Mobile Health Applications to Increase Health Literacy about Hypertension among Jamaican Adults

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# **Chapter 1: Introduction**

## **Background**

According to the World Health Organization (WHO), an estimated 1.13 billion people worldwide suffer from hypertension. Often referred to as “high blood pressure”, hypertension is a serious medical condition that significantly increases the risk of heart, brain, kidney and other diseases (World Health Organization, 2019). WHO (2019) marks hypertension as a major cause of premature deaths as it is estimated to cause 7.5 million deaths contributing to 12.8% of all deaths worldwide. The prevalence of hypertension in the Caribbean is high, affecting 21% of adults in Barbados and Trinidad and Tobago, 25% in Jamaica, and 35–38% in St Kitts, British Virgin Islands and Grenada (Figueroa, Harris, Duncan & Tulloch-Reid, 2017).

Hypertension rates have been shown to decline through the intervention of health literacy. By utilizing provided health-related resources, individuals can make informed decisions to take charge of their own health (Brabers, Jany J. D. Rademakers, Groenewegen, Dijk, & Jong, 2017). Health literacy has proven to be beneficial to overall patient health by increasing patient knowledge and satisfaction, provide better peace of mind as well as offer better compliance to treatment (Brabers et al., 2017). On the other hand, low or non-existent levels of health literacy have been shown to coincide with poor health outcomes, negative behaviour and higher health costs (Aoki & Inoue, 2017). Health literacy offers an approach to maximize individuals’ health knowledge, understanding of health-related issues and how to respond to those issues (Heijmans & Rademakers, 2018).

With the implementation of mHealth technology into the healthcare industry, an effective method was born to deliver healthcare services such as patient management, education and diagnosis support (Gagnon, Ngangue, Payne-Gagnon, & Desmartis, 2015). mHealth applications are rapidly transforming the way health services and information are accessed, delivered and managed (Han & Lee, 2018). An estimated 325,000 health, fitness, and medical mobile applications are available (Donevant, Estrada, Culley, Habing & Adams, 2018). Considering its ubiquity, mHealth technology provides a prospective way to promote health literacy and patient self-management (Bengtsson, Kjellgren, Hallberg, Lindwall, & Taft, 2015).

With respect to hypertension, several studies have been conducted on the use of mobile technologies in aid of keeping the condition under control. Patients using mHealth devices have shown improvements in blood pressure reduction as compared to those who do not (Bhavnani, Narula, & Sengupta, 2016). Moreover, Benggtsson et al. (2015) in a paper titled *“Improved Blood Pressure Control Using an Interactive Mobile Phone Support System”*, the self-monitoring of hypertension proved most successful when coupled with education and counselling.

A study of the influence of self-monitoring mHealth applications showed that hypertensive individuals eager to change health behaviours were excellent candidates and improved with the added aid (Kim, Wineinger, & Steinhubl, 2016). A randomized clinical trial with the use of home blood pressure telemonitoring alongside a self-care mHealth application yielded results of mean systolic blood pressure decreasing by more than 9 mm Hg (Logan, 2013). Improvements in blood pressure have also been demonstrated with the use of SMS interactive monitoring that sets reminders for patients, collects data and schedules visits (Marcolino, et al., 2018).

## **Problem Statement**

Hypertension is one of the most pervasive medical conditions globally and it affects approximately 1 in 4 Jamaicans (WHO 2019; Figueroa et al., 2017). One of the many reasons hypertension is so prevalent is due to a lack of health literacy. Health literacy is a social factor that involves the use of health-related education and services to make critical health decisions (Machado, Lima, Cavalcante, Araújo, & Vieira, 2014). Health literacy has proven to be beneficial to overall patient health, patient knowledge and satisfaction (Brabers et al., 2017).

Furthermore, mHealth tools, devices and applications have been shown to be successful in improving patients’ overall health (Han & Lee, 2018). Research has shown substantial evidence that mHealth applications have in fact reduced blood pressure in patients especially when paired with health education and counselling (Bhavnani, Narula, & Sengupta, 2016; Benggtsson et al., 2015). mHealth applications are accessible, available and offer an efficient means to counter hypertension by offering much-needed healthcare services as well as relevant health information to users (Ganon, et al.; Han & Lee, 2018); all in the palm of the hand. However, despite promising results involving the implementation of mHealth applications against hypertension, more clinical trials and real-world applications are needed (Parati, Torlasco, Omboni, & Pellegrini, 2017).

