UNIVERSITY OF TWENTE.

Faculty of Behavioral, Management and Social Sciences

The effect of 'Mijn GezondheidsPlatform' on physical activity and self-management by patients with chronic diseases

Johannes Jasper

B.Sc. Thesis
June 2016

Supervisors:
Martine Altena, M.Sc.
Dr. Annemarie L. M. Braakman-Jansen

Faculty of Behavioral, Management and Social Sciences
University of Twente

Abstract

Purpose: To ensure a professional and patient-oriented treatment of chronic diseases, the evaluation and assessment of e-Health based web platforms is essential. 'Mijn Gezondheidsplatform' (MGP) is an online platform which focuses on self-care and self-management of health. This study aimed to evaluate if MGP effects the improvement of self-management and physical activity by patients with chronic diseases.

Method: To evaluate the effect of MGP on patients' self-management and physical activity, patients with diabetes mellitus, cardiovascular disease, asthma or COPD were divided into an experimental- and control group. Patients in the experimental group used MGP for one year. To measure patients self-management and physical activity, the 'Patient Activation Measure' (PAM-13) and the 'International Physical Activity Questionnaire – Short Form' (IPAQ-SF) were used. For analysis, only the measurement just before the intervention (baseline, T0) and the measurement after the intervention (T= 12 months) were analyzed. Using covariation analysis (ANCOVA), it was tested if the differences of the self-management, resp. physical activity scores between 'baseline' and T5 are significant. Furthermore, Spearman's rank-order correlation was conducted to test if self-management and physical activity are associated with each other.

Results: It was found that using MGP for a period of one year does not effects patients' physical activity. However, the results indicate a significant decrease of self-management in the experimental group, with $F(1,89) = 4.679$, $p = .033$. In addition to that, results imply that self-management and physical activity are not related with each other.

Conclusion: This study revealed that MGP does not increase physical activity, but influences patients' self-management negatively. However, it should be noted that other aspects can influence patients' self-management and physical activity strongly (e.g. chronic conditions, character traits). These factors should be integrated into further research. An important limitation of this study is that it does not make use of log-data. However, analysing log-data is an important requirement to evaluate the design of MGP, in order to increase adherence.

Introduction

Chronic diseases are the most widespread and economically significant health problems in industrialized-, but increasingly also in the less affluent countries. One important reason for the increased number of people with chronic diseases is the aging of the population. Half a century before about 200 million people (both, in developed- and developing countries) were 60 years or older. It is expected that in the year 2050 approximately 2000 million people will be 60 years, resp. older (United Nations, 2012). This development does not only has an impact on our society in general, but also on the health care systems. Parallel to the growing number of older people, patients with serious diseases and the costs of our health care systems will increase. Research shows that already today about 70% of all medical care expenditures are directly linked to the treatment of chronic diseases (Holman, 2004).

The most common chronic diseases are cancer, cardiovascular diseases, chronic lung diseases (e.g. COPD), mental disorders and diabetes mellitus (WHO, 2014). The World Health Organization (2016) defines chronic diseases as "non-communicable [nontransferable] diseases (NCDs), [which] are of long duration and generally slow progression." Because of the variety of chronic diseases, Holman (2004) defines chronic diseases not with a general definition, but with specific characteristics: "a multivariate causation, the unfolding over time, an undulating course, […] uncertainty of the diagnosis (uncertainty pervasive), indecisive therapies and a long-lasting management of the disease" (Holman, 2004).

Diagnosed with a chronic disease contains many challenges and impairments for the affected person, in particular the need for adaptation to new circumstances (changes in the daily life) and learning to cope with the consequences and treatments of the chronic disease. Patients with chronic conditions often need to change their behavior (e.g. medication, exercise, recreation, nutrition). Furthermore, chronic diseases can cause changes in social- and work circumstances, which often leads to emotional distress (Holman, 2004). Patients often are restricted in doing social activities (e.g. going out with friends, drinking alcohol, doing sports) and have reduced mobility. These impairments can result in social isolation and loneliness. In addition to that, people with chronic diseases often show a decreased level of physical activity, which then again affects the general health (Garcia-Aymerich et al., 2006). Because many employers require physical/ mental health, it is often difficult for patients with chronic diseases to maintain their job, resp. to find a new one. Living with a chronic disease and integrating it into the daily life requires patients active participation in making decisions, collaboration with specialists (e.g. general practitioner), the properly use of medications, taking symptoms seriously and actively overcoming emotional issues (Holman, 2004). All of

these requirements emphasize the patients' ability to self-manage the own disease (self-management).

