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**MOBILE HEALTH APPLICATIONS: USAGE, GENDER DIFFERENCES AND HEALTH LITERACY AMONG UNDERGRADUATES IN FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE**

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**Abstract**

*Studies indicate that undergraduates utilise mobile health applications for self-care health management. However, there is limited attention to gender differences in usage of mobile health applications and influence of usage on health literacy of undergraduates. This was the focus of this study employing uses and gratification and social categories theories as framework. Descriptive survey was conducted using structured validated questionnaire as research instrument. Multi-stage sampling was used to select 419 undergraduates of Federal University of Technology Akure, Nigeria as respondents. Data were analyzed quantitatively and findings show that undergraduates use mobile health apps regularly with diagnostic health apps being the most used. There was no significant difference ( $t=1.56, P>0.05$ ) in the usage of mobile health apps by males and female undergraduates; difference only exists in the type of mobile health apps used. Correlation ( $p=0.786, P>0.05$ ) between mobile health apps usage and health literacy of undergraduates was established. It is concluded that both Nigerian undergraduates (male and female) use mobile health apps to support their health care management. Health literacy of*

*undergraduates is improved with regular usage of mobile health apps. This study recommended that health practitioners should encourage undergraduates to use mobile health apps to complement their health care efforts.*

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**Key words:** *Health, Health literacy, Gender differences, Mobile health applications, Undergraduates, Usage of mobile health applications*

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## **Introduction**

Mobile health apps are increasingly gaining popularity and being used to attend to health needs.

Applications focused on health care promotion (mobile health apps) are available for download on mobile devices, with over 200, 000 health apps on Google play and Apple stores (research2guidance, 2017). These mobile health apps provide quick and easy access to health information, services, personnel and resources. Health apps are used to plan, monitor and achieve health goals such as track number of steps, heart rate, calorie intake, water intake, sleep pattern, to monitor medication intake, deliver health interventions. Examples of mobile health apps are Samsung Health, MiFit, Pedometer, PillPack, Apple Health, Calm, Water Reminder.

In Nigeria, there exists inequitable access to health professionals, facilities and resources that puts many young people (undergraduates) at risk to health conditions. Mobile health apps address this situation as they provide undergraduates with quick and easy features for self-care management as well as access and communication with health professionals.

Studies show that undergraduates are aware and utilize mobile phone technologies and applications for health information and health services. They use these apps to attend to health needs ranging from diagnostics, to physical fitness, heart rate monitoring, and water intake, with diet and fitness ranking tops (Singh & Alva, 2019; Jusoh, 2017; Obi, Agwu-Umahi, Ndu-Umeobieri and Charles-Okoli, 2017). In Nigeria, Glow, myPaddi, Period Tracker Frisky app,

LinkUp are some of the health apps used by youths and undergraduates (Eduoh, 2019; SimilarWeb, 2020). Gender is revealed as a mediating factor in the usage of mobile health apps. There exists gender differences as revealed in the study by Peprah, Abalo, Agyeman-Duah, Gyasi, Reforce, Nyonyo, Amankwaa, Amoako, and Kaaratoore (2019) and Singh and Alva (2019).

Access to and usage of health information and resources such as mobile health apps enhances an individual's health literacy. Health literacy is the ability of an individual to obtain, process, understand and utilize health information to make health decisions (Ratzan & Parker, 2000). With the avalanche of health information, undergraduates need health literacy skills to be able navigate, sift and interpret the variety of health information and use them correctly. The study of Obi, Agwu-Umahi, Ndu-Umeobieri and Charles-Okoli (2017) revealed high e-health literacy among undergraduates in Enugu, Nigeria as the students reported that they were more informed on health matters, and more eager to seek health care services as a result mobile health apps usage.

The researches cited indicate awareness of mobile health applications among undergraduates, however there seems to be unanswered questions regarding the type of mobile health apps used by undergraduates in Nigeria, the manner of usage of mobile health apps, the extent of difference in the usage pattern of mobile health apps among males and females as well as if usage of mobile health apps correlates with level of health literacy among undergraduates. This study found answers to these concerns by surveying undergraduates of Federal University of Technology, Akure, Nigeria.

