Print ISSN: 2233-4165 / Online ISSN: 2233-5382
doi:http://dx.doi.org/10.13106/ijidb.2019.vol10.no2.17

Factors influencing on smart health

Mincheol Kim*, Li Chen**, Sangwon Park***

Received: January 02, 2019. Revised: January 31, 2019. Accepted: February 05, 2019.

Abstract

Purpose - This study aims to clarify the impact of smart health gadgets (specfically, smart watches/sports wristbands) on promoting healthy behavior. It also aims to understand the use and characteristics of the devices, to explore the relationship between device factors and factors that affect healthy behavior, and to discuss the development of health promotion.
Research, design, data, and methodology - Smart device users were investigated through a random sampling method of 185 respondents, including all ages and all levels of occupation, education, and income. The SmartPLS 3.0 software enabled the path analysis and the descriptive statistical analysis; the theoretical model was evaluated for the parameter analysis.
Results - The size and path of each factor impacting health promoting behavior were ascertained. The objective factors that attract users to the smart wristband were investigated as well as the methods by which the device and the HPM are bound to each other and the correlation factors to seek out the closest relationship.
Conclusions - According to the analysis, the real-time smart watch/sports wristband exerts a positive impact on one's health promoting behavior. Health awareness is increasingly promoted in the process of using the device, and the impact of health awareness and self-efficacy effects on healthy behavior is considerable.

Keywords: Smart Health, Smart Watches/Sports Wristbands; HPM, Pender's Model.

JEL Classifications: I12, C10, C12.

1. Introduction

Recently, smart watches / sports wrist straps have been popularly adopted and the high-tech wearable intelligent device can be said. These smart watch / sports wristbands include fitness programs, sleep monitoring, vibration waking, heart rate measurement, and call alert. Therefore, the user wears the device 24 hours a day to record daily movements, sleep, diet and other data normally stored on the data platform, and the results can guide the user's healthy lifestyle (Wu, Li, Hu, & Wang, 2017). According to relevant statistics, 14 million high-tech wearers were sold in the global market in 2011, and in 2017, the number of intelligent wearers exceeded 70 million. These smart wristbands are increasingly being accepted in the market with data collection and data analysis capabilities (Wu, 2016). These results actually have the advantage of being able to monitor the physical condition of the user by sensing the user's body function, and the smart wristband is applied unconsciously to the user's life. Therefore, a greater awareness of your health condition will help promote better health and wellness (Patrick, Griswold, Raab, & Intille, 2008). As the population continues to increase, the life expectancy of the future population will increase, and the frequency of chronic diseases will increase naturally and the medical burden of medical insurance will increase due to the increase in population (He, 2018). Thus, there is a need to improve not only health awareness but also physical health and disease prevention. In particular, lack of exercise and obesity pose a major threat to the general health of the population (Patrick et al., 2008). However, People are

* First Author: Professor, dept. of Management Information Systems, Jeju National University, Korea.
Tel: +82-64-754-3182 E-mail: mck1292@jejunu.ac.kr
** Master's student. dept. of Management Information Systems, Jeju National University, Korea.
*** Correspondent Author: Associate professor, School of Tourism Management, The Hongkong Polytechnical University, HongKong.
Tel: +862-3400-2262 E-mail: sandwonpark@polyu.ac.hk

adopting intelligent products in large quantities, and as a result, the general public is getting more and more health knowledge through smart wristbands that are increasingly health-conscious (Rawassizadeh, Price, & Petre, 2015). It is hoped that among elderly people, especially those with serious illnesses, the awareness of disease prevention needs to improve, the probability of disease reduction, and health habits to be improved. It is therefore important to analyze and understand the impact of these smart bracelets on promoting healthy behaviors so that these devices promote healthy behaviors and tool compliance and ultimately promote social health education and health awareness development. Ultimately, this study aims to analyze the impact of smart bracelets on promoting healthy behaviors and promoting the use and characteristics of devices to explore the relationship between device function and factors affecting healthy behaviors.