Treatment of chronic diseases

There are several treatments for chronic diseases. Among others, these are the use of medication, physical therapies (exercise), support groups, cures, health-education, etc. All of these treatments can help patients to cope with certain aspects of their chronic disease(s). Nevertheless, most of these treatments focus on one specific issue and do not take other aspects for a successful treatment of chronic diseases into account (e.g. communication with professionals, patients self-reliance), resp. integrate those (Bodenheimer et al., 2002).

Bodenheimer et al. (2002) emphasize the importance of collaborative (patient-centered) care for a successful and lasting treatment of chronic diseases. In this context, the model of shared decision making should be emphasized. Frosch et al. (1999) define shared (medical) decision making as the "process by which patients and providers consider outcome probabilities and patient preferences and reach a health care decision based on mutual agreement." This definition states that health-related decisions should always be made by the patient and the professionals together. In addition to that, shared decision making implies that patient and professionals, both, should be responsible regarding the treatment of the disease. In this context, Aronson (2007) emphasizes that the free will of the patient always is central and should be accepted, which includes that the patient stays responsible for its own disease. Furthermore, the patient should always set the goals, experts (e.g. practitioner) should help the patient to reach these goals. One fundamental characteristic of shared decision making is the sharing of information (expertise) about the disease, which increases transparency and active communication between patient and professionals and highlights the role of the professional as the patient's supporter (Bodenheimer et al., 2002; Frosch et al., 1999).

An important aspect for the successful treatment of chronic diseases is patients´ adherence to the prescribed therapies (treatment adherence). Kelders et al. (2012) defines treatment adherence as "the extent to which the patients behavior matches the recommendations that have been agreed upon with the prescriber". This definition implies, that therapies and other treatments of the chronic conditions should always be agreed upon with the health professionals (shared decision making). Therefore, patients' treatment adherence is directly related to the collaboration between the patient and other stakeholders (e.g. practitioner). Research in the field of chronic diseases and treatment-adherence revealed, that approximately 60% of the patients with a chronic disease "are poorly adherent to

treatment" (Dunbar-Jacob, 2001). In one study, participants with a rheumatic disease self-monitored their daily intake of medication and exercise. Fifty percent of the participants showed non-compliance of the prescribed therapies (exercise and medication). For patients with diabetes mellitus the compliance-rate was 40-50% and for patients with osteoporosis 55-70% (Petermann et al., 2004). It should be mentioned that the participants' adherence was not directly observed/controlled. Therefore, it is assumed that the compliance-rate was even lower. Petermann et al. (2004) emphasize the unpredictable and irregular progress (constantly changes of wellbeing) of chronic diseases, which can lead to decreased motivation among the patients' and poor non-adherence to the prescribed therapies.

Patients' physical activity (PA) is another important aspect in the treatment of chronic conditions, which is closely related to quality of life, wellbeing and mortality (Araújo, 2016; Garcia-Aymerich et al., 2006; Rubin & Peyrot, 1999). PA is defined as "any bodily movement produced by skeletal muscles that result in energy expenditure" (Caspersen et al., 1985). Chronic diseases and its consequences often impair patients to be physical active. In one study, patients with COPD "walked 25% slower than healthy people, and […] spend 12% of the day-time lying down, compared to 4% for healthy elderly people". However, it was found that increased physical activity significantly reduces hospital admission and mortality by patients with COPD (Garcia-Aymerich et al., 2006). In addition to that, Rubin & Peyrot (1999) emphasize the importance of physical activity for patience quality of life: "Quality of life is measured as physical and social functioning, and perceived physical and mental well-being." Therefore, it is important to study how patients with COPD, resp. patients with chronic conditions in general, can be supported and motivated to be physical active.

