LONG PAPER

The role of culture in the adoption of mobile applications for the self-management of diabetes in low resourced urban communities

Mariam Jacobs-Basadien[1] · **Shaun Pather**[1] · **Fazlyn Petersen**[1]

Abstract

Diabetes mellitus has been documented as a global health problem with a high mortality rate. In the current digital age, the use of technology to overcome such health problems in pursuance of Sustainable Development Goal 3 is widely recognised. The increased penetration of mobile devices provides one avenue to support the self-management of conditions such as diabetes. As a first step towards this, individuals have to first accept and use the technology. However, the literature indicates low levels of technology use amongst diabetic patients with low socio-economic indicators. We posit that the culture of patients is a contributory factor for the low acceptance and use of technology. This study assessed how culture influences mobile health (m-health) acceptance among diabetic patients from low-resourced urban communities through semi-structured interviews. The theoretical model that was used as a lens for the investigation comprised a juxtaposition of Hofstede's cultural dimensions and the Unified-Theory of Acceptance and Use of Technology 2 (UTAUT2). The analysis of the resultant qualitative data indicates that culture does influence the adoption of m-health applications among the research population. The study determined that cultural dimensions in respect of masculinity-femininity have a negative influence while indulgence has a positive influence on mobile application adoption. The findings also indicated that uncertainty avoidance has both a positive and negative influence on m-health application adoption.

Keywords Technology acceptance · Mobile health (m-health) · Diabetes self-management · Culture · Hofstede's cultural dimension · Technology adoption · SDGs

1 Introduction

In 2004 and 2005, the United Nationals convened the first two World Summits on the Information Society. This was an important milestone in which all member countries affirmed the importance of Information and Communication Technologies (ICTs) on the lives of individuals especially the marginalised and vulnerable groups of society. Following on this, there has been much anticipation globally that the effective application of ICTs could alleviate social and economic ills, including those identified in the Millennium Development Goals (MDGs) and the current Sustainable Development Goals (SDGs).

The 2030 SDGs comprises 17 SDGs and 169 targets. The focus on health is evident in the seventeen 2030 SDGs. The third SDG focuses on ensuring and promoting a healthy lifestyle and wellbeing for people of all ages. The treatment for Non-Communicable Diseases (NCD), such as diabetes, has received specific focus due to the burden it places on health systems [1]. It is widely accepted that ICT must be leveraged to attain the SDGs, as ICT can help accelerate progress towards every single one of the 17 United Nations (UN) SDGs [2]. This suggests that ICT is an enabler to achieve the SDGs and that ICT, such as mobile technologies, should be used to accelerate diabetes self-management.

Diabetes mellitus (DM), an international pandemic, is a health problem in the twenty–first century [3]. Diabetes is a chronic disease with a high-level mortality rate.

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Worldwide 493 million people are living with diabetes, of which 19 million reside in Africa [4]. In South Africa, there are estimated to be 4.6 million cases of diabetes [4]. People living with diabetes come from both middle and low-income nations [5]. Statistics show that in 2017, 10.4% of the population of the Western Cape (WC) province have succumbed to diabetes [6]. The growing prevalence of diabetes in low-middle income countries (LMIC) is believed to be associated with many factors, including cultural and social changes [7]. Therefore, it is important that diabetic patients self-manage their diabetes.

Self-management is an essential part of diabetes management, and includes tasks such as healthy eating, exercise and taking prescribed medication regularly [8]. Essentially, poor self-management can result in poor quality of life and consequently has a significant effect on mortality [9]. Mobile applications have been found to be an ideal platform for delivering effective and efficient interventions such as disease self-management [10] on condition that individual users accept and use the technology [11]. However, in general, there is a trend of low uptake and use of ICTs among vulnerable and marginalised people. In the instance of diabetes specifically, low levels of technology use amongst diabetic patients from communities with poor socio-economic characteristics has been found [12]. This study [12] further established that behavioural intention to use ICTs did not translate into the actual usage of ICT, as almost 70% of the sample population did not use forms of ICT, including mobile health (m-health) applications. This is consistent with recent research that has found that uptake and continued subsequent use of diabetes self-management applications is low [13, 14].

Although m-health applications are freely available and more people have access to the internet, the observed low usage trends warrant investigation. The low conversion of intention to use ICT into actual use suggests that other factors may be the reason for low acceptance and use of m-health applications. One area of influence relates to culture. For example, individuals from all parts of the world communicate in different languages, practice diverse religious obligations, have a variety of eating habits and implement a range of social customs. Such a range of cultural parameters has been found to be factors that influence technology uptake and adoption [15]. Since culture manifests differently in different parts of the world, it is context-specific and cannot be understood in isolation. Therefore, the role of culture cannot be overlooked if the technology is to be adopted successfully in a community [16]. The influence of culture is important, especially amongst people with diverse ethnic and racial backgrounds, who maintain unique health behaviours which may vary from the cultural norms of the overall population [17].

Over the years, there has been extensive research pertaining to the link between cultural factors and the uptake of technology [18–21]. These studies illustrate that cultural factors and backgrounds play an imperative role in influencing the uptake and use of technology [16]. It has also been determined that culture is unique to geography and this also accounts for adoption trends [22]. However, cultural values on technology acceptance have been widely studied from a national perspective with limited studies focusing on the individual level [23].

In light of the foregoing problem this paper reports on an investing

ation into m-health adoption in which the effect of culture on individuals from communities that are relatively poor (or economically marginalised), is explored. The primary question that was investigated is *How does culture influence m-health acceptance of diabetic patients in historically disadvantaged communities*? This research, focuses on South Africa, specifically in the Western Cape province given that it has a high incidence of diabetes [6, 24].

The remainder of the paper is organised as follows. Section 2 provides reviews the extant literature on m-health applications, culture, and technology adoption in relation to diabetes self-management. Section 3 illustrates the research model underpinning the study, Sect. 4 then presents the methodology employed to answer the research question. Section 5 provides the research findings and discussion, and Sect. 6 discusses the lessons learnt and concludes the study.

2 Literature review

This section considers previous research related to mobile health (m-health) and diabetes self-management, models for technology adoption, the concept of culture and how it might relate to the self-management of disease such as diabetes.

2.1 The role of m-health in diabetes self-management

The role of technology to support diabetes management has been written about for some time. For example, Donsa et al. [25] indicated that due to improved patient education, therapy personalisation has increased. Yet, the existing challenge is that personalisation of diabetes therapy differs amongst patients as the success of diabetes therapy relies on factors such as health status, physical activity and nutrition intake. However, an amalgamation of these factors causes personalised therapy initialisation and optimisation to become a convoluted task. Therefore, to improve therapy adherence of diabetic patients, mobile applications are available [25].

With the increase in mobile phone penetration, m-health has emerged as a significant aspect of electronic

health (e-health) [26, 27] and has received lots of attention in the healthcare literature in recent years [28]. M-health has been developed to improve care by making health information and practices easily accessible through mobile communication technologies (e.g., tablets and smartphones), for patients with long term conditions such as diabetes [29, 30]. The focus on m-health is thriving due to the increasing number of mobile broadband subscriptions increasing in developing countries [31], making mobile applications affordable to all strata of society irrespective of their social or economic group. The emergence of m-health applications has shown great potential for diabetes self-management [32] as it allows patients to record their physical activity and caloric intake [33]. To effectively self-manage diabetes, patients are required to make lifestyle adjustments to reduce long-term complications that come with diabetes [34].