2. Research backgroudn

2.1. Promotion of health

The concept of health promotion was first proposed at the World Health Organization (WHO) meeting in Almaty in 1979. WHO's Brundtland, the former Secretary General, said this definition was used at the 5th World Health Promotion Conference in 2000, "Health promotion is what allows people to do everything possible to achieve optimal mental and physical health. (World Health Organization, 1986). In the end, health promotion is defined as "a shift in health education and environmental protection, lifestyle and social impacts , Reducing the incidence of disease, and improving the quality of life and physical fitness of the public "(Ru, 2011).

2.2. Pender's health model

The Health Promotion Model (HPM) was first proposed by a nursing educator in 1982 by a US scientist, Nola Pender, who pointed out that health promoting behaviors can reveal the origin of behavior in patients' health education and consequently analyze the behavior of poor patients Can be effectively optimized (Jing, 2014). Like others, HPM can affect the establishment of public health actions, such as the promotion of physical fitness and disease control (Pender, 2011; Heydari & Khorashadizadeh, 2014). HPM can be adopted by people of all ages by optimizing personal attitudes to improve interpersonal, environmental and personal health and improve personal health (Alkhalaileh, Khaled, Baker, & Bond, 2011). HPM is primarily adopted to control and prevent disease and provide health education. Chronic disease can be effectively controlled by HPM intervention (Pender, 2011). So you can stabilize your disease to avoid getting worse. In addition, the promotion of healthy lifestyles can effectively establish chronic disease prevention in adults. Furthermore, health education, health information, and health intervention can be widespread among the general public to help people acquire health care knowledge, establish healthy direction, and follow healthy behaviors voluntarily (Xue, No Reference 2016).

In particular, HPM has three basic components: personal traits and experience, behavior-specific cognitive and affective behaviors, and behavioral outcomes-health promoting behaviors, which implies commitment to action plans and responses to immediate competitive preferences (Ma, Chung, Fong, & Pendergast, 2014). Therefore, health promotion behavior is affected by many factors. Whether people exercise health promoting behaviors depends not only on their will, but also on their cognitive, experience, environmental and health needs.

2.3. Smart wristbands

Smart wristbands are smart devices that can be worn. The device allows the user to record daily exercise, sleep, diet and other real-time data. These data serve as guidelines for healthy living with mobile phones, tablets, iPods and other terminal synchronization. Currently, smart wear devices consist mainly of smart watches, smart sports wristbands and other related products. According to Gartner, total sales of global smart wearable devices in 2015 rose by 53.6% to 116 million units (Al-Nasser, 2014: Ha, Beijnon, Kim, Lee, & Kim, 2017). However, among these devices, the annual sales of smart bracelets account for about half of sales and are considered to be mainstream products on the spot (Smartwatch News, 2018). These smart wristbands are expected to be recognized as the most widely adopted tools to promote health in the future.

3. Research Methods

3.1. Data collection

The purpose of this study is to investigate the relationship between health promotion models and users of smart wristbands. Most adults are interested in health care, fitness and healthy living. At the same time, people with chronic diseases will be happy to use smart wristbands to improve the situation. Therefore, this study considers adults. Therefore, those who have used smart wristbands for health or those who adopt smart wristbands have been surveyed in this study in the form of questionnaires to address the importance of smart wristband attributes and the effect of devices on health.

3.2. Research model and hypotheses

The research model is based on Pender's HPM. The theoretical framework of this Pender's HPM is due to the subjective self-efficacy and social cognitive theory that the interference of external factors / tools as well as individual cognition and behavior will have some influence on future behavior change (Yang & Kim, 2015). Therefore, the research model selected representative attributes constrained by health promotion mode in smart wristbands as well as people's self-efficacy while using smart wristbands for two-dimensional variables. Smart wrist band factors and self-efficacy as a result of health awareness and health behavior enhancement were the primary variables of smart band users. This study used the SmartPLS 3.0 software to objectively and accurately assess the five key characteristics of health impacts and to show the relevance and potential relevance of these variables. Specifically, direct health behavior based on the Yang and Kim (2015) study.

The study model of this study is based on Pender's HPM in Figure 1.

