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Acceptance of mHealth Apps for Self-Management Among People with Hypertension

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Abstract. Background: Mobile health applications (mHealth apps) have the potential to help patients with chronic conditions such as hypertension by supporting self-management activities in daily life. However, the uptake of mHealth apps remains poor among patients. To improve the utilization of mHealth apps for hypertension, the analysis of the behavioral intention to use such applications must consider personality traits and illness-related perceptions. Method: Adults with hypertension in Germany and Austria filled out a selfadministered questionnaire in a cross-sectional study based on the UTAUT-model in order to identify potential predictors for the behavioral intention to use mHealth applications as an indicator for their early acceptance. Beyond the four core determinants of acceptance of the UTAUT (performance expectancy, effort expectancy, social influence and facilitating conditions), self-efficacy, openness to experience and perceived health threat were analyzed as predictors. Results: 145 participants (mean age 52.51 years, SD 14.33; 60% female) completed the survey. Acceptance was moderate on average (M=3.26, SD=1.07, min 1 to max 5). In a multiple hierarchical regression, performance expectancy and effort expectancy were confirmed as significant predictors of acceptance (step 1, $R^2 = .57$, p < .001), while self-efficacy could not be confirmed (step 2, p = .87). In addition, perceived health threat ($\beta = .12$, p < .05) and openness to experience ($\beta = .22$, p < .001) had a significant influence on acceptance of mHealth apps for hypertension (step 3, overall model with $R^2 = .62$). Age showed a negative association with the intention to use ($\beta = .22$, p = .005) while no influence of gender could be found (p = .06). Conclusion: Above expectations regarding effectiveness and usability, openness to experience and perceived health threat make a significant contribution in predicting the acceptance of mHealth solutions in the field of chronic diseases.

Keywords. mHealth, Intention, Hypertension, Cross-sectional Survey, Patient Acceptance of Healthcare, Illness Behavior, Personality

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1. Introduction

1.1. Scientific Background

Hypertension is highly prevalent in the adult general population and is often associated with poor adherence to medical treatment [1]. mHealth applications (apps) represent promising and cost-effective possibilities in prevention, diagnostics or therapy through reminder functions and networking with other systems and can thus support the self-management of chronic diseases, such as diabetes or cardiovascular diseases.

The users intentions to utilize such apps as an indicator of acceptance and use have hardly been taken into account in this target group to date. A first step for developers and providers of digital interventions for people with hypertension should thus be to identify facilitators and barriers for self-management [2]. According to the Unified Theory of Acceptance and Use of Technology (UTAUT), performance expectancy, effort expectancy and social influence are positive predictors of the behavioral intention to use a technological innovation, whereas facilitating conditions and behavioral intention (i.e., acceptance) are direct predictors of usage behavior [3].

Since the emergence of eHealth and mHealth, the UTAUT has been adapted and transferred to investigate user acceptance across a variety of medical settings and health conditions [4-6]. However, to the knowledge of the authors, no study has yet adapted and extended the UTAUT model to determine the general acceptance of mHealth apps for self-management among smartphone users with hypertension in Germany and Austria.

1.2. Rationale for this study

A recent systematic review of 21 trials on mHealth apps for hypertension has indicated the acceptance of the evaluated apps, including positive usability ratings (i.e., perceived ease of use), but the included studies that were mainly conducted in the US and Canada were associated a high risk of methodological bias [7]. The acceptance of mHealth apps for hypertension in general and outside the context of clinical trials or app usability studies among potential users remains poorly studied, particularly in Europe.