The literature indicates that diabetes self-care can be improved with mobile phone applications as it offers many opportunities to prevent disease complications [35] thereby improving patients' quality of life [36]. Diabetes applications support patients in improving their knowledge regarding their condition and include awareness of diabetes complications and competencies for their self-management. Kebede and Pischke [37] indicate that diabetes applications have the potential to improve diabetes self-management and overall develop healthier patient lifestyles. These findings are consistent with the finding from [38]. These authors have found that m-health applications improve diabetes self-care behaviour. A more recent study by [39] has found that self-care activities improved with smartphone-based self-management interventions. Although m-health applications improve self-care activities, uptake and continued usage is low.

2.2 User acceptance models

Technology adoption models have been developed to determine how users understand, accept and use technology [40]. The four prominent models are discussed with the inclusion of UTAUT2 and depicted in Fig. 1.

The Theory of Reasoned Action (TRA) developed by [41] is drawn from social psychology and gives insight into varied human behaviours. This model suggests that before people make any decision, they should consider the implications of their actions [42]. The two crucial constructs of the TRA are the individuals' *attitude toward behaviour* which is defined as "the individual's positive or negative evaluation of performing the behaviour of interest" [40] and *subjective norms*, "the person's perception of the social pressures put on him to perform or not perform the behaviour in question" [43].

The Technology Acceptance Model (TAM) [44] adapted from the TRA has been primarily developed to establish the users' behavioural intention towards the acceptance of new technology [44] and it includes two constructs, perceived usefulness and perceived ease of use. *Perceived usefulness* is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" [44]. *Perceived ease of use* is defined as "the degree to which a person believes that using a particular system would be free of effort" [45]. Research indicates that if a technology is perceived as difficult to use, potential users tend to dislike using it even if they believe that the technology is useful [46]. One the other hand, the more the technology is perceived as useful and easy to use, the more it will have a positive effect on acceptance by users [47]. This model has been widely used to study technology adoption in the healthcare sector [48–50]. Other studies have examined culture and its role in technology adoption. For example,

Fig. 1 The evolvement of models to study user acceptance
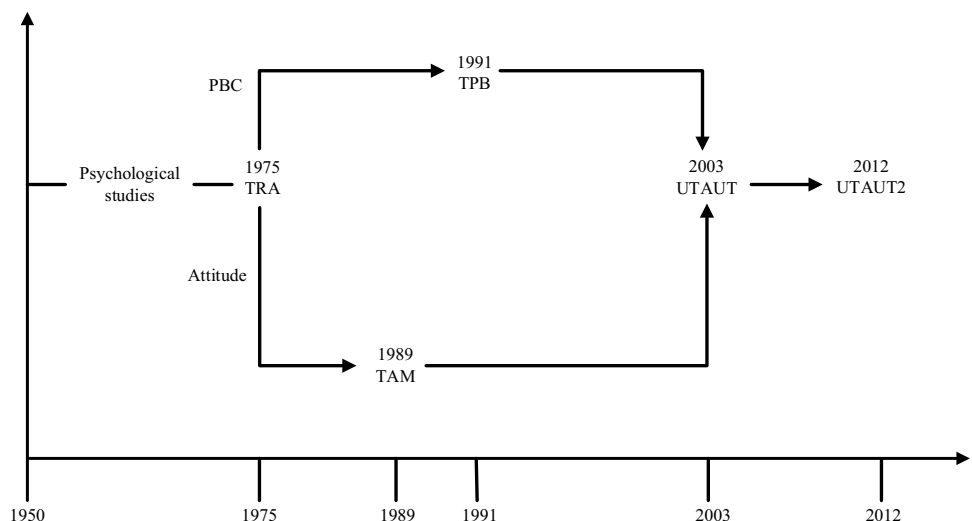
[51] found that Hofstede's power distance, masculinity has a significant impact on intention to use electronic health (e-health) whereas uncertainty avoidance, collectivism has a significant impact on intention to use. Culture has also featured in studies that have investigated technology adoption in other areas as well. In a study of electronic commerce, [21] found that that long-term orientation, masculinity, and collectivism have a significant impact on behavioural intention.

The Theory of Planned Behaviour (TPB) expanded the TRA by including a third component, perceived behavioural control (PBC) as a construct to predict behaviour. PBC is defined as "perceived ease or difficulty of performing the behaviour" [52]. The TPB has been used to predict self-care behaviours in people who are at risk of diabetes and those who have been diagnosed with type 2 diabetes [53, 54]. Furthermore, it has been used to acquire an improved understanding of the perceptions underlying the adoption of health-related behaviours [55]. In relation to culture, research shows supporting evidence for the impact of culture on the relationship between the constructs of TPB and physical activity intention [56].

The Unified Theory of Acceptance and Use of Technology (UTAUT) model has been developed based on TAM. The UTAUT model includes four core constructs, defined by [40] below:

- *Performance expectancy* (PE): "is the degree to which an individual believes that using the system will help him or her to attain gains in job performance";
- *Effort expectancy* (EE): "is the degree of ease associated with the use of the system";
- *Social influence* (SI): "is the degree to which an individual perceives that important others believe he or she should use the new system";
- *Facilitating conditions* (FC): "is the degree to which an individual believes that an organisational and technical infrastructure exists to support the use of the system".

The UTAUT has been used in various studies on mobile phones and health adoption [22, 57–59]. Other studies have examined culture and technology adoption. For example, Lai, Wang and Hu [60] found that Individualism-collectivism is found to be one the most explored cultural dimensions in technology adoption. Zhang, Weng and Zhu [61] found that PE and EE are crucial in high individualism countries, SI is important in high power distance countries and PE is crucial in high uncertainty avoidance cultures.

The UTAUT2 model is an extension of the UTAUT model for understanding consumer acceptance of new technology better and it is centred on the individuals' perspectives of technology adoption [62]. This model includes three additional moderators, namely hedonic motivation, price value and habit, which are defined by [62] as follows:

- *Hedonic Motivation* (HM): "the fun or pleasure derived from using a technology";
- *Price Value* (PV): "consumers' cognitive trade-offs between the perceived benefits of the applications and monetary costs for using them";
- *Habit* (HT): "the extent to which people tend to perform behaviours automatically because of learning".

Dwivedi et al. [22] have assessed the behavioural intention for m-health adoption behaviour. They have found that the four key constructs of the UTAUT, as well as PV and HM, are significant factors influencing behavioural intention leading to m-health adoption behaviour. Pancar and Yildirim [27] investigated the factors affecting consumers adoption of wearable devices in m-health. They have found that PE and habit are strong determinants of wearable device acceptance in the health field. Other studies have examined culture and its role in technology adoption. Baptista and Oliveira [63] have investigated the factors that affect the acceptance of mobile banking and how culture influences individual use behaviours. The results indicate that EE, SI, FC and PV did not have a significant influence on behavioural. In terms of culture, power distance, collectivism, uncertainty avoidance, and short-term orientation have been found to be the most significant cultural moderators for behavioural intention [63]. A study on the relationship between culture and new technology adoption found that low power distance and low levels of uncertainty avoidance but a high individualist culture, tend to adopt and accept new technology quickly [64]. Lan et al. [65] investigated the factors that influence the intention to adoption m-health applications and found that power distance, uncertainty avoidance, masculinity-femininity and individualism-collectivism are insignificant associated with intention to use m-health applications.

In addition to the various constructs identified in the models described in the preceding paragraphs, prior research has also identified that previous exposure to technology (PET) has an effect on technology acceptance. Holzinger, Searle and Wernbacher [66] found that the enjoyment individuals experience with technology is positively related to PET. Venkatesh, Thong and Xu [62] found that having previous experience with technology is crucial in evaluating technology acceptance. Nunes, Limpo and Castro [67] found that age, gender, smartphone experience and ICT acceptance determinants explained 69% of the variance in behavioural intention to use m-health applications.

