heidelberg.

Kijsanayotin, B., Pannarunothai, S. and Speedie, S.M., 2009. Factors influencing health information technology adoption in Thailand's community health centers: Applying the UTAUT model. *International journal of medical informatics*, *78*(6), pp.404-416.

Klasnja, P., Consolvo, S., McDonald, D.W., Landay, J.A. and Pratt, W., 2009. Using mobile & personal sensing technologies to support health behaviour change in everyday life: lessons learned. In *AMIA Annual Symposium Proceedings* (Vol. 2009, p. 338). American Medical Informatics Association.

König, L.M., Sproesser, G., Schupp, H.T. and Renner, B., 2018. Describing the process of adopting nutrition and fitness applications: Behaviour stage model approach. *JMIR mHealth and uHealth,* 6(3), p.e55.

Körmendi, A., 2015. Smartphone usage among adolescents. Psychiatria Hungarica: *A Magyar Pszichiatriai Tarsasag Tudomanyos Folyoirata*, 30(3), pp.297-302.

Krebs, P., and Duncan, D. T., 2015. Health app use among US mobile phone owners: A national survey. *JMIR MHealth UHealth*, 3(4), e101.

Kumar, S., 2020. Impact of E-Learning Technologies in Higher Education. *Journal of Ideal Review*

Lakshminarayan, K., Westberg, S., Northuis, C., Fuller, C.C., Ikramuddin, F., Ezzeddine, M., Scherber, J. and Speedie, S., 2018. A mHealth-based care model for improving hypertension control in stroke survivors: Pilot RCT. *Contemporary clinical trials*, *70*, pp.24-34.

Lee, S.H., Nurmatov, U.B., Nwaru, B.I., Mukherjee, M., Grant, L., and Pagliari C., 2016. Effectiveness of mHealth interventions for maternal, new-born and child health in low- and middle-income countries: Systematic review and meta-analysis. *Journal of Global Health*. 2016;6(1):1–17.

Leon, N., Schneider, H. and Daviaud, E., 2012. Applying a framework for assessing the health system challenges to scaling up mHealth in South Africa. *BMC medical informatics and decision making*, *12*(1), p.123.

Lerret, S.M., 2019. Using MHealth to Improve Outcomes for Children Following Solid Organ Transplant. *Journal of pediatric nursing*, *46*, pp.134-135.

Levine, D.M., Lipsitz, S.R. and Linder, J.A., 2016. Trends in seniors' use of digital health technology in the United States, 2011-2014. *Jama*, *316*(5), pp.538-540.

Li, J., Hodgson, N., Lyons, M.M., Chen, K.C., Yu, F. and Gooneratne, N.S., 2020. A personalized behavioural intervention implementing mHealth technologies for older adults: A pilot feasibility study. *Geriatric Nursing*, *41*(3), pp.313-319.

Lund, S., Rasch, V., Hemed, M., Boas, I.M., Said, A., Said, K., Makundu, M.H. and Nielsen, B.B., 2014. Mobile phone intervention reduces perinatal mortality in Zanzibar: Secondary outcomes of a cluster randomized controlled trial. *JMIR mHealth and uHealth*, 2(1), p.15.

Macire, K., 2017. *An ICT Model for Increased Adoption of Agricultural Input Information by Cereal Farmers in Developing Countries: A Case in Sikasso,* Mali Doctoral dissertation, University of Nairobi.

Malelelo-Ndou, H., Ramathuba, D.U. and Netshisaulu, K.G., 2019. Challenges experienced by health care professionals working in resource-poor intensive care settings in the Limpopo province of South Africa. *Curationis*, 42(1), pp.1-8.

Marrie, R.A., Leung, S., Tyry, T., Cutter, G.R., Fox, R. and Salter, A., 2019. Use of eHealth and mHealth technology by persons with multiple sclerosis. *Multiple sclerosis and related disorders*, *27*, pp.13-19.

Martino, S.C., Ellickson, P.L. and McCaffrey, D.F., 2009. Multiple trajectories of peer and parental influence and their association with the development of adolescent heavy drinking. *Addictive behaviours*, 34(8), p.693.

