UNIVERSITI PUTRA MALAYSIA

EFFECT OF EDUCATIONAL BREAST CANCER SMARTPHONE APPLICATION ON KNOWLEDGE, HEALTH BELIEFS AND BREAST SELF-EXAMINATION PRACTICES AMONG FEMALE UNDERGRADUATE STUDENTS AT A COLLEGE UNIVERSITY IN SAUDI ARABIA

ALMUTAIRI AESHAH HAMDAN M

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By

ALMUTAIRI AESHAH HAMDAN M

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

December 2020

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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By

ALMUTAIRI AESHAH HAMDAN M

December 2020

Chairman : Professor Shamsul Bahri Mohd Tamrin, PhD
Faculty : Medicine and Health Sciences

Breast cancer is the most frequently diagnosed cancer and the leading cause of cancerous deaths among females worldwide. In Saudi Arabia, breast cancer (BC) is the leading cause of cancerous deaths among Saudi women. Early detection of breast cancer can play an important role in reducing cancer morbidity and mortality. Early detection could be promoted by increasing knowledge, and by minimizing barriers about breast cancer. Previous studies have shown low breast cancer awareness among young Saudi women. Web based and smartphone applications covering a wide range of health topics including healthy lifestyle, fitness, disease management, and public health are currently available across all app stores with over 70% of them targeted at health. The main objective of this study is to develop, implement and evaluate the effectiveness of the educational program on breast cancer through a smartphone application based on knowledge, breast self-examination practices and health beliefs related to breast cancer among female students in university colleges in Saudi Arabia.

This study is comprised of two phases which are the development of an educational application and also the evaluation of the educational protocol through a randomized controlled trial (RCT) among female students. The first phase is based on the qualitative approach and through a panel of experts, the final version of the apps was prepared and validated. The second phase of the study was done through a randomized controlled trial (RCT) for the selection of the participants. All female students who fulfilled the study's inclusion criteria were invited to participate in the study with the provision of the informed consent form. Baseline data were

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collected from 144 female students (72 from the intervention group and 72 from the control group).

The research instruments which included components on knowledge, practices, health belief and technology acceptance were adapted and adopted based on the literature. Content and face validity, on the other hand, were assessed by a panel of experts, followed by a pilot study. The intervention module is composed of an educational program on breast cancer and was validated and developed using a smartphone application. The data were collected at baseline, one month, 3 months and six months after intervention for both groups. The descriptive and inferential statistics used were the two-way repeated measure ANOVA and Chi square test for data analysis purpose using the SPSS software version 24.

The results of the two-way repeated measure ANOVA indicate that the level of knowledge in the intervention group significantly increased after using the application. According to these results, it was found that the frequency of self-examination in the intervention group was (79.5%) in follow-up1 and increased to 86.3% in follow-up 2, which was significantly different from the control group ($p<0.001$). These results also showed that the effects of intervention on the level of health belief components (perceived seriousness, perceived susceptibility, perceived benefits, perceived barriers, confidence and health motivation) in the pre, post and follow-up tests in the intervention have increased significantly: perceived seriousness [3.23(SP 0.36), 3.65(SD 0.53), 3.71(SD 0.46), 372(SD 0.43), $p<0.01$], and perceived susceptibility [2.90(SD 0.29), 3.79(SD 0.34), 3.79(SD 0.35), 3.83(SD 0,35),$p<0.01$],and perceived benefits [2.83(SD 0.34), 3.66(SD 0.24), 3.72(SD 0.22), 3.87(SD 0.19),$p<0.01$] and perceived barriers [4.14(SD 0.29), 2.46(SD 0.32), 2.22(SD 0.39), 2.19(SD 0.40), $p<0.01$] and confidence [3.08(SD 0.37), 3.77(SD 0.31), 3.85(SD 0.31), 3.83(SD 0.22), $p<0.01$] and health motivation [2.94(SD 031), 3.86(SD 0.27), 3.99(SD 0.25), 3.97(SD 0.28), $p<0.01$]. Differences between the intervention and control group were also statistically significant in the post-test, follow-up1 and follow-up2 ($p<0.05$). The results for the technology acceptance components among students in the intervention group indicated that that the level of all components related to using provided application have significantly improved across time. The study concluded that educational breast cancer smartphone application was an effectiveness approach on improving the knowledge, breast self-examination practices and health belief components to breast cancer among female students. Based on the findings of this study, more intervention experiments are needed to be applied to workplaces, rural, urban and other areas. in addition, this app could be used in hospital/community health settings. It can also be used individually by the females to detect breast cancer without incurring great costs.