This section has described several models for user acceptance in the context of m-health and culture. The literature provides evidence that technology adoption models can be applied in studies of culture. The constructs in the UTAUT model as well as, price value, and hedonic motivation are found to have a significant impact on mobile application adoption. In terms of culture, individualism-collectivism,

uncertainty avoidance and power distance were found to be the dimensions the most explored in technology adoption. In addition, previous research has found that uncertainty avoidance has an impact on individuals' intention to use technology and that persons who subscribe to individualistic cultures accept technology quicker.

2.3 Culture and diabetes self-management

The literature shows that even though many diabetes self-management applications exist, only a few patients use them [68]. Low usage could be due to demographic characteristics such as age, ethnicity or geographical location, and socio-cultural factors appear to influence access to, uptake of and satisfaction with any m-health application [69]. To integrate m-health applications successfully in the healthcare system, culture needs to be considered especially for individuals in low-income regions and racial or ethnic minorities [70] as it may differ from one context to another.

Researchers have investigated culture and the role of cultural differences in the adoption and acceptance of information technology [51]. The notion of culture is imperative to grasp when discussing the influence, it has on people's daily lives. Culture comprises of many definitions and in this study, we define culture based on the definition of [71], as "the collective programming of the mind which distinguishes the members of one human group from another" [71]. Culture is specific to a particular context and should not be viewed in isolation. Culture in different environments has a local context. Societies consist of different racial and ethnic groups, and each forming a separate community with its own culture and traditions [72]. In addition, people from diverse racial or ethnic groups may share comparable cultural values due to living similar lifestyles [73]. This is especially evident when comparing South Africa and New Zealand's cultural values [73].

Hofstede [71] developed an index model and presented four cultural values of culture: power distance, individualism versus collectivism, masculinity versus femininity, and uncertainty avoidance. Hofstede then included long-term versus short-term orientation as a fifth dimension [74] and later included indulgence versus restraint as a sixth dimension [75]. Table 1 presents the dimensions of culture defined by Hofstede [75] and the definitions associated with it. The table further explores the potential implications of culture on diabetes self-management activities as well as how South Africa scores on Hofstede's cultural dimensions. The latter is derived from Hofstede's insights [73] in which he compares countries to the different cultural values.

Table 1 above illustrates the potential implications of culture on using m-health for diabetes self-management. The application of Hofstede's cultural dimensions was conducted to understand how diabetic patients will react to m-health

applications in different cultural dimensions. The assessment of Hofstede's cultural dimensions indicates that, in relation to the study, these dimensions may be a relevant to study culture in this context. The application of the dimensions will provide a basis to conduct the empirical study and answer the research question "How does culture influence m-health acceptance of diabetic patients in historically disadvantaged communities".

3 Research framework

Figure 2 presents a juxtapositioning of the UTAUT2 against Hofstede's cultural dimensions. The two theoretical models were applied in the investigation into whether cultural factors affect the acceptance and use of m-health for diabetes self-management. Firstly, the UTAUT2 was used as a model to obtain insight into participants' acceptance and usage of m-health to self- manage their condition. Secondly, Hofstede's cultural dimensions were used to understand whether diabetic patients' culture influences their self-care behaviours and whether their culture influences their m-health acceptance and usage for their self-management.

Following on the above, Table 2 was derived as a framework for the empirical work. Nine constructs are derived from Fig. 2. Each construct was then defined, by drawing on the relationship between UTAUT2 and Hofstede's cultural dimensions. Each definition is then cast according to the context of the research problem in relation to m-health applications for diabetes self-management. Lastly, in the third column, a list of prior research which lends support to the combined construct, as reflected in the first column, is indicated.

The table above presents the relationships between the UTAUT2 and Hofstede's cultural dimensions. In addition, it demonstrates how the different relationship can have an influence on diabetic patients' ability to use m-health applications for diabetes self-care activities.

4 Methodology

4.1 Research design

This research followed the principles of case study design [85]. One of the underlying objectives of the selected strategy was to uncover an in-depth insider perspective on culture from diabetic patients in a community instead of a broad survey of diabetic patients from several communities.

The Western Cape Province in which this study was conducted has the third-highest prevalence of diabetes [24]. Research has shown this population to be most at risk of developing diabetes as the incidence of diabetes was forecast

Table 1 Mapping Hofstede's cultural dimensions [75] to diabetes self-management activities

Dimension	Hofstede's definitions of culture	Potential implication of culture on diabetes self-management activities of patients. If a patient…	South African values [73]
Power distance (PD)	"the extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally."	…subscribes to a power distance culture s/he may only trust their doctors or prefer visiting a doctor. The patient would possibly prefer professional assistance and advice from a health care professional rather than using an m- health application	Moderate Power distance
Individualism - collectivism (IDV)	Individualism "refers to societies in which the ties between individuals are loose: everyone is expected to look after him or herself and his or her immediate family." "Collectivism as its opposite pertains to societies in which people from birth onward are integrated into strong, cohesive in-groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty."	…forms part of an individualistic society, s/he will make their own informed decision as to how to manage their condition …forms part of collectivistic cultures s/he will make health-related decisions based on the values and beliefs of their society	High Individualism
Masculinity- Femininity (MAS)	Masculinity refers to a "society in which emotional gender roles are clearly distinct." Femininity is seen as a "society in which emotional gender roles overlap: both men and women are supposed to be modest, tender, and concerned with the quality of life."	…subscribes to a masculine society, s/he may not self-manage their condition effectively as working is a means of survival and success …subscribes to a femininity culture, s/he will be viewed as nurturers who care for others. These patients will make informed health decisions to assist others in leading healthier lifestyles. This suggests that s/he cannot manage their condition as s/he must see to the needs of the others	High Masculinity
Uncertainty Avoidance (UA)	"the extent to which the members of a culture feel threatened by ambiguous or unknown situations."	…subscribes to an uncertainty avoidance society, s/he may find it difficult to self-manage their diabetes due to factors such as crime and the fear of making an error which could result in someone obtaining their personal information	Moderate Uncertainty avoidance
Long-term orientation- short term orientation (LTO)	Long-term orientation: "the fostering of virtues oriented toward future rewards—in particular, perseverance and thrift." Short-term orientation: "the fostering of virtues related to the past and present—in particular, respect for tradition, preservation of face, and fulfilling social obligations."	…subscribes to a long- term orientation culture, s/he will plan their diabetes self-care activities to ensure enough finances are available to maintain their condition …subscribes to a short- term orientation culture, s/he will follow the traditions of their society in terms of managing their condition	Low Long-term orientation
Indulgence-restraint (IR)	Indulgence refers to a "society that allows relatively free gratification of basic and natural human desires related to enjoying life and having fun." Restraint refers to a "society that suppresses gratification of needs and regulates it by means of strict social norms."	…subscribes to an indulgence society, s/he will make health-related decisions that are satisfactory to them to ensure that they are happy …subscribes to a restraint culture, s/he will not take the initiative to make their own health-related decision as rules are essential in following a diabetes self- management regime	High Indulgence

Fig. 2 Research model
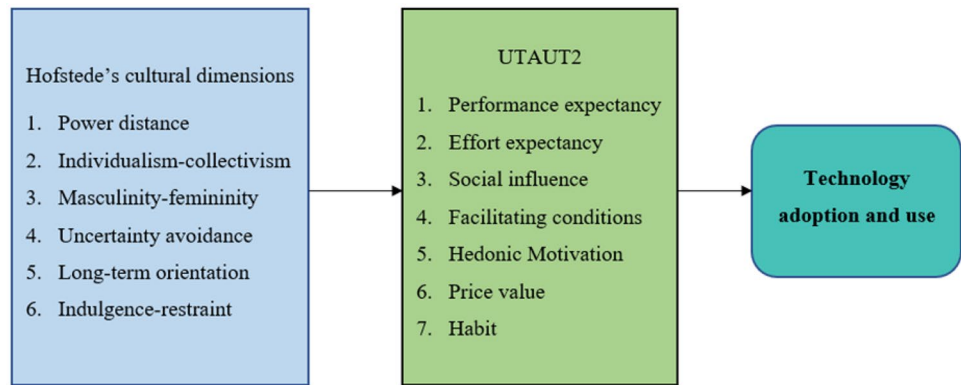
to be 7.2% in the Western Cape [86]. In selecting the Western Cape, we examined the rate of diabetes incidences all over the country and whilst the Western Cape was selected for the reason just mentioned, it simply serves as a region that exhibits the phenomenon of diabetes. The South Africa Demographic Health Survey 2016 shows that the incidences of diabetes in Cape Town in 2016/17 was 1.2 (per 1000) cases [87].

