

# Use of Mobile Health Applications and the Self-Management of Cancer: A Gendered Approach

Rita Mano

Department of Human services, University of Haifa, Haifa, Israel

Email: ritamano@research.haifa.ac.il

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## Abstract

The growing use of mobile health applications for health purposes increased the expectations about their effectiveness. The study examines the effectiveness of mobile health applications on the self-management behaviors of 168 individuals diagnosed with cancer. The results of a secondary analysis indicate that using extensively mobile health applications significantly increases women's health empowerment attitudes—reaching health decisions, changing their approach to health concerns, seeking additional health consultation. However, the use of mobile health applications does not increase the likelihood of adopting self-management behaviors. The study indicates that the effectiveness of mobile health applications in self-management practices is contingent upon a set of personal characteristics and the level of technology skills.

## Keywords

Cancer, Mobile Health Applications, Self-Management, Women

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## 1. Introduction

The rapid development of communication technologies and the widespread dissemination of information has affected individuals and the health sector. The internet has increased individuals' possibilities providing quick access to online health information and online health services and offered them a better perspective on a particular health condition, treatment or medication [1] [2] [3]. Approximately 81% of US adults use the internet, 59% admit to searching online for health information and 35% have gone online to determine what medical condition they or someone else may have. In Europe, some 7.4% of the population reported contacting a family doctor, specialist or other health professionals

via email or the Web to request or renew a prescription, 9.9% to schedule an appointment, and 6.7% to discuss specific health problems. In a recent online survey of 3020 EU adults aged 18 and older, 82% of surveyed internet users in Italy, 76% in Germany and 71% in France went online for health-related activities in the surveyed period, while in the United Kingdom the figure was 56% [4].

*Mobile health applications (Mapps)* are a common way for individuals in the general population to address their health needs and learn about health-related products and services on their own time and at their own pace. In the US 21% of adults aged 18 - 24 [5] use Mapps to follow a health regimen and facilitate communication exchanges with others who have similar health concerns [6] [7] or to contact healthcare providers to seek information and advice [8]. In Israel access to mobile health services for appointment reminders and lab tests [9] is on the rise. Similarly, in the EU a majority of respondents (69%) report that a faster and more reliable connection to digital sources would encourage them to use digital technologies more frequently to increase their wellbeing and address their health concerns [10]. Updating the information and content of Mapps is quite common in the US, especially in the delivery of health services [7] [11].

The empowering effect of Mapps on individuals manifests in increased health-related activity online [12]. Studies report that more people use the internet to search for health-related information than for banking and other similar applications [13] [14] [15]. The vast majority of health-related applications were reported to be “useful” [16] [17], as manifested in a “health-wise” lifestyle that includes better decisions regarding health management [18] and willingness to adopt new health behavior or change existing behavior [19].

Mapps effectiveness however is not clear though due to two main reasons [20]: 1) the discrepancy between motivations and active engagement in health-related activity is considerable [21]; 2) the differences in individual’s demographic and socioeconomic background such as age, gender and education [1] [9]. As a result, the evidence concerning the link between Mapps use and gender differences in the cancer self-management is limited [22] [23] [24]. Studies report indeed, the effect of gender on m-Health utilization in two contradictory ways. On the one hand, women are more likely to search for health information online [1] [25]. On the other hand, though, Some studies contend that women dislike using technology devices for health communication purposes [19] and doubt the “perceived functionality” of Mapps, especially when health concerns involve health risks [26] [27]. This is because technology devices do not allow them to process information selectively and hence lower the level of actual “gratification” [1] [28]. In fact, a substantial number of studies have raised concerns that the “technology embedded” cyber sources of health information and services may negatively affect women as well as individuals who lack the necessary skills or simply dislike using computer-mediated communication to seek information. Indeed, according to the *techno-feminism approach*, technology devices are not gender neutral and technology-based devices are mostly masculine. Since women differ from men with regard to their internal mental workings communi-

tion needs and preferences [29], the “masculine” technology restrains women from fully capitalizing on Mapps.