Marziniak, M., Brichetto, G., Feys, P., Meyding-Lamade, U., Vernon, K., and Meuth, S.G., 2018. The use of digital and remote communication technologies as a tool for multiple sclerosis management: Narrative review. *JMIR Rehabil. Assist. Technology*. 5 (1), e5.

McCarrolla, R., Eylesa, H., and Mhurchua, C.N., 2017. Effectiveness of mobile health (mHealth) interventions for promoting healthy eating in adults: A systematic review. *Preventive Medicine*, 105 (2017),pp.156–168.

McKay, F.H., Wright, A., Shill, J., Stephens, H. and Uccellini, M., 2019. Using health and well-being applications for behaviour change: A systematic search and rating of applications. *JMIR mHealth and uHealth,* 7(7), p.e11926.

Mohr, D.C., Zhang, M. and Schueller, S.M., 2017. Personal sensing: understanding mental health using ubiquitous sensors and machine learning. *Annual review of clinical psychology*, 13(2017), pp.23-47.

Morgan, D. W., 1970. Determining sample size for research activities. *Educational and psychological easurement.*

Muessig, K.E., Pike, E.C., LeGrand, S. and Hightow-Weidman, L.B., 2013. Mobile phone applications for the care and prevention of HIV and other sexually transmitted diseases: a review. *Journal of medical Internet research*, *15*(1), p.e1.

Ndayizigamiye, P. and Maharaj, M., 2016. Mobile health adoption in Burundi: A UTAUT perspective. In *2016 IEEE Global Humanitarian Technology Conference (GHTC)* (pp. 613-623). IEEE.

Ndayizigamiye, P. and Maharaj, M., 2017. Determinants of Mobile Health Adoption in Burundi. *African Journal of Information Systems* 9 (3), pp.171-191.

Ndayizigamiye, P. and Maharaj, M., 2018. A Systematic review of mHealth interventions for public healthcare in East Africa. 24th Americas Conference on Information Systems, New Orleans, LA, USA, August 16-18, 2018.

Ndayizigamiye, P., 2016. *Potential adoption of mobile health technologies for public healthcare in Burundi* [Doctoral dissertation, University of KwaZulu-Natal]. UKZN ResearchSpace database.

Ndayizigamiye, P., and Maharaj, M., 2016. Applying bridges framework to investigate challenges to the adoption of mHealth in Burundi. 2016 IST-Africa Week Conference, Durban, South Africa.

Ndayizigamiye, P., Hangulu, L. and Akintola, O., 2017. A design of a mobile health intervention to enhance home-carers' disposal of medical waste in South Africa. In *2017 IEEE Global Humanitarian Technology Conference (GHTC)* (pp. 1-6). IEEE.

Ndayizigamiye, P., Kante, M. and Shingwenyana, S., 2020. An adoption model of mHealth applications that promote physical activity. *Cogent Psychology*, *7*(1), p.1764703.

Neiger, B.L., Thackeray, R., Van Wagenen, S.A., Hanson, C.L., West, J.H., Barnes, M.D. and Fagen, M.C., 2012. Use of social media in health promotion: purposes, key performance indicators, and evaluation metrics. *Health promotion practice*, *13*(2), pp.159-164.

Neuman, W. L., 2014. *Basics of social research*, Pearson/Allyn and Bacon.

Nunes, A., Limpo, T. and Castro, S.L., 2019. Acceptance of mobile health applications: examining key determinants and moderators. *Frontiers in psychology*, 10, p.2791.

O'Dea, S, Number of mobile (cellular) subscriptions worldwide from 1993 to 2019, Available at: https://www.statista.com/statistics/262950/global-mobile-subscriptions-since-1993/ [data accessed:17 January 2021]

Okumus, B., Ali, F., Bilgihan, A. and Ozturk, A.B., 2018. Psychological factors influencing customers' acceptance of smartphone diet applications when ordering food at restaurants. *International Journal of Hospitality Management*, 72 (2018), pp.67-77.

Orji, R. and Mandryk, R.L., 2014. Developing culturally relevant design guidelines for encouraging healthy eating behaviour. *International Journal of Human-Computer Studies*, *72*(2), pp.207-223.

