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Exploring the Mobile Phone Digital Divide among Individuals Experiencing Mental Illness: A Secondary Analysis

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ABSTRACT

Aim: To test van Dijk's (2005) Framework for Understanding the Digital Divide. This framework examines social inequalities that influence the phenomenon of the digital divide and the implications it has upon social participation for individuals with mental illness.

Background: Mental illness is the second leading cause of disability and premature death, and constitutes more than 15% of the burden of disease in Canada (Centre for Addiction and Mental Health, 2012). Mobile phones may be useful in promoting health and social wellness among this population. It is unclear whether these individuals face disparities in the access to and use of mobile phone technology and how this may affect social participation.

Methods: This study was a secondary analysis on data from the *Mental Health Engagement Network (MHEN)* (Forchuk et al., 2013). The *MHEN* evaluated the efficacy of using an electronic personal health record to promote the health of individuals with mental illness. A cross-sectional analysis of baseline data from individuals living with mental illness in London, Ontario and the surrounding area (N=403) was done. Relationships between sociodemographic variables and mobile phone ownership were explored using logistic regression. The concept of social participation was explored using independent T-tests to compare community integration, health, and quality of life between those with and without mobile phones.

Results: Only 43% of participants reported owning a mobile phone. Age, income, comfort with technology, and psychiatric diagnosis were found to be significant predictors of mobile phone ownership, and explained 20% of the variance. Participants who owned a mobile phone reported significantly better community integration scores than those without. No difference between general health and quality of life was found.

Conclusion: Sociodemographic inequalities may influence whether or not individuals with mental illness own a mobile phone. Owning a mobile phone may also affect an individual's ability to participate in society. Practicing nurses, researchers, and policy makers should take efforts to bridge this digital divide. Further research is needed to support this study's findings and strengthen this framework.

***Keywords*:** mental Illness, digital divide, mobile phone

CO-AUTHORSHIP STATEMENT

Jefferey Reed completed the following work under the supervision of both, Dr. Cheryl Forchuk and Dr. Richard Booth, who will be co-authors on the publication resulting from the manuscript.

DEDICATION

I dedicate this work to my family and friends who have provided immeasurable support and encouragement over the years. I would also like to dedicate this work to the hundreds of participants in the *Mental Health Engagement Network (MHEN)* study who I had the pleasure of meeting. Your stories and experiences have inspired me to continue on the path of public service.

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CHAPTER ONE

Background and Significance

Mental illness can be a devastating life experience that has detrimental effects on the wellness of the population, and the economic sustainability of the Canadian healthcare system. It is estimated that one in five Canadians will experience a mental illness during a one year period (Smetanin et al., 2011) and that this will constitute more than 15% of the burden of disease in the health care system (Centre for Addiction and Mental Health [CAMH], 2012). In Ontario, the burden of mental illness and addiction is estimated to be more than 1.5 times that of all cancers and seven times greater than all infectious diseases (Ratnasingham, Cairney, Rehm, Manson, & Kurdyak, 2012). This translates into an economic burden of mental illness in Canada of around $50 billion annually (Lim, Jacobs, Ohinmaa, Schopflocher, & Dewa, 2008). In recent years, it has been recognized that individuals with mental illness experience inequities among many of the social determinants of health, ultimately leading to poorer health outcomes when compared with the rest of the population (Druss et al., 2010; Health Council of Canada, 2010; Marmot, 2010). Experiencing mental illness tends to be associated with living in lower socioeconomic standards, and conversely, living in low socioeconomic standards tends to exacerbate mental illness (Campion, Bhugra, Bailey, & Marmot, 2013). This vicious cycle is a grim reality for those with mental illness and is very difficult to break (Canadian Mental Health Association, 2007). Health research must work to unveil social inequities among this population so that future practice and policy can be shaped to be more inclusive of those with mental illness.

Over the last two decades, society has witnessed the pervasiveness of technology in our political, social, educational, financial, and cultural institutions (Castells, 2011). These tools used for communication, internet access, banking, social networking, managing health, and others have come to be known collectively as Information and Communication Technologies (ICTs). Mobile phones are multifunctional, wireless ICTs that have become an important medium among society (Oksman, 2010). The ubiquitous nature of mobile phones has created a fertile ground for innovative applications fundamental to social participation. Mobile phones are a cheaper and more pragmatic medium for communicating and accessing the internet than desktop computers (Ennis, Rose, Denis, Pandit, & Wykes, 2012). They have become the most common device to access the internet from and have surpassed desktop computers in terms of ownership rates among the adult population (Anderson, 2015). Reports have found that individuals do not just use mobile phones as a means of communication and social connection, but that mobile phones also help them considerably in multiple facets of life, like finding health information, financial management, in employment searching, consumer research, and for political and community participation (Catalyst, 2015; Smith, 2015). The importance of mobile phones for social participation also exists among individuals with mental illness. Mobile phones and the internet – which can be widely accessed from most modern-day mobile phones – may improve key social determinants of health like employment, education (Baum, Newman, & Biedrzycki, 2012), and social support (Cotton et al., 2013; Hampton & Gupta, 2008; Rainie, Horrigan, Wellman, & Boase, 2006). Mobile phone technology is becoming increasingly embedded into everyday life and is an essential tool for meaningful participation in many of today's social spheres (Krishna, Boren, & Balas, 2009; Newman, Biedrzycki, & Baum, 2010).

Mobile phones are also being used in the provision of mental health care and the dissemination of health information. Multiple studies have demonstrated that text-messaging programs are effective in symptom reporting (Miklowitz et al., 2012; Montes, Medina, Gomez-

Beneyto, & Maurino, 2012; Shapiro et al., 2010), medication and appointment adherence (Granholm, Ben-Zeev, Link, Bradshaw, & Holden, 2011; Montes et al., 2012; Sims et al., 2012) and have led to significant improvements in health outcomes and service delivery. Consumer-driven monitoring tools and health records have also become a novel way for individuals to participate in their own health maintenance. Studies have demonstrated that applications that log patterns of behaviours and symptoms among individuals with mental illness were useful to quantify and track their mental health (Depp, Kim, Vergel de Dios, Wang, & Ceglowski, 2012). Participants reported positive experiences with these applications (Bardram et al., 2013; Depp et al., 2012; Reid et al., 2013), and also demonstrated significant improvements in symptoms and treatment outcomes (Kauer et al., 2012; Meglic et al., 2010). Mobile Personal Health Records (PHRs) that offer individuals access to their health information and a variety of tools to help them manage their health have also been shown to reduce costly health and social service use (Forchuk et al., 2014) and improve negative symptoms associated with mental illness (Proudfoot et al., 2013). Mobile phone technology also has the ability to deliver traditional behavioural therapies that are typically costly and resource-intensive. Applications that implement Cognitive Behavioural Therapy (CBT) and Dialectical Behavioural Therapy (DBT) have been shown to reduce fear and avoidance measures, decrease emotional intensity and urges for substance use, reduce depression and stress, and reduce negative thoughts (Dagoo et al., 2014; Rizvi, Dimeff, Skutch, Carroll, & Linehan, 2011; Whittaker et al., 2012). Mobile phones make it possible for new and innovative health applications to be delivered to individuals with mental illness in order to augment traditional treatment options and improve the provision of mental health services.

Since mobile phone technology has been shown to have the potential to facilitate improvements in health and social wellbeing, it is important to understand the implications for individuals who do not have access. This concept, known as the *digital divide*, describes an unequal distribution of technology among members of society (Mossberger, Tolbert, & Stansbury, 2003; van Dijk, 2005). This unequal distribution of capital occurs when certain social groups lack access to technologies due to circumstances beyond their control (Warren, 2007). These groups have traditionally been females, those older in age, those with less income, and less education (Kenny & Milne, 2014; Statistics Canada, 2009; van Dijk, 2008; Witte & Mannon, 2010), but newer research suggests that those with disabilities and medical conditions may also lack access to digital technology (Rainie, 2015; Wang, Bennet, & Probst, 2011). Digital divide research – in particular research on mobile phone technology – among individuals with mental illness is far from being well-developed, but some studies provide insight into this concept. Some studies have found the rate of mobile phone ownership among individuals with mental illness to be lower than the averages of the general adult population (Ben-Zeev et al., 2013; Firth et al., 2015). Other studies have found rates to be closer in comparison (Ennis et al., 2012; Torous et al., 2014). These wide ranging reports do not give a clear understanding of a potential digital divide among individuals with mental illness and are not reflective of the Canadian population.

A digital divide in mobile phone ownership may have implications for those with mental illness. van Dijk (2005) posits that those who do not own and use digital technologies will not have adequate means of full social, economic, cultural, political, and institutional participation and may be at risk for social disenfranchisement. This is supported by studies that have found that lacking access to technology may be a barrier to social participation (Newman et al., 2010; Smith et al., 2014) and may exacerbate existing inequalities among the general population (Dimaggio, Hargittai, Celeste, & Shafer, 2004). As such, it is not only important to investigate whether a divide exists, but also to understand how a potential divide may affect the health and social wellness of individuals with mental illness living in Canada.

Statement of the Problem and Research Questions

The number of users of mobile phone technology among the general adult population is growing, but certain groups lag in access. The existence of a mobile phone digital divide among individuals with mental illness is unclear based on the current literature; however, evidence revealing that this group is often caught in a cycle of poverty and poor social conditions (Mikkonen & Raphael, 2010) suggests that they may be at a disadvantage in their ability to access mobile phone technology. Mobile phones are instrumental to societal participation and this dependence may grow as technology permeates into the realm of health care. According to van Dijk (2005), old communication and information mediums will soon be insufficient for participation in an increasingly technological society. Individuals who lack access to mobile phone technology may have barriers to employment, education, social networking, culture, politics, and in other social spheres (Baum et al., 2012). This divide in access has the potential to further exacerbate social and health disparities and create an inequitable class system among society (van Dijk, 2005; van Dijk, 2008). As mobile phone technologies become increasingly influential in the pursuit of optimal health and social wellness, it is important to understand how inequitable access may construct further disparity among those with mental illness. Investigation to further elucidate the concept of this digital divide is still needed. Basic concepts of the divide, like physical access, are still not well defined, meaning that current research is quite superficial (van Dijk, 2005). With that in mind, the following research questions were developed:

Research Questions

1. How does the rate of mobile phone ownership among individuals with mental illness compare to the general adult population?
2. What variables influence whether or not an individual has access to a mobile phone?
3. What are the health and social implications of owning or not owning a mobile phone?