### **Mobile Health Apps: Nature, Uses and Gender Differences**

Mobile health apps refer to all mobile devices which can transmit data, provide health support, delivery and intervention via mobile technologies such as smart phones, tablets and wearables such as watches and bands (Milward 2019). Mobile health apps record and analyze the user's daily activities and habits, provide interface and related content to help maintain a healthy lifestyle. Mobile health apps have features of visual representation of progress report on activity goals, tutorials, graphs showing activity trends, reminders and notifications,

challenges, in-app rewards for goal achievement (stars, badges, points), and social engagement features (find other users, make friends, join chat groups). The Statistics Portal (2016) estimated 3.2 billion downloads for mobile health applications in 2016. Data also show that the number of downloads keep on increasing from 1.7 billion in 2013 to 3.2 in 2016 (Jusoh, 2017). These mobile health apps address diverse health needs. They include fitness app (tracking physical activity, weight, diet, sleep, calorie, stress), diagnostic and self-management app (monitoring blood pressure, heart rate, breath rate), treatment-related apps. According to Ventola (2014), 24% of mobile health apps are used for medical information, 22% are dedicated to the monitoring of physical parameters, 18% to track disease, 16% for education and management, and 6% for diagnosis. The study by Singh and Alva (2019) revealed high awareness rate (91%) of mobile health apps as well as above average usage rate (59%) among undergraduates of India. While in Ghana, 51% prevalence rate of usage mobile health technologies was recorded among undergraduates of Kwame Nkrumah University of Science and Technology, Ghana (Peprah, Abalo, Agyeman-Duah, Gyasi, Reforce, Nyonyo, Amankwaa, Amoako, & Kaaratoore, 2019). The study of Obi, Agwu-Umahi, Ndu-Umeobieri and Charles-Okoli (2017) found that among undergraduates in Enugu, Nigeria, information relating to diet advice (n=171, 45.1%) and exercise (n=136, 33.4%) were the most accessed on mobile health platforms compared to information on specific diseases and conditions. In a meta-analysis of academic literature between 2013 and 2017, Jusoh (2017) found that approximately 50% of mobile health app subscribers use fitness apps. These fitness apps focus on tracking weight, diet, calorie, stress, managing fat loss and others.

Evident from the studies on usage of mobile health apps is the principle of the uses and gratification that users are active and they select and use media and/or their contents actively to meet their needs (gratification) (Littlejohn and Foss, 2008). In relation to this study, undergraduates download and use specific mobile health apps that attend to their specific health issues. For example, a user who wants to determine or improve his/her water drinking habits, will download and use a mobile app that counts water intake.

In the usage of mobile health apps, gender can account for differences. The social categories theory affirms this espousing that “a person’s social category (age, gender, economic status, culture) determines the media of mass communication he uses and how he uses them” (Anaeto, Onabajo and Osifeso 2008, p. 132). With gender being a social category, the implication for this study is there will be differences in the types and manner of usage of mobile health apps by male and female undergraduates. The study by Peprah, Abalo, Agyeman-Duah, Gyasi, Reforce, Nyonyo, Amankwaa, Amoako, and Kaaratoore (2019) found gender inequity in the knowledge of mobile health applications among undergraduates in Ghana. Female students had limited knowledge of mobile health compared to the males. Conversely, a study of undergraduates in India revealed that females (56%) used health apps more than the males (Singh & Alva, 2019).