Oyibo, K. and Vassileva, J., 2020. Persuasive Features that Drive the Adoption of a Fitness Application and the Moderating Effect of Age and Gender. *Multimodal Technologies and Interaction*, 4(2), p.17.

Pai, R.R. and Alathur, S., 2019. Determinants of individuals' intention to use mobile health: insights from India. *Transforming Government: People, Process and Policy*.

Petersen, F., Brown, A., Pather, S., & Tucker, W. D. (2019). Challenges for the adoption of ICT for diabetes self-management in South Africa. *Electronic Journal of Information Systems in Developing Countries*, 86(e12113), pp.1–14.

Pew Research Centre: Parents and teens report varying level of attachment, distraction due to their cell phones. Available at https://www.pewresearch.org/internet/2018/08/22/how-teens-and-parents-navigate-screen-time-and-device-distractions/pi_2018-08-22_teens-screentime_0-05/ [Date accessed: 07 November 2020]

Punch, K. F. (2013). Introduction to social research: Quantitative and qualitative approaches. *Sage*.

Quartz, 2018. Even teens are worried they spend more time on their phones, view 04 November 2020 >https://qz.com/1367506/pew-research-teens-worried-they-spend-too-much-time-on-phones/>

Régnier, F. and Chauvel, L., 2018. Digital inequalities in the use of self-tracking diet and fitness applications: interview study on the influence of social, economic, and cultural factors. *JMIR mHealth and uHealth*, 6(4), p.e101.

Robbins, R., Krebs, P., Jagannathan, R., Jean-Louis, G., Duncan, D.T., 2017. Health app use among US mobile phone users: analysis of trends by chronic disease status. *JMIR mHealth uHealth,* 5(12), e197.

Röcker, C., Ziefle, M. and Holzinger, A., 2014. From computer innovation to human integration: current trends and challenges for pervasive HealthTechnologies. *In Pervasive health* (pp. 1-17). Springer, London.

Rogers, E. M. 2003. *Diffusion of Innovations, 5th Edition*, Free Press.

Rosenstock, I.M., 2005. Why people use health services. *The Milbank Quarterly*, *83*(4).

Santero, M., Morelli, D., Nejamis, A., Gibbons, L., Irazola, V. and Beratarrechea, A., 2018. Using mHealth strategies in a Diabetes Management Program to improve the quality of care in Argentina: study design and baseline data. *Primary Care Diabetes*, *12*(6), pp.510-516.

Sarantakos, s. 1998. Varieties of social research. *Social research.* Springer.

Saunders, M. N. 2011. *Research methods for business students, 5/e*, Pearson Education India.

Saunders, M., Lewis, P. and Thornhill, A, 2007. *Research methods. Business Students*. 4th edition Pearson Education Limited, England.

Saunders, M.N. and Lewis, P., 2012. *Doing research in business & management: an essential guide to planning your project,* pearson.

Saunders, M.N., Lewis, P., and Thornhill, A.,2009 *Research Methods for Business Students*. Harlow: Pearson Education, pp. 122–161.

Schmitt, T.A. and Sass, D.A., 2011. Rotation criteria and hypothesis testing for exploratory factor analysis: Implications for factor pattern loadings and interfactor correlations. *Educational and Psychological Measurement,* 71**,** pp.95-113.

Schomakers, E.M., Lidynia, C. and Ziefle, M., 2018. Exploring the Acceptance of mHealth Applications-Do Acceptance Patterns Vary Depending on Context?

International Conference on Applied Human Factors and Ergonomics (pp. 53-64). Springer, Cham.

Schwaferts, D., 2015. Applying Saunderss Research Onion.

Sekaran, U. and Bougie, R. 2016. *Research methods for business: a skill building approach*, John Wiley & Sons.

Shin, S., Yeom, C.W., Shin, C., Shin, J.H., Jeong, J.H., Shin, J.U. and Lee, Y.R., 2016. Activity monitoring using a mHealth device and correlations with psychopathology in patients with chronic schizophrenia. *Psychiatry Research,* 246 (2016), pp.712-718.