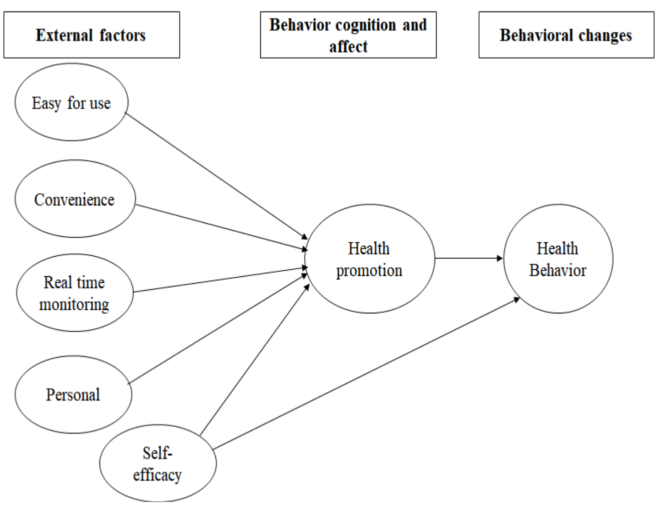

Figure 1: Research model based on Pender's HPM

Based on these findings, the following hypothesis was set.

Hypothesis 1: The factors (Easy to use/ Convenience/ Real-time monitoring / Personal /Health self-efficacy) of HPM have a positive effect on health promotion realization

Hypothesis 2: Health self-efficacy of HPM has a positive effect on health behavior

Hypothesis 3: health promotion realization has a positive effect on health behavior

3.3. Measuring Instruments

3.3.1. Adoption of partial least squares (PLS)

PLS is a main application for multi-factor variables and multi-independent causal modeling. It also counts as a new iterative estimation method for collecting principal component analysis and multiple regressions. The smart wristband is adopted to promote health factors in the investigation and to study the numerous effects that may be exerted on health promotion. Additionally, these observations are not isolated, and accordingly, the observed variables are correlated with each other to different degrees. Thus, in this study, we develop the models using SmartPLS 3.0 path analysis software, obtain the path coefficients to examine the relationship between the hidden variables and the implicit and measured variables, and verify the rationality of the model. PLS modeling has no distribution requirement for the data. The test method for PLS is different from the traditional test method. The model is employed to obtain the average variance extracted (AVE), incorporate reliability, the R^2 value, Cronbach's alpha, redundancy as well as use bootstrapping for model significance testing (Hui & Lin, 2004).

(1) AVE: Similar indicators of commonality adopted to measure the implied variables caused by the observed error from the corresponding observed variables obtain the total amount of variance. AVE is adopted to evaluate the merits of the model, even implicit variable reliability. Normally, the AVE value is greater than 0.5; the larger the value of AVE, the better the effect. (2) Composite reliability: As the reliability factor of the measurement tool, if a high reliability coefficient is incorporated, the implied variables corresponding to the measurement indicate a high degree of consistency. A factor greater than or equal to 0.7 indicates that the measurement tool employed is reliable(Fornell & Larcker, 1981) (3) R^2 value : A cross-test of the consistency indicators can be adopted to, evaluate the structural model and its ability to interpret the results; the larger the value, the better. (4) Cronbach's alpha : As the most commonly employed reliability factor, alpha values are between 0 and 1. From the general perspective, the reliability coefficient of the total scale is preferably above 0.7. (5) Redundancy : the smaller the general redundancy, the better the degree of model fit.

In this study, Smartpls 3.0 version was used to make these analysis results.

3.3.2. Methodology

This study used Pender's Health Promotion Model (HPM) to identify factors that affect behavioral changes in the health sciences. This has recognized that external factors influence health promotion behaviors. In this study, the relationship between factors is basically set as reflective direction. Therefore, based on the research methodology, the questionnaire divided the user's basic information and issues into two parts. Key questions have been revised from existing literature. Personal questions are based on the definition of literature. Each question was measured on a 5-point scale from 1 point to 5 points, and I strongly agree with 5 points. Users had to make reasonable judgments in light of personal circumstances and choose appropriate responses. The research process has proven that variables can be accurately understood as user problems. The scale was chosen because it is easy to understand, the questionnaire is accurate and feasible, and the data is authentic and reliable. For this study, 50 users conducted a pilot test of the questionnaire. The adjustment was made according to the pre-measured questionnaire and the final questionnaire was created. This data was collected through Jeju International Airport visitors and online surveys and was conducted between August and September 2017.