Research shows that historically disadvantaged communities show low technology adoption. The study selected a single community which exhibit a high prevalence of diabetes and characteristics of being socially and economically disadvantaged. Mitchells Plain (MP) was selected as the area of study as it has a high incident of diabetes. The chronic disease audit of Mitchells Plain Community Health Centre recorded that 60% of the sample had Hemoglobin A1C over 7% despite a majority of the sample (70%) being educated concerning diet and exercise [88]. Research shows that in the 'Coloured' population, approximately 28.2% of individuals over the age of forty have diabetes or are at risk of developing diabetes [89].

4.2 Instrument design

The interview guide was compiled based on two theoretical frameworks. The investigation comprised a juxtaposition of (1) Hofstede's cultural dimensions [71, 75] and (2) the UTAUT2 [40, 62]. The constructs of culture and technology acceptance and use were validated in prior research and adapted in this study to answer the research question.

4.3 Population and sampling

The research population was made up of type 2 diabetic patients from Mitchells' Plain, Cape Town and included both males and females of all ages. Purposive sampling was used to collect data as the research focused on a specific type of population, this being diabetic patients in the Mitchells' Plain community.

4.4 Data collection

Twenty semi-structured telephonic interviews were undertaken with diabetic patients in Mitchells Plain. The researchers contacted the diabetes support group to find suitable respondents. In addition, the researcher posted a message on social media platforms such as Facebook, WhatsApp, Instagram and LinkedIn to invite people to participate in this study. Once participants replied to the invitation, the researcher decided participant was eligible. Once all participants understood, and had agreed to take part, appointments for interviews were setup telephonically.

4.5 Data analysis

The study followed the prescripts of thematic content analysis as outlined by [90]. Atlas.ti, a qualitative data analysis program was used to facilitate the analysis.

The steps used to analyse the data were applied as follows:

- Each interview was transcribed and uploaded to Atlas Ti;
- Each transcription was analysed by identifying common themes across the transcripts;
- The additional ad hoc probing questions were analysed and placed into common themes;
- After the themes had been identified, codes were assigned to the themes according to the two theoretical frameworks, Hofstede's cultural model and UTAUT2;
- Once codes have been assigned, categories have been developed;
- After patterns have been recognised, relationships were identified between Hofstede's cultural dimensions and the UTAUT2. The empirical findings were then linked and compared with the theories presented in the literature review.

Table 2 The relationship between UTAUT2 and Hofstede's cultural dimensions

Constructs	Definitions in relation to this study	Research supporting the relationship between constructs
Performance expectance and Masculinity- Femininity	The way in which gender roles or gender stereotypes influence a diabetic patient's expectation of how an application will lead to his/her ability to make improvements in relation to self-care behaviour activities	[21] [61] [20] [76]
Effort expectancy and Masculinity- Femininity	The way in which gender roles or gender stereotypes have an influence on a diabetic patient's expectation of how easy or difficult it would be to use an application for diabetes self-care behaviour activities	[21] [20]
Effort expectancy and Uncertainty avoidance	The way in which the patients' perceptions of ease or difficulty in using an application influence their decision to adopt/use an application in support of self-care activities	[77] [76] [78]
Social influence and Power distance	When diabetic patients believe that people in high positions and power, e.g., healthcare professionals believe that they should use an application for self-care behaviour activities	[79] [61] [76]
Social influence and Individualism- Collectivism	The way in which a diabetic patient makes his/her own decision and those important others do not have an influence on a diabetic patients' decision of whether to use an application for self-care behaviour activities. The way in which a diabetic patient makes his/her decisions based on their society, e.g., family and their important people have an influence on whether he/she should use an application for self-care behaviour activities	[77] [80] [76] [81]
Facilitating conditions and Uncertainty avoidance	The way in which support exists to reduce uncertainty around the use of an application for diabetes self-care behaviour activities	[82] [80] [81]
Hedonic motivation and Individualism-collectivism	The way in which the pleasure from using an application has an influence on a diabetic patient's willingness to use	[60] [83]
Price value and Long-Term Orientation-Short- Term Orientation	The way in which the perceived benefit and the cost of using an application have an influence on diabetic patients' willingness to persevere and save. The way in which the perceived benefit and the cost of using an application has an influence on diabetic patients' traditions and values	[80] [83]
Habit and Indulgence- Restraint	When people make the decision automatically because of learning, and that decision is one that satisfies them. It refers to the way in which the choices taken by diabetic patients have an influence on self-care activities. The way in which societal rules have an influence on whether diabetic patients use an application for self-care behaviour activities	[84]

4.6 Ethical considerations

Ethical approval was received from the University of the Western Cape Biomedical Ethics Committee before the commencement of the data collection. Once ethical approval was received, participants received an information sheet along with a letter of consent requesting their involvement in the study. Participants were informed that this is a voluntary process and may refuse to answer any question. The confidentiality of the participants was maintained as no clinical information, such as blood glucose readings or personal information such as residential addresses or place of employment were requested. There was low risk in the participation of the study as the interviewer did not ask sensitive questions but instead focused on respondents' daily routines and their attitudes towards managing such routines with the assistance of a mobile application. The researcher only probed respondents based on their diabetes self-management and whether

they would use an m-health application to improve the management of their condition.

5 Research findings

In this section, the demographics of participants are presented, after which the resultant qualitative analysis output is discussed.

5.1 Demographics of participants

Demographic data (Table 3) show that the majority of the respondents that participated in this study are females (70%). In terms of age, the majority of the respondents (55%) were aged between 50 and 65 years old, with 25% of the respondents being between 26 and 35 years old, 15% of the respondents being between 26–35 years old, and the minority (5%) being between 18 and 25 years old. This indicates that many of the participants are digital immigrants who were born prior to 1985 and thus would find using a mobile application difficult to use.

A majority of the population's highest educational level is grade 12 (Matric) (25%), grade 10 (25%) and a diploma (25%), with a minority of the sample (5%) having grade 8, 9, 11, degree and honours as their highest educational level. This indicates that many respondents have not completed their education. Despite the low educational level, the findings show that 55% of participants are employed, while 45% of participants are unemployed, which is not unexpected given the level of education of this population. 50% of participants reported having medical aid, whereas the remainder of the population do not have medical aid as a result of high unemployment and affordability.