Shisana O, Labadarios D, Rehle T, Simbayi L, Zuma K, Dhansay A, Reddy P, Parker W, Hoosain E, Naidoo P, Hongoro C, Mchiza Z, Steyn NP, Dwane N, Makoae M, Maluleke T, Ramlagan S, Zungu N, Evans MG, Jacobs L, Faber M, and SANHANES-1 Team (2013) South African National Health and Nutrition Examination Survey (SANHANES-1). Cape Town: HSRC Press *(PDF) South African National Health and Nutrition Examination Survey (SANHANES-1)*. Available at: https://www.researchgate.net/publication/280155019_South_African_National_Health_and_Nutrition_Examination_Survey_SANHANES-1 [Date accessed: 26 January 2020].

Soni, T.C., Ndayizigamiye, P. and Kante, M., 2019. *Determinants of the Adoption of Self-healthcare Monitoring Mobile Applications*. *Fortieth International Conference on Information Systems (ICIS)*, Munich, Germany.

South Africa. Independent Communications Authority of South Africa. (2020). The State of the ICT Sector Report in South Africa. Available at: https://www.icasa.org.za/uploads/files/State-of-the-ICT-Sector-Report-March-2020.pdf [Date accessed:26 August 2020].

South Africa. The Presidency, The National Youth Policy (2008). Available at: https://www.youthpolicy.org/national/South_Africa_2009_National_Youth_Policy.pdf [Date accessed: 18 January 2021]

Statista, 2020. Global unique mobile subscribers from 2010 to 2015. Available at: https://www.statista.com/statistics/740154/worldwide-unique-mobile-subscribers-by-region/#:~:text=In%20fact%2C%20figures%20show%20that,penetration%20rate%20to%2073%20percent [Date accessed: 06 June 2020]

Stephens, J. and Allen, J., 2013. Mobile phone interventions to increase physical activity and reduce weight: a systematic review. *The Journal of cardiovascular nursing*, *28*(4), p.320.

Steyn, K. and Damasceno, A., 2006. Lifestyle and related risk factors for chronic diseases. *Disease and mortality in Sub-Saharan Africa*, 2, pp.247-65.

Suen, L.J.W., Huang, H.M. and Lee, H.H., 2014. A comparison of convenience sampling and purposive sampling. *Hu Li Za Zhi*, *61*(3), p.105.

Swanson, J.O., Nathan, R.O., Swanson, D.L., Perez, K.M., Bresnahan, B.W., Mirza, W. and Goldenberg, R.L., 2019, August. Use of ultrasound and mHealth to improve perinatal outcomes in low- and middle-income countries. In *Seminars in perinatology* (Vol. 43, No. 5, pp.267-272). WB Saunderss.

Taherdoost, H. 2016. Sampling methods in research methodology; how to choose a sampling technique for research. *How to choose a sampling technique for research (April 10, 2016)*.

Tomlinson, M., Rotheram-Borus, M.J., Swartz, L. and Tsai, A.C., 2013. Scaling up mHealth: where is the evidence? *PLoS Med*, *10*(2), p.e1001382.

Torrey, T., 2020, Overview of disease management, Available at: https://www.verywellhealth.com/disease-management-2615164 [Date accessed: 07 August 2020].

Uhlig, K., Patel, K., Ip, S., Kitsios, G.D. and Balk, E.M., 2013. Self-measured blood pressure monitoring in the management of hypertension: a systematic review and meta-analysis. *Annals of internal medicine,* 159(3), pp.185-194.

University of KwaZulu-Natal, 2018. Institutional Intelligence Reports. Available at: https://ii.ukzn.ac.za/ [Date accessed: 06 April 2018].

Urbach, N. and Ahlemann, F., 2010. Structural equation modeling in information systems research using partial least squares. *Journal of Information technology theory and application,* 11(2)**,** pp.5-40.

Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D., 2003. User acceptance of information technology: Toward a unified view. *MIS quarterly*, pp.425-478.

Vervloet, M., van Dijk, L., Santen-Reestman, J., Van Vlijmen, B., Van Wingerden, P., Bouvy, M.L. and de Bakker, D.H., 2012. SMS reminders improve adherence to oral medication in type 2 diabetes patients who are real time electronically monitored. *International Journal of Medical Informatics*, 81(9), pp.594-604.