Self-management

The problem of poor treatment adherence and low physical activity among patients with chronic diseases shows, that patients' ability to self-manage their disease and its consequences is a necessary requirement to treat chronic diseases effective. It is assumed that improving patients' self-management improves treatment outcomes and patients general health.

Self-management is defined "as a person's ability to manage the symptoms and the consequences of living with a chronic condition, including treatment, physical, social, and lifestyle changes" (Barlow et al., 2002). In this context, Lorig et al (2003) emphasize that self-management of chronic disease(s) is a "lifetime task" and that self-managing the chronic conditions should always "keep wellness in one's psychological foreground". Furthermore,

Lorig et al (2003) divide self-management into three main abilities: patients' ability to take medication properly, patients' ability to manage their changing "life roles" in daily life (caused by changing chronic conditions), and patients' ability to cope with psychological aspects of the disease (e.g. frustration, stress management). Several self-management (SM) skills are derived from these main abilities.

First of all, *problem solving* is an important SM-skill, which implies that the patient can define health related problems, consider solutions to this problem, implement them and finally evaluate the effectivity of the outcomes (Lorig et al., 2003). As an example, assuming that a patient with type 2 diabetes mellitus never wants to go out with his friends and always says that he does not feel good. Actually, he is afraid to forget his medication (insulin) when leaving his apartment. Later, he talks with his friends about his anxiety and suggests to meet at a place close to this apartment, where he easily can get his medication. In this example, the patient realized the underlying health problem (anxiety) and thought about a solution for his problem (meeting at a place close to his apartment). Finally, he implemented his solution (talking to his friends about his anxiety) and evaluated the outcome of his solution (he met with his friends without having anxieties).

Dishman (2005) emphasizes, that unpredictable changes in the chronic conditions directly challenge the patient to make decisions. For this reason, *decision making* is another important SM-skill. To respond to the changing chronic conditions and to make appropriate decisions, patients need to have knowledge about their disease, the effects of the treatment, their current health status, etc. (Lorig et al, 2003). Self-management training programs can prepare patients for future situations, e.g. when a patient has pain and needs to decide if he/she should visit a health professional or not. For this case, patients could be told which symptoms are serious and which are temporary.

Patients often do not know where to get additional support (e.g. information) regarding health related issues. For example, a patient with COPD wants to communicate with other patients with chronic lung diseases to exchange experiences regarding the diseases, but does not know how to make contact with these other patients. Therefore, Lorig et al (2003) emphasize the importance of *resource utilization.* This SM-skill contains the ability to know, find and use health supporting resources (e.g. the internet, information center, phone numbers of health professionals, making contact to self-help groups, etc.). To know, find and make use of these recourses help the patient to self-manage its chronic conditions.

Collaboration with professionals and shared decision making are central aspects in the treatment of chronic diseases. Therefore, Lorig et al (2003) imply that "*forming partnerships*

with health care providers" is another important SM-skill for patients with chronic conditions. Patients need to learn how to collaborate with health professionals (e.g. practitioner), in order to report health related problems, the progression of the disease, personal health goals, anxieties, uncertainties regarding the treatment, etc. To be able to report health related aspects, helps the patient to self-manage the chronic conditions and enables shared decision making with health professionals.

Finally, *taking action* is an important SM-skill, which refers to the skill to change and adapt the own behavior (Lorig et al., 2003). Because patients need to feel confident to be able to change their behavior, "taking action" often interacts with patients' *self-efficacy* (a person's confidence to achieve a particular goal) (Bodenheimer et al., 2002). For example, if a patient with type 2 diabetes mellitus feels uncomfortable, he/she should be convinced to be able to measure his/her level of blood sugar and react to the indicated value accordingly (e.g. diet, inject insulin). In addition to that, taking action refers to the ability to plan (health related) future actions and to carry them out. A planned action could be: "From now on, I will not use the elevator any more, but will go upstairs to my apartment."