Table 3 Demographics of participants

	Frequency		Percent
Gender	Female	14	70%
	Male	6	30%
	Total	**20**	**100%**
Age	18–25 years old	1	5%
	26–35 years old	3	15%
	36–49 years old	5	25%
	50–65 years old	11	55%
	Total	**20**	**100%**
Race	Coloured	18	90%
	Indian	2	10%
	Total	**20**	**100%**
Level of education	High school	13	65%
	Post-school	7	35%
	Total	**20**	**100%**
Marital status	Married	14	70%
	Divorced	5	25%
	Widowed	1	5%
	Total	**20**	**100%**
Employment status	Employed	11	55%
	Unemployed	9	45%
	Total	**20**	**100%**
Language	English	15	75%
	Afrikaans	5	25%
	Total	**20**	**100%**
Medical aid	Yes	10	50%
	No	10	50%
	Total	**20**	**100%**
Area	Mitchells Plain	20	100%
Type of diabetes	Type 2- insulin resistant, using oral diabetes medication, e.g., metformin	12	60%
	Type 2- using oral diabetes medication and insulin	8	40%
	Total	**20**	**100%**

5.2 Findings

The outcomes of the qualitative analysis are presented in Table 4, against the *Themes* conceptualised from the literature. In the table, the third column reflects the core *Concepts* derived from the data following the process of thematic analysis. These were in turn synthesised into a higher order, as reflected in the *Category* column.

Each of the themes, and their associated categories, are expounded upon in the following sub-sections.

5.2.1 The role of masculinity-femininity practices on users' expectations of Performance of m-health applications

This finding explores the way in which gender roles or gender stereotypes influence a diabetic patient's expectation of how an application will lead to his/her ability to make improvements in relation to self-care behaviour activities.

The first of the two categories in this theme, relates to Breadwinner Obligations. It, therefore, has a strong alignment with the notion of masculinity. The data indicate that it has a negative influence on users' ability to adopt and use m-health. A few reasons have been uncovered in this regard. Everything that is outside of breadwinner obligations is less of a priority for them as a result of work being their main priority. In this population, diabetic patients must work to survive which indicates that anything that is outside of breadwinner obligations is simply not a priority and more of a time-consuming task. The following interview excerpts demonstrate how being a breadwinner in a working-class home creates a strain to focus on anything else, including ICTs:

> "I am working all the time so when I get home sometimes, I am too tired to even self-manage my diabetes"(51-year-old female) *and.*
> "It will take a lot of time and I think work is also a concern, it will definitely be something that will influence my work as well"(43-year-old male).

Even though participants had similar views regarding work influences and time management, having a negative impact on the adoption and use of mobile applications, they continued to have a positive view. This is reinforced by [61]

Table 4 Summary of research findings in relation to UTAUT2 and Hofstede's cultural dimensions

Themes	Categories	Concepts derived from the qualitative analysis
Performance expectancy in relation to Masculinity-Femininity	1. Breadwinner Obligations 2. Caregiver Obligations	Work influences Time management Caregiver Influence Application expectations
Effort expectancy in relation to uncertainty avoidance	1 Technological impediments 2 Technological convenience	Technology anxiety Distrust in application Find alternative application Compatibility of cell phone
Social influence in relation to power distance	1. Medical practitioner influence 2. Opinions towards medical practitioners	Preferring doctor Doctors provide advice Disagreement with doctors Comfortable with doctor
Social influence in relation to individualism-collectivism	1. Individual responsibility 2. Social Cohesion	Accountable for self-management Negative Attitude Social support Support group
Facilitating conditions in relation to uncertainty avoidance	1. Pre-disposing factors of avoidance 2. Social advocacy	Fear of crime Lack of skills Awareness of application Application assistance
Price value in relation to long-term orientation-Short- term orientation	1. Monetary mindset 2. Traditional mindset	Saving- low priority Thrift Willing to persevere Tradition Pricing of application
Habit in relation to indulgence	1. Personal regulation	Choices Manage diabetes with application
Hedonic motivation and individualism	1. Perceived enjoyment 2. Negative drivers of application use	Application is fun Application is enjoyable Age Application is challenging

who found that in masculine cultures, the adoption of new technology would be high when it is for work purposes and lower when it is for personal use. This was found not to be the case in this study population. The data shows that participants did have a view that mobile applications were an instrument that would improve their productivity, mainly in improving their self-management. This is reinforced by [21] who found a high degree of masculinity may have a positive impact on perceived usefulness and perceived ease of use.

The second category in this theme is Caregiver influence. It has strong alignment with the notion of femininity and has a negative influence on users since diabetic patients are responsible for taking care of their family and others are both home-carers and providers at the same time, for their families. This indicates that patients are more concerned with the quality of their life and family than with the adoption of mobile applications. For example, participants stated that,

"I don't at the moment. It's a big, big battle because I've got a one-year-old and a two-year-old. Uhm… so, they take up a majority of my day"(35-year-old female) *and*.

"I'm the chef here in the house. I, I cook and I'm the one that shops so I'm, I'm one hundred percent responsible for my own and for my husband because he doesn't like taking medication so … But I'm the one that's responsible"(44- year-old female).

Based on findings in this section, it is evident that these participants subscribe to a moderate femininity culture which indicates that the quality of life and relationships are most important [23]. This is reinforced by [59] who reported that the more an m-health application is perceived as a benefit to one's health, the intention to use an m-health application is stronger. In this society, it is not quite the case as women value both work obligations and caregiver relationships.

5.2.2 The role of uncertainty avoidance on users and non-users' expectations of effort to use m-health applications

This finding explores the way in which the patients' perceptions of ease or difficulty in using an application influence their decision to use an application in support of self-care activities.

The first category that emerged from the data within this theme was **Technology impediments**. This is aligned to the cultural notion of **uncertainty avoidance** and has a negative influence on users' ability to adopt and use m-health. Technology anxiety has been identified amongst older diabetic patients. These elderly patients found mobile application stressful. While younger patients did not. This is due to their lack of understanding of m-health applications. The

distrust in application use has also resulted in a negative influence as a result of personal information being easily accessible by others.

For example, participants stated that,

"Yes, I, ek dink nie ek sal die knowledge… ek het nie daai knowledge om daai te doen nie sonder help van iemand nie"(59-year-old female),
Translation "Yes I, I don't think I will have the knowledge. I don't have the knowledge to do this without the help of some one"(59-year-old female) and.
"Yes, because I don't know how to use it and what if the app takes money from my account every month"(65-year-old female).

Individuals that subscribe to high uncertainty avoidance cultures are more apprehensive about fraud and privacy [61]. He and Freeman [91] found that females commonly have higher technology anxiety and lower self-efficacy when using technology. This is the case in this research population too. Tarhini, Hone and Liu [92] found that women are more worried about security issues than males, while males are more mindful of the efficiency of technology. This was found to be the case in this study population too. In this study sample, respondents acknowledge uncertainty avoidance, which indicates that they are less likely to adopt new technology if they lack confidence and trust in it.

The second category in this theme, relates to Technology convenience. It has a strong alignment with the notion of uncertainty avoidance and has a positive influence on users and non-users' ability to adopt and use m-health application. A few reasons have been uncovered in this regard. Many mobile applications existing which are freely available to diabetic patients. The data shows that diabetic patients who are not using m-health applications would like to adopt a mobile application that is suitable for their needs. This indicates that diabetic patients would search for an application that is easier to use as opposed to abandoning an application in its entirety. Examples of respondents who demonstrates the latter:

"I'd probably look for something easier if it was too difficult"(35-year-old female) and.
"I would probably look for something easier because they are so many applications when it comes to that diabetes monitoring"(35-year-old female).

