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Understanding factors influencing the usage intention of mobile pregnancy applications

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Abstract. Advancement in digital technology and the need to provide alternate healthcare delivery channels to individuals in developing countries has led to the boom in mobile Health (mHealth). A wide range of mHealth applications (apps) and services are available today to combat the maternal and newborn health disparities in India. Yet, there is scant research in understanding the predictors of pregnant women's adoption towards pregnancy apps in developing countries. The objective of this study is to identify the most significant predictors influencing behavioural intention to use pregnancy apps. To meet this objective, a conceptual model was developed and empirically tested by extending UTAUT with relevant constructs namely personal innovativeness in IT and perceived risk. A conceptual model along with the hypothesized causal paths among the constructs are empirically validated with the help of structural equation modeling using Smart PLS 3.0 with a sample of 220 pregnant women. Results showed that intention to use pregnancy apps by women was predicted by six influencing factors: performance expectancy, effort expectancy, facilitating conditions, social influence, personal innovativeness and attitude. Perceived risk had no significant effect on the behavioural intention to use pregnancy apps.

Keywords: mHealth, mobile pregnancy apps, UTAUT, developing country, perceived risk, personal innovativeness, health informatics, pregnancy

1 Introduction

Health 2.0 has enabled to focus more on patient care due to the evolving relations between healthcare providers and patients. Information and Communication Technologies (ICT) usage by hospitals and healthcare professionals has increased tremendously which has enabled new forms of communication between patients and health professionals (Antheunis et al., 2013). There is a shift towards patient empowerment in maternal care, which now accommodates electronic devices into its functioning by incorporating the use of shared maternity care needs. Blogs, wikis, forums, discussion groups, social media, mobile health (mHealth) apps have played an important role in eliciting information and gaining support about early motherhood and parenting matters (Doty & Dworkin, 2014). Pregnant women consider information obtained through online platforms to be reliable and of good quality (Szwajcer et al., 2008; Huberty et al., 2013). The information found online plays a significant role in women's decision-making during pregnancy (Lagan et al., 2010).

In an increasing digitized world, the introduction of smart phone has revolutionized the way in which healthcare services are provided. Mobile applications (apps) are end user software that are designed to be used on mobile devices like smartphones and tablets. During the first quarter of 2020, there were 43,285 mHealth apps available in the Google Play store, according to the study published in May 2020 by Statista (2020a). According to a report by Statista (2020b), published in May 2020, over 500 million users in India will use mobile phone internet by 2023.

There is a decline in the extended family structure in India. The use of digital media has increased tremendously in supporting the needs of pregnant women. Consultations are limited by time particularly in a busy clinical setting. Women seek information from online media and pregnancy-related apps to search, share personal experiences and information about pregnancy and parenting. The accessibility, pervasiveness and popularity of mobile pregnancy apps make them a cost-effective and easy way for women to monitor their health. However, these apps are fairly new in developing countries, which means that the behavioural intention for women to use them are not completely understood. Thus, the objective of this study is to understand the factors that may directly and indirectly influence user's behavioural intention to use pregnancy apps.

2 Literature Review

Maternal care now accommodates electronic devices into its functioning by incorporating the use of mHealth apps. According to study by Trip et al., (2014), out of the pregnancy apps available in the app distribution platforms, forty per cent of the apps were informative, thirteen per cent interactive, nineteen per cent had medical tools, eleven per cent were social media apps. This study also points that the reliance on healthcare professionals may be reduced with the proliferation of such interactive and personalized apps.

These findings were confirmed by a study in Dublin where women had used an app during pregnancy. Women drew their attention to digital media to get information related to pregnancy, subscribed to the use of online discussion forums, shared their pregnancy photos and status on social media, used micro-blogs and podcasts. Disadvantaged women in Ireland reported high levels of digital media usage during pregnancy to obtain health information (O'Higgins et al., 2014). Similar findings were observed in a focus group study carried out in Australia by Lupton (2017). This study suggested, social media, mobile apps, content-sharing platforms and online platforms were very important to the participants to connect with family and friends, post images about their pregnancy, track their pregnancy, and child's development. Maternal subjects used social media features provided on smartphone apps as a new form of communication, or socialization whilst staying at home. Women view health apps as a means to monitor and improve their pregnancies, health, and their children's development and health (Johnson, 2014).