In this study, we examine the importance of gender differences in the use and effectiveness of Mapps in the self-management of cancer. We consider the possibility that women diagnosed with cancer who need to access health-related information and address daily functions, are less likely to capitalize on the use of Mapps to address their condition. As a result, the benefits of preventive online and offline medical health support [30] [31] for women are reduced lowering the likelihood for effective self-management of cancer [9] [24] [32].

## 2. Background

The rise of the information society and the adoption of the internet have the capacity to reduce existing health inequalities [33] because technology devices have become a significant means of health self-management because they serve many health goals [34]. This is especially evident in the growing use of mobile technology supporting eHealth and mHealth platform for health purposes narrowing gaps in access to information and services [1].

Technology skills enable individuals to capitalize on technology-based applications [6] such as those available in Mapps help people access relevant information on health concerns and health services [7], provided and that socio-demographic characteristics such as age [4], cultural variations [1] and gender [9] [35] do not limit the extent of Mapps use. The literature discussing the use of technology makes two alternative and contradictory predictions.

According to the *normalization hypothesis*, these skills help individuals with chronic diseases to search for more information [9], consult online rankings or reviews [36], engage in online health-related activity [37] and exchange information with others who have similar health concerns. Thus, the use of Mapps decreases gaps in health information and services [30] [38]. In contrast, the *techno-feminism approach* suggests that technology may increase the discrepancies between those who do and do not possess the skills necessary to capitalize on technology. In this case, Mapps will not necessarily provide greater health empowerment and improved self-management for individuals who lack the necessary skills or place less trust in virtual health sources [30] [38] [39]. As a result women with cancer may not be able to overcome the technology barrier and will therefore be less willing to rely upon this medium to address the self-management of cancer [9] [40].

### 2.1. Technology Use and Chronic Disease

Empirical evidence regarding the effect of Mapps on individuals diagnosed with chronic diseases (hereafter CDs) is limited and contradictory [9]. On the one hand, individuals with chronic disease use digital technologies to search for updated and innovative solutions to their health conditions. Nevertheless, their use of digital health services is limited [30] [31]. As a result, individuals with chronic

disease are less likely to adopt self-management behaviors, after using Mapps [32]. Indeed, evidence of the direct effect of Mapps on health behaviors remains inconclusive, raising concerns regarding the extent to which Mapps adequately serve the health concerns of specific chronic disease groups [30] [31]. The *Health Belief Model* offers an important theoretical approach for understanding these contradictory findings.

The *Health Belief Model* (HBM) uses a set of constructs to consider the impact of perceived threat [40] and perceived benefits associated with the probability of adopting a particular behavior [41]. Perceived threat refers to a situation in which individuals assess they are at risk of some threat to their health [42]. Items used to measure this construct include evaluations that you or someone in your close circle is vulnerable (e.g., a history of disease in the family or the likelihood that your close partner will contract a disease) [40]. The association between HBM constructs and health outcomes was assessed for gender-mixed samples, but the evidence for individuals diagnosed with chronic conditions is contradictory [43].

On the positive side, ample evidence indicates that individuals with a medical condition are more motivated to search for health and medical information about their condition, its symptoms and their meaning, medication side effects and effectiveness, and even alternative treatments. This motivation increases the odds of monitoring a health problem in time or providing timely access to lab test results [18] [33]. Existing studies show, that a heart condition [44], diabetes [45], cancer [46] [47] and other long-term conditions are more likely to use Mapps to communicate with health care providers so they can receive feedback and social support and tracking (e.g., graphical displays of uploaded personal data). On the negative side, other studies indicate that the use of technology devices to provide health services falls short of their intended purposes and fails to provide effective health services [30] [38] [39]. Indeed, for specific chronic disease such as cancer [46] [47], heart conditions [44], diabetes [45] and other long-term conditions [48] [49], lower medication adherence and less health care utilization have been observed [50]. Hence, we hypothesize that:

*H1: A cancer diagnosis will increase the likelihood of Mapps use.*

## 2.2. Gendered Effects on Mapps Use

The issue of gender in health-related internet use is a main area of studies in the fields of internet sociology and public health, with ample evidence indicating that female users are more likely to search for health information than male users [1]. The odds of men using virtual sources of health and consulting online rankings are lower than for women [36], and consistent findings indicate that women use the internet for health purposes more than men [1] [18]. These consistent findings on gender effects derive from assumptions regarding women's traditional role when it comes to health-related issues both within and outside the family [9] [25]. Women are indeed more likely to engage in selective processing of information and carefully weight advantages and disadvantages of

technology use [1] [28] [51]. In fact, it is important to understand the influence of technology-embedded communication in terms of “friendly” or “unfriendly” means of communication.

First, gender is a central parameter that affects the digital divide because women are more likely to prefer face-to-face communications. Second, gender has been associated with how people evaluate information and determine the extent to which it is practical, costly or effective in daily activities [9] [19]. Gender may sustain or block health information included in Mapps [22]. Studies show that women seek a higher level of “gratification” regarding health concerns [26] [27], as explained by women’s unique internal mental workings and communication style. Women are highly discerning about the scope of their internet use. They are likely to search different sites to use information in different ways [30] [34] and for several persons at once including family and community members [34]. These gender-based differences in communication uses may affect the “perceived functionality” of Mapps. Hence, we hypothesize that:

*H2: Gender differences will manifest in the extent of Mapps use.*

Virtual sources of health are apparently an efficient means for attaining health information (best process), although not necessarily the most effective means (best outcome). According to the functionality assumption, women who use traditional information sources—newspapers, physicians’ advice, and books—can also use the internet to expand their knowledge. In fact, the internet is a complementary source of health information rather than as a substitute for more traditional media sources [1]. Thus, a state of “critical consciousness” regarding the existing health situation prevails which combined with the evaluation of available resources activates the process of health related search and use of technology. Women’s willingness to use Mapps to access health services may indeed reflect the perceived risks because beliefs about health risks and benefits are a strong predictor of an individual’s potential to exercise control over health practices, especially when health concerns are present. As a result, women “comply” with the source of health information only when the benefits outweigh the barriers [51] [52] [53] [54]. It is due to these contradictory reports that some recent studies suggest that Mapps overlook or misunderstand the specific needs of individuals with chronic diseases [30]. Women’s cancer conditions may affect their willingness to use Mapps to access health services since knowledge about health risks and benefits for different health issues is a strong predictor of the need to exercise control over health practices, especially in the presence of health concerns. Thus, gender can moderate the perceived functionality of Mapps, necessitating selective processing [1] [28] in order to reach a higher level of gratification regarding health concerns [26] [27]. Hence, we hypothesize that:

*H3: Women will be less likely to use Mapps for cancer self-management.*

### 3. Methods

**Sample:** This study is a secondary analysis of data released by Princeton [5].

The sample draws upon the National Tracking survey of 3000 adults over the age of 18 contacted by landline and/or cellphone. The analysis is based on individuals who reported that they used mobile health applications (N = 1009). Of these, 168 reported having cancer (85% women).

**Dependent variables:** *Lifestyle self-management:* Do you track weight, diet, or exercise routine? (1 = *Yes*); *Healthcare self-management:* Do you track blood pressure, blood sugar, sleep patterns, headaches, or any other indicator? (1 = *Yes*).

**Independent variables:** 1) Health empowerment attitudes: *Approach:* Mapps changed my overall approach to maintaining my health (1 = *Yes*). *Decision-making:* Mapps affected a decision about how to treat my illness/condition (1 = *Yes*). *Consulting:* Mapps encouraged me to ask a doctor new questions or to seek a second opinion from another doctor (1 = *Yes*). 2) Technology skills: *Updating information and content of Mapps:* (1 = *Yes*); *Frequency of updating Mapps:* (1 = *regularly*).