To improve self-management by patients with chronic diseases, the effects of self-management training programs were investigated many times (e.g. Barlow et al., 2002; Holman et al., 2004; Lorig et al., 2000). In one study, after following a self-management training course, patients with chronic diseases (males and females, age range of 10-45 years) felt more "confidence and assertive" and stated that "various self-management techniques provided them with the necessary tools to help cope with life events" (Barlow et al., 2002). In another study, participants with one or more chronic diseases followed a self-management program for seven weeks. After one year, there were found "statistically significant improvements in seven of the nine health status measures: fatigue, shortness of breath, pain, social activity limitation, illness intrusiveness, depression, and health-distress" (Lorig et al., 2000).

E-Health

An innovative and future-oriented approach in the treatment of chronic diseases is the application of electronic health care technologies (e-Health) to improve patients' ability of self-management permanent, independent from time and place. The power of e-Health is to integrate and incorporate several treatment-related aspects: the interaction between the patient and professionals (enables bilateral communication and shared decision making), the irregular and long-term progress of the chronic disease (helps coping with changing chronic

conditions) and the patient's own responsibility. Economic advantages of e-Health applications are increased efficiency (saving money, time) and the possibility to reach many patients simultaneously (Gemert-Pijnen, 2013).

The aim of e-Health applications is to "motivate people [patients] toward healthy behavior, and thereby possibly delay or even prevent medical problems" (Oinas-Kukkonen et al., 2009). To do so, e-Health technologies make use of persuasive communication, resp. *persuasive systems*. Oinas-Kukkonen et al. (2008) define persuasive systems as "computerized software or information systems designed to reinforce, change or shape attitudes or behaviors or both without using coercion or deception". This definition implies, that persuasive systems (e.g. web-based self-management interventions) do not only aim to change a person's behavior/attitude, but also to reinforce existing (good/healthy) behavior/attitudes.

In this context, it should be mentioned that Ajzen´s "Theory of Planned Behavior" (TPB) (1991) is an important theory behind persuasive communication, because it provides a model of the most important psychological processes, which strongly influence/determine a person's behavior. TPB contains the elements "Attitude", "Subjective Norm" and "Perceived Behavioral Control". "Attitude" is a person's belief of the (positive) consequences of a behavior change. "Subjective Norm" is a person's belief what significant others (relatives, friends, etc.) think about the behavior (-change) and "Perceived Behavioral Control" is a person's confidence to be able (to have the power/control) to change the own behavior (Ajzen, 1991). These underlying psychological processes can be find back in several persuasive communication systems.

Persuasive System Design

The "Persuasive System Design-model" (PSD) consists of a framework of different systems, which influences the effectiveness of an e-Health technology. In this context, "effectiveness" refers to the extent to which the e-Health technology motivates user (e.g. patients) to make regularly use of it and persuades them to change their behavior. Following persuasive system design, an e-Health technology should contain three main elements: "Primary Task Support", "Dialogue Support" and "Social Support" (Oinas-Kukkonen et al., 2009). Social Support elements try to motivate participants to compare their own performance with others (through Social learning, Social comparison/facilitation and Competition). Because of the diversity and seriousness of chronic diseases, it is assumed that these elements frustrate patients or even keep patients away from regularly using the e-Health application

(further research is necessary). Elements of the system "Dialogue support" try to remind participants to regularly use the technology (Reminders, Suggestion), resp. to give the user a feeling of joy and attachment, when using the e-Health technology (Similarity, Liking, Social role). In a study, the combination of using Dialogue support elements (especially Reminders) and at the same time facilitating active (collaborative) communication between patient and professionals "significantly predict[s] better adherence" (Kelders, 2012).