A study on pregnancy and parenting apps usage by 410 Australian women revealed that women found apps useful in providing information, documenting changes in their own bodies, self-monitoring foetal development or child development and providing reassurance. However, while using these media the participants in the focus group had not considered the issues of third-party access and use of personal data. Women were aware of the digital ties these apps had however, they were not fully aware of some of the privacy challenges these apps posed (Lupton & Pedersen, 2016).

Convenience, immediacy, ease of access, sharing experiences and easy access to information were the major benefits of pregnancy apps according to the participants in South Korea. Information concerning signs of risk and disease during pregnancy was searched most often followed by physical changes in the body, prenatal education, and breastfeeding (Lee & Moon, 2016). Features in pregnancy apps can help pregnant women make informed choices about nutrition, weight gain and development of the baby. According to a study in Australia, parents used online media such as social media platforms, blogs, websites, online discussion forums, apps during pregnancy as they provided immediate, regular, detailed, entertaining, customized, practical, professional, reassuring and unbiased information (Lupton, 2016). In another study participants described pregnancy apps being as more significant and beneficial than other forms of health communication in receiving information related to pregnancy (Rodger et al., 2013). Participants in a randomized controlled trial demonstrated higher use of mobile applications as against the use of distributed notebooks to record details about their pregnancy (Ledford et al., 2016).

3 Theoretical Framework

The success of any Information System (IS) depends on the way users accept it (Venkatesh et al., 2003). The most extensively used models to understand technology acceptance are Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT).

3.1 UTAUT

UTAUT model focusses on explaining user intentions towards IS usage. The theory has key constructs performance expectancy, effort expectancy, social influence, and facilitating conditions which act as the direct determinants of behaviour intention to use (Venkatesh et. al., 2003). Gender, voluntariness of use, experience and age are posited to moderate the impact of the four main constructs on usage intention and behaviour (Venkatesh et. al., 2003). Critics believe that attitude leading to behaviour is missing in this model and that intention to use may or may not lead to use behaviour. In this study, the UTAUT model provides the theoretical framework underpinning the research which is extended with personal innovativeness and perceived risk to understand and empirically test the factors that influence user's intention to use mobile pregnancy apps in a developing country's context (Refer Fig.1)

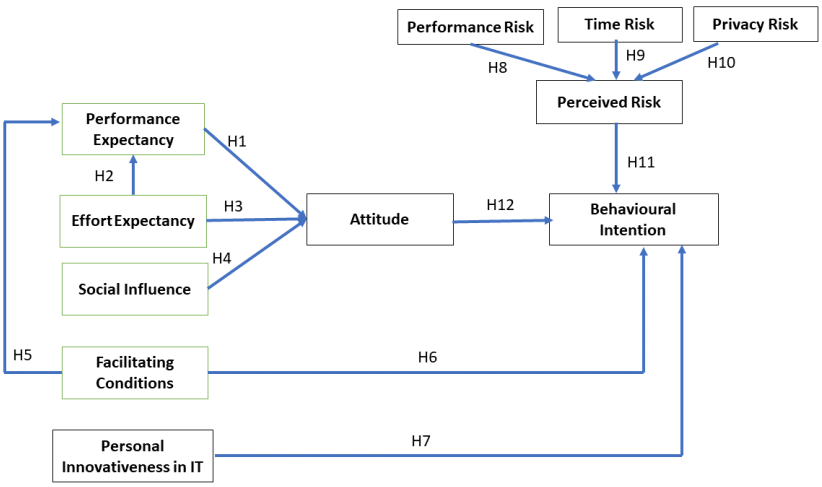

Fig. 1. Proposed Research Model

3.2 Performance Expectancy

Users are inclined to use a technology if they find it useful and advantageous in their day-to-day activities (Alalwan, Dwivedi & Williams,2016; Davis 1989). Performance expectancy in the context of pregnancy app usage is the degree to which users believe that using pregnancy apps would improve their ability to manage their health. When users perceive pregnancy apps useful in seeking information and managing their health, the perception generates positive attitude towards using them. Thus, it is reasonable to hypothesize that:

H1: Performce expectancy has a positive and significant effect on attitude to use pregnancy apps

3.3 Effort Expectancy

Effort expectancy is defined as "the degree of ease associated with the use of the system" (Venkatesh, Morris, Davis & Davis, 2003, p.450). Studies related to mHealth applications (Zhang et al., 2014) have pointed out that effort expectancy is a major attribute leading to intention to use these systems. Thus, the hypothesis,