Statement of Study Purpose

The purpose of this study was to test van Dijk's *Framework for Understanding the Digital Divide* (2005) by examining the relationship between demographic inequalities and the ownership of mobile phones among those with mental illness. Furthermore, this study will explore how mobile phone ownership influences health, quality of life, and community integration. This study was a secondary analysis of data collected as part of *The Mental Health Engagement Network*, a three year study that evaluated the use of an electronic personal health record accessed from smartphones for individuals with mental illness (Forchuk et al., 2013; Forchuk et al., 2014, Forchuk, Donelle, Ethridge, & Warner, 2015). The initial baseline interview of this study generated useful data that allowed a cross-sectional analysis of relationships between sociodemographic variables and access to mobile phones. The concept of participation in society was also explored by comparing measures of health, quality of life, and community integration between those with and without access to mobile phone technology. Exploring the relationships among these variables may be helpful to identify a subset of categorical inequalities among those with mental illness in terms of accessing mobile phone technology and how lacking mobile phone access affects their everyday lives and health.

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CHAPTER TWO

Background

Information and Communication Technologies (ICTs) are becoming increasingly essential to participation in society, and individuals who lack access may be subject to an unequal distribution of social capital (van Dijk, 2005). This divide, commonly known as the *digital divide*, describes the gap between those who have and do not have access to ICTs (van Dijk, 2005). Dimaggio, Hargittai, Celeste, and Shafer (2004) argue that ICTs may have the potential to exacerbate inequalities among the general population. This inequality in access to and use of ICTs happens when a discrete sector of the population suffers a significant lag in its adoption of technologies through circumstances beyond their immediate control (Warren, 2007). This idea can be conceptualized on a spectrum of inequality. One side marks a small group of elite information and technology users, and the opposite side a small group of individuals who are digitally excluded, with the majority of individuals falling somewhere in between based on their access and ability to understand and use technologies (van Dijk, 2000).

Mobile phones – a common type of ICT - have become omnipresent in many facets of society and are now emerging in health services. As they continue to proliferate into different societal spheres, their effect on social participation have become increasingly apparent (Krishna, Boren, & Balas, 2009; McEwen, 2010). The last decade has produced a great deal of understanding of social inequities faced by those with mental illness, but until recently, the use of mobile phone technology has remained largely understudied as a possible influencer of health and wellness. As such, it is important to identify and address inequities in access to mobile phone technology among individuals with mental illness to ensure equal opportunities for social participation. As mobile phone technology becomes more embedded into society and healthy living, research must identify and measure the disparity in access to mobile phone technology, identify underlying demographic traits that further exacerbate the mobile digital divide, and understand how this divide affects the everyday life of those with mental illness.

Theoretical Framework

This study was guided by van Dijk’s (2005, 2008) *Framework for Understanding the Digital Divide* (Figure 1). van Dijk has focused much of his program of research on understanding and clarifying the digital divide. With the overwhelming spread of the internet, computers, and mobile phones, the gap in physical access to ICTs has narrowed; however, certain populations still lag behind the average in terms of access to the internet (Dimaggio et al., 2004; Haight, Quan-Haase, & Corbett, 2014; Jackson et al., 2008; Kiel, 2005) and mobile phone technology (Ben-Zeev, Davis, Kaiser, Krzsos, & Drake, 2013, Firth et al., 2015). Perhaps more importantly, van Dijk asserts that differences in physical access are not the only issue. Society is also experiencing a deepening divide, where differences in skills, motivation and usage among the population have emerged. van Dijk (2005) stresses that the digital divide is not just a simple issue of physical access, but rather a complex phenomenon influenced by social, economic, and cultural dynamics.

van Dijk (2005) emphasizes that the study of the digital divide should go beyond the study of the individual attributes and merits of haves and have-nots, and use a relational approach made popular by Wellman and Berkowitz (1988). The relational approach shifts the focus away from individual motivation to use technology and focuses on social inequalities and social positions between groups in society. This approach is appropriate, as ICT research among those with mental illness tends to show that acceptance and motivation to use ICTs are generally high (Alvarez-Jimenex et al., 2014; Ennis et al., 2012; Torous et al., 2014) and therefore not equipped to solely explain the cause of digital divides. As an example, the relational approach may be able to describe any differences in digital access and use among individuals with a difference in income. A child growing up in an affluent family may be given early access to the most cutting-edge toys and devices. From an early age, that child is given the opportunity to develop the technical and informational skills to become proficient with ICTs, while taking advantage of all the social opportunities those technologies present. As the child matures, they may continue to have increased access to newer and better technologies than those who are less wealthy. They may also be more likely to harness their superior technical aptitude to excel in school and eventually move into higher-paying jobs, thus continuing a cycle of social inequality. A superficial view of this example may lead to the conclusion that poorer individuals are not as motivated to learn new technologies as those more affluent, however, examining the issue with a relational lens would suggest that underlying social mechanisms may be better equipped to explain inequalities than individual attributes (van Dijk, 2005).

The relational view is also beneficial because no particular categorical inequality used in the model is given priority over another (van Dijk, 2005). For instance, adolescents may be more motivated to own a mobile phone than seniors, but having a low-income or education may inhibit their ability to own and access a mobile phone (Pew Research, 2015). van Dijk (2000) uses this notion in one of his earlier works to show that the digital divide should be conceptualized as a continuum, where inequality of access to ICTs is influenced by relative differences between groups of people. This is an important mainstay of the model, as it shows that the digital divide is not a two-tiered, black-and-white concept, but rather much more complex.

van Dijk (2005) stresses that inequality is fundamentally a matter of categorical differences between societal groups, and that the focus of analyses should be on the positions of individuals and groups in society and the relationships between them (van Dijk, 2005). With this relational approach at its core, van Dijk (2005) proposes a theoretical framework on which researchers can base further investigation. Within this framework (Figure 2) are a particular set of concepts and the relationships between them to explore the causes and consequences of the digital divide. The five concepts include: *categorical inequalities*, *the distribution of resources*, *access to ICTs*, *the characteristics of that ICT, and fields of participation in society*. The major concepts in this model are described below and are illustrated in Figure 1.

1. Categorical inequalities generate an unequal distribution of societal resources.
2. This unequal distribution of resources influences access to digital technologies.
3. This unequal distribution of access depends on the characteristics of the ICT
4. Unequal access to technologies influences the individual's participation in society
5. Unequal participation in society reinforces categorical inequalities.

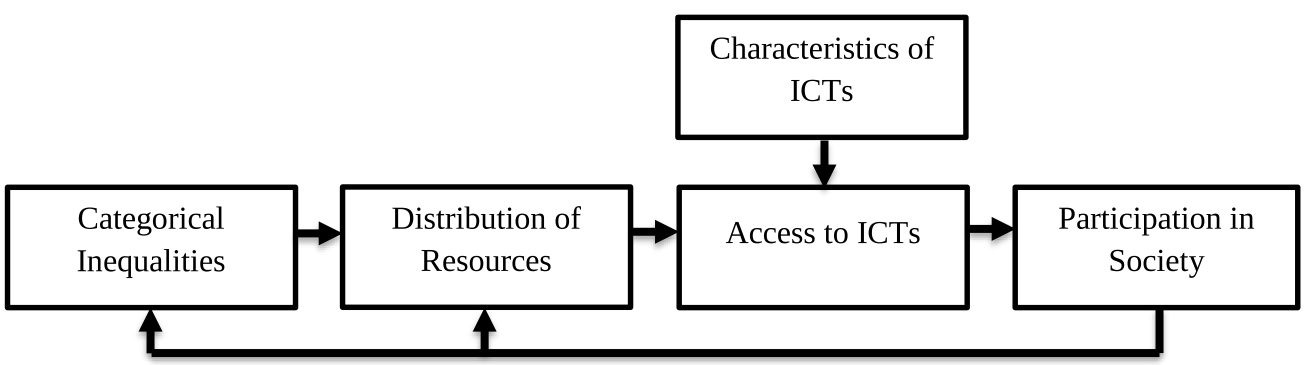


Figure 1: van Dijk's (2005) Framework for Understanding the Digital Divide

This framework can be conceptualized as a feedback loop in which categorical inequities produce an unequal distribution of resources and in turn, an unequal access to ICTs. The unequal access to ICTs leads to an unequal participation in various facets of society, which in turn, reinforces the categorical inequalities at the beginning of the loop (van Dijk, 2005).

Literature Review

To understand the current state of research associated with access to mobile phones among individuals with mental illness, a literature review was performed using scholarly databases from the nursing field and other disciplines. A search was done using the terms: "*Mental Disorders*" or "*Mental Illness*". "*Cellular Phone*" or "*Mobile Phone*" and "*Digital Divide*" or "*inequity*" or "*inequality*". Databases representing literature from nursing, health, medicine, and psychology fields were used for this review. These databases included CINAHL, Proquest Nursing Journals, Pubmed, and PsychINFO. The search was limited to articles that were peer-reviewed and written in the English language. After examining abstracts and article keywords, a total of 28 articles relevant to the study were selected to be analyzed for this review. The reference lists of these articles were also scanned to find nine additional articles.

Physical Access to Mobile Phones among Individuals with Mental Illness

With mobile phone technologies having quickly become a main point of connectivity to the internet and to communication applications, it is important to understand the level of access to mobile phones among the general population and among individuals with mental illness. The digital divide in terms of physical access to mobile phones among the general population is narrowing. A recent report demonstrated that roughly 83% of Canadians had an active mobile phone, up 5% since 2010 (Canadian Wireless Telecommunications Association, 2015). Despite the growing rate of mobile phone ownership, Canada lags far behind nearly all countries who are part of the Organization for Economic Co-operation and Development (OECD). This has been attributed in large part to the cost of owning and operating a mobile phone in Canada, which has been shown to be among the highest of all OECD countries (OECD, 2013). There appears to be a mobile phone digital divide affecting certain groups of Canadians (Communications Management Inc., 2015) that reflects the demographic inequalities of age, sex, income, and education level, as outlined by van Dijk (2005). A recent study among over 44,507 individuals living in the United States found that a digital divide also exists between those who reported a medical condition and those who did not (Wang, Bennet, & Probst, 2011). This raises the question of the rate of mobile phone ownership among individuals experiencing mental illness.

Upon reviewing the literature, it was found that the rates of mobile phone ownership among individuals with mental illness are wide ranging. In a meta-analysis of 12 unique samples of patients with psychosis (N=3227) across the United Kingdom, the United States, Canada, and India, Firth et al. (2015) found that only 66.4% of psychiatric patients owned a mobile phone, 35.4% of which were smartphones. However, studies within the meta-analysis that were published between 2013 and 2015 showed that ownership rates had increased to 81.4% among individuals with psychosis (Firth et al., 2015). Similarly, Ben-Zeev et al. (2013) found that among 904 individuals with psychosis from a community rehabilitation agency in the United States, only 63% of participants owned a mobile phone. At the other end of the spectrum, Ennis et al. (2012) found that among 121 individuals with a serious mental illness (SMI) in urban communities in the United Kingdom, access to mobile phones was greater than 90%, which was similar to the general adult population in the U.K. This was comparable to another study that found that among 100 psychiatric outpatients from an urban teaching hospital in the U.S.A., the overall ownership of mobile phones was found to be 97%, 72% of which were smartphones (Torous et al., 2014). This study had some major limitations in that participants did not have chronic mental illness and they also did not collect data on type of psychiatric diagnosis. In between the two extremes, a different study from Ben-Zeev and et al. (2013) found that among 1592 individuals in the greater Chicago area with mental illness, 72% owned a mobile phone. Carras, Mojtabai, Furr-Holden, Eaton, and Cullen (2014) found that among 189 community-dwelling individuals with mental illness in the Baltimore area, 86% reported owning a mobile phone. Based on the literature, it is not clear what percentage of the psychiatric population has physical access to mobile phones. Furthermore, the literature also does not accurately elucidate whether or not ownership statistics among this population reflect smart phone ownership, whether or not individuals can access the internet from their phones, or whether or not individuals have the abilities and knowledge required to use mobile phone technology.