Design and Implementation of e-Health

To design and implement e-Health applications efficient, Fogg (2009) presents its "Eight-step design process". Following Fogg (2009), first of all, it is important to define the (patient´s) desirable target behavior (e.g. walking three times a week for 30 minutes). Next, the target audience of the e-Health intervention should be chosen (e.g. patients with COPD). Then, it should be analyzed what the target group prevents from doing the target behavior, which could be a lack of motivation/abilities (e.g. breathlessness, pain, frustration). The next step is to choose a technology channel, which could be used to reach the target audience (e.g. web-based health platform, mobile-phone application). When this is done, similar existing interventions should be analyzed (effectivity, applicability) and central elements integrated into the own e-Health intervention. Finally, the e-Health application should be tested, evaluated and adapted repeatedly (Fogg, 2009).

However, e-Health technologies also have barriers, which make the implementation difficult. Gemert-Pijnen (2013) mentions, that a lot of patients do not have the necessary skills to use e-Health platforms properly (older people, children, etc.). For this reason, the target group of e-Health technologies is restricted. Furthermore, Gemert-Pijnen et al. (2011) emphasizes that the implementation of e-Health technologies often is unsuccessful, because of poor communication/coordination between the different stakeholders (patients, users, health professionals, etc.). In addition to that, e-Health technologies often lack "human centeredness", which means that the technology does not consider the end users (e.g. patient) personal characteristics and circumstances. This can lead to a lack of motivation among users (patients) to use the e-Health application, which in turn decreases treatment-adherence (Gemert-Pijnen, 2013). In this context, Dishman (2005) emphasizes, that unpredictable changes in the chronic conditions directly challenge patients' self-management skills. If patients show poor treatment-adherence and do not regularly use the e-Health application, it is difficult to improve their self-management permanent. Therefore, it is important to analyze if and how e-Health applications motivate (persuade) patients to make regularly use of it (PSD).

However, literature already indicates, that successful implemented web-based health platforms can increase self-management by patients with chronic conditions, which influences patients' physical activity positively (McKay et al., 2001). In a study, participants with type 2 diabetes mellitus used the internet-based physical activity program "Diabetes Network Active Lives PA Intervention" for eight weeks. The study revealed a "significant relation between extent of web site use and level of improvement in PA [Physical Activity]" (McKay et al., 2001).

Mijn GezondheidsPlatform

Mijn GezondheidsPlatform is designed by Medicinfo. Medicinfo develops products and solutions for e-health-based health care. With MGP, Medicinfo presented a new approach for the treatment of (chronic) disorders. In collaboration with the company behind Medicinfo, students of the University of Twente studied Mijn GezondheidsPlatform. The aim of this study is to get to know what the effects of using MGP are and if using MGP supports patients to manage their chronic conditions effective.

Mijn GezondheidsPlatform (MGP) is an online platform which focuses on self-care and self-management of health. MGP is used in primary care groups for patients with type 2 diabetes mellitus, cardiovascular disease, asthma or COPD (Chronic obstructive pulmonary disease) who participate in a care program for chronic diseases. The program supports patients with chronic conditions to self-manage their disease and to integrate it into their daily lives. Thereby, MGP improves general wellbeing and quality of life. Components that can be found in MGP are care records, individual treatment plans, measurements (self-measured values, but also laboratory tests), communication tools to interact with the healthcare provider, online coaching and personalized health information. Mijn GezondheidsPlatform is used by both: professionals (e.g. clinicians) and patients with chronic conditions. The big advantage of MGP is that it integrates different health-related aspects in one program: coaching of one or more chronic diseases and guidance on general lifestyle improvement.

Research questions

The first research question is, if MGP can increase patients' physical activity level. 1. RQ: **"Does using MGP for one year increase the physical activity by patients with diabetes mellitus, cardio-vascular disease, COPD of asthma?"** In this context, physical activity is seen as an important factor, which influences patients' quality of life, mortality and general health. Next, this research paper focusses on patients' self-management skills. It is assumed, that self-management is an important variable, which determines the treatment-

outcomes of using MGP strongly. The second research question is, if MGP increases patients' ability of self-management. 2. RQ: **"Does using MGP for one year increase the ability of self-management by patients with diabetes mellitus, cardio-vascular disease, COPD of asthma?"** Moreover, this study verifies the assumption, if physical activity (dependent variable) correlates positive with patients' ability of self-management (independent variable). 3. RQ: "**Is self-management associated with physical activity?"**

Summarized, this study examines if MGP increases physical activity and self-management among patients with type 2 diabetes mellitus, cardio-vascular disease, COPD of asthma. In addition to that, this study examines to what extent both variables are associated with each other. Thereby, this study provides insight into how web-based health platforms can be used to treat patients with chronic conditions effective in order to increase patients' quality of life, general health and treatment satisfaction.