Wang, Y. and Wang, J., 2020. Modelling and prediction of global non-communicable diseases. *BMC Public Health*, 20(822), pp.1-13.

Wardle, J. and Steptoe, A., 2003. Socioeconomic differences in attitudes and beliefs about healthy lifestyles. *Journal of Epidemiology & Community Health*, 57(6), pp.440-443.

Watterson, J.L., Walsh, J. and Madeka, I., 2015. Using mHealth to improve usage of antenatal care, postnatal care, and immunization: a systematic review of the literature. *BioMed Research International*.

Watterson, T., Keath, A., Wells, G., Beaudet, B. and Watkins, K., 2017. Can A Mobile App Motivate Adolescents into a Healthier Lifestyle?

Wei, J., Vinnikova, A., Lu, L. and Xu, J., 2020. Understanding and Predicting the Adoption of Fitness Mobile Applications: Evidence from China. *Health Communication*, pp.1-12.

Weigel, F.K., Hazen, B.T., Cegielski, C.G. and Hall, D.J., 2014. Diffusion of innovations and the theory of planned behaviour in information systems research: A metanalysis. *CAIS*, 34(31), pp 619-636.

Weston, R. and Gore Jr, P.A., 2006. A brief guide to structural equation modelling. *The Counselling Psychologist*, 34(5), pp.719-751.

Whittaker, R., McRobbie, H., Bullen, C., Rodgers, A. and Gu, Y., 2016. Mobile phone-based interventions for smoking cessation. *Cochrane database of systematic reviews*, (4).

Wong, K.K.K., 2019. *Mastering partial least squares structural equation modelling (PLS-Sem) with Smartpls in 38 Hours*. iUniverse.

World Health Organization, 2014. *Global status report on noncommunicable diseases 2014* (No. WHO/NMH/NVI/15.1). World Health Organization.

Yee, T.S., Seong, L.C. and Chin, W.S., 2019. Patient's Intention to Use Mobile Health App. *Journal of Management Research*, *11*(3), pp.18-35.

Yi, Y.J. and Bae, B.J., 2017. An analysis of non-users of mobile healthcare applications: Based on diffusion of innovations theory. *Journal of the Korean Society for information Management*, 34(1), pp.135-154.

Young, S.C., 2015, Factors Affecting the Adoption of New Technology: the case of 311 Government Call Centers.

Yu, P., Wu, M.X., Yu, H. and Xiao, G.Q., 2006, June. The challenges for the adoption of m-health. In *2006 IEEE International Conference on Service Operations and Logistics, and Informatics* (pp. 181-186). IEEE.

Zhao, J., Freeman, B. and Li, M., 2016. Can mobile phone applications influence people's health behaviour change? An evidence reviews. *Journal of medical Internet research, 18*(11), p.e287.

Zubaydi, F., Saleh, A., Aloul, F. and Sagahyroon, A., 2015, November. Security of mobile health (mHealth) systems. In *2015 IEEE 15th International Conference on Bioinformatics and Bioengineering (BIBE)* (pp. 1-5). IEEE.

Žukauskas, P., Vveinhardt, J. and Andriukaitienė, R., 2018. Philosophy and paradigm of scientific research. Management Culture and Corporate Social Responsibility, p.121.

APPENDICES

Appendix A: CONSENT FORM

UNIVERSITY OF KWAZULU-NATAL
School of Management, IT and Governance

Research Project

Researcher: Nompumelelo Cebisile Witness Mtshali, +27 (0) 73 4664 103, 211525884@stu.ukzn.ac.za

Supervisor: Dr Patrick Ndayizigamiye, +27 (0) 33 260 6291, Ndayizip@ukzn.ac.za

Co-Supervisor: Prof Irene Govender, +27 (0) 31 260 7251, Govenderi4@ukzn.ac.za

Research Office: Humanities & Social Sciences Research Ethics Administration, Govan Mbeki Building, Westville Campus, Tel: + 27 (0)31 260 8350, Email: hssreclms@ukzn.ac.za