## **Purpose of the Study**

The purpose of this study is to explore the effectiveness of health literacy through the use of a mHealth application to counter hypertension. We will examine how mHealth applications can incorporate the use of health literacy to improve the self-managing behaviours of individuals by fostering informed thinking and decision making.

## **Significance of the Study**

It is anticipated that through the use of mHealth applications, hypertension rates may be successfully reduced by introducing standardized health literacy in Jamaica. We expect an overall better health status for Jamaicans. In addition to this, it is hoped that the Jamaican health sector can exploit the use of mHealth technology to improve Jamaica’s healthcare system.

## **Research Questions**

1. What is the hypertension health literacy levels of urban Jamaican adults (by age, sex and education level)?
2. What is the technology acceptance of mHealth among urban Jamaican adults?
3. How effective can mHealth applications be in improving the hypertension health literacy of urban Jamaican adults? (look at additional literature)

**Delimitations**

Overall participant sample is restricted only to the Papine, St. Andrew population.

## **Definition of Terms**

* **Hypertension** - Known as high blood pressure, is the atypical high in arterial blood pressure throughout the body.
* **Systolic blood pressure** - The pressure at which the heart beats – while the heart muscle is contracting (squeezing) and pumping oxygen-rich blood into the blood vessels.
* **Diastolic blood pressure** - The pressure on the blood vessels when the heart muscle relaxes. The diastolic pressure is always lower than the systolic pressure.
* **mm Hg** - Millimetres of mercury. Unit of measure for pressure.
* **mHealth** - the use of mobile and wireless communication technologies to improve healthcare delivery, outcomes, and research**.**
* **Health Literacy** - Health Literacy has been defined as the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health.

# **Chapter 2: Literature Review**

## **Introduction**

Hypertension is one of the most pervasive medical conditions in the world and is responsible for millions of deaths annually. It can be described as abnormally high arterial blood pressure, thus the reason for its more common name “high blood pressure” (Singh, Shankar, & Singh, 2017). Often dubbed the “silent killer”, hypertension tends to remain unseen during its early stages unless detected by measurements or as a result of severe ailment (Singh et al., 2017). However, adjustments in lifestyle can effectively prevent or tame the condition (Rajati et al., 2019). The contributors to higher blood pressure are being overweight or obese, excessive salt intake, alcoholism, poor dieting and not enough physical activity (Carey, Muntner, Bosworth, & Whelton, 2018). These factors are not only linked to higher than normal blood pressure but allow hypertension to be the main risk factor for other medical issues such as coronary heart disease and failure, chronic kidney disease, stroke, and cerebrovascular disease among many others (Singh et al., 2017; Carey et al., 2018).

Health literacy is a means by which hypertension can be targeted. With greater levels of health-focused education for hypertension, it can be managed and/or prevented. mHealth technology has proved most effective in combatting well-known diseases. Hence, the use of mHealth applications could prove a feasible medium to administer health literacy. mHealth applications are cost-effective, accessible and available to individuals who need it. The literature confirms the issue of the prevalence of hypertension in Jamaica, health illiteracy as a huge contributing factor, and how with the use of mHealth applications, hypertension can be prevented, managed and/or controlled.

## **Prevalence in Jamaica**

All Jamaicans at some point another have heard of hypertension or by its more common name ‘high blood pressure’. It is estimated that at least 1 in 4 Jamaicans are hypertensive (Figueroa, Harris, Duncan & Tulloch-Reid, 2017).

There have been multiple studies and surveys captured over the years which highlight statistics about this medical condition that has plagued the island. One such body is The Jamaica Health and Lifestyle Survey which is tasked with conducting and analyzing various medical surveys on the island. Based on a study conducted by the Jamaica Health and Lifestyle Survey in 2007-2008, a parallel study was published by Trevor et al. in 2018. This study aimed to give insight into how prevalent hypertension was amongst you adults. From the study, 898 young adults between ages 18 and 20 were tested for various medical attributes such as blood pressure, glucose levels as well as other anthropometric measurements. From the blood pressure test that was carried out on the sample approximately 21% tested for hypertension (Trevor et al., 2018). Statistically, in comparison to other studies, this number could’ve been much higher if a wider range in age were included in the survey.