H2: Effort expectancy has a positive and significant effect on performance expectancy to use pregnancy apps

When users perceive using pregnancy apps less complex and requiring less effort to use them, they will use the apps. This leads to the following hypothesis,

H3: Effort expectancy has a positive and significant effect on attitude to use pregnancy apps

3.4 Social Influence

Social influence is defined as "the degree to which an individual perceives how important others believe he or she should use the new system" (Venkatesh et al., 2003). Social influence helps one understand the fact that though an individual may not have a positive attitude to use a particular technology, how under the influence of family, friends one may use it anyway as it may be expected of one to do so (Venkatesh & Morris, 2000). Thus, the following hypothesis is postulated

H4: Social Influence has a positive and significant effect on attitude to use pregnancy apps

3.5 Facilitating Conditions

Facilitating Conditions (FC) define a users' belief that infrastructure (technical and organizational) are available to support the use of the system (Venkatesh et al., 2003, Dwivedi et al. 2016). In the case of mobile pregnancy apps, not all Indian users have equal access to information, mobile phones, knowledge, internet connectivity and other resources that enable the usage of these apps. Thus, the following hypotheses is proposed,

H5: Facilitating Conditions has a positive and significant effect on performance expectancy to use pregnancy apps

H6: Facilitating Conditions has a positive and significant effect on intention to use pregnancy apps

3.6 Personal Innovativeness

Personal Innovativeness in IT describes the tendency of an individual to adopt a product/service relatively before others (Jackson, Mun & Park, 2013; Lassar et al.,2005, Agarwal & Prasad, 1998; Rogers,1983). Agarwal and Prasad (1998) referred to PI as the degree to which a person believes that he/she is positively predisposed towards the

use of new technologies. The extent to which a user is open to experimenting, experiencing new technologies indicates their novelty and innovativeness-seeking abilities.

H7: Personal Innovativeness has a positive and significant effect on intention to use pregnancy apps

3.7 Perceived Risk

Perceived risk refers to the likelihood of certain negative outcomes and consequences from engaging in those behaviours. In the context of pregnancy apps, it is defined as "the degree to which an individual perceives certain negative outcomes and the danger and severity of negative consequences from using pregnancy apps". Performance risk refers to "the possibility of the product malfunctioning and not performing as it was designed and advertised and therefore failing to deliver the desired benefits" (Featherman & Pavlou, 2003). It refers to the losses which a user may incur due to incorrect processing of health information.

H8: Performance Risk is negatively associated with Perceived Risk of using pregnancy apps

In the context of pregnancy apps, some user may be time conscious and guard against the loss of time they may incur in having to learn how to setup, use and maintain the app.

H9: Time Risk is negatively associated with Perceived Risk of using pregnancy apps

Researchers have studied the effects of privacy risks in the context of online services (Cocosila, 2013; Lee, 2009; Featherman & Pavlou, 2003; Shareef, Kumar & Kumar, 2008) which affects their intention to use those services. Pregnancy apps may communicate personal information about users with third parties. This uncertainty of how personal information will be used leads to privacy concerns related to the app usage. This leads to the following hypotheses

H10: Privacy Risk is negatively associated with Perceived Risk of using pregnancy apps
H11: Perceived Risk is negatively associated with Behavioural Intention of using pregnancy apps

3.8 Attitude

Attitude towards using a system is defined as the extent to which a user positively or negatively evaluates that system to carry out the behaviour in question. In mHealth, a number of studies (Hajiheydari & Ashkani, 2018; Canhoto & Arp, 2017; Du et al., 2016; Zhao, Ni & Zhou, 2018; Deng, Zhang & Zhang, 2012) have supported the relationship between attitude and behavioural intention. Considering the importance of attitude in IS adoption research, the following hypothesis is proposed:

H12: Attitude is positively associated with Behavioural Intention to use pregnancy apps

4 Research Methodology

4.1 Instrument Design

Instrument developed for this study borrowed scale items from previously established studies. As the scale items in the study were modified to suit the context of this study, it is essential to test the validity and reliability of the scale. Tests for the construct validity, face validity, content validity, discriminant and convergent validity were performed. Multiple items were used to measure constructs, in order to increase the reliability of the construct. These were measured on a five-point Likert scale with anchors ranging from 1= "Strongly Disagree" to 5= "Strongly Agree". The construct validity is met by examining discriminant and convergent validity (Forner & Larcker, 1981).