Keywords: breast cancer, knowledge, practice self-examination, Saudi Arabia, female student, intervention study.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN PENDIDIKAN KANSER PAYUDARA MELALUI APLIKASI TELEFON PINTAR TERHADAP PENGETAHUAN, KEPERCAYAAN KESIHATAN DAN AMALAN PEMERIKSAAN KENDIRI PAYUDARA DALAM KALANGAN PELAJAR PRASISWAZAH PEREMPUAN DI SEBUAH UNIVERSITI KOLEJ DI ARAB SAUDI

Oleh

ALMUTAIRI AESHAH HAMDAN M

Disember 2020

Pengerusi : Profesor Shamsul Bahri Mohd Tamrin, PhD
Fakulti : Perubatan dan Sains Kesihatan

Kanser payudara adalah kanser yang paling kerap dikesan dan penyebab utama kematian akibat kanser dalam kalangan wanita di seluruh dunia. Di Arab Saudi, kanser payudara adalah penyebab utama kematian akibat kanser dalam kalangan wanita Saudi. Pengesanan awal kanser payudara dapat memainkan peranan penting dalam mengurangkan morbiditi dan kematian akibat kanser. Pengesanan awal dapat dipertingkatkan dengan meningkatkan pengetahuan, dan meminimumkan halangan mengenai kanser tersebut. Kajian terdahulu menunjukkan kesedaran terhadap kanser payudara adalah rendah dalam kalangan wanita muda Saudi. Aplikasi berasaskan web dan telefon pintar yang merangkumi pelbagai topik kesihatan termasuk gaya hidup sihat, kecergasan, pengurusan penyakit, dan kesihatan awam kini tersedia di semua gedung aplikasi dengan lebih 70% daripadanya disasarkan untuk kesihatan.

Objektif utama kajian ini adalah membangun, melaksana dan menilai keberkesanan program pendidikan mengenai kanser payudara melalui aplikasi telefon pintar berdasarkan pengetahuan, amalan pemeriksaan kendiri payudara dan fahaman kesihatan berkaitan kanser payudara dalam kalangan pelajar wanita di kolej-kolej universiti di Arab Saudi.

Kajian ini merangkumi dua fasa iaitu pembangunan aplikasi pendidikan dan penilaian protokol pendidikan melalui percubaan terkawal secara rawak dalam kalangan pelajar wanita. Fasa pertama adalah berdasarkan pendekatan kualitatif dan melalui panel pakar, versi akhir aplikasi disiapkan dan disahkan. Fasa kedua

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dilaksanakan melalui percubaan terkawal secara rawak (RCT) bagi pemilihan peserta. Semua pelajar wanita yang memenuhi kriteria kemasukan kajian dijemput untuk mengambil bahagian dengan penyediaan borang persetujuan yang dimaklumkan. Data asas dikumpulkan daripada 144 pelajar wanita (72 daripada kumpulan intervensi dan 72 daripada kumpulan kawalan). Instrumen kajian yang merangkumi komponen pengetahuan, amalan, fahaman kesihatan dan penerimaan teknologi diadaptasi dan diguna pakai berdasarkan sorotan kajian. Kandungan dan kesahan muka pula dinilai oleh panel pakar yang diikuti dengan kajian rintis. Modul intervensi program pendidikan kanser payudara disahkan dan dibangunkan menggunakan aplikasi telefon pintar. Data dikumpulkan pada peringkat awal, satu bulan, tiga bulan dan enam bulan setelah intervensi bagi kedua-dua kumpulan. Statistik deskriptif dan inferensi yang digunakan adalah pengukuran berulang dua arah ANOVA dan ujian Chi square bagi menganalisa data menggunakan perisian SPSS versi 24.

Keputusan pengukuran berulang dua arah Anova menunjukkan bahawa kesan intervensi terhadap pengetahuan tentang kanser payudara dalam ujian-ujian pra, pasca dan susulan adalah signifikan dan tahap pengetahuan dalam kumpulan intervensi meningkat setelah menggunakan aplikasi tersebut. Berdasarkan keputusan ini, didapati bahawa kekerapan pemeriksaan kendiri dalam kumpulan intervensi adalah (79.5%) bagi ujian susulan 1 dan meningkat kepada 86.3% dalam ujian susulan 2 yang jauh berbeza berbanding kumpulan kawalan ($p < 0.001$). Keputusan ini juga menunjukkan bahawa kesan intervensi (menggunakan aplikasi) terhadap tahap komponen fahaman kesihatan (tanggapan-tanggapan terhadap keseriusan, kerentanan, manfaat serta halangan, keyakinan dan motivasi kesihatan) dalam ujian-ujian pra, pasca dan susulan dalam intervensi telah meningkat dengan ketara: keseriusan [3.23(SP 0.36), 3.65(SP 0.53), 3.71(SP 0.46), 372(SP 0.43), $p<0.01$] dan kerentanan [2.90(SP 0.29), 3.79(SP 0.34), 3.79(SP 0.35), 3.83(SP 0,35), $p<0.01$] dan manfaat [2.83(SP 0.34), 3.66(SP 0.24), 3.72(SP 0.22), 3.87(SP 0.19), $p<0.01$] dan halangan [4.14(SP 0.29), 2.46(SP 0.32), 2.22(SP 0.39), 2.19(SP 0.40), $p<0.01$] dan keyakinan [3.08(SP 0.37), 3.77(SP 0.31), 3.85(SP 0.31), 3.83(SP 0.22), $p<0.01$] dan motivasi kesihatan [2.94(SP 031), 3.86(SP 0.27), 3.99(SP 0.25), 3.97(SP 0.28), $p<0.01$] masing-masing. Perbezaan antara kumpulan intervensi dan kawalan juga signifikan secara statistik dalam ujian pasca, susulan 1 dan susulan 2 ($p < 0.05$). Keputusan bagi komponen penerimaan teknologi dalam kalangan pelajar kumpulan intervensi menunjukkan peningkatan ketara sepanjang masa bagi semua tahap.