Successive Types of Access to Mobile Phones among Individuals with Mental Illness

In van Dijk's (2005) framework, access to technology goes beyond the traditional notion of have and have-not. He conceptualizes successive kinds of access to technology, where the ability to physically access technology is not an exclusive concept. He argues that motivation, skills, and usage are also important influencers of an individual's experience with technology. Individuals with poor information and technical literacy have been shown to be significantly less likely to own and adopt technologies (Choi & DiNitto, 2013; Jensen, King, Davis, & Guntzviller, 2010). While research in the past has demonstrated that individuals with mental illness are interested in using mobile technology (Ben-Zeev et al, 2013; Forchuk, Donelle, Ethridge, & Warner, 2015), there is a dearth of research that has investigated the abilities, skills, and literacy needed to optimize mobile technologies among this population.

Categorical Inequalities

In van Dijk's (2005) framework, he identifies a set of personal and positional categories that are collectively deemed as *categorical inequalities*. He uses Tilly's (1998) definition to describe inequality as the, "unequal distribution of resources in society as a result of the competition of categorical pairs, which produces systems of social closure, exploitation, and control" (Tilly, 1998 in van Dijk, 2005, p.12). This definition is important as it distinguishes these categorical disparities from individual differences and identifies them as systemic characteristics of an inequitable society. As a result, van Dijk proposes a set of personal and positional categories as predictors of group differences in digital access and use. Personal categories are reflective of physical or mental characteristics of individuals, such as age, sex, and race. On the other hand, positional categories are reflective of social positions in the distribution of wealth, labour, and education, such as income and level of education. In other works (van Dijk 2003; van Dijk, 2008) he describes the categorical variables of income, education, and age as the most important predictors of a digital divide. This coincides with other digital divide research that identify sex (Belanger & Carter, 2009; Brown & Venkatesh,2005), age (Brown, Dennis, & Venkatesh, 2010; Kenny & Milne, 2014), income (Agerwal, Animesh, & Prasad, 2009; Belanger & Carter, 2009, Kenny & Milne, 2014), and education (Agerwal et al., 2009; Belanger & Carter, 2009, Kenny & Milne, 2014) as predictive of ICT ownership and use among the general adult population. A recent study of the literature also supported the notion that age, sex, income, and education are the four strongest socio-demographic variables affecting ICT acceptance in the literature (Niehaves & Plattfaut, 2014). As such, the following subsections will explore these four sociodemographic variables in relation to the mobile phone digital divide among individuals with mental illness.

Age. Throughout the literature, age is consistently identified as a significant predictor of mobile phone ownership and successful use. In terms of ICTs, studies of individuals with mental illness show that age is significantly associated with internet and computer ownership, where older age is negatively associated with use and ownership (Borzekowski et al., 2009; Carras et al., 2014; Ennis et al., 2012, Zickhur & Smith, 2012). This seems to be consistent with the use and ownership of mobile phones as well. Mobile phone ownership rates were compared in a recent meta-analysis of cross-sectional studies on individuals with psychosis living in the U.K. Firth et al. (2015) found that among these participants, those younger in age were significantly more likely to own a mobile phone. Similarly, in a study of 1568 individuals with serious mental illness in the greater Chicago area, Ben-Zeev et al. (2013) found that younger individuals with mental illness were significantly more likely to own a mobile phone, with each year in age causing a decrease of 3% in the odds of ownership. This was also consistent with findings among 251 individuals at a substance treatment center in Washington D.C., where younger participants were more likely to own a phone (Dahne & Lejuez, 2015). Evidently, age is likely to be a significant predictor of mobile phone ownership among those with mental illness.

Sex. Sex as a categorical barrier to the use of mobile phones is debatable. Some research has shown that males are more likely to use ICTs when compared with females (Belanger & Carter, 2009; Brown & Venkatesh, 2005); however, more recent reports show that the gap in use of ICTs between sexes has closed among the general adult population (Perrin & Duggin, 2015; van Dijk, 2008; Zickhur & Smith, 2012). This may be true for individuals with mental illness as well. A study among 100 individuals with serious mental illness in the Baltimore area demonstrated that sex was not a significant influence on internet use or computer ownership (Borzekowski et al., 2009). A different study among 189 individuals with serious mental illness in the Baltimore area also demonstrated that sex was not associated with the ownership of mobile phones, computers, or the internet (Carras et al., 2014). While the literature suggests a narrowing digital divide between males and females, there has not been adequate investigation among those with mental illness and thus this area requires further attention.

Income. Given that cost has been consistently cited as the biggest barrier to adopting ICTs and mobile phones (Ben-Zeev et al., 2013; Borzekowski et al., 2009; Forchuk et al., 2015; Proudfoot et al., 2010), it is not surprising that income has been shown to influence the uptake of ICTs. In the general adult population, research has demonstrated that patients with lower socioeconomic status had lower odds of owning and using computers and the internet (Kontos, Blake, Chou, and Prestin, 2014; Witte & Mannon, 2010). In a recent report, Zickhur and Smith (2012) demonstrated that among the general adult population in the U.S., households earning less than $30,000 annually were the least likely adults to have any access to the internet. A study of 1568 individuals with mental illness showed that having an annual income greater than $10,000 increased the odds of owning a mobile phone by 33% (Ben-Zeev et al., 2013). While these studies demonstrate a relationship between income and ICT ownership, more evidence is needed to suggest that income is a significant predictor of mobile phone ownership among individuals with mental illness.

Education. Education is another consistently significant predictor of mobile phone ownership. Evidence shows that those with less education are significantly less likely to access ICTs (Borzekowski et al., 2009; Carras et al., 2014; Kontos et al., 2014; Zickhur & Smith, 2012). This finding is also consistent with mobile phone ownership among the psychiatric population. Among 251 individuals from a substance use treatment center in Washington D.C., individuals were significantly less likely to own a phone if they had less education (Dahne & Lejuez, 2015).

The same conclusion was reached in a meta-analysis of four studies among individuals with serious mental illness in the U.K. (Firth et al., 2015). Furthermore, Ben-Zeev et al. (2013) demonstrated that among individuals with serious mental illness, having an education beyond high school increased the odds of owning a mobile phone by 15%. Based on the literature to date, it is evident that education level has an influence on mobile phone ownership among individuals with mental illness.

Participation in Society

It is important for research to investigate the effect mobile phone technology access may have on the health and social wellness of individuals with mental illness, who are already at risk of, or experiencing marginalization. The main consequences of technology access as defined by van Dijk's (2005) model are the inclusion or exclusion of individuals among fields of participation in society. The particular societal fields within this concept are identified as, "labour, education, politics, culture, social relationships, spatial arrangements, and institutions like social security and health provisions" (van Dijk, 2005, p.23). According to the model, those who have less access to digital technology will be less likely to participate in these fields of society, thus becoming second or third class citizens (van Dijk, 2005). This is particularly important as technology becomes more ubiquitous. The old means of communication, information gathering, and other social expressions will become obsolete, rendering those who do not have access to technology or those who use it less effectively with inadequate means of participating in society. This is consistent with other works (Farooq et al., 2015) that argue that the increase in digital platforms for discussion and social participation will cause individuals with mental illness to be further excluded in society.

ICTs have been known to improve health and social wellness indirectly by facilitating measures such as employment and education (Baum, Newman, & Biedrzycki, 2012), but the effect of mobile phone ownership on outcomes measuring health and social participation were scant among the literature. Some studies have shown that lack of access to ICTs may worsen social inequities and health issues (Newman, Biedrzycki, & Baum, 2010; Smith et al., 2014), but there is a dearth of research that focuses on mobile phone ownership among Canadians with mental illness. This gap in the literature presents the opportunity to test this concept using data from the primary study, which measure health, quality of life, and community integration outcomes.

Hypotheses and Rationale

According to van Dijk's framework (2005, 2008), access to technologies may be dependent on a number of categorical inequalities found among various groups in society. Recent research has demonstrated this concept with ICT use among the general population, finding that age, sex, income, and education may strongly predict ICT acceptance (Niehaves & Plattfaut, 2014) and ownership (Belanger & Carter, 2009; Kenny & Milne, 2014). It has also been found that individuals with low information literacy and comfort with technology may be less likely to own and use them (Choi & DiNitto, 2013; Jensen, King, Davis, & Guntzviller, 2010). This aligns with van Dijk's (2005) supposition that motivation, comfort, and digital may influence ICT ownership. The emerging literature focusing on individuals with mental illness suggests that age, income, and education level may indeed be predictive of the ownership of mobile phones (Ben-Zeev et al., 2013; Dahne & Lejuez, 2015; Firth et al., 2015). Given the findings from recent research and guided by van Dijk's framework, is expected that age, sex, income, education level, and comfort with technology among individuals with mental illness in Canada will be predictive of whether or not they have access to mobile technology.

ICTs have also become increasingly embedded into various social spheres and have shown to be influential on social determinants of health (Baum, Newman, & Biedrzycki, 2012; Cotton et al., 2013; Hampton & Gupta, 2008; Rainie, Horrigan, Wellman, & Boase, 2006). van Dijk (2005) also posits that the increasing dependence on technology use for societal participation will leave those without access inadequate means to participate and thrive in society. As such, those with access to mobile phone technologies may have better outcomes in terms of social participation and measures of health. Based on van Dijk's Framework (2005) and the literature review, the following hypothesis were made:

1. Income, education level, sex, age, and comfort with technology are predictive of mobile phone ownership,
2. Those who own a mobile phone have better self-reported measures of health status than those who do not own a mobile phone,
3. Those who own a mobile phone have better self-reported measures of quality of life than those who do not own a mobile phone, and
4. Those who own a mobile phone have better self-reported measures of social integration.