### **Link between Usage of Mobile Health Apps and Health Literacy**

Health literacy empowers individuals to be in control of health decisions and management for themselves. This is a needed skill, especially for undergraduates, because there are increasingly numerous health information sources. The use of electronic and online health resources such as mobile health apps can advance health literacy of users. Tse, Bridgesm Srinivasan and Cheng (2015) alluded to this stating that “as health systems increasingly rely on internet usage ...access to online health services, presents another medium to build health literacy “(p 2.). The study by Shiferaw, Mehari and Eshete (2020) reported a relatively low ehealth literacy level among nursing students in Ethiopia and found gender, residence, and enrollment year to be predictive variables of eHealth literacy. And low health literacy is associated with risky health behavior such as poor diets and sedentary lifestyle (Tse, Bridgesm Srinivasan and Cheng (2015). To this end, this study intends to find out the relationship between usage of mobile health apps and health literacy.

### **Methodology**

#### **Participants and Sampling**

Descriptive survey research method was employed to study a population made up of undergraduates of the Federal University of Technology, Akure, Nigeria. From the population, which is approximately 25,400 undergraduates (as obtained from the Office of Student Affairs), the research sample was obtained using multi-stage sampling, with the aid of simple random sampling technique. Two schools from the seven schools in the university were selected and then one department from each of the schools was selected through ballot method. Metallurgical and Medical Engineering Department had 197 students and Bio-Medical Technology had 242 students making a total of 439 undergraduates. Total enumeration was then applied in which all students of the two (2) selected departments (100 level to 500 level) formed the sample/respondents for the study. Inclusion criteria were minimum 18 years of age (no maximum) and recent experience (at least one month) with any mobile health app. This brought the total respondents to 427 undergraduates.

#### Instrument and Administration

A 20-item structured questionnaire was used to collect data. The questionnaire items were drawn from conceptual and theoretical constructs review from similar studies such as Obi, Agwu-Umahi, Agunwa, Umeobieri, & Charles-Okoli (2017), Parthaje, Unnikrishnan, Thapar, et al (2016) and Peprah, Abalo, Agyemang-Duah, *et al.* (2016). The questionnaire items were structured using a 4-point Likert rating scale where 4 is considered very high usage or literacy level and 1 is very low usage or literacy level. Participation in the study was voluntary and verbal consent was obtained from participants after explanation of the research objectives. Permission and ethical clearance was obtained from Babcock University Health Research Ethics Committee. For reliability, a pretest of the instrument was done by administering it to thirty (30) undergraduates of Babcock University, Ogun state. After the pretest, some of the items in the instrument were restructured for clarity. The Cronbach's (1951) alpha was also used to measure the internal consistency and strength of the questionnaire items and the overall result was 0.895 indicating the reliability of the instrument. Copies of the questionnaire were self-administered to the respondents in their lecture rooms and collected immediately.

### Data Analysis

Data processing was done using IBM SPSS V22 and the summary were presented using percentages, mean, standard deviation and cross tabulations. T-test was used to predict gender differences in usage of mobile health apps among undergraduates. Pearson product moment correlation analysis was used to determine the relationship between usage of mobile health apps and health literacy of undergraduates.

### Results

Of the 427 copies of questionnaire administered, 419 copies were found valid and used for the analysis, representing a 98% response rate. The response rate was due to the one-on-one method employed to distribute the questionnaire. In the survey, there were 223 (53.2%) females and 196 (46.8%) males; respondents were more in the age range of 23 - 26 (n=135).

Table 1 shows that undergraduates mostly use more than one mobile health apps on their smartphones. It was found that while majority of male undergraduates (20.7%) use two health apps on their smartphones, majority of female undergraduates (21.7%) use four or more of such health apps. Among the health apps used by the respondents are Phone Doctor Plus, Fat Burning Workouts, Pedometer Step Counter Free and Calorie Burner, Water Diet Plan, My Plate Calorie Tracker, Blood Glucose Tracker, Apple Health and Activity Tracker.