In order to improve the uptake of such apps among smartphone users with hypertension, it is vital to understand the determinants of acceptance and use and to explore additional predictors related to the disease and other user characteristics that may be relevant for the successful adoption of digital behavior change interventions. Such user characteristics involve, for instance, the disease, demographic characteristics, traits (e.g., personality), cognitive factors (e.g., self-efficacy, knowledge), beliefs and attitudes (e.g., expectations, perceived benefits and barriers, intentions), physiological factors or skills [8]. Personality traits can either impede or promote the acceptance of health apps. Although the user characteristics have received increasing attention in technology development in recent years, studies that integrate personality traits into a comprehensive approach to technology acceptance are rare [9]. Openness to experience refers to the need for diversity, novelty and change [9], so that people who are more open to new experiences appear more inclined to accept novel technologies [10, 11]. Openness to experience correlates positively with a significantly higher intention to use mHealth apps [9]. Furthermore, Broadbent et al. argue that individual illness perceptions have an influence on health behavior [12]. Patients who experience their illness as an existential threat may be more likely to actively seek treatment options

[13]. Dou et al. found that the perceived illness threat influences the patients' intention to use mHealth apps to self-manage their chronic disease [14].

1.3. Objectives of the study

The aim of this pilot study was to determine the acceptance of mHealth apps for selfmanagement purposes (in terms of the behavioral intention to use) among people with hypertension and to explore determinants of acceptance.

In addition to the four UTAUT predictors and self-efficacy, it is postulated that perceived threat of the disease and openness to experiences are positively associated with the acceptance of mHealth apps for disease-management. Openness to experience is expected to have a positive predictive value on mHealth acceptance.

Given the scarcity of data on associations between individual characteristics and the acceptance of mHealth apps among people with hypertension, this study explores socio-demographic, eHealth-related and illness-related predictors of the intention use mHealth apps.

2. Methods

2.1. Study design and setting

This survey study was conducted using a non-interventional cross-sectional design. Data was collected voluntarily and anonymously between 23.11.2018 and 16.12.2018 via an online survey on 'Unipark' (Enterprise Feedback Suite survey, version Winter 2018, Questback). In addition, a paper-and-pencil version was distributed in an osteopathy and physiotherapy practice in Sprockhövel and a psychosocial counselling center in Berlin.

2.2. Participants and recruitment

The target group were smartphone users with chronic hypertension who were at least 18 years old. The participants were recruited through self-help forums, interest groups, medical leagues and social networks (e.g., XING, Facebook and Twitter,). As an incentive to participate in the study, interested participants could receive a summary of key findings via e-mail after survey completion.

2.3. Variables and Measures

Based on the UTAUT [3], acceptance was operationalized as the intention to use mHealth apps for self-management. Acceptance was measured using 3 items ("*I would like to try an mHealth-app for self-management*", "*I would use an mHealth-app if offered to me.*", "*An mHealth-app would be worth paying for.*") analogous to Hennemann et al. [5]. All items were rated on 5-point Likert scales ranging from (1) "*totally disagree*" to (5) "*totally agree*" with higher scores indicating greater level of acceptance.

For the analysis of the UTAUT items, the operationalizations of Hennemann et al. were used [5]. To measure self-efficacy, the "German general self-efficacy short form"

was used with a total of 3 items whose reliability (with Cronbach's α values between .81 and .86) can be classified as good [15].

In order to assess the perceived threat of the disease, the "The brief illness perception questionnaire" (IPQ) with a total of 8 items was used [12] (Cronbach's α = .66). The short form contains questions about the general and emotional impairment as well as the perceived control of the disease. An overall score can be formed across all 8 dimensions, reflecting the perceived threat posed by the disease.

Openness to experiences was evaluated using the 10 items from the Big Five personality test by Satow (2012) were used; the reliability of Cronbach's α of .76 was within the acceptable range [16].

In addition, demographic (age, gender, country of residence) and disease-related variables (diagnosis date of hypertension, medication against hypertension) were recorded.

The average completion time for the survey was 10-15 minutes.

2.4. Methods for data analysis

Predictors on the intention of use (i.e., acceptance) were included in blocks examined using a hierarchical multiple regression analysis. The first block consists of the UTAUT predictors (expected benefit, expected ease of use, social influence and facilitating conditions). The second block included the investigation of self-efficacy and the third block involved the UTAUT model extensions for the context of hypertension (perceived threat of the disease and openness to experience). Only completed data sets were considered for statistical analyses using IBM-SPSS, version 25.0. For 21 participants, the values for age could not considered for data analysis, because the free-text fields appeared to have resulted in unrealistic responses.