Aplikasi telefon pintar pendidikan kanser payudara adalah pendekatan berkesan dalam meningkatkan pengetahuan, amalan pemeriksaan kendiri payudara dan komponen kefahaman kesihatan terhadap kanser payudara dalam kalangan pelajar wanita. Berdasarkan dapatan kajian ini, lebih banyak eksperimen intervensi diperlukan bagi diterapkan di tempat kerja, kawasan luar bandar, bandar serta kawasan lain. Selain itu, aplikasi ini boleh digunakan di dalam domain hospital/kesihatan kemasyarakatan. Ia juga boleh digunakan secara individu oleh pelajar-pelajar wanita bagi mengesan barah payudara tanpa menanggung kos yang besar.

Kata kunci: kanser payudara, pengetahuan, praktik pemeriksaan diri, Arab Saudi, pelajar perempuan.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Shamsul Bahri Hj Mohd Tamrin, PhD
Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Chairman)

Norliza Ahmad, PhD
Medical Lecturer
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Member)

Rahmita Wirza O.K. Rahmat, PhD
Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 06 May 2021

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LIST OF ABBREVIATIONS

BC	Breast Cancer
BSE	Breast Self-examination
CBE	Clinical Breast Examination
SA	Saudi Arabia
SCR	Saudi Cancer Registry
GCC	Gulf Cooperation Council
ASIR	Age-standardised incidence Rate
ICTs	Information and communication technologies
HRT	Hormonal Replacement Therapy
CCP	Contraceptive Pills
BMI	Body Mass Index
HBM	Health Belief Model
App	Application
TAM	Technology Acceptance Model
ANOVA	Analysis of Variance
EFA	Exploratory Factor Analysis
CFA	Confirmatory Factor Analysis

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CHAPTER 1

INTRODUCTION

1.1 Study Background

As the most typically diagnosed kind of cancer, breast cancer is the one of the leading reasons of death for females globally, with about 1.7 million diagnosed cases and 521,900 deaths in the year 2012 (Jacques Ferlay, 2015). Breast cancer makes up 25% of all cancer cases and 15% of every cancer death for females (Torre et al., 2015).

In the United States, this kind of cancer is responsible for more deaths in females than cancers in any other site, apart from lung cancer (American Cancer Society, 2008). Across all racial and ethnic groups, it is the most typically diagnosed invasive cancer in the U.S. with about 232,340 new cases that are diagnosed annually, and in the near future 39,620 BC deaths are predicted to occur among US females (Siegel, Naishadham, & Jemal, 2013). Generally, one in every eight females in the US will develop BC in her life. BC rates rise slightly for African American females (DeSantis, Ma, Bryan, & Jemal, 2014).

In Africa, BC is characterised by patients presenting advanced disease, an absence of information about BC incidence, great costs of screening and inaccessibility of screening facilities (Groot, Baltussen, Uyl-de Groot, Anderson, & Hortobágyi, 2006).

According to a study by (Wong & Cheng, 2002) conducted on Thai females, the cost of screening and the distance to screening facilities are important factors that in investigating the rate of screening services for BC. The high cost of clinic breast examination as well as mammography, particularly in developing nations is a very significant barrier to the acceptance of such services by females (Yip et al., 2011). Another study conducted by (Maheswaran, Pearson, Jordan, & Black, 2006) discovered that breast screening is negatively correlated with travel distance to the screening facility, i.e., the greater the travel distance to the screening facility, lower the rate of breast screenings.

In the Gulf Cooperation Council (GCC) nations, BC rates are the highest in Bahrain, followed by Kuwait and then Qatar, in comparison with other Arab nations like Saudi Arabia 22.4/1000 population or like Yemen 20.8/1000 population (Kandasamy Ravichandran & Al-Zahrani, 2009).