Specifically, in the process of confirmatory factor analysis, we usually multiply the latent variable by 20 times. In this paper, since the total number of potential factors calculated from the exploratory factor analysis is 7, about 140 Analysis of the sample is possible (Sosik, Kahai, & Piovoso, 2009). As another criterion, PLS-based SEM can be determined by multiplying the number of possible paths by 10 times (Barclay, Higgins, & Thompson, 1995). Therefore, the number of samples in this study can be applied to this study without any problems.

4. Results and Analysis

4.1. Demographic analysis

Basically, te researchers selected respondents who are adults (18 years or older) who use smart watches for health check purposes. Among the 185 valid responses, The ratio of male (48.6%) to female (51.4%) responded similarly. Age was the highest in 20s and 30s, and officer was the highest with 40.5%. In the education, 58.9% of university graduates responded the highest.

4.2. Validity, reliability and factor analysis

Measurement model validation is mainly adopted to analyze the reliability and validity of the variables. Reliability is employed to indicate whether the results of the scale are credible. The validity includes aggregation validity and discriminant validity. Convergent validity indicates the degree to which the variables and their corresponding variables are correlated. The discriminant validity tests whether one variable and another are correlated more than the other variable correlations, as shown in Table 2. Specifically, It is composed of a single scale ('I want to use the smart watch / exercise band continuously'), which is the final dependent variable, health behavior, which is not shown in Figure 2.

Table 1: Demographic analysis

Variable	Category	Frequency	Ratio(%)
Gender	Male	90	48.6
	Female	95	51.4
Age	18-25	42	22.7
	26-30	60	32.4
	31-40	47	25.4
	41-50	32	17.3
	51-60	2	1.1
	More than 60	2	1.1
Job	Student	12	6.5
	Housewife	16	8.6
	Officer	77	40.5
	Profession	9	4.9
	Self-employment	8	5.4
	Others	63	34.1
Eduction	Less than middle school graduation	18	9.7
	Less than high school graduation	11	5.9
	University Student	30	16.2
	University graduation	109	58.9
	More than graduate school	17	9.2
Total		185	100

The survey results encompass seven factors in total. According to table 2, the factor loading of all the variables is greater than 0.6, meaning that the items can well explain the variable. All variables had an alpha value greater than 0.7, which means the model has good reliability. For the composite reliability (CR), as a reliability measurement coefficient, the incorporation of a high reliability coefficient implies that the variables correspond to the measurement with a high degree of consistency; a factor greater than or equal to 0.7 indicates that the measurement tool employed is reliable. The CR values in Table 2 satisfy the evaluation criteria of reliability greater than or equal to 0.7. The Table shows that the variables have good internal consistency. Specifically, the AVE value was above 0.7 and met the standard requirements greater than 0.5, which indicates that the model has good convergence validity and good model polymerization efficiency. So, The factor analysis enables an understanding of the implicit relationship between the various factors; thus, the correlation analysis of the latent variables ensures the structural validity.

Table 2: Construct reliability and validity

		Factor loading	Cronbach's Alpha	Rho_A	CR	AVE
Easy to use	EU_1: Smart watch / band operation (use) is easy.	0.922	0.782	0.859	0.872	0.699
	EU_2: There is no difficulty when using smart watch / band.	0.910				
	EU_3: arious functions of Smart Watch / Band can be easily seen.	0.647				
Convenience	convenience_1: The smart watch / band is easy.	0.896	0.881	0.889	0.926	0.806
	convenience_2: When I exercise, I want to carry more smart watch / band than smartphone.	0.888				
	convenience_3: If possible, I would like to use my smartphone as a smart watch / band instead.	0.910				
Real-time monitoring	RTM_1: I can get real-time personal health status through smart watch / band use.	0.930	0.926	0.927	0.953	0.872
	RTM_2: The smart watch / band has my health check and boosting effect.	0.927				
	RTM_3: Smart Watch / band can record real-time health data.	0.944				
Personal	personal_1: I can buy smart watches / bands that I want among various smart watches / bands.	0.895	0.908	0.913	0.942	0.845
	personal_2: The smart watch / band can basically satisfy what you need.	0.943				
	personal_3: The smart watch / band can be installed on my demand at the time.	0.919				
Health self-efficacy	HSE_1: Using smart watch / exercise bands, I am confident that I can do the health activities that I need to improve my health.	0.928	0.916	0.916	0.947	0.856
	HSE_2: With smart watch / exercise bands, I am confident of a balanced diet.	0.942				
	HSE_3: With smart watch / exercise bands, I am confident that I can overcome difficulties in doing health care.	0.905				
Health promotion realization	HPR_1: There is interest in healthcare using the smart watch / band.	0.940	0.936	0.936	0.959	0.886
	HPR_2: With smart watch / exercise bands, exercise for health care is needed.	0.950				
	HPR_3: The smart watch / exercise band is a good health promotion tool.	0.934				