3. Results

3.1. Demographic and other study coverage data

A total of 146 persons completed the questionnaire. One person indicating to not have answered the questions honestly was excluded. The sample thus consists of a total of N = 145 persons, 60 % female and 39.3 % male (1 answer: `other`, 0.7 %). The median age was 53 years (M = 52.51, SD = 14.33), with a range of 24-92 years. Most participants (82.8 %) were from Germany, 15.2 % from Austria, one participant from Switzerland and another one from the Netherlands. On average, the acceptance was moderate (3.26, SD 1.07, range of values: 1-5).

3.2. Study findings and outcome data

In the hierarchical multiple regression with blockwise inclusion of the predictors, only the first two included UTAUT predictors (performance and effort expectancy) were significantly positively associated with the acceptance of mHealth apps (block 1). Both social influence and facilitating conditions had no additional, significant influence to the first two UTAUT predictors. Above that, self-efficacy could not be identified as a determinant of mHealth acceptance (block 2). The two additional predictors, perceived threat of the disease ($\beta = .12$, p = .004) and openness to experience ($\beta = .22$, p < .001), were identified as positive predictors of mHealth acceptance (block 3). By adding the last block, R² increases by .05.

Further (subgroup) analyses of demographic characteristics showed that no significant differences in usage intention between men and women could be found using the t-test (p = .06). Age had a significant, negative influence on the acceptance (intention of use) of mHealth apps ($R^2 = 0.06$, $\beta = -0.25$, p = .005, N = 124).

4. Lessons learned (Discussion)

4.1. Key results in comparison to prior work

The present survey was the first of its kind to show that an extended UTAUT-model is feasible in identifying relevant barriers and drivers of mHealth acceptance in adults with hypertension. The results show that the expected benefit and ease of use are the strongest predictors of acceptance. This is in line with previous research [4]. The newly added constructs openness to experience and perceived illness threat led to an increase of the explained variance in a hierarchical regression.

Analogous to Hennemann et al. [5] self-efficacy could not be identified as a determinant of mHealth acceptance. The construct self-efficacy showed little variance, with rather high values. The results on age (significant) and gender (not significant) are also in line with previous research [17].

Overall, this exploratory study makes a significant contribution to better understand predictors of the acceptance of mHealth solutions in the field of chronic diseases. Data suggest a substantial acceptance of mHealth applications for disease management in hypertensive people, which is in line with a previous study on the acceptance of smartphone users with a chronic illness [6], but is higher compared to previous research in diabetic, chronic pain or mixed inpatient populations [5, 18]. Positive expectancies about the performance and ease of use, which could be fostered through information provided by healthcare professionals, might help promoting the acceptance of mHealth apps among people with hypertension.

4.2. Strengths and weaknesses of the study

Strengths of this study involve the novelty of the research questions with new insights into the acceptance of mHealth apps among people with hypertension, the theoretical foundation and the application of a complex research model. However, the exploratory and early nature of this research is also associated with limitations. First, the sample was relatively small. Second, participants were self-selected, mainly via the Internet (selection bias). Only 7 participants could be recruited in practices using the paper-and-pencil questionnaire so that people with higher online affinity might also be rather using and accepting apps. Finally, the reliability analysis for perceived health threat revealed questionable reliabilities for the IPQ. Hence, the present findings need replication with a larger, more diverse sample and a longitudinal assessment of the acceptance and use of such apps.

4.3. Unanswered and new questions

As the two UTAUT predictors social influence and facilitating conditions had no additional, significant influence one could question the operationalization of these constructs. Usually social influence indicates the relevance for self-help or mHealth apps of family, friends and GPs. Potentially, in mHealth apps the social influence of other users in terms of user ratings and download rates in app stores may be more relevant.

In addition, for facilitating conditions the operationalization for smartphone users may be to general.

5. Conclusion

In addition to well-known influence of positive expectations regarding the effectiveness and usability of mHealth apps, openness to experience and perceived health threat make a significant contribution in predicting the acceptance of mHealth solutions in the field of chronic diseases.

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Conflict of Interest

The authors state that they have no conflict of interests.

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