Method

Participants and Design

The participants of the study are patients with diabetes mellitus, cardiovascular disease, asthma or COPD, who belong to the care group PoZoB (Praktijkondersteuning Zuidoost-Brabant). A care group is a collaborative organization of general practitioners. The participants in the experimental group participated in a program for chronic care, using MGP as a treatment for chronic conditions. Participants in the control group did not participate in this program and did not use MGP. Because this study compares two groups in a period of one year, a *longitudinal between-groups* design is used. When the questionnaire for the first time was conducted (T0, baseline), the experimental group (MGP-users) consisted of 81 participants and the control group (not MGP-users) of 165 participants. In the experimental group 56 participants did not complete the study. These participants were excluded from further research. In the control group 79 participants did not complete the study, these also were excluded from further research. In total, 25 participants (21 man, 4 women) completed the study in the experimental group and 85 participants (56 men, 29 women) completed the study in the control group (T5). All of the participants are of Dutch nationality and aged between 18 to 95 years. For an overview of the participants' distribution, see figure 1.

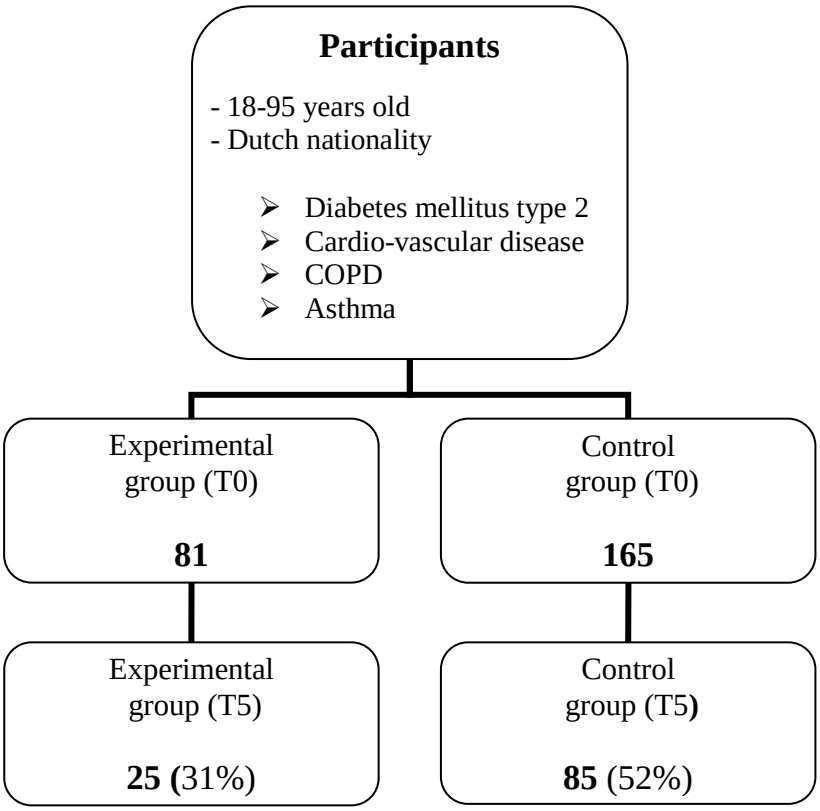

Figure 1: *Flow chart of participants: experimental- and control group*

Materials

To analyze the effects of using the web-based platform Mijn GezondheidsPlatform (MGP) on patients' physical activity and self-management, an online survey was filled in by the participants of the experimental- and control group. This survey consisted of several, valid questionnaires and contained questions about personal data, internet-usage/behavior, personality traits, attitude towards MGP and the company behind it, physical activity, quality of life and self-management. For this study, only questions concerning physical activity and self-management are considered.

