



Determining the Continuance Intention of Military volunteers to Use the Quit and Win Smartphone App Using the Technology Acceptance Model

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Background: Determine factors influencing the continuance intention of the Quit & Win smartphone app based on the technology acceptance model (TAM). **Methods:** This cross-sectional study was conducted on volunteer military personnel who smoke. Participants were asked to download a smoking cessation app and use it for 15-20 minutes before completing a questionnaire. Items in the questionnaire included those on demographic information, perceived usefulness, perceived ease of use, and continuance intention. The structural equation modeling (SEM) was applied to evaluate the TAM. **Results:** A total of 90 participants were included in this study. The model accounted for 0.81 of the variance in participants' intention to continue using the app. The results revealed that perceived usefulness affected continuance intention, self-efficacy affected perceived ease of use, and perceived ease of use affected perceived usefulness. **Conclusions:** This study applied the TAM to determine the factors influencing the continuance intention to use a smoking cessation app and revealed that perceived usefulness is the most crucial factor affecting continuance intention. Therefore, future designers of smoking cessation apps shall improve perceived usefulness to increase the continuance intention of users.

Key words: Smartphone, apps, smoking cessation, technology acceptance model

INTRODUCTION

Smoking has negative effects on human health. The World Health Organization reported that approximately 8 million people die each year due to smoking-related causes; of these people, more than 7 million were active smokers, whereas 1.2 million of such deaths were caused by passive smoking.¹ In Taiwan, economic costs resulting from smoking hazards are approximately NT\$ 185.8 billion per year; this includes direct health-care expenses of approximately NT\$ 65 billion and indirect productivity losses of approximately NT\$ 120.9 billion (1.15% of national GDP).²

In 2017, 14.5% of Taiwanese adults were smokers; 26.4% and 2.3%, respectively, of Taiwanese men and women were

smokers. In the same year, a survey conducted on military personnel revealed that 30.5% of officers and soldiers in the recruit training center smoked, which is higher than the national average.² Soldiers have the highest smoking rate among military personnel.³

In response to the transformation of society related to information technology, smartphones have become a part of daily life, with many smartphone applications being developed. In 2017, 325,000 mobile health (mHealth) apps were available for download.⁴ A study revealed that the use of an app can

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increase the success rate of smoking cessation; however, the number of times such apps are used is low.⁵ A study found that only 6.1% of smokers have ever downloaded a smoking cessation app;⁶ therefore, designing an app in accordance with the needs of people wishing to stop smoking to improve the continuance usage intention of the app is a considerable challenge.

In 1985, Davis established the technology acceptance model (TAM) to determine users' acceptance level of new information technology; variables in this model included perceived usefulness, perceived ease of use, attitude toward using, intention to use, and usage behavior. In 1996, Davis modified the TAM and retained external variables and variables of perceived usefulness, perceived ease of use, intention to use, and usage behavior. The attitude toward using variable in the original version was modified as perceived ease of use and perceived usefulness. External variables refer to the personal characteristics of each user, perceived usefulness refers to users' perception of improving job performance using a particular system, and perceived ease of use is defined as users' perceptions of how much less effort they have to exert when using a particular system.⁷ The TAM has been used to study mHealth apps;⁸ for example, Jeon and Park⁹ used the original TAM to verify the intention of smartphone users to use a weight management app and Lai *et al.*¹⁰ applied the modified TAM to understand the intention of patients regarding the use of a smartphone app for hospital registration. However, such studies on smoking cessation apps have been rare. Therefore, the present study applied the TAM to understand the factors influencing the continuance intention to use smoking cessation apps by volunteer soldiers.