**Control variables:** Age. Older people may have more difficulty using technology than younger people since they did not use technology from the early stages of life [1] gender. Gender is a central moderating variable in technology studies because women are more likely to prefer face to face communications ((Ibarra & Suman, 2008. Health status, such as the diagnosis of a chronic disease or condition may serve as a motivational factor for health-related technology use [18]. Education. Improved cognitive skills attributed to highly educated individuals lead to better evaluation of health information [18], causing these individuals to want to use social media for health more than less educated individuals. Marital status: Having a steady life partner means that one has social control over one's health. Married persons make more use of online health services [55] and consult online rankings or reviews [36] more frequently than those who are not married.

#### 4. Statistics Analysis

First, we present the proportions of use of mobile health applications for health management among individuals diagnosed with cancer. Second, we examine gender differences in use of Mobile health applications and health management; third, we use logistic regression analyses to predict gender effect on 1) health empowering attitudes and 2) lifestyle and healthcare management.

#### 5. Findings

In **Table 1** we present a general description of Mapps use among cancer patients.

The findings in **Table 1** indicate that more than 25% of individuals diagnosed with cancer use Mapps for the search of information and general health empowerment. Of these, 24.2% use Mapps for health-related decisions, 32.5% for obtaining further health consulting and 46.1% for changing their approach to

health concerns. These empowering attitudes are in line with the users' lifestyle self-management (57.1%). However, only 14.2% of the users conform to health tracking behavior following their use of Mapps. Next in **Table 2**, we focus on gender differences in Mapps use.

The findings in **Table 2** point to distinct gender-based differences in health empowerment and health behavior. First, the proportion of men capitalizing on the use of Mapps is higher than that of women both for health tracking (40% vs. 10.2%) and for lifestyle (80% vs. 54%) health behaviors. Similar trends emerge for health empowering attitudes. Yet, more women (18%) than men (8%) use Mapps. Moreover, women tend to update Mapps (21.2%) at a rate equal to men (21.2%). It is interesting to note that more women report cancer diagnoses ( $N = 143$ ) than men ( $N = 25$ ).

The findings in **Table 3** indicate that technology skills play a significant role in health empowering attitudes. First, the number of Mapps updates increases the likelihood of adopting a new approach to health concerns (Exp. B = 1.216), of seeking further consultation (Exp. B = 5.059) and of making decisions (Exp. B = 1.930). Second, the frequency of updates is important as well because it increases the likelihood of forming a new approach to health concerns (Exp. B = 3.970) and decision-making (Exp. B = 1.930). Being in a conjugal relationship is also important because it increases the likelihood of a new approach to decision-making (Exp. B = 1.881). Furthermore, gender has important implications for health empowerment attitudes. Being a woman increases the likelihood of forming a new approach to health concerns (Exp. B = 2.325) and decision-making (Exp. B = 1.881). We ran a logistic regression model to detect gender effects in self-management practices following Mapps use.

The findings in **Table 4** indicate that technology skills play a significant role in predicting self-management among cancer patients, though in an unexpected way. First, an increase in the number of Mapps used has a limited but significant diminishing effect on the likelihood of lifestyle self-management ( $B = -0.855$ ; Exp. B = 0.425) but a positive effect ( $B = 0.298$ ; Exp. B = 1.347) on healthcare self-management. A stronger effect emerges regarding frequency of updates: Frequent Mapps updates have a significant and positive effect on lifestyle

**Table 1.** Proportions of mobile health applications for health management among individuals diagnosed with cancer.

	HEALTH TECHNOLOGY BEHAVIORS		HEALTH EMPOWERING ATTITUDES				
	Health track management	Lifestyle management	Extent Use	frequency upgrades	health decisions	approach to health concern	health consulting
<i>Cancer diagnosis (N)</i>	167	169	168	169	169	167	167
<i>Mapps use (%)</i>	25 (14.2)	98 (57.1)	39 (23.4)	55 (32.5)	41 (24.2)	77 (46.1)	38 (22.7)