Hoehle, Zhang and Venkatesh [93] found that "espoused cultural values play an important role in affecting the relationship between mobile application usability and individuals' continued intention to use mobile social media applications". Similarly, in a different context, this seems to be the case in this population too. It is evident that cultural backgrounds and values need to be taken into consideration when developing an application. Ozturk et al. [46] suggest

that improving the usability of an application increases the perception of the value of an application, and this, in turn, influences continuance intention to use. This was found to be the case in this study population too. The data show that participants acknowledge the perceived benefit of an application as many of them would not abandon an application entirely but rather search for an application that is easier to use. This, in turn, has a positive effect on m-health adoption and use amongst diabetic patients.

5.2.3 The role of power distance on users and non-users' in respect of how social influences bear on their use of technology

This finding explores whether people who are perceived to be in positions of power, such as healthcare professionals, have any effect on the use of mobile applications for self-care behaviour activities.

The first category in this theme is Medical practitioner influence. It has strong alignment with the notion of power distance and has a negative impact on users and non-users' ability to adopt and use m-health. The data shows that diabetic patients are less likely to adopt and use a mobile application if their doctors do not inform them about it or if they perceive that their doctors would not be in favour of them using mobile applications for self-management activities. This suggests that people accept and adhere to the hierarchical order, which in this context is healthcare professionals. The following interview excerpts demonstrates that patients prefer their doctor:

> "I don't think the decisions I make will be better than a doctor. A doctor is qualified even though he does not know my body, his advice is always much more better"(30-year-old male) *and.*
> "I would choose going to the doctor if something seems off than using an App"(25-year-old female).

Overall, these findings are in accordance with findings reported by previous scholars that elderly participants would prefer traditional health services [94]. However, it must be pointed out that in this research population, the data indicates that younger participants would also prefer visiting the doctor as opposed to solely using an application.

The second category that emerged from the data within this theme is Opinions towards medical practitioners. This is aligned to the cultural notion of power distance and has a positive impact on users and non-users' ability to adopt and use m-health. Diabetic patients comply with the opinions of their doctors as they fear disagreeing with them. As such, this may result in having a positive influence on a participant's ability to adopt and use mobile applications. This indicates that if their doctors inform them about a mobile application, they would adopt it.

> "I like to talk to my doctor. He knows more than I do"(65-year-old female), *and.*
> "Yes because at the end of the day they supposed to be the knowledgeable people…they should direct you the way it should be"(46-year-old male).

These findings show that participants feel more worried about conforming to the opinions of others. This is reinforced by [64] who found that high power distance cultures tend to show lower levels of new technology adoption. In this study population, this tends to be the case too. Hassan, Shiu and Parry [95] found that individuals that subscribes to high power distance countries would not feel persuaded to act on their attitudes and inclination. Thus, they are likely to resist change.

5.2.4 The role of individualism-collectivism on users and non-user in respect of how the social influence bear on their use of technology

This finding explores the way in which a diabetic patient makes his/her own decision and those important others do not have an influence on a diabetic patients' decision of whether to use an application for self-care behaviour activities.

The first category in this theme is Individual responsibility. It therefore has strong alignment with the notion of individualism and has a negative impact on users and non-users' ability to adopt and use m-health. This has resulted in users having a negative attitude towards the adoption and use of mobile applications. The data shows that some diabetic patients are not seeing the benefit of adopting an application. A few reasons can be identified as to why these respondents will not use an application e.g., they are not part of the working class, they are not technologically savvy and thus does not see the benefit of an application. This indicates a negative attitude towards the adoption and use of mobile applications. For example, participants stated that,

> "To be honest, nothing will make me want to use an app"(65-year-old female).

and

> "It doesn't really appeal to me, honestly. I don't even sit on my phone"(50-year-old male).

Individual responsibility which has a strong alignment with the cultural notion of individualism also has a positive influence on users and non-users' ability to adopt and use m-health since individuals prioritise their own interests rather than the opinions of important others in their society, for example, participants stated that,

> "I feel it's my responsibility, to be honest, because my doctor is just there to, sort of, to help manage and, you

know, give the medication part of it. Um, but it is my responsibility every day to ensure that I'm doing the right thing for myself to sort of benefit at the end of the day"(36-year-old female) *and.*

"I am responsible and it is up to me how I manage it"(51-year-old female).

In relation to the notion of culture, the study's population sample subscribes to a high individualist culture. This is reinforced by [23] who found that a high individualist culture have a positive attitude towards using application adoption as they perceive that the technology can help them perform tasks effectively.

The findings below explore the way in which a diabetic patient makes his/her decisions based on their society, e.g., family and their important people have an influence on whether he/she should use an application for self-care behaviour activities.

The second category in this theme is Social cohesion. It has a strong alignment with the notion of collectivism and has a positive influence on users and non-users' ability to adopt and use m-health. Since diabetic patients are more likely to use a mobile application for diabetes self-management when there are people who support the use of m-health applications. The data shows that family and friends influence the way patients manage their diabetes and whether or not they would adopt and use applications for their self-management. The following interview excerpts demonstrate how doctor, family and colleagues influenced them to adopt an m-health application.

"She's [the doctor] actually is the one that we like downloaded it together. She showed me how I should be using it. We set it up together in her office. So, she was really the… I think the instigator in me utilising the application to begin with"(35-year-old female), "My family encouraged me to use the application so that made it easier"(30-year-old male).

Although majority respondents are not mobile application users, the data shows that many of the participants stated that if their family were aware of an application, they would support and influence them in adopting a mobile application. For example, participants stated that,

"The support group don't know about the app either, if they did they would tell me about it and also support me"(65-year-old female).

and

"If my family knew about a diabetes application, they would have told me about it ages ago. They would probably download it for me also because they can see that I struggle to manage my diabetes because of working so much. So, they would download it for me, show

me what is for what and make sure I use it daily"(51-year-old female).

The data shows that m-health application users would consult their online support group to ensure they are on track with their self-care. This is summarised in the following quotations:

"but I also check on the diabetes support group Facebook page if what I am doing is okay or if someone had the same concern as me previously"(30-year old male) *and.*
"I'm part of a group called…I think it's type one diabetes on Facebook. It's relief and medical information and it's for people from everywhere"(35-year-old female).

The findings in this section, suggest that a individuals' subscribes to collectivistic culture, and this is perpetuated by social cohesion. Lin [96] found that subjective norms have a more significant influence on behavioural intentions to adopt new technology in collectivistic cultures.

5.2.5 The role of uncertainty avoidance practices on users and non-users' facilitating conditions to use m-health applications

This finding explores the way in which support exists to reduce uncertainty around the use of an application for diabetes self-care behaviour activities.

The first category that emerged from the data within this theme was predisposing factors of avoidance. It has a strong alignment with notion of uncertainty avoidance and has a negative influence on users and non-users ability to adopt and use m-health. A few reasons have emerged in this regard. The data shows that using mobile applications can be a stressful activity due to cyber-crime and unsafe communities where they reside. The following interviews excerpts demonstrate that a fear of uncertainty may result in resistance to adopting the technology.

"what if someone steals my phone when I go fetch my pension and then they can see all my personal information. Also, I won't have the information anymore and then I can't show my doctor my progress"(65-year-old female).

and

"Crime is another thing that would stress me out. My phone getting stolen with all my information on the app is something that would put me off from using a diabetes application"(51-year-old female).

In this research population, many of these participants are over 50 years old and are not from the digital age. This

implies that they may not possess the necessary skills to operate an m-health application. Petersen, Jacobs and Pather [97] found similar findings. However, even though participants do not have the skills, the data indicates that if they had the necessary skills, they would adopt and use an m-health application. Participants stated the following:

If I had the skills to do it, I would have been on it already (35-year-old female).

and

If I knew, yes, then I would but I must always ask someone to help me (63-year-old female).