Methods

Study Design

A cross-sectional design was used for this secondary analysis (Plichta Kellar & Kelvin, 2013). Data were collected as part of the *Mental Health Engagement Network (MHEN)* (Forchuk, et al., 2013; Forchuk et al., 2014), a large, mixed-methods study that evaluated the efficacy of an electronic Personal Health Record (PHR) intervention for individuals with mental illness. The primary study collected data from participants at four different time points (baseline, 6, 12, and 18 months). After baseline data were collected, participants were given a mobile phone and access to a PHR that enabled client-patient communication, information sharing, health maintenance tools, and other mental health services. This secondary analysis will look solely at baseline data from the primary study, before participants had received either the mobile phone or the PHR. Approval for the primary study was obtained from Western University's research ethics board for Health Sciences Research Involving Human Subjects, and participants consented to having their data used for secondary analysis.

Data Collection Procedures

Data from the primary study were collected through face-to-face interviews at four different time points throughout the 36-month study; an initial baseline interview followed by three consecutive interviews, each six months apart. All data were collected and recorded by Research Assistants in face-to-face interviews with study participants. This ensured that data were collected in a consistent way and reduced the amount of missing data for analysis (Kraenzle Schneider & Deenan, 2004). All participants read and signed a letter of information and consent form prior to starting each interview to uphold a commitment to ethics (Polit & Beck, 2012). Each interview consisted of eight instruments and took approximately one hour to complete, after which participants received a $20 honorarium. For the purposes of this secondary analysis, the data being analyzed came from the initial baseline data, before the study participants had received the intervention and a mobile phone (Forchuk et al., 2013).

Study Sample

The *MHEN* study used convenience sampling – a non-probability sampling technique – for the recruitment process (Plichta Kellar & Kelvin, 2013). Participants were recruited from two large hospitals and two community agencies in Southwestern Ontario, all of which provide community mental health outpatient services. Participants met the inclusion criteria for the primary study if they were; (a) between the ages of 18 and 80; (b) receiving outpatient community mental health treatment from a mental health care professional; (c) had a primary mood or psychosis diagnosis; (d) were able to read and write English to the degree necessary to complete interviews; and (e) were able to make informed consent to participate in the study (Forchuk et al., 2013). Because the study's intervention involved engaging with the health care provider, participants needed to be receiving community care during data collection. Participants were excluded if they were involved in another experimental study throughout data collection. This resulted in a total sample size of (N=403) participants from the initial primary sample at baseline (Forchuk et al., 2013). Sample size for the secondary analysis was determined by using G*Power 3.1 to conduct a power analysis. Based on an alpha level of 0.05, a power level of 0.80 and a non-experimental design (Faul, Erdfelder, Lang, & Buchner, 2007), the power analysis revealed that 262 participants were required to detect a small to moderate effect size (0.2).

Instrumentation

Data used in this secondary analysis were collected using three standardized instruments and a demographic questionnaire in order to measure the study variables.

Hypothesis	**Instrument**
Hypothesis 1:	Demographics
Hypothesis 2:	SF-36 Health Survey

Hypothesis 3:	Lehman's Quality of Life Interview
Hypothesis 4:	Community Integration Questionnaire (CIQ)

Demographics. The demographic data from the original study were used to summarize the descriptive statistics of those in the secondary analysis (Forchuk, et al., 2013). Age, sex, education level, and income was also used to test the influence of categorical inequalities on the ownership of a mobile phone. While not explicitly defined in the theoretical framework, the addition of mood and psychosis into the analysis were explored and differentiated the relationship between mobile phone ownership and primary diagnosis. In addition to the dichotomous measure of owning a mobile phone, data from this instrument also offered some additional insight into successive kinds of access by measuring one's comfort with technology. Additional variables measuring skills and literacy were not readily available in this dataset and so an exploration of all perspectives of access was not possible. Given the importance of comfort with technology, this measure was included in the analysis as a control variable so as to explore the unbiased relationship between the sociodemographic variables and mobile phone ownership. This variable was measured on a seven-point Likert Scale, where one indicated extreme comfort with technology and seven indicated extreme discomfort with technology.

SF-36 Health Survey. The SF-36 is a 36 item scale that yields a measure of one's physical and mental health based on eight subscales. Reliability measures have typically exceeded a Cronbach's alpha of 0.80 (McHorney, Ware, Lu, & Sherbourne, 1994) and the content validity has been compared to widely used health surveys (Ware, Keller, Gandek, Brazier, & Sullivan., 1995). For the purposes of measuring health as part of participation in society, the general health score from this instrument was used in the analysis. General health, was a self-reported measure of 5 items within the SF36 instrument. These items were summed for a total general health score for each participant that ranged from zero to one hundred. A higher score indicated a better self-reported measure of general health (Ware & Sherbourne, 1992).

Lehman's Quality of Life Interview (QoLI). Lehman's QoLI is a 74-item instrument that covers eight life domains; including living situation, family and social relations, leisure, work, safety, finances, and physical health. Measures within each domain are summed to produce an overall domain measure (Lehman, 1983). Internal consistency using Cronbach's alpha coefficients in the subjective measurements was high (0.79 to 0.88), with the objective scale being slightly weaker (0.44 – 0.82, median 0.68) (Lançon et al., 2000). The instrument has also been found to have discriminant validity, with correlations among scales ranging from 0.11-0.37 (Lehman, 1988). For the purposes of this analysis, a pre-survey and post-survey measure of overall QoL score was measured on a Likert-scale known as the *delighted-terrible* scale that ranges from one to seven. This scale denotes an individual's feelings, where delighted (7) and pleased (6) characterize positive feelings, mostly satisfied (5), mixed (4), and mostly dissatisfied (3) characterize mixed feelings, and unhappy (2) and terrible (1) characterize negative feelings (Stinson, 1997). The two scores were averaged to produce a total QoL measure for each participant.

Community Integration Questionnaire (CIQ). The community Integration Questionnaire (CIQ) is a reliable measure of an individual's level of integration into the home and community following traumatic brain injury; however, the instrument has also been used successfully among individuals with mental illness. It aims to measure how an individual functions at home, their social participation, and how they function outside of the home through work, school, volunteering, and other vocational activities (Willer, Ottenbacher, & Coad, 1994). This instrument consists of 15 items that are broken up into subsections measuring concepts of social integration (range=0-12), home integration (range=0-10), and productivity (range=0-7). The sum of the subscale scores generates a total score ranging from 0-29, where a higher score demonstrates enhanced community integration (Dijkers, 2000). Results of some studies have shown that interrater reliability is satisfactory, but more recent research suggests that the home dimension of the instrument has produced some discrepancies. Multiple studies also demonstrate the internal consistency of the instrument to exceed a Cronbach's alpha of 0.8 (Dijkers, 2000). Though the CIQ was developed to study individuals following a traumatic brain injuries, other studies have demonstrated the validity of its psychometric properties in other populations (Hirsh, Braden, Craggs, & Jensen, 2011). Since this variable was most congruent with van Dijk's (2005) concept of social participation, the analysis explored both the total CIQ score and the score of the subvariables.

Data Analysis Plan

Data from this secondary analysis were analyzed using the Statistical Software Package for Social Sciences (SPSS), version 23 (International Business Machines, 2011). All data were analyzed cross-sectionally at the primary study's baseline data collection point, when participants had not yet been given the intervention. Descriptive statistics were calculated on the study's sample. The level of significance used for all tests was an alpha level of 0.05, which is consistent with health research (Plichta Kellar & Kelvin, 2013).

The data were checked for missing values. Thirty-eight participants had not reported an income, which was not surprising given that individuals tend to be reluctant to report their income (Oakes, N.D.). The majority of these participants reported not knowing their income because their finances were managed by either their parents or the Office of the Public Guardian and Trustee. This meant that the data were not missing at random (MNAR) and that employing a list-wise deletion strategy for such a large group of participants may create bias, since a particular cohort of this sample would be lost (Gelman & Hill, 2006). Mean imputation strategies are practical and commonly used in systematic reviews (Higgins & Green, 2011); however, this may lead to the variance being wrongly estimated, resulting in inaccurate regression coefficients and inferences about the data. (Carpenter & Kenward, 2013). As such, an imputation strategy was used that estimated the participant's income based on other data they had provided. Many participants who had missing data for income did report their source of income. When participants reported that their income was solely from a particular government-funded subsidy or program, an imputation was made based on the average income of participants who also reported income solely from that program. Since the probability of having an income reported was not influenced by the outcome variable, a list-wise deletion strategy was reasonable to use for the remainder of missing data (Carpenter, Bartlett, & Kenward, 2014; Howell, 2012). Together, these strategies attempted to mitigate bias without reducing the power of the sample. Also, after reviewing the descriptive statistics for the income variable, four data points were found to be greater than three standard deviations away from the mean (Osborne & Overbay, 2004). Notes from the data indicated that these four participants had included atypical lump sums into their monthly income. For example, one participant included a total government student loan as part of their monthly income while another included money won in a lawsuit. In order to get the most accurate estimation of population representation, evidence supports that these outliers be removed from the analysis (Barnett & Lewis, 1994; Judd & McClelland, 1989). After these strategies, the total sample size for the regression was 380.

A correlation matrix was created to test for relationships among the study variables. Spearman correlation tests were used to investigate relationships between ordinal and ratio level data and Phi coefficients were used to test relationships between nominal level data (Plictha Kellar & Kelvin, 2013). This was done to ensure that only variables with significant relationships to the dependent variable were included in the regression analysis, thereby making the model as parsimonious as possible. If two independent variables were highly intercorrelated (φ or $\rho >$ 0.500), only the variable with the strongest relationship to the dependent variable was included in the regression analysis (Plichta Kellar & Kelvin, 2013).

To test the first hypothesis, a multiple logistic regression analysis was used to analyze the relationships between mobile phone ownership (dichotomous dependent variable) and a collection of independent variables of interest. All categorical variables were transformed into dummy variables before being used in the regression analysis. The income variable was recalculated to reflect increments of $1000, instead of $1 to simplify the odds ratios without losing data by categorizing the variable. This model used a hierarchical approach to determine whether the addition of the four sociodemographic independent variables added to the explanatory power of the model (Plictha Kellar & Kelvin, 2013). These four variables were added to the other variables of interest in a second block so as to explore the unbiased relationship between the sociodemographic variables and mobile phone ownership.

For the second, third, and fourth hypotheses, independent t-tests were used to test the difference in means of general health, quality of life, and community integration (dependent variables) between individuals who did and did not own a mobile phone (independent variable). Data were assessed for normal distribution using Pearson's skewness coefficient and Fisher's measure of skewness and the mean and standard deviation was calculated for each variable (Plichta Kellar & Kelvin, 2013). A Cronbach's alpha was calculated for all instruments to determine internal consistency and reliability.

Results

Participant Statistics

Demographic statistics are presented in Table 1. The average age of participants was 38.4 (*SD*=13.8) years of age. The majority were male (61.3%), single (69.7%), and had no children (69.0%). Most reported high school as their highest level of education (44.7%), were not employed (74.7%), and had an annual income of $12,659 (*SD*=$7872). Participants had been diagnosed with either a mood (59.1%) or psychotic disorder (58.3%). On average, participants were around 22 years old (*SD*=9.3) when they had their first contact with the mental health system and have had six (*SD*=10.2) total psychiatric hospitalizations in their lifetime. 174 (43.2%) participants reported owning a mobile phone, whereas 229 (56.8%) reported having no mobile phone.