**Table 2.** Gender differences for use of Mobile health applications and health management.

Total CD sample N = 168	HEALTH BEHAVIORS				TECHNOLOGY SKILLS				HEALTH EMPOWERING ATTITUDES					
	Health track		Lifestyle		More than one application		More than once a day upgrades		Effect on health decisions		Effect on approach to health concern		Effect on additional health consulting	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
MEN with CD = N = 25														
Men with CD using mobile applications	10	40	20	80	2	0.8	8	30	12	50	12	50	17	68
% men / total CD sample (N = 168)	0.05		0.12		0.011		0.047		0.071		0.071		0.82	
WOMEN with CD N = 143														
Women with CD using mobile applications	15	10.2	78	54	36	18	31	21.2	29	20	65	45.1	38	26.2
% women / total CD sample (N = 168)	0.08		0.464		21.4		18.4		17.2		38.1		22.6	

**Table 3.** Predicting health empowering attitudes.

	B	S.E.	Wald	df	Sig.	Exp(B)	B	S.E.	Wald	df	Sig.	Exp(B)	B	S.E.	Wald	df	Sig.	Exp(B)
	APPROACH						CONSULT						DECISION					
Number of Mapps	-0.251	0.105	5.784	1	0.016	0.778	0.447	0.104	18.375	1	0.000	1.563	221	0.121	20.684	1	0.000	0.577
Number of updates	0.196	0.167	1.369	1	0.242	1.216	1.621	0.166	94.866	1	0.000	5.059	0.158	0.158	17.411	1	0.000	1.930
Frequency of updates	1.379	0.124	122.882	1	0.000	3.970	-0.293	0.120	6.026	1	0.014	0.746	0.109	0.119	0.650	1	0.420	0.908
Age	0.000	0.006	0.002	1	0.963	1.000	-0.010	0.006	3.354	1	0.067	0.990	0.002	0.005	6.937	1	0.008	1.014
Sex 91 = woman)	0.844	0.121	49.031	1	0.000	2.325	0.091	0.117	0.606	1	0.436	1.095	0.144	0.119	28.114	1	0.000	1.881
Married	0.027	0.033	0.660	1	0.417	1.027	0.053	0.033	2.572	1	0.109	1.055	0.054	0.034	5.632	1	0.018	1.083
parent	0.214	0.135	2.495	1	0.114	1.238	-0.209	0.137	2.337	1	0.126	0.811	0.141	0.137	0.113	1	0.737	0.955
Education	-0.140	0.035	15.850	1	0.000	0.869	-0.126	0.035	12.578	1	0.000	0.882	0.058	0.035	13.675	1	0.000	0.878
Constant	-0.308	0.358	0.738	1	0.390	0.735	0.003	0.365	0.000	1	0.993	1.003	0.223	0.360	0.682	1	0.409	0.743

**Table 4.** Predicting lifestyle and healthcare management.

	LIFESTYLE							HEALTHCARE						
	B	S.E.	Wald	df	Sig.	Exp(B)	B	S.E.	Wald	df	Sig.	Exp(B)		
Number of Mapps	-0.855	0.140	37.506	1	0.000	0.425	0.298	0.106	7.837	1	0.005	1.347		
Number of updates	-0.312	0.232	1.813	1	0.178	0.732	0.112	0.169	0.439	1	0.507	1.118		
Frequency of updates	2.385	0.233	104.387	1	0.000	10.857	0.396	0.121	10.662	1	0.001	1.486		
Age	-0.064	0.009	56.366	1	0.000	0.938	-0.043	0.006	52.600	1	0.000	1.044		
Sex (1 = woman)	-1.03	0.196	27.923	1	0.000	0.354	-0.033	0.120	0.075	1	0.784	0.968		
Married	-0.039	0.051	0.572	1	0.449	0.962	0.219	0.035	39.865	1	0.000	1.245		
parent	0.041	0.193	0.046	1	0.830	1.042	0.700	0.143	23.847	1	0.000	2.014		
Education	0.375	0.051	53.729	1	0.000	1.455	-0.099	0.037	7.161	1	0.007	0.906		
Constant	3.346	0.550	37.008	1	0.000	28.387	-3.94	0.400	97.526	1	0.000	0.019		