The second category in this theme is Social advocacy. This is aligned to the cultural notion of uncertainty avoidance and has a negative influence on users and non-users ability to adopt and use m-health since diabetic patients have a lack of awareness of the existence of mobile applications which would result in low uptake of applications. For example, participants stated,

"No, I never knew it existed. This is the first time that I hear about that application"(59-year-old female),

and.

"I wasn't approached by anybody or, didn't have an app, like you the first person talking to me about an app on my phone"(60-year-old female).

The literature indicates that uncertainty avoidance would have a negative influence on technology use [60]. In this population, this is the case too.

Social advocacy which is aligned to the cultural notion of uncertainty avoidance has also resulted in a positive influence on users and non-users since the assistance to use an application is available. Diabetic patients are more likely to adopt mobile applications when organisational and technical infrastructure exists. The data reveals that for both male and female participants', support is readily available for respondents should they need it. In addition, what the data also indicates is that for many participants, immediate family such as children and spouse are available to assist in using an m-health application. For example, participants stated,

"My kids, around me, is quite savvy where apps and mobile phones and stuff is concerned, so I know they will be able to assist me, should I get to a roadblock or whatever, you understand"(59-year-old male).

and

"My husband is available. He is more tech savvy than me so he would be able to go through the app and explain to me what I need to do and where I need

to go on the app to actually do… get the outcome I need"(42-year-old female).

5.2.6 The role of long-term orientation and short-term orientation on the value of price for technology use

This finding explores the way in which the perceived benefit and the cost of using an application have an influence on diabetic patients' willingness to persevere and save.

The first category in this theme is Monetary mindset. It has a strong alignment with the cultural notion of long-term orientation and has a negative influence on users and non-users' ability to adopt and use m-health application since saving is of a low priority and thrift is an important factor. The data shows that individuals may not be able to adopt mobile applications due to being unable to save money. For some participants, money generated needs to be spent on necessities and not spent carelessly. The findings also show that elderly diabetic patients survive off their pension and thus cannot save money to download a mobile application for use. Participants stated that although saving is important, it is not a priority as there is no money to save for an m-health application. This is demonstrated in the extracts below:

"Saving is not an option uhm whatever comes in must go out again"(46-year-old male).

and

"So, there's no savings that I can say that I've got savings. I'm gonna take from the savings and buy that and that. I'm living from one month to the next month"(59-year-old female).

In the context of mobile banking adoption, [63] found that low long-term orientation had a strong and negative moderating effect. In line with this research, this is found to be the case too. Participants may not be able to use mobile applications to self-manage their diabetes in the future due to not being able to save money. Some participants stated that there is no future to save for as they have to use their resources sparingly to uphold a healthy lifestyle. Examples of responses that demonstrate the latter are:

"It's not really important because I'm old already, I don't have a future to save for also, pension is very little. I try to live within my means and spend money on keeping me healthy"(65-year-old female),
"I don't have money to waste. I would rather spend money on food, healthy fruits and vegetables than on that"(65-year-old female).

In relation to the notion of culture, the study's population sample subscribes to a low long-term orientation culture. Literature indicates that low long-term orientation plays

a significant moderating role when studying technology acceptance and use at the individual level [93].

Monetary mindset as a long-term orientation concept may also have a positive impact on users and non-users' mobile application adoption. The data indicates that many of the participants are not using mobile applications for their diabetes self-management. Although participants are not using mobile applications as yet, respondents perceive that using a mobile application will be beneficial to them. For example, participants stated that,

> "Yes, I wouldn't have leave it, because it's no use going into the diet app, in my concern, and at the end of the day it will help you. So I don't think why will I leave it [the app], even if it's a little bit difficult"(61-year-old female),

and

> "I think the more I play with it, the more the more I'll know how to use it and use it properly to my advantage"(42-year-old female).

Literature indicates in the context of learners' voluntary technology adoption that long-term orientation would have a positive influence on technology use and intention to use [60]. In this research population, this is the case too.

This finding explores the way in which the perceived benefit and the cost of using an application has an influence on diabetic patients' traditions and values.

The second category in this theme is traditional mindset. It has a strong alignment with the cultural notion of short-term orientation and has resulted in a negative influence on users and non-users ability to adopt and use m-health since elderly diabetic patients prefer the traditional way of seeking information as opposed to using a mobile application adoption. Participants stated,

> "I'm more old school, I like the traditional way of visiting my doctor, where my health is concern"(65-year-old female).

and

> "I am very old school I just…the only thing I really kept are a record of my blood sugar so that I..if anything could go wrong, I can atleast give that to my doctor and say, this is what the sugars look like over the past two weeks"(57-year-old female).

This indicates that this society subscribes to a high short-term orientation culture. This is similar to Hofstede' view of culture where South Africans scored low in long-term orientation [73] as they prefer to uphold traditions and are skeptical about change. This indicates that the participants will follow the traditions of their society in terms of managing

their condition and in this case, face to face consultations with their doctor.

Traditional mindset, which is aligned to the cultural notion of short-term orientation has resulted in a positive influence on users and non-users' ability to adopt and use m-health. The data reveals that participants feel that many m-health applications exist and they would rather choose to download m-health applications that have no cost associated with them. Participants stated,

> "No, I don't think I've ever downloaded an app that cost me money. I steer clear from those kinds of apps, any app that has a cost involved"(53-year-old male),
> "There's many apps available that you don't pay for so I don't see the need to download one that I need to pay for"(42-year-old female).

The literature indicates that the price value is positive when the benefits of using mobile applications are perceived to be greater than the associated monetary cost [63]. This is the case in this research population as well. While delving deeper into the data, it was found that other participants would pay for an m-health application. For example, the data indicate that when participants find an application that adds value to their life and offers what they need, they will pay for the application. This is demonstrated in the abstracts below,

> "If you've got good reviews on it and if you feel that it would add value to your life then why not"(50-year-old male),
> "I would have to go through the apps and see what it offers for me and if that is the one I want before I decide to pay for it"(57-year-old female).

5.2.7 The role of indulgence on users and non-users' in respect of how habit bear on their use of technology

This finding explores when people make the decision automatically because of learning, and that decision is one that satisfies them. It refers to the way in which the choices taken by diabetic patients have an influence on self-care activities.

The category in this theme is **Personal regulation**. This is aligned to the cultural notion of indulgence and has resulted in a positive influence on users and non-users ability to adopt and use m-health as a result of diabetic patients' decision to act on their own choices and desires. The data shows that diabetic patients can make their own decisions on whether to adopt mobile applications. This indicates that they are more likely to adopt and use a mobile application to gratify their desires and impulses. Participants stated,

> "I make my own choices, my children can't tell me what to do it's my body and my health"(65-year-old female),

"I prefer making it on my own because the doctors already advised me at the beginning. They only need to tell you once. They don't need to repeat themselves"(50-year-old male).

The data reveals that application users found that managing their diabetes with an m-health application is beneficial. These participants felt as if they were in control of their condition and in turn, using a mobile application became second nature to them. For example, the participants stated:

"I do think that I manage my diabetes better when I use the app because I can take all the things, I do such as my eating habits and medication intake, like you call it self-care activities"(30-year-old male),
"Became like a second nature kind of thing like when I tested my sugar, I would go to the application and then input the data" (35-year-old female).

5.2.8 The role of individualism on users and non-users in respect of how hedonic motivation bear on their use of technology

This finding explores the way in which the pleasure from using an application has an influence on a diabetic patient's willingness to use.