Table 3: Latent variable correlations of the measurement model

Factors	Behavior	Convenience	EU	HPR	HSE	Personal	RTM
Behavior	1						
Convenience	0.6	0.898					
EU	0.616	0.764	0.836				
HPR	0.866	0.652	0.653	0.941			
HSE	0.735	0.679	0.695	0.767	0.925		
Personal	0.593	0.82	0.809	0.628	0.629	0.919	
RTM	0.693	0.823	0.77	0.726	0.737	0.824	0.934

Note: Items on the diagonal (in bold) represent the square root of AVE scores

4.3. Structural model analysis

In the light of the results, Smart PLS3.0 output was used for the entire smart wristband data on the health impact factor model of the path coefficient. In this study, three independent factors (easy of use, convenience & personal) were excluded from the final model because they were not statistically significant. Finally, the higher the real-time monitoring and self-efficacy, the more positively the health promotion realization. In addition, self-efficacy and health promotion realization may ultimately affect health behavior (see Table 4).

Table 4: Results of PLS

Hypotheses	T value	P value	results
EU -> HPR	0.585	0.559	Reject
Convenience -> HPR	0.304	0.761	Reject
RTM -> HPR	2.006	0.045 **	Accept
Personal_ -> HPR	0.123	0.902	Reject
HSE -> HPR	3.33	0.001 **	Accept
HPR -> Behavior	11.579	0.000 **	Accept
HSE -> Behavior	2.601	0.010 **	Accept

Note 1: *p<0.05, **p<0.01

5. Conclusion

The health promotion model (HPM) applied in this study has been used extensively in an increasing number of fields. In addition, intelligent health devices are booming as more and more people accept them. For this reason, it is inappropriate to study health interventions through the adoption of HPM. We need to integrate cutting-edge science and technology that integrate into our social lives. As a result, intelligent products have proven to be an effective aiding tool for HPM adoption. This study investigates smart wristbands in the context of HPM to identify factors that affect behavior. This study primarily seeks to identify elements of smartlist band usage that affect health promotion and to conduct analysis and speculation carefully.

This study was conducted according to previous theories and models. As you can see from the survey, more and more people are focusing on healthy lives. 62% of respondents actively monitor and maintain their health and spend time, money and effort on it. From a different perspective, smart bracelets are primarily used by people between the ages of 18 and 50 years. Among them, teachers, workers and those who work long hours indoors and lack physical labor tend to use this device. Factors affecting HPM have been effectively evaluated in terms of investigation and analysis of the users and functions of the device.

First, the concept of health promotion was introduced in this study, and the composition of Pender's HPM and the development of a wrist bracelet were revealed. Second, we looked at the objective factors of attracting users to the smart bracelet band and how the devices and HPM are connected. How the factors are related is found to find the closest relationship.

Third, the testing of factors through data analysis verifies the validity and relativity of HPM observational and latent variables and the rationality of the structural model. The impact of health awareness and promotion of behavioral changes through the use of smartlist bands has been gained through a number of causal effects through SmartPLS software, Obtained to determine the impact on HPM.

Promoting health awareness and health self-efficacy has a crucial impact on health behaviors. In this study, the self-efficacy and real-time monitoring of the SmartList bands have proven to be directly related to the promotion of health awareness. Therefore, high self-efficacy and real-time monitoring of the device have a significant impact on health promoting behaviors.