self-management ( $B = 2.325$ ,  $\text{Exp. } B = 10.347$ ;  $p < 0.05$ ) but a lower effect on healthcare self-management ( $B = 0.396$ ,  $\text{Exp. } B = 1.486$ ). Second, socio-demographic characteristics remain important after controlling for the effects of technology skills. Age has a negative effect on both lifestyle ( $B = -0.64$ ,  $\text{Exp. } B = 0.938$ ) and healthcare self-management ( $B = -0.043$ ,  $\text{Exp. } B = 1.486$ ). More importantly, after controlling for age effects, being a woman has a negative effect on lifestyle ( $B = -1.03$ ,  $\text{Exp. } B = 0.354$ ) and no effect whatsoever on healthcare self-management.

## 6. Discussion and Conclusions

The use of mobile health applications in promoting lifestyle and healthcare self-management has enhanced the health empowerment of many individuals. By providing easy and immediate access to health information, mobile health applications enable individuals to gain control over the way they monitor their health habits. While the bulk of studies indicate that mobile health applications are an effective means of achieving health objectives, the effect of such applications on the health practices of individuals with chronic diseases is questionable. Similar doubts are evident regarding the use and effectiveness of mobile health applications among women. Existing studies have pointed to two difference sources for the lack of solid evidence with respect both to chronic conditions and to gender effects. One possible reason is that mobile health applications do not provide the best range of solutions for individuals with chronic conditions. A second reason is that existing studies use mixed samples and do not focus on the implications of technology for women's health.

Considering these gaps in evidence, in the current study, we drew upon the areas of communication studies, public health and women's studies to assess the effect of mobile health applications on the self-management practices for cancer. We considered the possibility that mobile health applications may not be effective in the case of women diagnosed with cancer. In general, we showed that using mobile health applications is a significant factor in generating health empowering attitudes among women diagnosed with cancer. More specifically, as a first step, we examined the extent to which women have the appropriate technology skills and capitalize on the accessible and updated health information available on mobile health applications.

The study indicates that women do indeed capitalize on the ease of use of mobile health applications and form health empowering attitudes, thus significantly increasing their likelihood of getting a second opinion and changing their approach to health concerns. Nonetheless, the findings also indicate that the health empowering attitudes and healthcare self-management behaviors ensuing from Mapps use are not necessarily compatible. Women diagnosed with cancer are not likely to initiate lifestyle self-management behaviors despite their technology skills and health empowering attitudes, especially after controlling for age effects traditionally related to lower technology use [1]. These findings indicate that our

hypotheses have been assessed. Women's use of Mapps differs is unique supporting our claims that Mapps use is "tainted" by the gendered technology effects. The study's results indicate that in the case of women with cancer, 1) perceived threats and benefits associated with the probability of adopting self-management behaviors are higher among women [41], and 2) gaps between motivations and actual behaviors need further examination [21].

All these indications moderate the perceived functionality of mobile health applications among women with cancer because women are more selective in information gathering processes seeking a higher level of gratification regarding health concerns [26] [27]. Thus, while hypotheses drawn from the Health Belief Model and the normalization hypothesis [1] remain valid, we still must address the theoretical premises that will assist in delineating the link between gender, chronic conditions and self-management.

## 7. Limitations and Recommendation for Future Studies

The sample used in this study is small, precluding generalization of the results. Yet, it is clear that introducing the use of technology devices in health and promoting their use at all costs should be carefully assessed, because such devices are helpful only to a certain extent and are apparently less suitable to the self-management needs of cancer among women. Moreover, cross-sectional studies examining women with different chronic conditions should assess the extent to which gendered technology has an equal effect on all types of chronic conditions.

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## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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