Table 1: *Description of Participants*

Categorical Variables	Description of Participants (*N*=403)		
	Sub Variable	Frequency (*n*)	Percentage (%)
Sex			
	Female	156	38.7
	Male	247	61.3
Marital Status			
	Married or Common-law	36	8.9
	Separated or Divorced	83	20.6
	Single – Never Married	281	69.7
	Widowed	3	0.7
Having Children			
	Yes	125	31.0
	No	278	69.0
Employed			
	Yes	102	25.3
	No	301	74.7
Education Level			
	College or University	96	23.8
	High School	180	44.7
	Grade School	124	30.8
	Don't know	1	0.2
	Other	2	0.5
Psychiatric Diagnosis			
	Mood Disorder	238	59.1
	Psychotic Disorder	235	58.3
	Anxiety Disorder	129	32.0
	Substance Disorder	55	13.6
	Personality Disorder	25	6.2
	Disorder of Childhood and Adolescence	20	5.0
	Developmental Handicap	3	0.7
	Organic Disorder	3	0.7
	Other	10	2.5
	Unknown	2	0.5
Mobile Phone Ownership			
	Yes	174	43.2
	No	229	56.8

Continuous Variables	Description of Client Participants (*N*=403)		
	Mean	Standard Deviation	Range
Age	38.4	13.8	18-78
Annual Total Income	\$12,659	\$7,872	0-\$60,000
Annual Disposable Income	\$2,785	\$3,397	0-\$30,000
Age at first contact with the mental health system	21.6	9.3	3-61
Estimated total number of psychiatric hospitalizations	6.3	10.2	0-100

Descriptive Statistics

The descriptive statistics for the dependent variables measured in hypotheses two, three, and four are found in Table 2. Participants reported a moderate degree of general health (M=55.39, SD=24.15). Participants reported that they were mostly satisfied with their quality of life (M=4.68, SD=1.43). There was also a moderate level of community integration among the participants (M=17.61, SD=4.49). In this study, the reliability coefficients for general health, quality of life, and community integration were α=0.81, α=0.86, α=0.78, respectively.

Table 2: *Descriptive Statistics of Dependent Variables*

Variable	Range	Mean	Reliability Statistic (α)
General Health (n=400)	0-100	55.39 (*SD*=24.15)	0.81
Quality of Life (n=402)	1-7	4.68 (*SD*=1.43)	0.86
Community Integration (n=380)	0-26.75	17.27 (*SD*=4.58)	0.78

Hypothesis 1:

The correlation table (Table 3) demonstrates the strength of relationships between study variables. The correlation coefficients demonstrate that the independent variables – age (ρ =-.252, p<0.01), sex (φ =.120, p<0.05), education (ρ =.107, p<0.05), and income (ρ =.145, p<0.01) – were all significantly correlated to mobile phone ownership. Comfort with technology (ρ =-.158, p<0.01), having either a mood (φ =-.125, p<0.05) or psychotic disorder (φ =-.158, p<0.01), and total number of psychiatric admissions (ρ =-.184, p<0.01) were also correlated to mobile phone ownership. There were a number of statistically significant correlations observed between independent variables. The total psychiatric admissions variable had a moderate and positive correlation to age (ρ=.498, p<0.01) and having a psychotic disorder had a moderate and negative correlation to having a mood disorder (φ=-.632, p<0.01). Since these intercorrelated variables had the potential to lead to inaccurate interpretations of the regression analysis, only the variable with the highest correlation to the dependent variable (age and psychotic disorder) were included. Other significant correlations between independent variables were low in strength, and therefore were not omitted from the regression analysis (Plichta Kellar & Kelvin, 2013).

Table 3: *Correlation Matrix for Study Variables*

	Variable	1	2	3	4	5	6	7	8	9
1	Mobile Phone Ownership	-								
2	Age	-.252**	-							
3	Sex	.120*	.076	-						
4	University/College Education	.107*	.109*	.090	-					
5	Income	.145**	.221**	.049	.133**	-				
6	Comfort with Technology	-.158**	.317**	.121*	-.120	.015	-			
7	Psychotic Disorder	-.158**	-0.67	-.268**	-.092	-.067	-.004	-		
8	Mood Disorder	.125*	.136**	.320**	.101*	.148**	.048	-.632**	-	
9	Total Psychiatric Admissions	-.184**	.498**	-.009	-.094	.137**	.094	.077	.048	-

* $p<0.05$, ** $p<0.01$.

Table 4 shows the tests used to understand the model and how it fits with the data. The alternate model consisted of the hypothesized variables of interest added in addition to the demographic variables in the null model. The omnibus test of model coefficients produced a chi square statistic used to determine the statistical significance of the overall model (Plichta Kellar & Kelvin, 2013). The chi-square statistic for the model with all study variables was 62.84 ($p<0.01$), indicating that the predictive value of the overall model was significant. As outlined in Table 4, significance of the Hosmer-Lemeshow statistic for the hypothesized model was 0.29, which is greater than the set alpha of 0.05. This suggested that this model was a good fit to the data and thus the

Table 4: *Logistic Regression Model Tests*

Omnibus Tests of Model Coefficients			
	Chi-Square	df	Significance
Null Model	23.591	3	0.000
Alternate Model	62.848	8	0.000
Hosmer and Lemeshow Test			
	Chi-Square	df	Significance
Null Model	6.901	8	0.554
Alternate Model	9.636	8	0.294
Model Summary			
	-2 log likelihood	Cox & Snell R Square	Nagelkerke R Square
Null Model	498.10	0.062	0.084
Alternate Model	458.85	0.151	0.201

df = Degrees of Freedom

null hypothesis was rejected. The Cox and Snell and Nagelkerke R^2 values demonstrated that after adding age, sex, income, and education level, the alternate model was able to explain 20% of the variance in mobile phone ownership, which was 12% more than the null model.

Table 5 shows the regression coefficient (β), the adjusted odds ratios (Exp(β)) with confidence intervals, and also the statistical significance of the variables in the equation. The independent variables that significantly predicted mobile ownership were age (β=-0.047, p<0.01), income (β =0.049, p<0.05), comfort with technology (β=-0.152, p<0.05), and whether or not the participant had a psychotic disorder (β =-0.715, p<0.05). The predictive equation for

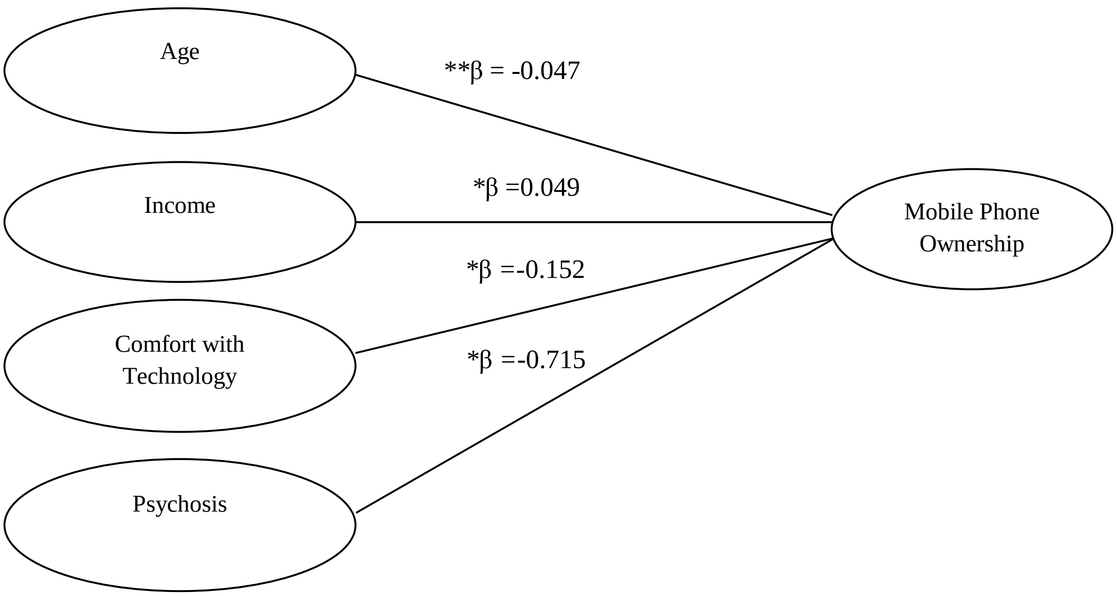
Table 5: *Regression Variables*

	β	Wald Statistic	Significance	Adjusted Odds Ratios	95% C.I. for Exp(β)	
					Lower	Upper
Age	-0.047	24.679	0.000**	0.954	0.936	0.972
Sex	0.456	3.412	0.065	1.578	0.973	2.562
College or University	0.410	1.993	0.158	1.506	0.853	2.661
High School (Reference)	-	-	-	-	-	-
Grade School	-0.104	0.151	0.698	0.901	0.532	1.525
Income	0.049	8.893	0.003*	1.051	1.017	1.085
Comfort with Technology	-0.152	4.074	0.044*	0.859	0.741	0.996
Psychotic Disorder	-0.715	5.742	0.017*	0.489	0.272	0.878
Constant	1.535	9.740	0.002	4.640	-	-

C.I. = Confidence Intervals, β = Regression Coefficient, * p<0.05, ** p<0.01

this model would be as follows: Mobile Phone Ownership = 1.535 (constant) – 0.047 (Age) + 0.049 (income) - 0.152 (comfort with technology) - 0.715 (psychotic disorder). The relationship between the significant predictor variables and mobile phone ownership can be seen in Figure 2.

Figure 2: *Final Logistic Regression Model*



*Values significant at *p*<0.05, ** Values significant at *p*<0.05

Hypothesis 2:

Descriptive statistics (Table 6) show that the group of participants without a mobile phone reported an average general health score higher than the group of participants who did own a mobile phone. An independent t-test was used to investigate if there was a significant difference between the means for these two groups with an alpha level set at 0.05.

Results from this analysis (Table 7) show the variances between the groups were not assumed to be equal (f=2.6, p>0.05). It can be concluded that there was no statistically significant difference in general health scores between participants who did not own a mobile phone (*M*=57.5, *SD*=24.8) and those who did own a mobile phone (*M*=52.6, *SD*=23.0), *t*=-1.7, *p*>0.05.