METHODS

This cross-sectional study was reviewed and approved by the Institutional Review Board of the Tri-Service General Hospital of the National Defense Medical Center (1-106-05-028). Purposive sampling was employed to recruit military volunteers who were also smokers in the recruit training center from April to July 2019. On the basis of the suggestion of Boomsma, the sample size should include at least 100 participants.¹¹

Procedure

First, the researcher disclosed the research objectives to participants. On agreeing to the conditions, the participants were asked to sign a consent form. Subsequently, the researcher presented and explained the eight functions of the Quit and Win app and gave the participants instructions on downloading it. The participants then downloaded the app on their own and used it for 15–20 min before answering a digital

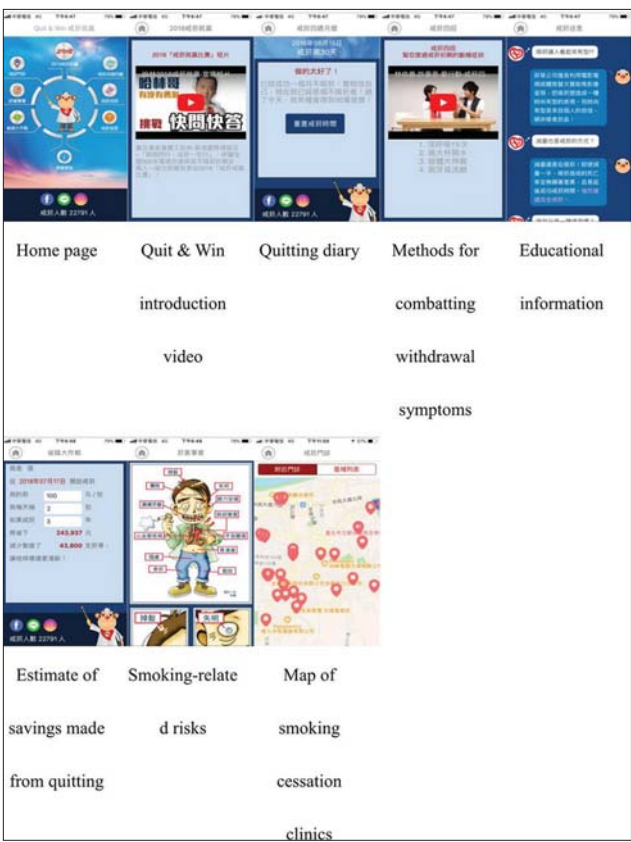


Figure 1: Sample screenshots of Quit and Win

questionnaire on Google through scanning a quick response code. The Quit and Win app [Figure 1], authorized by the John Tung Foundation of Taiwan, was used in this study. The main purpose of this app is to promote the biennial Quit and Win competition held in Taiwan and collect the demographic data of all competitors. This app provides a quitting diary, Quit and Win introduction video, and information related to (1) methods for combatting withdrawal symptoms, (2) education, (3) smoking-related risks, (4) estimates of savings made by quitting, and (5) a map of smoking cessation clinics.

Instruments

The questionnaire included items regarding demographic data and the TAM. The demographic data included age, gender, education level (general senior high school, vocational senior high school, or college and above), household income (NT\$ 20,001 and below, NT\$ 20,001–40,000, NT\$ 40,001–60,000, NT\$ 60,001–80,000, NT\$ 80,001–100,000, or NT\$ 100,001 and above), and self-efficacy (this item determines the ability of participants to research smoking cessation information; options are poor, regular, good, and excellent).¹² Questionnaire items were designed according to the TAM.¹³ Experts in medical and

public health fields were asked to examine the questionnaire based on the content validity index (CVI). Each item was evaluated and graded as follows: extremely appropriate =5 points, appropriate=4 points, acceptable=3 points, inappropriate =2 points, and extremely inappropriate =1 point; items scored >3 points by the experts were kept. The overall CVI was 0.95. A five-point Likert scale was adopted for all questionnaire items (1= strongly disagree to 5= strongly agree). TAM items included perceived ease of use (3 items), perceived usefulness (5 items), and continuance intention (1 item). Items of perceived ease of use were as follows: (1) for me, the operation of the Quit and Win app is fairly clear, (2) for me, learning to operate the Quit and Win app is not troublesome, and (3) for me, the Quit and Win app is easy to use. The average score of the three items was obtained, and the Cronbach's α was 0.958. Items of perceived usefulness were as follows: (1) I can obtain required information and assistance through the Quit and Win app, (2) using the Quit and Win app increases the effectiveness of smoking cessation, (3) using the Quit and Win app improves my ability to quick smoking, (4) the Quit and Win app makes the process of smoking cessation smoother, and (5) the Quit and Win app is helpful for quitting smoking; the average score of these five items was obtained, and the Cronbach's α was 0.960. For continuance usage intention, only one item was listed: I would like to continue using the Quit and Win app.