CONSENT

I____(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

____________________ ____________________

Signature of Participant Date

This page is to be retained by researcher

Appendix B: QUESTIONNAIRE

UNIVERSITY OF KWAZULU-NATAL
School of Management, IT and Governance

Dear Respondent,

Research Project

Researcher: Nompumelelo Cebisile Witness Mtshali, +27 (0) 73 4664 103, 211525884@stu.ukzn.ac.za
Supervisor: Dr Patrick Ndayizigamiye, +27 (0) 33 260 6291, Ndayizip@ukzn.ac.za
Co-Supervisor: Prof Irene Govender, +27 (0) 31 260 7251, Govenderi4@ukzn.ac.za
Research Office: Humanities & Social Sciences Research Ethics Administration, Govan Mbeki Building, Westville Campus, Tel: + 27 (0)31 260 8350, Email: hssreclms@ukzn.ac.za

I, Nompumelelo Cebisile Witness Mtshali, am a Master of Commerce student in the School of Management, IT and Governance at the University of KwaZulu-Natal. You are invited to participate in a research project entitled **"Potential adoption of mHealth applications to induce healthy lifestyles among UKZN (PMB) students".**

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this research project. Confidentiality and anonymity of records will be maintained by the researcher and School of Management, IT and Governance (UKZN). All collected data will be used solely for research purposes and will be destroyed after 5 years.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number: HSS/2166/018M).

Sincerely

Researcher's signature_________________________________ Date_______________

Researcher's Name : Nompumelelo Mtshali

This page is to be retained by participant

PLEASE NOTE: MOBILE HEALTH APPLICATIONS (MHEALTH) ARE DEFINED AS MOBILE APPLICATIONS THAT BE DOWNLOADED ON SMARTPHONES AND USED FOR HEALTHCARE PURPOSES. THIS STUDY FOCUSES ON THE ADOPTION OF MOBILE HEALTH APPLICATIONS THAT CAN HELP MONITOR YOUR DIET (EATING HABITS) OR PHYSICAL ACTIVITY (SUCH AS EXERCISE ROUTINES).

SECTION A: DEMOGRAPHIC INFORMATION

Please indicate your response to the question by ticking in the appropriate box.

1. Which age group do you belong to?

18 – 23	24 - 29	30 – 35

2. What is your gender?

Male	Female	Neutral

3. What degree are you registered for?

Undergraduate	Honours	Masters	PhD

4. Do you own a smartphone?

Yes	No

5. How often do you use the following applications?

5.1. Fitness applications (Runtastic, Home Workout, Pro Gym Workout and others)

Never	Rarely	Sometimes	Often	Very Often

5.2. Diet Applications (Weight loss, Military Diet, Health Diet Guide and others)

Never	Rarely	Sometimes	Often	Very Often

SECTION B: AWARENESS OF MOBILE APPLICATIONS THAT HELP INDUCE HEALTHY LIFESTYLES

6. Please indicate the extent to which you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
6.1. I have heard about mobile applications that help induce healthy lifestyles					
6.2. I have seen mobile applications that help induce healthy lifestyles.					
6.3. I have used mobile applications that help induce healthy lifestyles.					
6.4. I am currently using mobile applications that help induce healthy lifestyles.					

7. Please indicate the extent to which you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7.1. I have heard of mobile health applications that help to induce healthy lifestyles but have not used them.					
7.2. I have come across mobile health applications that help to induce healthy lifestyles on social media.					
7.3. I have seen mobile applications that help to induce healthy lifestyles in a pamphlet.					
7.4. I have seen mobile applications that help to induce healthy lifestyles working on my peers' phone					

8. Where have you heard about mobile health applications?

8.1. Social media (e.g. Facebook, Twitter, WhatsApp) ☐
8.2. Healthcare providers (e.g. Clinic nurse, Doctors) ☐
8.3. Educational institutions (e.g. School, College) ☐
8.4. Traditional media (e.g. Newspapers, Radio, TV) ☐
8.5. Word of mouth ☐
8.6. Other ☐

Please Specify ……………………………………………

SECTION C: DETERMINANTS OF MOBILE APPLICATIONS THAT HELP INDUCE HEALTHY LIFESTYLE

9. **Performance Expectancy**.