**Table 1: Description of Mobile Health Apps used by Respondents**

Statement	Male		Female	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Number of Mobile Health Apps used by Respondents				
<b>One</b>	22	5.2	26	6.2
<b>Two</b>	87	20.7	51	12.1
<b>Three</b>	60	14.3	55	13.1

<b>Four or more</b>	27	6.4	91	21.7
Frequency of Mobile Health Apps Usage among Undergraduates				
<b>Regularly</b>	98	23.3	115	27.4
<b>Occasionally</b>	60	14.3	67	15.9
<b>Rarely</b>	38	9.0	41	9.7
Category of Mobile Health Apps utilized by the Respondents				
<b>Fitness app</b>	42	10.0	36	8.5
<b>Menstrual app</b>	0	0	22	5.3
<b>Dieting app</b>	9	2.1	12	2.9
<b>Diagnosis app</b>	93	22.1	98	23.3
<b>Skin and Facials app</b>	19	0.46	24	5.7
<b>Others</b>	33	7.8	31	11.2
<b>Total</b>				

Although all respondents use mobile health apps, the frequency of usage varies. Majority of the male and female undergraduates ( $n = 98$  and  $n = 115$ ) use mobile health apps regularly to attend to their health needs while 9% and 9.7% of male and female undergraduates respectively rarely make use of mobile health apps (See Table 2). A study by Singh and Alva (2019) affirms regular usage of mobile health apps among undergraduates. The regular use of mobile health apps may be attributed to the fact that they are easy to use, convenient and cost effective (Cilliers, Viljoen, & Chinyamurindi, 2017).

Table 1 also discloses that undergraduates make use of diagnosis apps than any other categories of mobile health apps. This finding is significantly different from that of Ventola (2014), who found that only 6% of users use mobile health apps for diagnosis. This high usage of diagnostic apps could be because diagnosis apps evaluate users' data and show users the risk assessment for ailment, diseases and infections. Respondents listed Doctor Diagnose Symptoms Check, Prognosis, WEbMD Check Symptom Rx as some of the diagnostic apps that they utilise. Other categories of health apps used by



respondents are fitness apps, mensuration apps, dieting apps, skin and facials apps. Dieting apps had the least number of users among both male and female undergraduates (2.1% and 2.9% respectively).

**Undergraduates Usage of Mobile Health Apps**

Table 2 indicates a high level of mobile health apps usage by undergraduates (Average weighted mean= 3.0). It also establishes that undergraduates consistently follow the routines and protocols of mobile health apps and female undergraduates (28.8%) are more faithful to the routines than male undergraduates (19.8%). The result also reveals that to a high extent (x = 3.1) undergraduates present data from mobile health apps during consultations with medical professionals (doctors, nurses). This indicates the usefulness of the mobile health apps to undergraduates.

**Table 2: Mobile Health Apps Usage by Undergraduates**

Statements	Very High		High		Low		Very Low		MEAN	STANDARD DEVIATION
	Male F (%)	Female F (%)	Male F (%)	Female F (%)	Male F (%)	Female F (%)	Male F (%)	Female F (%)		
I consistently follow the routines and protocols prescribed by mobile health apps	53 (12.6)	70 (16.7)	83 (19.8)	121 (28.8)	33 (7.8)	15 (3.4)	27 (6.4)	17 (4)	2.8	0.92
I record my health data (number of steps, heart rate, water intake) on	71 (16.9)	65 (15.5)	77 (18.3)	114 (27.2)	28 (6.6)	21 (5)	20 (4.7)	23 (5.4)	2.9	0.93

mobile health apps										
I review my health records on my mobile health apps to track my progress	76 (18.1)	79 (18.8)	68 (16.4)	84 (19.9)	33 (7.6)	29 (6.9)	19 (4.5)	31 (7.3)	3.0	0.96
Data from my mobile health apps enable me to take decisions to seek help from medical professionals	84 (19.9)	87 (20.7)	79 (18.8)	96 (22.8)	15 (3.4)	14 (3.3)	17 ()	26 (6.2)	2.7	0.84
I present information from my health apps when I see medical professionals	61 (14.4)	64 (15.3)	53 (12.6)	82 (19.5)	41 (9.7)	38 (9)	41 (9.7)	39 (9.3)	3.1	0.97
<b>Average Weighted Mean</b>									3.0	0.90

Decision Rule: if mean is less or equal to 1.49=Very Low; 1.5 to 2.49=Low, 2.5 to 3.49=High, 3.5 to 4.0=Very High

### Health Literacy of Undergraduates

Undergraduates assessed their level of health literacy and the average weighted mean of 2.8 as presented in Table 3 demonstrates that undergraduates have high level of health literacy.