4.2 Data Collection and Sampling

The structured questionnaire was emailed to the participants to collect the primary data for the study. An online link was embedded in an email and sent to the participants. Questionnaires were mailed to 750 participants across the country. 243 completed questionnaires were obtained of which 220 were used for further analysis. 23 responses were eliminated in the process as they were incomplete or had the same value marked for all the questions in the survey. The final response rate was 32.4%.

4.3 Demographic Profile of the Respondents

The sample consisted of 220 females. Table 1 illustrates the respondents' demographic de-tails. 85 per cent of the respondents were less than the age of 35 indicating that the sample comprised of young or middle-aged respondents. 61 per cent of the population was well educated and 47 per cent of the respondents were working professionals.

Table 1. Demographic details of the respondents

Measure	Items	Frequency	Sample percentage
Gender			
	Female	220	100
Age			
	25 or Under	8	3.64
	26-35	179	81.36
	36-45	33	15
Educational background			
	HSC	6	2.72
	Graduate	67	30.45
	Post Graduate	135	61.36
	Other	12	5.45
Occupation			
	Student	6	2.72
	Working Professional	102	46.36
	Self-employed	33	15
	Homemaker	75	34.09
Location			

	Mumbai	184	83.63
	Others	36	16.36
How many Pregnancy apps do you have installed on your phone?			
	1	152	69.09
	2	116	52.72
	3	4	1.81
	More than three	7	3.18
Note: n=220, Others (Haryana, Kolkata, Nagpur, Jammu)			

5 Data Analysis

Tests for missing values and multicollinearity were conducted. The sample did not suffer from any multicollinearity issues as the VIF values were less than 7 (Hair et al., 2011). The data analysis process involves two steps proposed by Hair et al. (2006). The first step aims at evaluating the measurement model followed by the structural model.

5.1 Reliability and Validity Tests

In order to check the reliability of the constructs used in the instrument, the Cronbach alpha values were calculated. Table 2 represents the factor loadings for all constructs were higher than 0.5 (Byrne, 2001) and Cronbach's α values ranged from 0.749 to 0.922 establishing reliability of the measure. Convergent and discriminant validity in the study were met as mentioned in Table 3.

Table 2 – Reliability and convergent validity of the final measurement model

Constructs	**Items**	**Item Loadings**	**Cronbach's Alpha**	**rho_A**	**Composite Reliability**	**Average Variance Extracted (AVE)**
Performance Expectancy	PE1	0.775	0.749	0.755	0.857	0.666
	PE2	0.84				
	PE3	0.832				
Effort Expectancy	EE1	0.874	0.899	0.9	0.929	0.767
	EE2	0.897				
	EE3	0.881				
	EE4	0.85				
Social Influence	SI1	0.892	0.787	0.795	0.877	0.706
	SI2	0.888				
	SI3	0.731				
Facilitating Conditions	FC1	0.948	0.859	0.879	0.934	0.857
	FC2	0.924				
Personal Innovativeness	PI1	0.872	0.813	0.833	0.88	0.652
	PI2	0.637				
	PI3	0.768				
	PI4	0.922				

Perceived Risk	***	***	0.907	0.919	0.925	0.583
Perfor-mance Risk	PERF1	0.839	0.796	0.819	0.877	0.703
	PERF2	0.858				
	PERF3	0.819				
Privacy Risk	PRIV1	0.991	0.901	0.907	0.931	0.772
	PRIV2	0.891				
	PRIV3	0.935				
	PRIV4	0.878				
Time Risk	TRISK1	0.96	0.916	0.916	0.91	0.923
	TRISK2	0.961				
Attitude	ATT1	0.908	0.907	0.909	0.935	0.783
	ATT2	0.867				
	ATT3	0.864				
	ATT4	0.9				
Behav-ioural In-tention	INT1	0.918	0.922	0.929	0.951	0.865
	INT2	0.936				
	INT3	0.936				

After establishing the reliability and validity of constructs, the hypothesized relations in the model were tested using PLS-SEM. The path coefficients and the corresponding p-values are presented in Table 4.

6 Results

This research is concerned with understanding the factors that influence the behavioural intention of women to use mobile pregnancy apps. The model fit indices include SRMR as 0.097, and RMS theta as 0.191. This study aimed at understanding and explaining the significance of these constructs. It also aimed at understanding the driver construct and thus PLS-SEM was used in this study. Smart PLS 3.2.8 (Ringle et al. 2017) was used to analyse the data. The sample size in PLS is considered by the often cited ten times rule Barclay et al. (1995). The sample size in this study meets the recommended rule. The results obtained from the study are presented in Table V. H1, H2, H4, H6, H8, H9, H10, H12 are supported whereas H3,H5, H7, H11 are not supported.