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In the case of Saudi Arabia, the most typical kind of cancer among Saudi females is breast cancer. It is typically responsible for over25% of any diagnosed cancers in females (Radi, 2013). In Saudi Arabia, BC typically occurs at an advanced stage and more often in premenopausal young women compared to Western countries. (Chiedozi, El-Hag, & Kollur, 2003). Moreover, the Saudi Cancer Registry (SCR) has recorded the rate of cancer cases in this population to be around 8,054 (Saudi Cancer Registry, 2006). The cancer is more typical for females than men. In 2006, cancers were found to affect 5,476 (49.6%) males and 5,564 (50.4%) females, with a male to female ratio of 98:100. The most typical cancers for females in Saudi Arabia were breast, thyroid, colorectal, and Non-Hodgkin's lymphoma (Kandasamy Ravichandran, Al-Hamdan, & Mohamed, 2011).

In 2010, the breast cancer was the ranked ninth in leading cause of mortality among females in Saudi Arabia (SA) (Lozano et al., 2013; Mokdad et al., 2014). besides, an additionally 1,308 new BC incidents were recorded in 2009 and about a quarter of all the new cancer cases were among Saudi females (Bcheraoui et al., 2015). Breast cancer is predicted to rise in the future in Saudi Arabia (SA) because of the growth of the population in the country (Ibrahim, Zeeneldin, Sadiq, & Ezzat, 2008).

The term ‘social media’ is defined as the use of web-based and mobile technologies to transform communication into an interactive dialogue. Therefore, social media can be found in various forms such as social blogs, Twitter, photos, wikis, podcasts, videos, ratings as well as social bookmarking (Baruah, 2012).

Health apps on mobile phones are by the most widely used apps, with about 30% of U.S. adults found to use health apps on their mobile phones (Kratzke & Cox, 2012). It is projected that in the near future, 500 million people internationally are using health apps (Sarwar & Soomro, 2013). A small number of Internet research suggested that adults aged 30 to 49 (32%) used health apps slightly more frequently than young adults aged 18 to 29 (28%) as well as 50 years and older (20%) with numbers increasing annually for adults of all age groups (Kratzke & Cox, 2012).

The available apps include a range of health topics such as healthy lifestyles, disease management, fitness and public health (Covolo, Ceretti, Moneda, Castaldi, & Gelatti, 2017; Higgins, 2016). More than 17,000 mobile health and medical apps are available across all app stores with more than 70% of these apps designed for health professionals (Zhang & Koch, 2015).

Information and communication technologies (ICTs) are transmission defined and employed to convey and store data electronically. This can comprise SMS, e-mail, messaging, video chat, as well as social media (e.g., Instagram). It also comprises all the various computing equipment that enable a broad range of transmission information functions (Perron, Taylor, Glass, & Margerum-Leys, 2010). Mobile

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phones and text messaging have become important transmission tools linking diverse groups of people worldwide (Subrahmanyam & Greenfield, 2008).

1.1.1 Social Media and Health Care

Social media currently forms an essential aspect of the public health conversation (Heldman, Schindelar, & Weaver III, 2013). Social networking sites can be inexpensively applied without significant support from universities (Tiryakioglu &Erzurum, 2011). This also enables them to be successfully incorporated into educational processes (Tiryakioglu & Erzurum, 2011).

Medicine is constantly evolving in order to be adaptive to new technologies (Korica & Molloy, 2010). These advances have led to new therapies, diagnostic tools, and ways of transmission (Chretien & Kind, 2013). Advances in information technology introduced innovative design methods that support health care delivery and education/information (Demiris et al., 2008). Such developments can involve redesigning processes of health care and the combination of electronic connections at all levels (Wang, Kung, Wang, & Cegielski, 2017). Through the application of social media, many methods can be used for two-way communication. This also enables public trends and activities to be easily and rapidly monitored (Korica & Molloy, 2010; Vance, Howe, & Dellavalle, 2009). Such new technologies or programmes have the ability to improve public health, address many contemporary challenges and mandates about communicating with educating, engaging and monitoring a diverse public and society (Capurro et al., 2014).

1.2 Problem Statement

Every year, BC affects excess of 1.3 million women globally and constitutes approximately 14% of all cancer-related deaths (Jemal et al., 2011). Not only has the prevalence of BC increased in recent years, it is predicted to rise substantially in the coming years (Smith, Smith, Hurria, Hortobagyi, & Buchholz, 2009). Hence, BC remains a considerable health burden.