**Table 3: Health Literacy Level of Undergraduates**

Statements	Very High		High		Low		Very Low		MEAN	STANDARD DEVIATION
	Male F(%)	Female F(%)	Male F(%)	Female F(%)	Male F(%)	Female F(%)	Male F(%)	Female F(%)		
I use variety of sources (internet, medical personnel, health apps, TV programmes) to confirm health information on a particular health need	78 (18.6)	84 (20)	69 (16.4)	103 (24.5)	26 (6.3)	17 (4)	23 (5.4)	19 (4.5)	3.0	0.91
I determine the relevance of an health information to me before using it	70 (16.7)	75 (17.8)	67 (15.9)	96 (22.9)	28 (6.6)	25 (5.9)	31 (7.5)	27 (6.4)	2.8	0.87
I adjust my health practices based on the information from my mobile health apps	58 (13.8)	71 (16.9)	78 (18.6)	80 (19.0)	34 (8.1)	39 (9.3)	26 (6.3)	33 (7.8)	2.8	0.84
Based on health information from my	55 (13.1)	57 (13.6)	64 (15.2)	82 (19.5)	40 ()	50 (11.9)	37 (8.8)	34 (8.1)	2.7	0.79

mobile health apps, I can determine the kind of health services /personnel I should seek											
I can confidently explain my health issues/needs to medical professionals	74 (17.6)	76 (18.1)	71 (16.9)	105 (25)	28 (6.6)	20 (4.7)	23 (5.4)	22 (5.2)	2.7	0.81	
<b>Average Weighted Mean</b>									2.8	0.90	

Decision Rule: if mean is less or equal to 1.49=Very Low; 1.5 to 2.29=Low, 2.5 to 3.49=High, 3.5 to 4.0=Very High

Table 3 displays a high level of health literacy among undergraduates, both male and female, affirmed that they use variety of sources (internet, medical personnel, health apps, TV programmes) to get health information on a particular health need. This implies that they know that health decisions should not be based on only one piece of information. From Table 4, undergraduates acknowledged that they determine the relevance of health information to their health needs before using them ( $X=2.8$ ). That means, they do not use all information they receive, rather they process them and adopt only those that suits their health conditions and needs. This finding the health literacy of undergraduates as being able to process and determine information relevance is an indicator of health literacy. In terms of undergraduates' ability to confidently explain their health issues/needs to medical professionals, it was revealed that females ( $n=181$ ) could do this better than males ( $n=145$ ).

### Gender Difference in Usage of Mobile Health Apps among Undergraduates

The first hypothesis was to ascertain if there exists a significant difference in gender usage of mobile health apps among undergraduates. The T-test analysis as seen in Table 4 revealed no significant difference ( $t=1.56$ ,  $P>0.05$ ) in the usage of mobile health apps by male ( $x=70.49$ ) and female ( $x=56.48$ ) undergraduates. Though there is a slight dissimilarity in both gender, the difference is not statistically significant. This implies that there is only a little deviation in the usage of mobile health apps by male and female. This situation is attributed to the fact that most mobile health apps can be used by both male and female except for some specific health apps like menstrual apps which are only used by females. However, dieting app, diagnosis apps, glow apps, and dieting apps are used by both genders. This finding correlates with the study of Bol, Helberger, and Weert (2018) who found no significant differences in gender between users and non-users of mobile health app.