7 Discussion

In the study on intention to use pregnancy apps, the relationship between performance expectancy and attitude was found to be significant. If women perceive pregnancy apps useful, they develop a positive attitude towards them. Effort expectancy was found to be a significant predictor of performance expectancy. Effort expectancy was not found to be a significant predictor of attitude. This result is not in affirmation with studies that have indicated a strong relationship between the effort expectancy and attitude to use

online services (Ruane & Wallace, 2013; To et al., 2007; Lee, 2009). A reason to this could be as women were educated, belonged to cities and thus, were familiar with the use of mobile applications. Social influence was significantly related to attitude. Women rely on expertise by friends for making information seeking choices during pregnancy (Tiidenberg, 2017; Lupton,2017; Lupton & Pedersen,2016). Users did not feel that the access to knowledge and resources would help them improve performance. Facilitating conditions did not have an effect on performance expectancy. The relationship between facilitating conditions and behavioural intention was significant. The relationship between personal innovativeness and behavioural intention was significant. This implies women are wanting to learn new techniques to get more information about their foetus and manage their health well. The relation between perceived risk and behavioural intention was insignificant. Women usually will learn new things for the baby. Most women did not share their photos on these apps and thus did not fear loss of information.

8 Conclusion

From a theoretical perspective, this study adds to the field in two additional ways. First, the study extends UTAUT by adding perceived risk and personal innovativeness in IT to understand user's behavioural intention to use pregnancy apps. Second, the findings extend the existent knowledge on the relationships of UTAUT in the context of mobile pregnancy apps in a developing country.

Table 4 : Results

Hypothesis	Path	B values	t-statistics	P values	Result
H1	Performance Expectancy -> Attitude	0.108	4.698	0.00	Supported
H2	Effort Expectancy->Performance Expectancy	0.115	5.745	0.00	Supported
H3	Effort Expectancy->Attitude	0.127	0.223	0.82	Not Supported
H4	Social Influence ->Attitude	0.096	3.603	0.00	Supported
H5	Facilitating condition-> Performance Expectancy	0.13	0.101	0.92	Not Supported
H6	Facilitating condition-> Behavioural Intention	0.068	2.334	0.02	Supported
H7	Personal Innovativeness in IT ->Behavioural Intention	0.075	0.119	0.91	Not Supported
H8	Performance Risk->Perceived Risk	0.033	9.492	0.00	Supported
H9	Time Risk->Perceived Risk	0.019	15.706	0.00	Supported
H10	Privacy Risk->Perceived Risk	0.028	19.352	0.00	Supported
H11	Perceived Risk->Behavioural Intention	0.073	1.298	0.20	Not Supported
H12	Attitude->Behavioural Intention	0.101	6.482	0.00	Supported

Table 3: Discriminant Validity - Fornell Larker criteria

	Attitude	**Behavioural intention**	**Effort expec-tancy**	**Facilitat-ing condi-tions**	**Perceived Risk**	**Perfor-mance Risk**	**Perfor-mance Expec-tancy**	**Personal Innova-tiveness**	**Privacy Risk**	**Social Influ-ence**	**Time Risk**
Attitude	***0.885****										
Behavioural Intention	0.702	***0.93****									
Effort Expectancy	0.392	0.36	***0.876****								
Facilitating conditions	0.315	0.346	0.592	***0.936****							
Perceived Risk	-0.06	0.017	-0.355	-0.241	***0.764****						
Performance Risk	-0.023	0.025	-0.187	-0.19	0.806	***0.839****					
Performance Expectancy	0.607	0.463	0.671	0.406	-0.246	-0.146	**0.816**				
Personal Innovativeness	0.413	0.323	0.481	0.33	-0.09	0.01	0.299	**0.807**			
Privacy Risk	-0.055	0.016	-0.321	-0.174	0.929	0.607	-0.23	-0.081	**0.879**		
Social Influence	0.516	0.504	0.236	0.105	0.084	0.133	0.351	0.493	0.05	**0.84**	
Time Risk	-0.079	0.000	-0.418	-0.298	0.83	0.561	-0.257	-0.167	0.666	0.052	**0.961**

Note: * Square root of AVE

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