Data analysis

IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA) was used to conduct statistical analysis. Continuous variables were represented as mean and standard deviation, whereas categorical variables were represented by frequencies and percentages. In addition, independent *t*-tests, a one-way analysis of variance, and Pearson's correlation were used to analyze the relationships between the demographic data, perceived ease of use, perceived usefulness, and continuance intention. The TAM model was analyzed by the structural equation modeling using AMOS ver. 25.0 (IBM SPSS). The goodness-of-fit indices for the hypothetical model were evaluated as follows: chi-square test: $P > 0.05$, relative χ^2 (χ^2/df): < 2 , root mean square error of approximation (RMSEA): < 0.06 , goodness-of-fit index (GFI): > 0.95 , and normed fit index (NFI): > 0.90 .¹⁴

RESULTS

Demographic and descriptive statistics for the technology acceptance model variables

A total of 107 participants were recruited in this study, 17 of which were excluded due to incomplete responses; finally, 90 participants were included for analysis. The

Table 1: Demographics of sample

Variables	<i>n</i> (%) / mean $\pm$ SD
Age	21.28 $\pm$ 2.97
Gender	
Male	56 (62.2)
Female	34 (37.8)
Education level	
General senior high school	16 (17.8)
Vocational senior high school	60 (66.7)
College and above	14 (15.6)
Household income	
NT\$ 20,001 and below	14 (15.6)
NT\$ 20,001-40,000	20 (22.2)
NT\$ 40,001-60,000	23 (25.6)
NT\$ 60,001-80,000	13 (14.4)
NT\$ 80,001-100,000	12 (13.3)
NT\$ 100,001 and above	8 (8.9)
Self-efficacy	
Poor	7 (7.8)
Regular	46 (51.1)
Good	23 (25)
Excellent	11 (12.2)

SD=Standard deviation

Table 2: The score of each technology acceptance model

Variables	Mean $\pm$ SD
Perceived ease of use ^a	4.11 $\pm$ 1.06
The operation of the Quit and Win app is fairly clear	4.12 $\pm$ 1.13
Learning to operate the Quit and Win app is not troublesome	4.09 $\pm$ 1.11
The Quit and Win app is easy to use	4.13 $\pm$ 1.07
Perceived usefulness ^a	3.78 $\pm$ 1.14
I can obtain required information and assistance through the Quit and Win app	3.91 $\pm$ 1.15
Using the Quit and Win app increases the effectiveness of smoking cessation	3.78 $\pm$ 1.23
Using the Quit and Win app improves my ability to quick smoking	3.69 $\pm$ 1.29
The Quit and Win app makes the process of smoking cessation smoother	3.76 $\pm$ 1.26
The Quit and Win app is helpful for quitting smoking	3.78 $\pm$ 1.25
Continuance usage intention ^a	
I would like to continue using the Quit and Win app	3.79 $\pm$ 1.16

^a1: Strongly disagree to 5: Strongly agree. SD=Standard deviation

demographic data distribution of the participants is presented in Table 1: the average age of the participants was 21.18 years, 62.2% of the participants were men, most

had an education level of vocational senior high school (66.7%), most had a household income of NT\$ 20,001–60,000 (47.8%), and 51.1% of the participants reported having a regular level of self-efficacy.

Table 2 presents the score distribution of each TAM aspect. The mean score of each item for perceived ease of use was between 4.09 and 4.13 points; the mean score for this aspect was 4.11 points. The mean score of each item for perceived usefulness was between 3.69 and 3.91 points; the mean score of this aspect was 3.78 points. The mean score for continuance intention was 3.79 points.

Univariate analysis

According to the univariate analysis results for demographic data, perceived ease of use, perceived usefulness, and continuance intention [Table 3], the self-efficacy of the demographic data, perceived ease of use, perceived usefulness, and the continuance intention reached statistical significance. Perceived ease of use ($r = 0.777$, $P < 0.01$) and perceived usefulness had a significant correlation; the correlations between perceived ease of use ($r = 0.703$, $P < 0.01$), perceived usefulness ($r = 0.901$, $P < 0.01$), and continuance intention were also statistically significant [Table 4].