In Saudi Arabia, as is also the case in several other countries, BC is the most typical cancer among females. This is followed by other kinds of cancer such as thyroid and colorectal cancer (Alghamdi, Hussain, Alghamdi, & A El-Sheemy, 2013). In 2008, the International Agency for Research on Cancer (IARC) estimated the "age-standardised incidence Rate" (ASIR) of BC to be 22.4 per 100,000, with an age standardised death rate of 10.4 per 100,000 in Saudi Arabia (Ferlay et al., 2010). The Saudi Cancer Registry recorded 3,629 females with BC according to a World Health Organisation (WHO) report in 2019. Additionally, the highest percentages of BC in females, i.e. 38.6% and 31.2%, were recorded in females of age 30 to 44 years and 45 to 59 years, respectively (Alghamdi et al., 2013).

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In Saudi, between January and December 2015, 1,979 BC cases were recorded. BC accounted for 16.7% of all cancers recorded for the Saudi population, and 30.1% of all cancers recorded for females of all ages. The Age-Standardised Incidence Rate (ASIR) was 24.3/100,000 for the Saudi females. This percentage is significantly higher than the percentage of colorectal cancer, which is next highest among Saudis at 12.2 % or 1465 people. It is perhaps not surprising given that BC screening among Saudi women is low and that knowledge of BC among all Saudi women has been found to be poor (Al-Zalabani et al., 2018). In addition, it was also found that Saudi women have misconceptions regarding BC examination, particularly mammography (Alam, 2006; Al-Zalabani et al., 2018; Habib et al., 2010; Mahfouz et al., 2013; Sait et al., 2010).

Estimating cancer prevalence based on morbidity and mortality statistics is a necessary step towards prioritising cancer control (Veronesi, Goldhirsch, Boyle, Orecchia, & Viale, 2005). Delaying the diagnosis of early stages of BC may lead to poor treatment outcome, lower survival rates as well as increase in the costs of drugs and treatment process (Anderson BO, 2008). A significant factor contributing to the late diagnosis of BC among Saudi females is a lack of awareness which leads them place their trust in illness-related beliefs. Such lack of awareness is attributed to the lack of knowledge, as well as social and cultural factors (AL-Mulhim et al., 2018). Numerous studies have confirmed this lack of basic information and understanding and as its correlation with a late-stage diagnosis of the disease. Recent research conducted in Riyadh has revealed that, while more than 90% of females knew about breast self-examination (BSE), the majority (79%) did not perform it regularly (Saeedi, Al Amri, Ibrahim, & Kassim, 2014). Another study conducted in Saudi Arabia found that 29.7% of females practised BSE (Mahfouz et al., 2013).

In a study conducted to assess the effectiveness of social networking sites (SNSs) when applied as interventions to influence health behaviours, it was found that interventions through SNSs positively affected health behaviour-related outcomes (Cartledge, Miller, & Phillips, 2013). SNSs are used by BC patients usually to share information on the disease including information on awareness creating apps.

Generally, interventions that raise women's adherence to any BC screening guides are typically known to cause a considerable drop in the number of females reporting late-stage BC diagnoses. This would lead to lowered BC deaths among females (Saslow et al., 2012). On the other hand, in Saudi Arabia, the females lack awareness about BC screening (Abdel-Aziz et al., 2017; Binhussien & Ghoraba, 2018).

It has been proven that early detection of BC is crucial due to the established relationship between the stage of BC detection and the five-year survival rate (Ghoncheh, Pournamdar, & Salehiniya, 2016; Rahimzadeh, Baghestani, Gohari, & Pourhoseingholi, 2014). BC diagnosed at earlier stages (stages I and II) have higher five year survival rate than cases diagnosed in the late stages of III and IV (Jedy-

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Agba, McCormack, Adebamowo, & dos-Santos-Silva, 2016). In Saudi Arabia, over half of the cases were diagnosed at late stages (Alshahrani et al., 2019; Yousuf, Al Amoudi, Nicolas, Banjar, & Salem, 2012). Therefore, early detection is critical and should be prioritised in awareness campaigns to improve BC outcomes. As such, it is necessary to recognise the most crucial step of BC discovery, which is to find it at an early age, for example, when females are in high school or university (Memon, Kanwal, Sami, Larik, & Farooq, 2015; Younis, Al-Rubaye, Haddad, Hammad, & Hijazi, 2016).

To arrest the trend of rising cases of BC, Saudi Arabia has seen rapid changes across mobile and internet platforms that can be employed to raise awareness and provide remote medical care (Alosaimi, Alyahya, Alshahwan, Al Mahyijari, & Shaik, 2016; Alotaibi, Furnell, Stengel, & Papadaki, 2016). The Saudi Arabia is witnessing a rapid increase in the number of internet and smartphone users and it had been predicted that the number of these users would have reached 19.1 million by 2019 (Statista, 2016). Several research studies have demonstrated that social media and mHealth and eHealth technologies are effective tools for cancer patient education, support, prevention, management, and treatment (Attai et al., 2015).