According to the findings and analysis, this study provides a rational and effective basis for using smart wristbands in HPM. Especially in the context of today's society, the study claims that smart wristbands, which act as smart portable health devices for the public, can effectively monitor and oversee health conditions. Therefore, it is important to cultivate the public's perception of physical exercise and exercise behavior that form the health of the public and society, and to play a role that can not be replaced. In this regard, governments should encourage, guide, and promote devices in terms of policy and funding to foster health awareness, create a positive and healthy living environment, and actively promote the development of healthy behavior. Individuals should make full use of the various functions of smart wristbands to promote their health awareness and healthy behavior.

References

Alkhalaileh, M. A., Khaled, M. H., Baker, O. G., & Bond, E. A. (2011). Pender 's health promotion model: an integrative literature review abstract. *Middle East Journal of Nursing, 5*(5), 12-22.

Al-Nasser, K. (2014). *U.S. Patent No. 8,725,842*. Washington, DC: U.S. Patent and Trademark Office.

Barclay, D., Higgins, C., & Thompson, R. (1995). *The Partial Least Squares (pls) Approach to Casual Modeling: Personal Computer Adoption Ans Use as an Illustration*.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research,* 39-50.

Ha, T., Beijnon, B., Kim, S., Lee, S., & Kim, J. H. (2017). Examining user perceptions of smartwatch through dynamic topic modeling. *Telematics and Informatics*, *34*(7), 1262-1273.

He, D. (2018). World Population Development. *Population and Family Planning, 6*, 64.

Heydari, A., & Khorashadizadeh, F. (2014). Pender's health promotion model in medical research. *Studies, 41*, 59.

Hui, W. W., & Lin, H. F.(2004). Application of PLS path model in the establishment of comprehensive evaluation index. *System Engineering Theory & Practice, 24*(10), 80-85.

Lu, Y. P., & Zhang, Y. K. (2016). Development trends of global smart wearable devices. *World Telecom, 4*, 9.

Ma, W. W., Chung, L. M., Fong, C. W., & Pendergast, D. (2014). Walk Your Life to Health—Motivating Young Adolescents to Engage in a Brisk Walking Program. *Health, 6*(17), 2303.

Patrick, K., Griswold, W. G., Raab, F., & Intille, S. S. (2008). Health and the mobile phone. *American journal of preventive medicine*, *35*(2), 177-181.

Rawassizadeh, R., Price, B. A., & Petre, M. (2015). Wearables: Has the age of smartwatches finally arrived?. *Communications of the ACM*, *58*(1), 45-47.

Pender, N. J. (2011). *Heath Promotion Model Manual.* Retrieved from http://hdl.handle.net/2027.42/85350.

Ru, Y. (2011). *The Theory and Practice of "the Mode of Knowledge and Practice."* In School Health Education, China Light Industry Press.

Shan, X. Q., & Feng, A. C. (2016). Effect of WeChat Health Education Model on Intervention of Health Literacy. *Health education and health promotion, 2*, 98-99.

Smartwatch News (2018). *Love for smartwatches powers wearables growth – but the future is hearable.* Retrieved from https://www.wareable.com/smartwatches/

smartwatch-sales-2022-gartner-6781

Sosik, J. J., Kahai, S. S., & Piovoso, M. J. (2009). Silver bullet or voodoo statistics? A primer for using the partial least squares data analytic technique in group and organization research. *Group &Organization Management*, *34*(1), 5-36.

Wang, J. J., Sun, X., Ma, L., Zhu, G. H., Zhao, Y. S., & Zhang, G. L. (2014). The implementing effect of pension institutions' own homework health promotion mode. *Chinese Journal of Practical Nursing, 30*(14), 9-13.

World Health Organization (1986). *The Ottawa charter for health promotion.* First international conference on health promotion. Ottawa, November 21. Geneva: WHO.

Wu, J., Li, S., Hu, X., & Wang, L. (2017). An empirical study on the influencing factors of users' intention to integrate health wearable devices. *Journal of information resource management, 7*(2), 22-30.

Wu, Y. (2016). The application of smart wristbands in social sports. *Journal of Anhui Sports Science, 37*(4), 21-22.

Yang, Y., & Kim, M. (2015). Effect of HPM Factors on Adoption Attitude of u-Health System: Moderating Effects of Gender. *Journal of Digital Convergence, 13*(7), 213-221.