Table 3: Univariate analysis of the variables

Variables	Perceived ease of use		Perceived usefulness		Continuance usage intention	
	Mean±SD	t/F/r	Mean±SD	t/F/r	Mean±SD	t/F/r
Gender						
Male	4.22±0.91	1.117	3.90±1.06	1.207	3.98±0.98	1.919
Female	3.94±1.27		3.59±1.26		3.47±1.35	
Education level						
General senior high school	3.96±1.14	0.538	3.30±1.21	2.085	3.38±1.20	1.271
Vocational senior high school	4.10±1.08		3.83±1.15		3.87±1.14	
College and above	4.36±0.91		4.10±0.92		3.39±1.14	
Household income						
NT\$ 20,001 and below	4.24±1.08	0.230	3.85±1.03	0.156	3.86±1.10	0.194
NT\$ 20,001-40,000	4.11±1.07		3.66±1.18		3.80±1.24	
NT\$ 40,001-60,000	4.08±1.18		3.89±1.18		3.70±1.22	
NT\$ 60,001-80,000	3.97±1.30		3.75±1.27		3.77±1.36	
NT\$ 80,001-100,000	4.03±0.81		3.63±1.05		3.67±0.99	
NT\$ 100,001 and above	4.33±0.82		3.92±1.33		4.13±0.99	
Self-efficacy						
Poor	3.95±1.70	2.602*	3.40±1.74	3.188*	3.29±1.89	4.003**
Regular	3.85±1.10		3.48±1.10		3.46±1.08	
Good	4.32±0.82		4.14±0.85		4.24±0.83	
Excellent	4.88±0.40		4.55±1.03		4.55±0.93	

* $P < 0.05$, ** $P < 0.01$. SD=Standard deviation

Path analysis

Figure 2 presents the ultimate model of path analysis. During the process, nonsignificant paths were eliminated. Table 5 presents the GIFs for the model, where $\chi^2(3)$ is 32.494 ($P = 0.214$), χ^2/df is 1.203 (between 1 and 3), SRMR is 0.066 (< 0.08), RMSEA is 0.048 (< 0.05), GFI is 0.940 (> 0.90), NFI

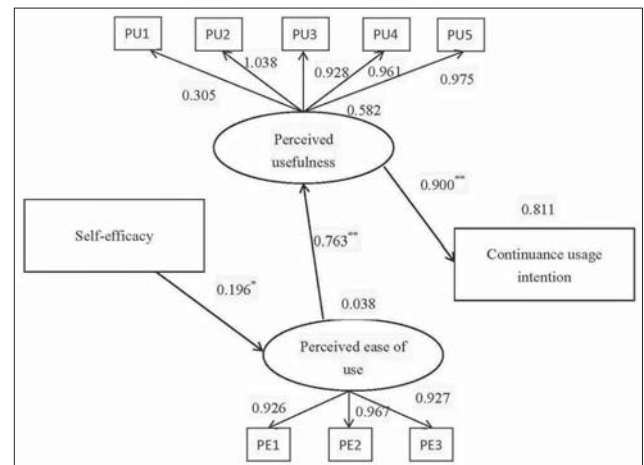


Figure 2: Path diagram of technology acceptance model for app (path coefficients are indicated in the path diagram). ** $P < 0.01$, *** $P < 0.001$

Table 4: Correlation of the continuous variables

Variables	Age	Perceived ease of use	Perceived usefulness
Age	1		
Perceived ease of use	0.072	1	
Perceived usefulness	0.041	0.777**	1
Continuance usage intention	-0.029	0.703**	0.901**

** $P < 0.01$

Table 5: Goodness-of-fit indices for the model

Fit index	Value	Recommended value
χ^2/df	32.494/27=1.203	1 < NC < 3
P	0.214	>0.50
SRMR	0.066	<0.08
RMSEA	0.048	<0.05
GFI	0.940	>0.90
NFI	0.974	>0.90
NNFI	0.992	> 0.90
CFI	0.995	>0.95

df: Degree of freedom, SRMR=Standardized root mean square residual, RMSEA: Root mean square error of approximation, GFI=Goodness-of-fit index, NFI: Normed fit index, NNFI=Nonnormed fit index, CFI=Comparative fit index