Despite this impressive array of studies, to date, to the best knowledge of this researcher, no research has been done in Saudi Arabia highlighting the creation of awareness about BC using smartphone apps. Besides, there is very little research information on BC in Saudi Arabia as well as an absence of awareness on BC for females, especially younger females. There is, therefore, a gap within the extant literature that needs to be bridged through scholarly attention. Although, several conceptual models have been proposed that offer frameworks for enhancing cancer screening care and identifying gaps in the screening processes (Taplin, Yabroff, & Zapka, 2012; Zapka, Taplin, Anhang Price, Cranos, & Yabroff, 2010). For instance, Zapka et al. (2003) proposed an ecological model that involves three tiers of individual woman, provider team, and organisation across three forms of care including screening detection, diagnosis, and treatment. Nonetheless, there lacks a cost effective and practical way for promoting BC screening self-examination for females in Saudi Arabia.

It is apparent from the above that there is a need for more intensive education to raise awareness related to BC symptoms and correct the misconceptions surrounding this disease. Educational intervention is of equal importance to overcome the barriers to practising self-examination regularly and improve women's confidence in their capability to perform it. To our knowledge, this interventional study is unique in attempting to increase BC awareness among the Saudi Arabian population, using the Health Belief Model (HBM) which is a theoretical model used in many studies as the theoretical framework for understanding early detection behaviours of BC. As a result of the lack of studies on educational BC applications in the Saudi context, this research seeks to develop an educational application that will educate women and provide the necessary information prevent, control and minimis the effects BC, particularly in women.

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1.3 Significance of the study

This research will be beneficial in the field of public health in Saudi Arabia as it targets a group of Saudi female undergraduate students to look at their current BC screening practices, especially BSE. Besides, they were asked about their knowledge and beliefs as such information would assist health care planners and providers to understand perceived beliefs and barriers among educated females in Saudi.

The findings from this study will add significantly to the existing body of knowledge required to design an effective health promotion programme to enhance breast self-awareness among Saudi women. On the basis of the information derived from this study, the health care providers (doctors, nurses, etc) can be familiar with women's perception of BC. Health care centres can manage intervention programmes to address BC awareness issues.

Increasing the level of BC knowledge and perception towards BSE among educated Saudi females can help health educators develop prevention programmes. Moreover, it can be used as a reference to assess future education programmes by health agencies.

The use of social media has enabled one to talk to with thousands of other people in real time. This method can facilitate the role of health educators and increase health awareness for people. Health educators can disseminate a lot of information through social network sites to the target audience.

In the Middle East, about 88% of internet users actively use SNSs. In Saudi Arabia, the number of SNS users is increasing. In 2013, there were 7.8 million Facebook users, 5 million Twitter users, and 1 million people on LinkedIn. With such a substantial audience, health authorities can deliver messages relating to health problems to a large number of Saudi females, especially more sensitive information such as BC prevention and its early detection. It is therefore necessary to initiate an interventional study to properly use these social network sites to create awareness regarding BC for females. A good method of doing so is by assessing awareness and practices regarding BC for females. Based on this perspective, the current study provides baseline information on the level of awareness and practice for these females.

According to (Pilevarzadeh, 2016), BSE is a lower-cost and lower-potential risk intervention. Therefore, this study may help females to detect BC early by practising self-examination at home via a cost-effective method through the app.

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Therefore, this study contributes to BC prevention measures through the use of a smartphone app that measures its impact on health education in relation to BC for female students in Saudi Arabia.

1.4 Research questions

In light of the above, the following research questions are formulated:

1- How does the educational intervention influence the knowledge and HBM of the university college students in Saudi Arabia?
2- What is the level of knowledge, practice and belief regarding BC and knowledge about self-examination practice among female students in University College in Saudi Arabia at baseline?
3- What is the effect of the intervention on increasing knowledge, breast self-examination practice and health beliefs among female students in University College in Saudi Arabia?

1.5 Study Objectives

1.5.1 General Objective

The general objective for this work is to construct, implement and assess the overall effectiveness of the proposed educational content regarding BC via smartphone app on influencing knowledge, breast self-examination practices and health beliefs related to BC for female university college students in Saudi Arabia.

1.5.2 Specific Objectives

i. To develop breast cancer smartphone App that can improve knowledge, breast self-examination and beliefs related to BC among female students in University College in Saudi Arabia.
ii. To determine the socio-demographic characteristics of the respondents for both intervention and control groups at baseline.
iii. To determine and compare the level of knowledge about BC and self-examination practice among female students in University College in Saudi Arabia between the intervention and control group at baseline.
iv. To determine and compare the level of health beliefs related to BC among female students in University College in Saudi Arabia at baseline.
v. To determine and compare the level of breast self-examination practice among female students in University College in Saudi Arabia at baseline.
vi. To compare the level of knowledge, practice of breast self-examination and health beliefs related to BC between and within each group intervention and control at baseline and post intervention.