Physical activity

To measure the physical activity of participants, the "International Physical Activity Questionnaire – Short Form" (IPAQ-SF) was used (see appendix). This questionnaire evaluates three levels of physical activity: walking, moderate physical activity and vigorous physical activity. This is an example of a question asked in the IPAQ-SF: "Now thinking about moderate physical activities you did in the last 7 days. On how many days did you do moderate physical activities, such as carry light loads, bicycling or swimming at regular

pace?" By definition, the physical activities are demanding/result in faster respiration and are practiced at least ten minutes straight. The frequency and duration of these activities were evaluated in days per week and hours/minutes per day. For each level of physical activity (walking, moderate, vigorous), the median value of MET-minutes per week (metabolic equivalent) was calculated. For Walking: "MET-minutes/week = 3.3 * walking minutes * walking days". For Moderate: "MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate-intensity days". For Vigorous: "MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days". To get a total score of physical activity, the MET-minutes/week scores of the three levels of physical activity were aggregated.

Self-management

To evaluate patients' level of self-management, the "Patient Activation Measure 13" (PAM-13) was used (see appendix). The PAM-13 consists of 13 questions regarding patients' expertise about the own health/disease, motivation and confidence to manage the chronic disease and general health. This is an example of a question: "When all is said and done, I am the person who is responsible for taking care of my health". Another one is: "I am confident that I can help prevent or reduce problems associated with my health". To answer and evaluate the questions, the PAM-13 uses a four-level Likert scale, ranging from "Disagree Strongly" to "Agree Strongly". To be sure that the test for self-management is reliable, the intern reliability of the PAM-13 was tested. The test gave a Cronbach's alpha (intern reliability) of α=0,718. Therefore, the reliability of the PAM-13 is good. To get a sum score of self-management for each participant, the answers were scored with points from one ("Disagree strongly") to four ("Agree strongly"). The alternate answer "nothing applies" was replaced with "999" and coded as missing value. To get a mean score of self-management for each person, the scores of all items were add together. Patients who score high in the PAM-13 are convinced that they can evaluate their own health-status properly and can adapt their behavior accordingly.

Procedure

The survey was conducted by patients with diabetes, cardiovascular disease, asthma or COPD, who belong to the care group PoZoB (Praktijkondersteuning Zuidoost-Brabant). During the study, participants of the experimental group used the web-based platform Mijn GezondheidsPlatform. Patients in the experimental group, who agreed to participate in research, was sent an e-mail with information and an invitation to participate in this study.

The e-mail also contained a link to the questionnaires. Participants of the control group also belong to the care group PoZoB, but did not use MGP during the one year study. Participants of the control group were addressed via a letter. The letter contained information, an invitation to participate in this study and the URL to the questionnaires. All participants received an informed consent. During the one year study, participants of the experimental- and control group filled in the questionnaire six times. The first time before using MGP (baseline, T0) and the last time after 12 months (T5).

Analysis

To answer the research questions, only the baseline questionnaire (T0) and the questionnaire after 12 months (T5) of the experimental- and control group were analyzed. For analysis, the raw data (four excel files) was imported to the statistic software "IBM SPSS Statistics", version 22 (IBM Corp., 2013). Participants, which did not fill in the questionnaires at all (T0 and/or T5), were sorted out. Missing values were redefined to "999" and marked as "missing value". Those data has not been taken into account for further calculations. Because participants with missing values were not completely deleted, the number of participants (n=25, resp. n=85) can vary. The histogram for general distribution demonstrated, that physical activity is not normally distributed among the participants. Self-management is well normally distributed among the participants, which was tested with the Kolmogorov-Smirnov test.