Please indicate the extent to which you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Diet Related Applications					
9.1. Mobile health applications could help me adopt a much healthier diet.					
9.2. Mobile health applications could help me monitor my eating habits.					
9.3. Using mobile health applications to monitor my diet could save me time.					
Physical exercise related Applications					
9.4. Mobile health applications could help me improve how I exercise.					
9.5. Mobile health applications could help me monitor my physical activity.					
9.6. Using health mobile applications to monitor my physical exercise could save me time.					

10. **Effort Expectancy**

Please indicate the extent to which you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Diet Related Applications					
10.1. Learning how to use mobile health applications to monitor my diet will be easy.					
10.2. Using mobile health applications to monitor my eating habits will be easy.					
10.3. It will be easy for me to become skilful at using mobile health applications to monitor my diet.					
10.4. I will find it easy to understand how mobile health applications can be used to monitor my diet.					
Physical Activity Applications					
10.5. Learning how to use mobile health applications to monitor my physical activity will be easy.					
10.6. Using mobile health applications to monitor my physical activity will be easy.					
10.7. It will be easy for me to become skilful at using mobile health applications that help me monitor my physical exercises.					
10.8. I will find it easy to understand how mobile health applications can be used to monitor my physical exercises.					

11. **Social Influence**

Please indicate the extent to which you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Diet Related Applications					
11.1. People who are important to me will recommend me to use mobile health applications to monitor my eating habits.					
11.2. My peers will encourage me to use mobile health applications to monitor my diet.					
11.3. My role model (s) will recommend me to use mobile health applications to monitor my diet.					
Physical Activity Applications					
11.4. People who are important to me will recommend me to use mobile health applications to monitor my physical activity.					
11.5. My peers will encourage me to use mobile health applications to monitor my physical activity.					

11.6. My role model (s) will recommend that I use mobile health applications to monitor my physical activity.					

12. Facilitating Conditions

Please indicate the extent to which you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Diet Related Applications					
12.1. I have technical skills required to use mobile health applications to monitor my diet.					
12.2. I have enough knowledge on how mobile health applications can be used to monitor my diet.					
12.3. I have access to a mobile device on which I can download a mobile health					
application that can help me monitor my diet.					
12.4. I have access to people who can assist me anytime I encounter difficulties using mobile health applications that can help me monitor my diet.					
Physical Activity Applications					
12.5. I have technical skills required to use mobile health applications to monitor my physical activity.					
12.6. I have enough knowledge on how mobile health applications can be used to monitor my physical activity.					
12.7. I have access to a mobile device on which I can download a mobile health application that can help me monitor my physical activity.					
12.8. I have access to people who can assist me anytime I encounter difficulties while using mobile health applications to monitor my physical activity.					

SECTION D: INTENTION TO ADOPT MOBILE APPLICATIONS THAT HELP INDUCE HEALTHY LIFESTLYES

13. Behavioural Intention

Please indicate the extent to which you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Diet Related Applications					

13.1. I intend to use mobile health applications to monitor my diet.					
13.2. I intend to use mobile health applications to help me monitor my diet if recommended					
13.3. I intend to use mobile health applications to improve my eating habits.					
Physical activity Applications					
13.4. I intend to use mobile health applications to monitor my physical activity.					
13.5. I intend to use mobile health applications to help me improve my physical activity if recommended.					
13.6. I intend to use mobile health applications to improve my physical activity.					

14. Use Behaviour

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Diet Related Applications					
14.1. I use mobile applications to monitor my diet.					
Physical activity Applications					
14.2. I use mobile applications to monitor my physical activity.					

THANK YOU FOR YOUR PARTCIPATION...

Appendix C: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

18 January 2019

Miss Nompumelelo Cebisile Witness Mtshali 211525884
School of Management, IT and Governance
Pietermaritzburg Campus

Dear Miss Mtshali,

Protocol reference number: HSS/2166/018M
Project title: Potential adoption of mHealth applications to induce healthy lifestyles among UKZN (PMB) students

Full Approval – Expedited Application
In response to your application received 30 November 2018, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]

Dr Shamila Naidoo (Deputy Chair)

/ms

cc Supervisor: Dr Patrick Ndayizigamiye and Professor Irene Govender
cc Academic Leader Research: Professor Isabel Martins
cc School Administrator: Ms Debbie Cunynghame

Humanities & Social Sciences Research Ethics Committee
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