Table 6: *Participation in Society Statistics*

Variable	**Participation in Society Measures**		
	Mobile Phone Ownership	*Mean*	*SD*
General Health (n=400)			
	Yes (1)	52.6	23.0
	No (0)	57.5	24.8
Quality of Life (n=402)			
	Yes (1)	4.5	1.45
	No (0)	4.8	1.41
Total Community Integration (n=391)			
	Yes (1)	18.1	4.3
	No (0)	16.6	4.7
Social Integration (n=403)			
	Yes (1)	8.5	2.3
	No (2)	7.4	2.3
Home Integration (n=394)			
	Yes (1)	6.4	2.9
	No (2)	6.2	3.1
Productivity Score (n=400)			
	Yes (1)	3.2	1.8
	No (2)	2.9	1.7

Table 7: *Hypothesis 2 T-Test Summary*

Variable	Levene's Test			T-Test			
	F Statistic	Sig.		T	Sig.	95% Confidence Intervals	
						Lower	Upper
General Health	2.581	0.109		-1.705	0.054	-9.583	-0.135

* Values significant at $p<0.05$, ** values significant at $p<0.01$

Hypothesis 3

Descriptive statistics (Table 6) show that the group of participants without a mobile phone reported an average QoL score higher than the group of participants who did own a mobile phone. An independent t-test was used to investigate if there was a significant difference between the means for these two groups with an alpha level set at 0.05.

Results from this analysis (Table 8) show the variances between the groups were not assumed to be equal (f=0.9, p>0.05). It can be concluded that there was no statistically significant difference in quality of life between those who did not own a mobile phone (M=4.8, SD=1.4) and those who did own a mobile phone (M=4.5, SD=1.5), t=-1.9, p>0.05.

Table 8: *Hypothesis 3 T-Test Summary*

Variable	Levene's Test			T-Test			
						95% Confidence Intervals	
	F Statistic	Sig.		T Statistic	Sig.	Lower	Upper
Quality of Life	0.885	0.347		-1.942	0.053	-0.563	0.003

* Values significant at $p<0.05$, ** values significant at $p<0.01$

Hypothesis 4:

Descriptive statistics (Table 6) show that compared to the group of participants who did not own a phone, the group of participants who owned a mobile phone reported a higher average score of total community integration, as well as higher average scores on all of the community integration subvariables. An independent t-test was used to investigate if there was a significant difference between the means for these two groups with an alpha level set at 0.05.

Results from this analysis (Table 9) show the variances between the groups are not assumed to be equal for total community integration (f=0.5, p>0.05), social integration (f=0.2, p>0.05), home integration (f=0.3, p>0.05), and productivity (f=2.1, p>0.05). It can be concluded that those who owned a mobile phone (M=18.1, SD=4.3) had a significantly higher total community integration score than those who did not own a mobile phone (M=16.6, SD=4.7), t=3.4, p<0.01. Those who owned a mobile phone (M=8.5, SD=2.3) also reported significantly higher social integration scores than those who did not own a mobile phone (M=7.4, SD=2.3), t=4.8, p<0.01. Similarly, those who owned a mobile phone (M=3.2, SD=1.8) reported a significantly higher productivity score than those who did not own a mobile phone (M=2.9, SD=1.7), t=2.5, p<0.05. The difference in the mean of the home integration score was not statistically significant between those who owned a mobile phone (M=6.4, SD=2.9) and those who did not own a mobile phone (M=6.2, SD=3.1), t=0.6 p>0.05.

Table 9: *Hypothesis 4 T-Test Summary*

Variable	Levene's Test			T-Test			
	F Statistic	Sig.		T Statistic	Sig.	95% Confidence Intervals	
						Lower	Upper
Community Integration	0.486	0.486		3.353	0.001**	0.634	2.432
Social Integration	0.151	0.698		4.761	0.000**	0.638	1.535
Home Integration	0.283	0.595		0.577	0.564	-0.417	0.764
Productivity	2.119	0.146		2.505	0.013*	0.091	0.759

* Values significant at p<0.05, ** values significant at p<0.01

Discussion and Implications

The purpose of this study was to examine the relationships between sociodemographic inequalities and the ownership of a mobile phone among individuals with mental illness. It was also intended to explore the implications of owning a mobile phone on measures of societal participation and social wellness. The findings from this study partially support van Dijk's Framework (2005), that certain demographic inequalities may influence mobile phone ownership among individuals with mental illness. Furthermore, the findings from the study help to delineate the relationship between mobile phone technology and social participation by showing that individuals with access to mobile phones may be better integrated into their communities.

The rate of mobile phone ownership among individuals with mental illness remains unclear. Some studies have found this rate to be quite comparable with that of the general population (Ennis et al., 2012; Torous et al., 2014), while others have demonstrated a significant lag in ownership (Ben-Zeev et al., 2013; Ben-Zeev et al., 2013; Firth et al., 2015). This analysis found that nearly 57% of participants did not own a mobile phone at the time of baseline data collection, a number that is considerably lower than that of the general adult population in Canada. The ownership rate was also lower than findings from other studies among individuals with mental illness. The demographic information of this sample may help to elucidate this low rate. While no illness severity measure was present in the data, this sample had a mean of over six (*SD=10.2)* lifetime psychiatric hospital admissions, which may be suggestive of chronic, persistent and severe mental illness (Gaynes et al., 2015; Swett, 1995). Furthermore, this study was conducted in Canada, which boasts some of the most costly mobile services globally (OECD, 2013). Since cost is a major barrier to mobile access among this population (Ben-Zeev, 2013; Borzekowski et al., 2009; Forchuk et al., 2015; Proudfoot et al., 2010), it is possible that physical access may be more difficult to overcome for Canadians than it is for citizens with comparable incomes in other countries. This finding is suggestive of quite a large disparity in mobile phone ownership among Canadians with mental illness and warrants further investigation. Future research should also explore the type of phone, the ability to access the internet, the presence and extent of a phone and data plan, and other capabilities. This information would be helpful to further understand and compare levels of mobile phone access and the implications it has on this population.

Sociodemographic variables give some clarity as to whom among this group are most likely to lack access to a mobile phone. van Dijk's (2005) Framework for Understanding the Digital Divide and the current literature have identified age, sex, income, and education as potential sociodemographic variables that are predictive of group differences in digital access and use. Comfort with technology and psychiatric diagnosis were also explored as variables of interest based on the literature review. These variables were analyzed in a logistic regression model to better understand the relationships they have between mobile phone ownership as well as each other. Results from this analysis demonstrated that the predictive value of the overall model with all of the independent variables was significant (p<0.01) and that the overall model was able to predict approximately 20% of the variance in mobile phone ownership. Age, income, comfort with technology, and psychiatric diagnosis were found to be significant predictors of mobile phone ownership. Education level and sex were not found to be significant predictors.

Age has been a consistent influencer of mobile phone ownership, both in the general population and among individuals with mental illness. This study demonstrates that among this sample, an individual's age may be a significant predictor of whether or not they will own a mobile phone. If all other significant variables remain constant, an addition of one year in age decreases an individual's odds of owning a mobile phone by 4.6% (Exp(β)=0.954, CI 95%

[0.936, 0.972]). This is despite the finding of significant positive correlations between age and income (ρ=0.221, p<0.01), and age and education (ρ=0.109, p<0.05), both of which were variables that were expected to increase the likelihood of owning a mobile phone. These findings are consistent with similar research conducted among individuals with mental illness (Ben-Zeev, 2013; Firth et al., 2015). An individual's comfort with technology may shed some light onto why it is that older individuals are less likely to own a mobile phone. A significant positive correlation was found between age and discomfort with technology (ρ=0.317, p<0.01). This finding fits with van Dijk's theory (2005) that physical access barriers do not exclusively explain a population's use of technology and that efforts need to also focus on motivation, skills, and digital literacy. While these findings showed that age may influence the degree to which an individual is marginalized technologically, it is important to understand what implications this may have. Czaja and Lee (2007) demonstrate that ICT usage offers the elderly the ability to remain independent and healthy longer. This was also shown in studies by Gatto and Tak (2008) and Niehaves and Plattfaut, (2014) who showed that ICTs promoted the independence of this particular cohort. This means that older individuals without access to mobile phones may be at a significant disadvantage to achieving health and social wellness through technology. Future research, social programs, and policy development should be made with this variable in mind by not only focusing on efforts to provide physical access to mobile phones, but to also enhance motivation to use mobile phone technology, and the skills and literacy necessary to participate.

Historically, females have had less access to and were less likely to adopt ICTs when compared with males (Belanger & Carter, 2009; Brown & Venkatesh, 2005). Although it was initially included as a categorical inequality in van Dijk's original Framework (2005), technology research has since shown that the digital divide between men and women is no longer significant (van Dijk, 2008; Zickhur & Smith, 2012). While being female was significantly correlated to owning a mobile phone (φ=0.120, p<0.05), sex was not found to be a significant predictor of mobile phone ownership. Being female was associated with a higher discomfort with technology (φ=0.121, p<0.05), which has been found in other studies as well (Ennis et al., 2012). While this study reaffirms that sex may not a significant predictor of mobile phone ownership, additional investigation is needed to strengthen these findings among individuals with mental illness. Further exploration of what factors may influence differences in mobile phone ownership between sexes would be helpful for the planning and implementation of future research and policy to ensure that access to mobile phones is equitable and inclusive of both sexes.

On average, participants among this population had a low annual income (*M*=$12,659, *SD*=7,872). The findings from this study demonstrated that annual income may be a significant predictor in mobile phone ownership. If all other variables remained constant, an addition of $1000 in annual income increases the odds of an individual owning a mobile phone by 5.1% (Exp(β)=1.051, CI 95% [1.017, 1.085]). This finding was consistent with similar research that has found income to be a significant predictor in mobile phone ownership (Ben-Zeev et al., 2013). These findings were not surprising, since the cost of owning and operating a mobile phone is consistently identified as a major barrier to access (Ben-Zeev, 2013; Borzekowski et al., 2009; Forchuk et al., 2015; Proudfoot et al., 2010). Income as a barrier to mobile phone ownership is problematic, as these technologies have been known to improve health and social wellness indirectly by facilitating key social determinants of health, like employment and education (Baum et al., 2012). With this in mind, focusing research and policy efforts around improving income for this population may help to close the gap in mobile phone ownership. It is important that future research and policy development consider the economics of mobile phone technology.

Despite support from both van Dijk's (2005) Framework and the literature review, having more than a high school education (β=0.410, p>0.05) or less than a high school education (β=-0.104, p>0.05) was not found to be significantly predictive of mobile phone ownership. Having a higher education level was significantly and positively-correlated with income (ρ=0.133, p<0.01), which was significantly predictive of owning a mobile phone. As such, it is possible that the multicollinearity among these variables is masking the predictive value of education in the regression analysis, since previous literature suggests that individuals with higher levels of education are associated with mobile phone ownership (Ben-Zeev et al., 2013; Dahne & Lejuez, 2015; Firth et al., 2015). Low education levels have also been shown to be associated with lower usage of technologies, partly because technical literacy is strengthened in school curriculums and because schools are one of the few social institutions that provide free access to technologies (Warren, 2007). It is for these reasons that the relationship between mobile phone ownership and education level should be further investigated and remain on the radars of those implementing interventions through mobile technology.