Table 6: Path analysis result - direct and indirect effects

Dependent variable	Independent variable	Direct effect	Indirect effect	Total effect
Continuance usage intention	Self-efficacy	-	0.135	0.135
	Perceived usefulness	0.900	-	0.900
	Perceived ease of use	-	0.687	0.687
Perceived usefulness	Self-efficacy	-	0.150	0.150
	Perceived ease of use	0.763	-	0.763
Perceived ease of use	Self-efficacy	0.196	-	0.196

is 0.974 (>0.90), nonnormed fit index is 0.992 (>0.90), and comparative fit index is 0.995 (>0.95). Table 6 details the direct and indirect effects of TAM variables on continuance intention, perceived ease of use, and perceived usefulness. Perceived usefulness had a significant and direct effect on continuance intention ($\beta = 0.900$, $P = 0.001$). Perceived ease of use had a significant indirect effect on continuance intention through perceived usefulness ($\beta = 0.687$), whereas perceived ease of use had a significant direct effect on perceived usefulness ($\beta = 0.763$, $P = 0.003$). In addition, self-efficacy has a significant direct effect on perceived ease of use ($\beta = 0.196$, $P = 0.017$).

DISCUSSION

The continuance intention value for participants using the Quit and Win app in this study was 3.79 points (1–5 points). A study revealed that patients with hypertension scored 4.64 points (1–5 points) for continuance intention to use the blood pressure assistant app,¹⁵ which is higher than the continuance intention score in this study. This may be because patients with hypertension must manage their blood pressure; however, the participants in this study were individuals who smoked rather than those who sought to quit smoking. In addition, we found that the perceived usefulness had the strongest effect on continuance intention among all variables. Moreover, the perceived usefulness was also low (3.78 points) in our study. As a result, the continuance intention to use the Quit and Win app was low.

This study applied the TAM to determine the continuance intention of military volunteers to use the Quit and Win app. The total variance explained of the results was 81.1%, which was higher than that of a study that applied the TAM to determine the continuance intention of patients with hypertension for using blood pressure assistant app (41.2% variance explained).¹⁵ The results proved that the TAM is capable of predicting the continuance intention of military volunteers to use a smoking cessation app.

According to the path analysis results, the factor that directly affected the continuance intention of smokers to use the Quit and Win app was perceived usefulness. Perceived ease of use did not directly affect continuance intention but indirectly affected continuance intention through the perceived usefulness, which is inconsistent with the findings of related studies. Jeon and Park⁹ revealed that the perceived ease of use directly affected intention to use the weight management app; the difference may be due to participants in this study being individuals who smoked rather than those who wanted to quit smoking, whereas the participants in the study of Jeon and Park⁹ sought weight management assistance. For users who are not actively seeking to improve their health, perceived usefulness is a critical factor affecting their continuance intention to use an app. Therefore, enhancing the effect of such apps on smoking cessation is the most crucial component of app design, which corresponds to the findings of previous studies. The most useful functions according to the participants were as follows: (1) the app offers information regarding the improvement of health after smoking cessation and money saved as a result and (2) the app evaluates reasons for smoking and offers personalized smoking cessation plans and techniques to reduce cravings for cigarettes.⁶ The results revealed that the participants focused on the information about smoking cessation that the app provides. A study revealed that

smoking cessation plans and techniques for reducing cigarette cravings are significantly and positively correlated with the effectiveness of smoking cessation.¹⁶

The results revealed that self-efficacy is directly correlated to perceived ease of use but does not affect perceived usefulness, which is inconsistent with the findings of related studies. Self-efficacy did not affect perceived ease of use or perceived usefulness,⁹ possibly as a result of the differences between tools for measuring self-efficacy. This study measured comprehensive self-efficacy rather than directly measuring system-specific self-efficacy from using the smoking cessation app. Similar to findings of relevant studies, in this study, comprehensive self-efficacy had a considerable influence on perceived ease of use.¹⁷

The limitations of this study were as follows. First, in this study, participants had a rather short time period to use the app (15–20 min); thus, long-term effects could not be observed. In addition, the relationship between app use and continuance intention could not be analyzed. Second, the participants were military volunteers aged between 18–32 years; the results may not be applicable to other age groups. Nevertheless, as smartphone app users are mainly young people,¹⁸ the contributions of this study are still of value.