The first category in this theme is **Perceived enjoyment**. It is aligned to the cultural notion of **individualism** and a positive influence on users and non-users m-health application as a result of diabetic patients finding an application enjoyable. The data shows that mobile application users are both intrinsically and extrinsically motivated to use an m-health application. For example, participants stated that an application was enjoyable as they felt as though they accomplished their goal. This is summarised below:

"I think sometimes the area in medical is not really entertaining, but definitely fun. Fun in a sense of… uhm… or more like accomplished. You felt like you had accomplished something when you have filled out all your readings and food units for the day… uhm… and insulin dosage"(35-year-old female),
"It was very fun. Yeh, all the exercises. There's different stuff that I didn't know about that's on the App. Like different kind of exercises and they give you advise as well on how to do it and they show you like different, how you shouldn't be doing certain exercises because you could hurt yourself"(25-year-old female).

From the findings above, the data indicates that for mobile application users, hedonic motivation is a contributing factor to continuous intention to use an application. The literature indicates that perceived enjoyment had significant positive effects on the perceived usefulness [98]. As these respondents subscribe to a high individualistic culture,

finding mobile applications intrinsically useful is associated with hedonic motivation.

The second category that emerged from the data within the theme was Negative drivers of application use. This is aligned to the cultural notion of individualism and has resulted in a negative influence on users and non-users m-health acceptance since participants found m-health applications challenging to use. The data shows that elderly diabetic patients perceived their age to affect their adoption behaviours. In addition, participants stated that they are not technologically inclined. Participants stated,

"I'm old and I won't be able to remember everything"(65-year-old female).

and

"I'm fifty-nine and technology is not my strong point. [laugh]"(59-year-old female).

In this research population, age was not the only issue. Participants felt that using an application would be challenging and thus would demotivate them to use an application. They were not born in the digital age and thus saw no need to use an application. In addition, they perceive these to be for the younger generation Example of respondents that demonstrate the latter are:

"I think it's more for the younger generation. I would be keen to try uhm like I said, but it's so difficult"(65-year-old female),
"It will be challenging for me to try new technology"(65-year-old female).

If individuals deem the technology to be beneficial and effortless, they are more likely to accept and use it [20]. In this study sample, this indicates that due to age, participants are less willing to use an m-health application for diabetes self-management.

6 Conclusion

The study presented in this paper drew on the extant frameworks (UTAUT2 and Hofstede's cultural dimensions), subjecting it to empirical investigation in this problem domain and as a result, has determined how the constructs interrelate in this problem context. Furthermore, the study provides evidence of the role of culture in technology adoption amongst diabetic patients in low socio-economic communities.

The results of the study have led to several key findings.

Breadwinner influence, which reflects masculinity, has a negative influence on users as a result of work being their main priority. Diabetic patients have to work in order to survive which indicates that anything else is simply not a

priority and more of a time-consuming task. Caregiver influence, which reflects femininity, has a negative influence on users as a result of diabetic patients being responsible for taking care of their families.

Technology impediments, which reflect uncertainty avoidance, have a negative influence on users as a result of declining cognitive capabilities. Elderly patients found mobile applications stressful while younger patients did not. The distrust in application use has also resulted in a negative influence as a result of personal information being easily accessible by others.

Technology convenience on the other hand had a positive influence on users and non-users as a result of many mobile applications existing which are freely available to diabetic patients. In addition, diabetic patients who are not using m-health applications would like to adopt a mobile application that is suitable to their needs. This indicates that diabetic patients would search for an application that is easier to use as opposed to abandoning an application in its entirety.

Medical practitioner influence, which reflects power distance, has a negative impact on users and non-users as a result of diabetic patients preferring their doctor. Diabetic patients are less likely to adopt and use a mobile application for self-management activities if their doctors do not inform them about it or if they perceive that their doctors would not be in favour of them using it. On the other hand, opinions towards medical practitioners have a positive impact on users and non-users. This indicates that if their doctors inform them about a mobile application, they would adopt it. As such, this may result in having a positive influence on a participant's ability to adopt and use mobile applications.

Individual responsibility, which reflects individualism, has a positive influence on users and non-users as a result of prioritising their own interests rather than the opinions of important others in their society, which indicates that they would adopt and use m-health applications. Social cohesion, which reflects collectivism, has a positive influence on users and non-users as a result of social support and support groups that exists. As such, participants are more likely to use a mobile application for diabetes self- management.

Predisposing factors of avoidance, which reflects uncertainty avoidance, has a negative influence on mobile application adoption. Diabetic patients indicate that using mobile applications can be a stressful activity due to cyber-crime and unsafe communities where they reside. A fear of uncertainty may result in resistance to adopting the technology. Social advocacy, on the other hand, has resulted in a positive influence on users and non-users as a result of application assistance that is available. Diabetic patients are more likely to adopt mobile applications when organisational and technical infrastructure exists.

Monetary mindset, which reflects long-term orientation has resulted in a negative influence on users and non-users as

a result of saving being a low priority. Diabetic patients may not be able to adopt mobile applications due to being unable to save money. For some, money that is generated needs to be spent on necessities and not carelessly. This indicates that diabetic patients will not waste money downloading an application for use. Traditional mindset, which reflects short-term orientation has resulted in negative influence on users and non-users mobile application adoption. Elderly diabetic patients prefer the traditional way of seeking information as opposed to using a mobile application adoption.

Personal regulation, which reflects indulgence has resulted in a positive influence on users and non-users as a result of a diabetic patients' decision to act on their own choices and desires. Diabetic patients are able to make their own decisions on whether to adopt mobile applications. This indicates that they are more likely than not to adopt and use a mobile application to gratify their desires and impulses.

Perceived enjoyment, which reflects individualism, has resulted in a positive influence on users and non-users as a result of diabetic patients finding an application enjoyable as they will be learning how to use the application for diabetes self-management. The findings of the study will therefore serve to inform other situations of low socio-economic communities where diabetes is prevalent and where technology adoption is at a low level.

In respect of mobile application development and deployment, we draw several lessons from this research as follows:

- The first concern is the development of a culturally sensitive m-health application for diabetic patients with low socio-economic status within the Western Cape. The findings indicate that key design considerations could be achieved by following a co-design approach. This entails a group of users and non-users' involvement in requirements gathering, engineering and testing phase. This will allow users and non-users to provide suggestions that would lead to the improvement of user interface and application features that would contribute to increased uptake and use of m-health applications for self-management;
- Although many m-health applications exist, security concerns came up as a key impediment to technology uptake and use. It is therefore imperative that software engineers mitigate these data security risks to ensure that the applications are secure and user data integrity is maintained;
- Furthermore, in respect of deploying an application as part of some planned intervention, the findings can be useful to Government policy makers. The intention is that policy-makers can embark on a pro conscientisation intervention by creating awareness to the use of promoting mobile applications for patients to self-manage their diabetes. This is not limited to any organised intervention, but this understanding would help government lead

a more successful awareness campaign. If policy makers understand the nature of how technology uptake is actually negatively influenced by culture, then they can mitigate these factors in programs by promoting technology use;

• While analysing the research data, it became clear that the community trusts the role of their healthcare practitioner as doctors plays a huge role in changing the discourse around mobile application adoption. It is the responsibility of the public health system to train doctors to use an m-health application as patients will be more willing to use an application when a healthcare professional provides them with this information. In addition, facilitators of diabetes support groups can promote m-health applications to mitigate low levels of uptake.

Finally, we propose that future research should be conducted in other geographical areas with similar low socioeconomic demographics as the population in this study, to compare findings.

Data availability The datasets generated during the present study are not publicly available due to the conditions of ethical clearance in relation to confidentiality that were granted to conduct the study. The datasets may be available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors have no competing interests to declare that are relevant to the content of this article.

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