Discomfort with Technology was included in this analysis as a control variable in order to explore the unbiased relationship between the sociodemographic variables and mobile phone ownership. This variable was a significant predictor of whether or not an individual owned a mobile phone. For each increase in score on the Likert scale (which indicated less comfort with technology), the odds of an individual owning a mobile phone decreased by 14.1% (Exp(β)=0.859, 95% C.I. [0.741, 0.996]). This coincided with literature that showed that those with feelings of discomfort, stress, and fear of technology were less likely to use it (Rockwell &

Singleton, 2002). van Dijk (2005) posits that this anxiety is stronger for older people, which helps to elucidate the significant association between being older and having less comfort with technology ($\rho=0.317$, $p<0.01$). While some research has shown that overcoming technology anxiety is possible (Stanley, 2003), this remains a barrier to accessing and optimizing mobile phone technology and should be considered in all future research. Without the motivation and physical access to mobile phones, individuals will not progress in the succession of developing the technical and informational skills needed to participate in a digital society.

Finally, having a psychotic disorder was also shown to be a significant predictor of mobile phone ownership. Having a psychotic disorder decreased the odds of owning a mobile phone by 51.1% ($\mathrm{Exp}(\beta)=0.489$, 95% C.I. [0.272, 0.878]). Evidence suggests that the typical onset of psychosis occurs most often in one's teenage years or early 20s, compared to the typical range of mood disorder onset between ages 25 to 45 (Kessler et al., 2007). This early onset can cause persistent disruptions in education and employment and often results in low income and educational achievement (Rinaldi et al., 2010; Sareen, Afifi, McMillan, Gordon, & Asmundson, 2011). It's possible that a relationship may exist between psychosis and other variables that may influence one's access to mobile phones, but this could not be substantiated with this study's findings.

While the digital divide is not a new concept, most of the studies to date do not explore the consequences of this phenomenon. A hallmark of van Dijk's framework used in this study (2005) is the recognition of the social exclusion faced by individuals who do not have equal access to technology. He argues that access to ICTs increases an individual's social capital by enhancing participation in the community, social relationships, the workplace, and other cultural endeavours (van Dijk, 2005). This has been reaffirmed with recent literature that demonstrates that mobile phone technology may influence one's health and social wellness (Czaja & Lee 2007; Krishna et al., 2009). In an effort to measure this concept, data on health, quality of life, and community integration were analyzed between individuals who did and did not own a mobile phone. The community integration score was thought to best embody van Dijk's concept of Participation in Society (2005) and has been used in other populations to measure social participation (Dalemans, de Witte, Lemmens, van den Heuvel, & Wade, 2008). Individuals who owned a mobile phone (M=18.1, SD=4.3) had a significantly higher total community integration score than those who did not own a mobile phone (M=16.6, SD=4.7), t=3.4, p<0.01. They also scored better on two of the instrument's three subscales, which have been found to be largely orthogonal (Willer, Ottenbacher, & Coad, 1994). Those who owned a mobile phone (M=8.5, SD=2.3) reported significantly higher social integration scores than those who did not own a mobile phone (M=7.4, SD=2.3), t=4.8, p<0.01, and similarly, those who owned a mobile phone (M=3.2, SD=1.8) reported a significantly higher productivity score than those who did not own a mobile phone (M=2.9 SD=1.7), t=2.5, p<0.05. The difference in the mean of the home integration score was not statistically significant between those who owned a mobile phone (M=6.4, SD=2.9) and those who did not own a mobile phone (M=6.2, SD=3.1), t=0.6, p>0.05. The findings here suggest that individuals who do possess a mobile phone may be more likely to participate in society. This finding is not surprising given the multitude of functions and applications mobile phones serves in everyday life. In a study of mobile phone use in the United States, Smith (2015) found that mobile technology was widely used for health research, employment resources, educational resources, news, and community and social engagement. The magnitude of mobile phone use in everyday life has also been demonstrated among the Canadian population as well (Catalyst, 2015). Evidently, not owning a mobile phone may have implications for an individual's ability to participate meaningfully in today's society.

The two other potential measures of participation in society were general health status and quality of life. No statistically significant difference in quality of life was found between those who did not own a mobile phone (M=4.8, SD=1.4) and those who did own a mobile phone (M=4.5, SD=1.5), t=-1.9, p>0.05. Similarly, there was no statistically significant difference in general health scores between participants who did not own a mobile phone (M=57.5, SD=24.8) and those who did own a mobile phone (M=52.6, SD=23.0), t=-1.7, p>0.05. While it was hypothesized that these measures would be higher in individuals who owned mobile phones, it is possible that health and quality of life were not congruent with van Dijk's (2005) concept of participation in society. Despite being insignificant in this analysis, health and quality of life may be influenced in the future as people increase their use of technologies to access health information (Underhill & McKeown, 2008) and as healthcare interventions are increasingly delivered through mobile mediums (Depp, Kim, Vergel de Dios, Wang, & Ceglowski, 2012; Forchuk et al., 2013; Granholm, Ben-Zeev, Link, Bradshaw, & Holden, 2012). As such, future research should investigate how mobile phones are influencing health and quality of life as they continue to permeate into society.

Limitations

While the results contributed to the understanding of the mobile digital divide among individuals with mental illness, there were some methodological limitations that should be considered when interpreting its findings and recommendations. After baseline data collection in the primary study, individuals were given a mobile phone and thus data analysis had to occur at one point in time. Given the cross-sectional nature of this study, it was very limited in its ability to make causal claims about its findings (Polit & Beck, 2008). The findings elucidate some of the relationships between study variables, but the strength and direction of these relationships are not clear. Future research focusing on longitudinal data collection would be helpful to draw stronger conclusions. Individuals recruited to this study were done so through convenience sampling. While participants were recruited from a variety of programs among different organizations, the participants were from one region and were primarily outpatients. As such, the results from this sample may not be generalizable to the greater population of individuals with mental illness. Furthermore, the incentive to receive a new mobile phone had the potential to attract participants who were without a phone to begin with, or individuals with a strong interest in using mobile phones. The data from the primary analysis also came from self-report questionnaires that have the potential to be affected by response-bias. Stressing the importance of confidentiality during data collection was paramount to mitigate this type of risk (Polit & Beck, 2008). Lastly, the handling of missing data was a limitation of the study. While the study incorporated the strengths of different strategies to prevent bias and maintain the power of the full sample, ultimately some participants were lost and some degree of bias was introduced.

There were also limitations related to how the theoretical framework was used to guide this study. Because this was a secondary analysis, the ability to thoroughly measure theoretical concepts was limited. For instance, one of the hallmarks of this theoretical framework and emerging research is that access to technology goes beyond merely owning a mobile phone. van Dijk (2005) describes a multifaceted succession of technological access that includes motivation, material and physical access, skills access, and usage. While this study was adequately able to measure physical and material access as well as one’s comfort with technology, a more in depth understanding of digital skills, technical and informational literacy, and phone-specific information would have been helpful. Some researchers have made attempts to measure this concept by looking at one's basic literacy skills, functional literacy, occupational literacy, technological literacy, informational literacy, and adaptive literacy (Carvin, 2000). van Dijk's Framework (2005) also proposes a concept that mediates categorical inequalities and access to technologies. This mediating concept – the distribution of resources – is conceptualized by measures of social and economic capital which were not readily available in the primary dataset. While this study was not able to study the digital divide from the varying perspectives available today, it did employ a multivariate analysis that provided insight into some of the sociodemographic influences of the digital divide. However, having additional data to measure additional divide concepts would have elucidated the complex relationships between social inequities, the varying types of technology access, and its effects on health and social wellness.

Conclusion

The results of this study provide partial support for van Dijk's (2005) Framework for Understanding the Digital Divide. Individuals in this sample reported lower rates of mobile phone ownership when compared with average of the general adult population. In a regression analysis, age, income, comfort with technology, and psychiatric diagnosis were all found to be significantly predictive of 20% of the variance of mobile phone ownership. This demonstrated that inherent sociodemographic inequalities found within the sample may be affecting one's access to mobile phone technology. Individuals who were younger, who had higher income, who were more comfortable with technology and who did not have a psychotic disorder were most likely to own a mobile phone. Education and sex, variables that are commonly cited in the literature as predictive of mobile phone ownership, were not found to be significant predictors in this study. Mobile phone ownership was also shown to have a relationship with one’s participation in society based on measures within this study. Total community integration, social integration, and productivity scores were found to be significantly higher for individuals who owned a mobile phone than those who did not. Differences in general health and quality of life among these groups were not found to be significant. It is essential that practicing nurses, educators, researchers, and policy makers working with this population be cognizant of factors that may influence access to mobile phones for individuals with mental illness. These stakeholders should also promote policies and approaches to care that improve sociodemographic inequities and promote the access to and optimization of mobile phone technology for this population.

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CHAPTER THREE

The purpose of this study was to test van Dijk's *Framework for Understanding the Digital Divide* (2005) by examining the relationship between a multitude of sociodemographic variables and the ownership of a mobile phone among individuals with mental illness in London, Ontario and the surrounding area. Another goal was to explore van Dijk's (2005) concept of participation in society and to test whether or not having access to mobile phone technology influenced one's health, social and community inclusion and quality of life. It was found that individuals with mental illness had considerably lower rates of mobile phone ownership than the general adult population in Canada. A logistic regression analysis demonstrated that an individual's age, income, comfort with technology, and psychiatric diagnosis were all significantly predictive of mobile phone ownership, and together, were able to explain 20% of the variance of mobile phone ownership. Despite support from both the theoretical framework and the literature, this analysis also showed that education level and sex were not predictive of mobile phone ownership. In contrast to individuals who did not own a mobile phone, those with physical access to a phone had significantly better measures of total community integration, social integration, and productivity, which measured one's participation in education and employment. One's home integration, quality of life, and health status were not significantly influenced by mobile phone ownership. Together, these findings demonstrate that social inequalities may hinder the ability for those with mental illness to own a mobile phone. Consequently, those without access to a mobile phone may be at risk for lower community integration, social inclusion, and less productivity in work and education. The results of this study suggest that van Dijk's Framework (2005) may be used to inform nursing practice and education, health policy development, and research among this population.

Implications for Nursing Practice

As mobile phone technology continues to proliferate throughout society, it will become increasingly necessary for societal participation (van Dijk, 2005). Findings from this study demonstrate low rates of mobile phone ownership among this sample, which may exacerbate old inequities and create new ones for individuals this population. As such, it is important for practicing nurses who work with similar populations to recognize the potential for inequitable access to mobile phones among their clients. This is especially true now that health information and health maintenance tools are proliferating into mental health care (Dagoo et al., 2014; Forchuk et al., 2014; Granholm, Ben-Zev, Link, Bradshaw, & Holden, 2011; Kauer et al., 2012; Meglic et al., 2010; Sims et al., 2012; Whittaker et al., 2012). Nurses should be cautious when providing health information or treatment through the means of mobile phones. Baum, Newman, and Biedrzycki (2012) recommend tailoring any digital information and interventions to match client abilities, and to offer non-digital resources in conjunction with online or mobile resources.