Another example is a study of a blood pressure campaign carried out by the International Society of Hypertension. This campaign took place from May to June of 2017 (Nwokocha, et al., 2019). The participant sample comprised of 566 individuals who volunteered to be a part of the study. These volunteers hailed from 5 different eastern parishes and included participants from various factions such as schools, churches, and civil institutions as well as accounting for individuals from both rural and urban areas. According to Nwokocha, et al. (2019), of the 566 participants tested for hypertension, 267 were classed as hypertensive which is 43.7%. Of those who tested positive 35.6% were completely unaware they were hypertensive.

Additionally, an alternative study was carried out by Lock Haven University in the United States. In this study, a basic health clinic was set up in a rural community in Manchester, Jamaica (Hershey & Way, 2017). This clinic collected medical data such as BMI and blood pressure readings along with the medical history of the 95 individuals. Their results concluded that 42% of the individuals interviewed and tested were hypertensive.

Many more hypertension surveys and initiatives have been carried out over the years. All the results of these studies point to the obvious fact that the Jamaican population is struggling with dealing with the medical condition**.** Given the facts presented it is quite clear that this issue of hypertension needs to be taken into serious consideration and addressed urgently.

## **Health Literacy**

As described by Machado, Lima, Cavalcante, Araújo, & Vieira (2014), health literacy is defined as “the capacity to obtain, process and understand basic health information and services required to make appropriate health decisions”. Higher levels of health literacy are equivalent to better health status such that it allows individuals to adopt healthier behaviours and utilize critical thinking to gather and seek out relevant health information (Jacobs, Lou, Ownby, & Caballero, 2014; Chan & Kisa, 2019). Health literacy can be regarded as a social factor that influences or has a positive impact on overall health (Loan, et al., 2018). Loan, et al., (2018) states that this social factor is geared towards effectively focusing and promoting greater control over health through education and an individual’s internal motivation to keep healthy. On the contrary, low health literacy has proven to be synonymous with poorer health status, non-adherence to medication and increased hospitalization rates (Jacobs, Lou, Ownby, & Caballero, 2014). Jacobs et al., (2014) in a published systematic review, stated that a lack of health literacy influenced the increased use of health services which led to higher health costs.

## **Health Literacy and Hypertension**

With hypertension estimated to affect approximately 1.56 billion people by the year 2025, an intervention needs to be put in place to lessen its occurrence (Rajati, et al., 2019). Many interventions have been approached over the years to utilize health literacy to combat common diseases such as asthma, diabetes and heart failure (Halladay et al., 2017). However, very few studies have been conducted for the hypertensive community (Halladay, et al., 2017). Hypertension health literacy in response, is the capacity to obtain information on the condition, process and understand this basic health information and utilize services available to make appropriate health decisions.

Health literacy is an effective way to keep high blood pressure at bay while simultaneously self-managing the condition to ward off the likelihood of contracting other diseases caused by hypertension’s risk factors (cardiovascular disease, kidney disease, etc.) (Yilmazel & Çetinkaya, 2017). In a study carried out by Yilmazel and Çetinkaya (2017), substantial evidence points to the fact that increased health literacy levels indeed helped to manage hypertension. In a clinical trial conducted by Halladay et al., a multi-level approach was taken to infuse clinical staff and hypertensive patients with the principle of health literacy. The trial proved successful in reducing the average systolic blood pressure amongst the participant sample (Halladay, et al., 2017). The heavy incorporation of health-related information and “by the book” understanding and procedures made the trial even more successful than initially thought possible.

Improvements in hypertension health literacy have been shown to successfully aid in managing and controlling the condition. With a wider range of focus on the application of health literacy to not only incorporate the basics of reading and writing, more interactive approaches should also be taken to maximize patients’ potential (Heijmans & Rademakers, 2018). Nutbeam introduced an interactive approach that entailed the use of a more advanced form of health literacy focused on social skills coupled with active participation. Nutbeam suggests this approach provides health information and allows individuals to formulate informed decisions that allowed them to adapt to changing circumstances (Heijmans & Rademakers, 2018 cited Nutbeam 2000). Thus, it is imperative a method be designed to appropriately administer health-related information hypertensive as well as non-hypertensive patients alike.

## **mHealth Technology**

To define mHealth technology, it is the utilization of mobile technologies to realize health objectives (Blackwell, 2018). Some of these objectives comprise of but is not limited to, enhancing healthcare for underserved populations with limited access to traditional healthcare resources, fill the deficit for primary care physicians and variations in physicians’ practice behaviour, to decrease emergency department visits and lowering healthcare costs (Nelson, et al. 2016; Logan, 2013; Steinhubl, 2013). Health-related applications have great potential for good professional care practices in health promotion, which encourages users to become more aware and responsible in adopting healthy lifestyles (Delgado, et al. 2017). Considering this, mHealth technology provides a prospective way to promote self-management and provide useful tools for obtaining patient information and the monitoring of their well-being (Benggtsson et al., 2015).