**Table 4: T-test Analysis of Gender Differences in Usage of Mobile Health Apps among Undergraduates**

Gender	N	Mean	S.D	Std. Error	df	t	Sig of t
Female	223	56.48	15.11	1.43	417	1.56	0.190
Male	196	70.49	14.19	0.96			

### Influence of Mobile Health Apps Usage on Health Literacy of Undergraduates

In order to test the assumption that mobile health apps usage will significantly influence the health literacy of undergraduates, Pearson Product Moment Correlation was used. As shown in Table 5, there is a correlation between mobile health apps usage and health literacy of undergraduates (coefficient = 0.786 or 78.6%)

**Table 5: Correlation Analysis of Mobile health Apps Usage and Health Literacy of Undergraduates**

		Mobile health apps usage	Health Literacy
Mobile health apps usage	Pearson Correlation	1.00	.786
	Sig. (2-tailed)	-	.000
	N	419	419
Health Literacy	Pearson Correlation	.786	1.000
	Sig. (2-tailed)	.000	-
	N	419	419

*Correlation is significant at the level of 0.05 level (2-tailed)*

This finding denotes that undergraduates who use mobile health apps will possess ability to source, navigate, understand and use health information. This is consistent with previous finding by Bol, Helberger, and Weert (2018) that among a Dutch population mobile health app users had higher levels of e-health literacy skills than non-users.

### **Discussion of Findings**

The study examined usage of mobile health apps among undergraduates, gender differences in usage and influence of mobile health app usage on health literacy. The study investigated usage of mobile health apps based on the principle of uses and gratification theory. Based on the findings of this study, it is accepted that uses and gratification theory provides adequate explanation for the use of mobile health apps among young people. Undergraduates' use of mobile health apps stems from the fact that they get gratification from the apps. In this study, respondents indicated that they use the apps to record health data, provide health support and for diagnosis of health conditions. Also, in line with the uses and gratification theory, undergraduates' regular use of mobile health apps is based on gratifications they get. This principle is also corroborated by the findings of

Singh and Alva (2019) which revealed that undergraduates are willing to continue using the health apps because they motivate them to be healthy.

Findings indicate that female undergraduates use more mobile health apps than male undergraduates. It can be inferred that the use of different health apps is to maximize on the health benefits of the apps since there are different apps for different health needs. The study also revealed that diagnosis apps were the most used mobile health apps by undergraduates while dieting apps were the least used. This contrasts the findings of Omotoso, Bello and Akadiri (2013) which revealed diet and exercise to be the major health information needs of Nigerian undergraduates (n=103 85.8%) while diagnosis of medical conditions came next as an health information need (n=85;70.8%).

The study demonstrated no significant difference ( $t=1.56, P>0.05$ ) in male and female undergraduates usage of mobile health apps. This indicates that both male and females use similar health apps relating to diet, exercising, and diagnosis. This finding negates one of the assumptions of the social categories theory that people of different sub categories (age is a category) use media differently.

Correlation between mobile health apps usage and health literacy of undergraduates was established in this study. This means that continuous interaction with data and features of mobile health apps enhances users' ability to access and process health information and resources and their ability to apply such information to their own health needs. The continued use of mobile health apps means that young people will be better equipped to address various health issues.

## **Conclusion**

Undergraduates utilize mobile health apps for self-care practices and diagnostics. Continued usage of mobile health apps impacts the health literacy of users. Individuals should have health apps on their mobile phones and medical professionals (doctors and nurses) should encourage young people to use mobile health apps as they empower them for informed decisions and greater control over health choices. Another contribution to knowledge is that

male and female use mobile health apps similarly except in case of gender specific apps. This suggests that developers of mobile health apps should make apps with features usable by both male and females. Based on the findings of this study, it is accepted that the uses and gratification theory provides adequate explanation for the use of mobile health apps among undergraduates.

### Limitations and Future Research

The study found out that usage of mobile health apps correlated with health literacy of undergraduates. However, there may be other factors responsible for the high literacy level. Future studies could therefore examine these. We sampled respondents from one university and this suggests that the findings may not be generalizable to all undergraduates in Nigeria. Although, the age and gender of the sampled population is typical of Nigerian undergraduates, a larger population of undergraduates is suggested for future research.

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