The results of this analysis provide some insight for practicing nurses who have clients at risk of lacking access to mobile phone technology. Based on these findings, nurses should focus additional attention on those who are older, who have limited income, who are less comfortable with technology, as well as those who have a psychotic disorder. Nurses are urged to take efforts to improve access to mobile phone technology for their clients. For instance, nurses may help secure the financial capital needed for low income clients who wish to own and operate a phone (van Dijk, 2005). Nurses linking clients to libraries and other non-profit agencies that provide technology support may also help narrow the divide (Chatterjee, 2002). This is especially true for those who lack comfort with technology or aging clients who may not possess the skills and confidence to operate a mobile phone. Results from this analysis suggest that by striving to increase access to mobile phone technology, nurses may improve the social integration, productivity, and overall community integration of their clients.

Nurses are also in a unique position to use their strong, trusted political voice to engage with all levels of government (Whitehead, 2003) in an effort to improve access to mobile phones for those with mental illness. The nursing profession should draw attention to the mobile digital divide and put the issue at the forefront of government priorities through further research and scholarship, media outlets, and government lobbying. Nurses should work collaboratively with other health professionals, but more importantly with mental health consumers and advocacy groups to draw attention to the issue (Whitehead, 2003). Collectively, this unified effort may focus much needed attention to the issue and create an environment fertile for reform.

Implications for Policy

Given the findings of this study, it is recommended that health policies focus on pragmatic solutions that ensure equal opportunity and inclusion in the digital world for all individuals experiencing mental illness. Based on works by van Dijk (2005, 2008), it is clear that comfort and motivation to use technology are antecedents to ownership and use. While studies have shown that individuals experiencing mental illness are generally open to using mobile technologies (Ben-Zeev et al., 2013; Forchuk, Donelle, Ethridge, & Warner, 2015; Torous et al., 2014), this study demonstrated that lacking comfort with technology decreased an individual’s odds of owning a mobile phone. More specifically, being female, older in age, having a mood disorder, and having a more persistent mental illness based on psychiatric admissions were all negatively associated with technology comfort. As such, it is recommended that government, institutions, and businesses develop information and programs targeted at these specific groups that promote the benefits and uses of mobile phones. Innovators and businesses are also encouraged to enhance user-friendliness with these groups in mind, as currently, individuals with disabilities tend not to be considered in technology development (Jaeger, 2012). Together these policy suggestions may help to drive interest and make mobile phone technology more approachable and accessible for these groups who report high levels of discomfort.

Policies that focus on skills development and literacy among this population may also increase the uptake of mobile phones among digitally disadvantaged groups (Baum et al., 2012; van Dijk, 2005). Stanley (2003) studied low-income individuals from ethnic minorities who were apprehensive and uncomfortable with computers. After having a hands-on experience in a supportive learning environment, these individuals reported that they quickly overcame their fears about technology and expressed relief and improved self-esteem. With this in mind, it is recommended that policies focus on providing supportive learning opportunities and capacity building for individuals with mental illness. This education should appeal to groups that are more likely to be uncomfortable with mobile phones or who are without access. For instance, workshops on using mobile phones in the development of vocational skills or job searching skills would be both appealing and pragmatic for those unemployed or with low income. Policies may focus on the diversion of funds to public libraries to support workshops such as these (Baum et al., 2012). Similarly, the finding that age was a negative predictor of mobile phone ownership, and was also significantly and negatively associated with technology comfort, indicates that this group may benefit from additional education. Incorporating mobile phone skills development into current adult education programs may also enhance skills and increase uptake. Health care organizations may create funding for workshops in their mental health departments where individuals are coached on using mobile phones to research credible health information or to use mobile applications to improve health and promote social inclusion (Chang et al., 2004).

While policies that work towards enhancing comfort, skills, and mobile literacy are important steps for closing the mobile digital divide, they become futile if economic barriers prevent vulnerable groups from having access to mobile phone technology. It is recommended that governments create policies that lead to universal access to mobile phones among individuals with mental illness. Results from this study suggest that individuals with lower income may be less likely to own a mobile phone. Given that cost is the biggest barrier to mobile phone access among this population (Ben-Zeev, 2013; Borzekowski et al., 2009; Forchuk et al., 2015; Proudfoot et al., 2010), policies should focus on both affordability and social subsidies. More specifically, van Dijk (2005) recommends government intervention in promoting competition between mobile service providers so as to lower prices. This policy recommendation is especially important for Canada, whose citizens face some of the highest costs for mobile phone service among the world (Organization for Economic Co-Operation and Development, 2013). Until a competitive mobile market is created, prices among the select few oligarchical companies will remain artificially high and out of reach for those with low-income. Another approach may be to develop government subsidies for mobile phones and services targeted at groups who lack access (Ben-Zeev et al., 2013; van Dijk, 2005). For instance, individuals with mental illness could be eligible for a monthly subsidy to cover or reduce the cost of a mobile phone and plan if their income falls below a certain threshold (van Dijk, 2005). Similarly, low-income seniors could be eligible for a tax credit on their mobile service plan. Economic policies should not just be limited to government and social subsidies. Businesses could be lobbied to donate older-model or used mobile phones to be distributed among vulnerable populations. For instance, Cell Phones for Soldiers is a program in the United States where used mobile phones are donated to veterans who lack access (Cell Phones for Soldiers, 2016). Also, encouraging businesses and philanthropists to make investments and donations to programs that enhance the uptake of mobile phones among individuals with mental illness may foster a symbiotic relationship between the business and public sector. For instance, the Bill and Melinda Gates foundation has invested more than $250 million to enhance hardware, software, and training at libraries around the United States, and has also funded research into improving digital access among the population (Palmer, 2015). Together, these policies may offer pragmatic solutions that target groups who are at risk of social exclusion from a lack of mobile phone access.

The digital divide is just as much of a social problem as it is a technological problem. Without addressing social inequalities, new digital divides might appear as technology evolves and new technology emerges (van Dijk, 2005; van Dijk, 2008). As such, it is recommended that the aforementioned polices be developed in conjunction with upstream social policies in order to diminish the influence of social disparities on the access to mobile phone technology. Policies that aim to improve the social determinants of health and reduce poverty among individuals with mental illness should remain a top priority (Canadian Nurses Association, 2009). Broader strategies will indirectly, and perhaps more effectively, diminish the digital divide.

Recommendations for Nursing Education

All nurses who interact with individuals with mental illness should recognize the potential for inequitable mobile phone access among this population and the implications that may have. Chang and colleagues (2004) recommend that educators and curriculum developers tailor education programs so that nurses become aware of these inequalities and be taught strategies to help mitigate the divide in future practice. Findings from this analysis may inform educators of mental health and nursing informatics by shedding light on the difference in mobile phone ownership among individuals with mental illness when compared to the general population. Furthermore, these findings highlight the connection between lacking access to a mobile phone and diminished social participation. The findings of this study also partially support van Dijk's Framework for Understanding the Digital Divide, which may be useful to graduate nursing students who are studying and researching other technologies and digital divides. Nurses have the ability to use their practice and political voice to enhance access to mobile phone technology among this population. As such, it is important that they are aware of this issue and are equipped with the knowledge and understanding to address it in future practice.

Recommendations for Future Research and Theory

It is encouraged that future researchers build upon the findings from this study and continue to test and refine van Dijk's *Framework for Understanding the Digital Divide* (2005). This study found that individuals with mental illness in this sample had a considerably lower rate of mobile phone ownership than the general Canadian population. Future studies should continue to measure and monitor ownership rates among this population to quantify disparities and to measure the success of health policies and government interventions (Andreasson, 2012). This study identified age, income, comfort with technology, and psychiatric diagnosis as sociodemographic variables that significantly predicted mobile phone ownership. It is important that future mental health researchers recognize these sociodemographic inequalities, understand their effects on access, and work to mitigate further disparities that may be caused by introducing new technologies (Newman, Biedrzycki, & Baum, 2010). Researchers investigating the digital divide are encouraged to retest these findings and to assess for other inequalities affecting access that lead to a better understanding of the mobile digital divide. Finally, it is recommended that the implications of a mobile digital divide among this population be further explored and monitored. Broader knowledge on the subject can enable critical consciousness-raising and set priorities for future research (Whitehead, 2003). Furthermore, a greater understanding of the implications can also be helpful to gauge progress in the efforts to promote equitable mobile access and to inform government and stakeholders about the continued need for action.

This study was able to test specific parts of van Dijk's *Framework for Understanding the Digital Divide* and offered some new insights into applying this framework specifically to those with mental illness. However, there were some limitations in its ability to assess and measure all concepts within the model. It is recommended that researchers build upon the results of this study by testing the relationships between other concepts and the model as a whole. In particular, it is recommended that future researchers seek to gain understanding of van Dijk's successive kinds of access (2005). Ensuring everybody with mental illness has a mobile phone is only half of the battle. Understanding the relationships between sociodemographic inequalities and other successive types of access – like motivation, information and health literacy, and digital skills – will help to explicate the mobile digital divide beyond just physical access (DiMaggio & Hargittai, 2001). Furthermore, researchers should seek to explore van Dijk's (2005) concept of the distribution of resources. Understanding how social capital ties into the model not only moves the focus from the individual to society, but it helps to map how demographic inequalities translate into digital disparities. Future research surrounding mobile phone access and the digital divide should also collect pertinent information about mobile phone technology as it evolves. For instance, exploring the types of mobile phones individuals own, what capabilities they have, how their service plans enable or limit them, and costs of mobile access are all things that help to further understand the mobile digital divide.

Conclusion

The results of this study partially support van Dijk's *Framework for Understanding the Digital Divide* (2005) and how it applies to individuals with mental illness. The results helped draw attention to the low rate of mobile ownership among individuals with mental illness in this sample. The findings also identified individuals among this population who may lag behind in terms of access to mobile phones, including those older in age, those with lower income, those who have less comfort with technology, and those who have a psychotic disorder. Finally, it was found that those who lack access to mobile phones may have poorer community integration. Together, these findings may be useful in helping to improve the practice of nurses who find themselves and their clients in a world of increasing digital dependency. These results may also inform multi-level and multisectoral policy reform in an effort to foster universal mobile access and equal opportunity for those with mental illness. Finally, the results may encourage further exploration of this issue and this framework among educators and researchers. As mobile phones become more embedded into the fabric of society, it is important that efforts be made to break the insidious cycle demonstrated by van Dijk's *Digital Divide Framework* (2005). These recommendations based on the results of this study seek to break this cycle and to encourage equal access and opportunity for all individuals with mental illness.

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