## **Computer mHealth Applications**

mHealth applications are rapidly transforming the way health services and information are accessed, delivered and managed (Han, 2018). Their numbers have doubled since 2015 and are projected to be valued at US$102.85 billion by 2023 (IQVIA, 2017), with an estimated 325,000 health, fitness and medical mobile applications available (Donevant, Estrada, Culley, Habing & Adams, 2018).

## **Computer mHealth Applications for Hypertension**

With a growing number of smartphone users and an ever-increasing amount of mHealth applications, there is a ubiquitous method for monitoring hypertension (Kitt, Fox, Tucker, & Mcmanus, 2019). Patients using mHealth devices have shown improvements in blood pressure reduction as compared to those who do not, and as such, numerous blood pressure monitoring devices have been developed (Bhavnani, Narula, & Sengupta, 2016). Take, for example, an iOS application called Cardiogram, which was developed for wearable devices and programmed using deep learning technology. Cardiogram has shown moderate blood pressure reduction for its users by using deep learning algorithms to predict hypertensive state from heart rate input and steps per day count (Kitt, Fox, Tucker, & Mcmanus, 2019).

Likewise, Benggtsson et al. (2015) conducted a clinical trial over an 8 week period using a mobile phone-based self-management support system which incorporated blood pressure self-reports, pulse, lifestyle as well as symptoms, well-being, delivery reminders and encouragement. The daily use of the mHealth system significantly reduced the blood pressure levels of the patients. The system mostly benefited users with moderate to high blood pressure levels. However, optimal results were best seen when the system was used for only a short period of time. Nevertheless, this mobile support application was an effective tool and showed that a mobile support system may be a useful tool to assist with patient self-managing their hypertension (Benggtsson et al., 2015). To add, a study of the influence of mobile self-monitoring health applications showed that hypertensive individuals eager to change health behaviours were excellent candidates and improved with the added aid (Kim, Wineinger, & Steinhubl, 2016).

However, despite growing popularity and widespread availability and accessibility, mHealth applications in general, lack efficacy and very few are successful (Marcolino, et al., 2018; Alessa et al., 2019). Marcolino et al, (2018) summarized that even with positive results in blood pressure reduction as well as improved quality of life, there are not enough clinical trials and systemic reviews to evidently apply mHealth applications on a wider scale. Marcolino et al, (2018) attribute this to sub-par quality in the methods used in published systematic reviews. Promising results from mHealth applications are evident, however, larger and more long-term medical trials are required before these apps can be relied upon to deliver the best possible service (Parati, Torlasco, Omboni, & Pellegrini, 2017). Similarly, Logan (2013) pointed out that a major issue inhibiting the successful nature of mHealth application is lack of “rigorous usability testing”.

Research has shown most mHealth applications lack a theoretical foundation (Alessa et al., 2019). Alessa et, al. (2019) defines the “*theory*” as the identification of patients’ behaviours and how this behaviour can be changed to improve health. Also, present mHealth applications lack privacy and the necessary security measures and as such pose a threat to users’ confidentiality. Most notably, most of these mHealth applications lack the involvement of health care professionals’ influence in the development process. Mckay et al. (2016) highlighted a lack of regulated health promotion as a factor affecting the successful integration of mHealth applications. With that said, collaboration is needed amongst health care professionals, application developers, policymakers and researchers to successfully enhance the process of delivering safe, secure and effective mHealth applications to improve overall health and promote individuals’ self-management (Zhao, Freeman, & Li, 2016).

## **Conclusion**

The literature reviewed gives much-needed insight on the scope of hypertension, health literacy and mHealth applications substantially impacting the structure of our proposed mHealth application. Most notably from the literature, it can be said that hypertension is a huge issue plaguing Jamaica. Nevertheless, though hypertension is so prominent, many Jamaicans are uneducated about the medical condition and this contributes to its growth. Research shows that health literacy focused on hypertension has proven effective in fighting against the condition. With increased health literacy, individuals can process and understand basic health information on hypertension and utilize services available to make appropriate health decisions.