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vii. To determine the level of technology acceptance model (TAM) component among female students in University College in Saudi Arabia.
viii. To determine the effect of educational content regarding breast cancer via smartphone application on knowledge, health belief and self-examination practice among female students in University College in Saudi Arabia between intervention and control groups at baseline, one month, three months and six months after intervention.

1.6 Research Hypothesis

i. Educational intervention has significant influence on the knowledge and HBM of the university college students in Saudi Arabia
ii. There are significant differences between control and intervention groups for knowledge, breast self-examination practice and health beliefs related to BC at baseline, one month, three months and six months after intervention.
iii. There are significant differences in the level of technology acceptance model after intervention among the intervention group.
iv. There are significant differences between baseline and post intervention assessment of the knowledge, breast self-examination practice and health beliefs related to BC among the intervention group.

1.7 Conceptual Framework

An overview of the conceptual framework of this study is presented in Figure 1.1 below The Health Beliefs Model is utilised as a guideline in implementing the education programme. By adopting the components of the HBM model, the education helps to enhance BC prevention behaviours. Based on HBM, females are more likely to perform breast self-examination if they knew that women are usually susceptible to BC and it is a dangerous illness to have.

Additionally, females who see increased benefits from BSE with less barriers are more likely to perform BSE. Also, females who are more encouraged to enhance their health overall are more likely to practise BSE, particularly if they are confident in performing it correctly. The objectives of increased susceptibility and seriousness, benefits, health motivation and reduced barriers are attained by supplying those with information on BC and methods to carry out self-examination through the BC app. Socio-demographic factors like individual factors are linked to female's knowledge about BC as well as BSE practice techniques. Furthemore, based on the main outcomes for the intervention-based group, the components of the technology acceptance model were evaluated to assess the level of acceptance and usability of a new app for students.

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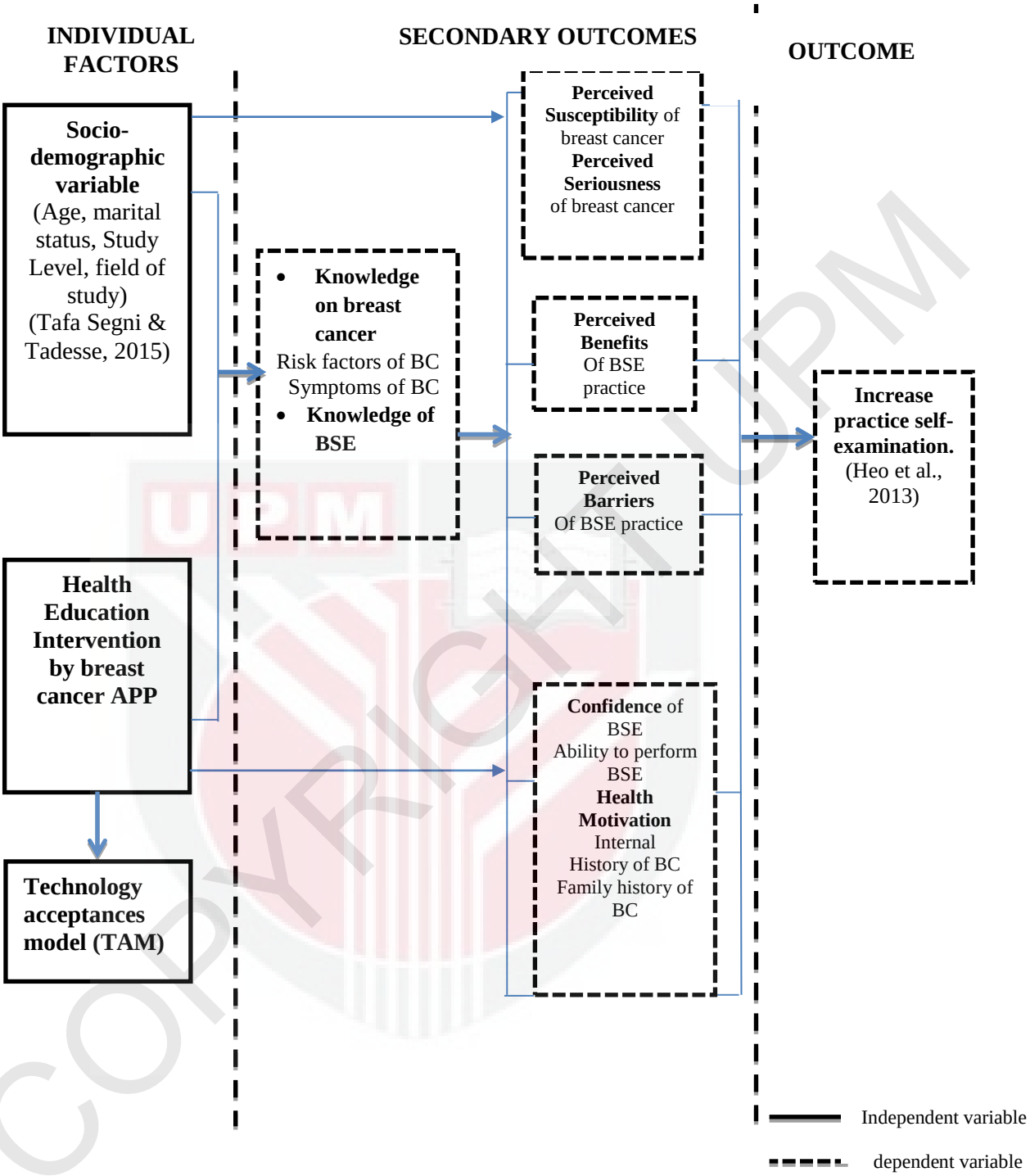