CONCLUSIONS

This study verified that the TAM can be used to predict the continuance intention to use smoking cessation apps. The results revealed that self-efficacy had a positive effect on perceived ease of use, perceived ease of use had a positive effect on perceived usefulness, and perceived usefulness had a positive effect on continuance intention. Therefore, improving the perceived usefulness when designing a smoking cessation app can increase the continuance intention of users. Future research could follow up and evaluate the factors related to the use of Quit and Win app. In addition, researchers are advised to evaluate the effect of such apps on smoking cessation.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. World Health Organization. Tobacco; 2019. Available from: <https://www.who.int/news-room/fact-sheets/detail/tobacco>. [Last accessed 2019 Sep 03].
2. Health Promotion Administration, Ministry of Health and Welfare, Taiwan. 2018 Taiwan Tobacco Control Annual Report; 2018.
3. Medical Affairs Bureau, Ministry of National Defense, Taiwan. National Army Tobacco and Betel Nut Hazard Prevention Project. Taipei: Medical Affairs Bureau, Ministry of National Defense, ROC (Taiwan); 2015.
4. Research2Guidance. mHealth App Economics 2017 / 2018: Current Status and Future Trends in Mobile Health; November, 2017.
5. Regmi K, Kassim N, Ahmad NA, Tuah N. Effectiveness of mobile apps for smoking cessation: A review. *Tobacco Prev Cessation* 2017;3:1-11.
6. Oliver JA, Hallyburton MB, Pacek LR, Mitchell JT, Vilardaga R, Fuemmeler BF, *et al.* What do smokers want in a smartphone-based cessation application? *Nicotine Tob Res* 2018;20:1507-14.
7. Venkatesh V, Davis FD. A model of the antecedents of perceived ease of use: Development and test. *Decision Sci* 1996;27:451-81.
8. Rahimi B, Nadri H, Lotfnezhad Afshar H, Timpka T. A systematic review of the technology acceptance model in health informatics. *Appl Clin Inform* 2018;9:604-34.
9. Jeon E, Park HA. Factors affecting acceptance of smartphone application for management of obesity. *Healthc Inform Res* 2015;21:74-82.
10. Lai YH, Huang FF, Yang HH. A study on the attitude of use the mobile clinic registration system in Taiwan. *Technol Health Care* 2015;24 Suppl 1:S205-11.
11. Boomsma A. The Robustness of LISREL against Small Sample Sizes in Factor Analysis Models. *Systems under Indirect Observation: Causality, Structure, Prediction*; 1982. p. 149-73.
12. Finkelstein J, Cha EM. Using a mobile app to promote smoking cessation in hospitalized patients. *JMIR Mhealth Uhealth* 2016;4:e59.
13. Venkatesh V, Davis FD. A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Manag Sci* 2000;46:186-204.
14. Hooper D, Coughlan J, Mullen M. Structural Equation Modelling: Guidelines for Determining Model Fit. *Articles*; 2008. p. 2.
15. Dou K, Yu P, Deng N, Liu F, Guan Y, Li Z, *et al.* Patients' acceptance of smartphone health technology for chronic disease management: A theoretical model and empirical test. *JMIR Mhealth Uhealth* 2017;5:e177.

16. Heffner JL, Vilardaga R, Mercer LD, Kientz JA, Bricker JB. Feature-level analysis of a novel smartphone application for smoking cessation. *Am J Drug Alcohol Abuse* 2015;41:68-73.
17. Hasan B. Delineating the effects of general and system-specific computer self-efficacy beliefs on IS acceptance. *Inform Manag* 2006;43:565-71.
18. Ernsting C, Dombrowski SU, Oedekoven M, O Sullivan JL, Kanzler M, Kuhlmei A, *et al.* Using smartphones and health apps to change and manage health behaviors: A population-based survey. *J Med Internet Res* 2017;19:e101.