The literature has highlighted mHealth technology, specifically mHealth applications, as an avenue to execute health literacy. mHealth applications, across several studies, have been shown to reduce blood pressure levels. In addition, mHealth applications provide a prospective way for patients to monitor their own health and self-manage themselves based on informed decision making. However, the literature has also shown that most mHealth applications are actually ineffective in providing the best possible care for hypertension. Many of these applications are developed lacking the collaboration of application developers, policymakers, health care professionals and proper research in order to make the applications deliver more accurate, meaningful and a wider array of care.

# **Chapter 3: Methodology**

## **Research Design**

A quantitative research approach will be taken, where an experimental design (pre-test and post-test design) will be implemented. The aim of the study is to determine how effective a mHealth application will be at improving hypertension health literacy in users and explore the impact the application would have in promoting self-managing behaviours. The quantitative research will include the collection of statistical and numerical data.

The experiment will be tested on two groups of persons selected from Papine, St. Andrew area, labelled Group A and Group B. Group A will be the experimental group, which will be given access to the mobile application while Group B will be the control group that will not have access to the mobile application. Both groups will be surveyed to test their initial familiarity with hypertension, their current standing health literacy and a UTAUT2 model will be implemented to determine test groups technology acceptance. Data results collected from the pre-test survey will be used as the baseline of the experiment. Results from the pre-test survey for each group will be analyzed separately. Both Group will be given the developed mobile application to use for a set amount of time. After the set time has elapsed, the post-test survey will be executed. The post-test will include an updated survey to test the changes in a user’s standpoint towards their literacy of hypertension and self-care after being exposed to the application. Post-test data collected will be analyzed separately per group and compared to the Pre-test data collected from the same group. Changes in the analyzed data will be used to represent its group, then be compared to the data collected in the other group.

## **Population**

The target population for this research will be persons traversing the Medical Center of the University of Technology which may include school staff and students, as well as individuals commuting the Papine area in St. Andrew. We are targeting individuals aged 18 and older.

## **Sampling**

The survey sample consists of 70 individuals from the sample population using convenience sampling. Participants are selected based on availability, accessibility and willingness to be a part of the survey. They have the option to opt-out of the survey if they feel the need to.

## **Instrumentation**

A survey will be administered using a questionnaire. The questionnaires will consist of a total of 27 questions. The UTAUT approach to test the technological acceptance of the user was modelled based on the approach used by Pontiggia & Virili in Network effects in technology acceptance (2009). Questions in the survey to assess health literacy were based off an approach used in Health Literacy in Rural Areas of China: Hypertension knowledge survey by Xia Li. The age criteria for this survey which is 18 years and older. The questions will be closed-ended and open-ended with the aim of collecting basic information and determining participants’ hypertension health literacy and technology acceptance towards mHealth applications.

## **Procedure and Timeframe**

The questionnaire will be issued over a one-and-a-half-week period, commencing from February 17, 2020, to February 24, 2020. We will issue the questionnaire via an online format for students at the University of technology and allow them to share the questionnaire over social media via a link to their friends. We will also utilize the online format for individuals outside of the UTECH campus in and around the Papine, St. Andrew vicinity.

## **Analysis Plan**

The data collected from the tests will be analyzed using Qualitative and Quantitative analysis. For quantitative analysis, the number of persons who did well on the hypertension health literacy assessment and technology acceptance testing in the survey will be recorded. For the qualitative analysis, we will focus on the level of knowledge that persons have on hypertension. Based on their answers to the questionnaire, they will be given a score on how much they know about the disease (eg. lvl-1, lvl-2, etc.). Next, a statistical analysis will be performed using the Statistical Package for Social Sciences software, to examine the correlation between the quantitative and qualitative data and to see whether implementing the mHealth application is feasible to increase hypertension health literacy.

## **Limitations**

The limitations that were faced by the researchers during the process of carrying this study include:

* Difficulty in gathering enough participants in the Papine, St. Andrew vicinity because the area is usually busy which may cause people to be unwilling to be a part of the survey.
* Participants, especially commuters in the Papine area not wanting to share their phone numbers to receive the questionnaire’s online link.
* Participants being sensitive about their age when completing the questionnaire.
* Participants may provide rushed responses because they were busy at the time of filling out the questionnaire.
* Participants not wanting to seem unknowledgeable about questions from the questionnaire and provide untruthful responses.
* Participants not wanting to complete the entirety of the questionnaire.

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