Figure 1.1 : conceptual framework of study based on Health Belief Model (HBM) (Source : Rosenstock, Strecher, & Becker, 1988)

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1.8 Operational Definitions of Study Variables

Breast Self-Examination (BSE)

Breast Self-Examination increases a female's overall awareness of breast health by looking for any possible changes in their breasts. It is crucial to be aware of the need to carry out BSE correctly. This involves applying correct techniques to practice BSE and performing BSE at the correct times and frequencies. Essentially, this is an assessment done by a female on her breasts to check for lumps or any other changes.

Knowledge of breast cancer

This is defined as "information about definition, abnormal symptoms and signs, the risk factors for BC and early detection measures of BC". It is assessed by measuring the proportion of right awareness that the participant has. In the current research, BC knowledge is shown to be a secondary dependent variable that impacts the practice of BSE, and the educational BC mobile app impacts knowledge about BC.

Knowledge of breast self-examination

This is defined as "information on the BSE definition, its properties, values, frequencies, as well as the most suitable time duration for BSE practice". Other than this, the secondary dependent variable that impacts BSE practices is overall knowledge about BSE.

Health Belief constructs

This means "to construct a relevant intervention programme, the programme is grounded on the six constructs of the Health Belief Model, which are: susceptibility, seriousness, benefits, barriers, health motivation, and confidence". The Health Belief Model is a theoretical framework widely used in the design of health education programmes.

Within this framework, females are more likely to perform BSE if they see that they are prone to BC at any time and that BC is a very serious disease. Also, females who believe that there are more benefits and less barriers to BSE practice are more likely to perform BSE. Different factors involve the motivation females have to improve their health and also the confidence in their capability to perform BSE. In the present study, HBM is the secondary dependent variable that affects engagement in BSE, while the techniques of health education affect HBM.

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Health Education Intervention

This is explained as "a health education programme designed to provide health information through a smartphone app related to BC. This information includes signs and symptoms of BC, risk factors, survival rates and stages, screening methods, treatment process and prognosis of BC for females" . All of this new knowledge is provided to study participants during the intervention phase via a particular package used to bridge the knowledge gap among the up-to-date existing knowledge and that which is known by the study participants.

The education package comprises general information about BC, videos, photos, two languages (English and Arabic), and an alarm to remind the study participants of the right time for doing BSE.

Socio-demographic Attributes Variable

The socio-demographic variables are described as "information about the following characteristics: age, level of education, income of family, as well as marital status, that are investigated in this study.

1.9 Definition of terms

Breast cancer

BC is " a kind of cancer whereby the cells in the breast tissue divide and grow without control" (American Cancer sociaty, 2012).

Breast self-examination (BSE)

This is " a diagnostic technique regularly performed by a female on her breasts to check for lumps or other changes" (Okolie, 2012).

Health education

The term health education is " a combination of the learning experiences created to help people enhance their health, by raising knowledge or influencing their overall attitudes" (Nutbeam, 2000).

Mobile phones

Mobile phones are " devices with more abilities and tools like e-mail, messaging, video chat, as well as wireless access" (Miangah & Nezarat, 2012).

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App

An app is " a downloadable software product that runs on mobile devices" (Sherwin-Smith & Pritchard-Jones, 2012).

Health belief model (HBM)

The Health Belief Model (HBM) is "a model that explains the health behaviours by determining on the attitudes of individuals." This was initially developed in the 1950s by the social psychologists Kegels, Hochbaum, and Rosenstock working in the US Public Health Service (Calnan, 1984).

Technology Acceptance Model (TAM)

It is "an established model based on any psychological interaction of users with technology. It aims to address issue of how users use or accept information technology". The TAM uses the following constructs: The Perceived Usefulness (PU), the Perceived Ease-of-use (PEOU) and the Attitudes Towards Usage (ATU). These are used to predict the general adoption of any new technological systems (Davis, 1989).

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