First of all, descriptive analysis was conducted for physical activity and self-management (for an overview, see table 2). The total baseline- (T0) and posttest (T5) scores (median) of physical activity were calculated for the experimental- and control group. For self-management, the mean scores were calculated. The *paired-samples t-test* was conducted to analyze if the difference (between Baseline and posttest) of physical activity, resp. self-management *within* the experimental- and control group is significant ($p<0.05$).

The first research question was: "Does using MGP for one year increase the physical activity by patients with diabetes mellitus, cardio-vascular disease, COPD of asthma?" To answer this question, an *analysis of covariance* (ANCOVA) was conducted to analyze if the difference of physical activity *between* the MGP- and control group is significant. The covariate was the baseline-score of physical activity.

The second research question was: "Does using MGP for one year increase the ability of self-management by patients with diabetes mellitus, cardio-vascular disease, COPD of asthma?" To answer this question, again, an *analysis of covariance* was conducted to analyze

if the difference of self-management *between* the experimental- and control group is significant. The covariate was the baseline score of self-management.

The third research question was: "Is self-management associated with physical activity?" To answer this question, the correlation between self-management (sum score/individual) and physical activity (sum score MET-minutes/individual) within the experimental group (between post-tests, T = 12 months) was tested. Because the sample of physical activity is not normally distributed, it was chosen to conduct *Spearman's rank-order correlation* (see results, table 3).

Results

In total, 25 participants completed the study in the experimental group (31%) and 85 participants completed the study in the control group (52%). Most of the participants in the experimental- and control group were higher educated. For an overview of the participants' characteristics, see table 1.

Table 1: *Baseline Characteristics of participants and non-participants*

Characteristics	MGP (N=25)	Control Group (N=85)
Age, mean (SD), years	52.6 (27.2)	50.4 (27.1)
Gender		
Man, N, (%)	21 (84)	56 (66)
Education, N, (%)		
Lower school	0 (0)	3 (3.5)
Primary education	3 (12)	7 (8.2)
Lower general secondary education	3 (12)	15 (17.6)
Intermediate Vocational education	4 (16)	17 (20)
Higher general secondary education	0 (0)	7 (8.2)
Higher vocational education	13 (52)	24 (28.2)
Scientific education	2 (8)	9 (10.6)
Other	0 (0)	2 (2.4)
Physical activity, Median (Interquartile range)	720.0 (1344.5)	360.0 (1095.0)
Self-management, mean (SD)	45.0 (3.8)	41.5 (4.9)

Descriptive analysis was conducted for the control- and experimental group. In table 2, the total scores of physical activity (median) and self-management (mean) are presented for "Baseline" (T0) and "Post-test" (T5). It is striking, that in the experimental group the

baseline- score of physical activity is much greater (*Median* = 720.0, *IQR* = 0.0-1344.5), compared with the baseline- score of physical activity in the control group (*Median* = 360.0, *IQR* = 0.0-1095.0). Furthermore, it is noticeable that in the experimental group the baseline-score of self-management is greater (*M* = 45.0, *SD* = 3.8), compared with the post-test score of self-management (*M* = 41.1, *SD* = 8.5), see table 2.

The first research question was, if using MGP for one year increase the physical activity by patients with chronic conditions. The *analysis of covariance* (ANCOVA) demonstrated that the difference of physical activity between the MGP- and control group is statistically not significant, with $F(1, 15) = 2.185$, $p = .160$.

Table 2: *Baseline and Post-test Characteristics of physical activity and self-management of participants and non-participants*

Characteristics	Baseline (T0)	Post-test (T = 12 months)	Change from Baseline- T = 12 months	p Base vs Post	MGP vs Control
Physical activity, Median (Interquartile range)					
MGP group (n=25)	720.0 (0.0-1344.5)	649.0 (0.0-1161.7)	-71	p=0.529	p=0.160
Control group (n=85)	360.0 (0.0-1095.0)	675.0 (0.0-1173.5)	315	p=0.752	
Self-management, Mean (SD)					
MGP group (n=25)	45.0 (3.8)	41.1 (8.5)	-4.5	p=0.051	p=0.033
Control group (n=85)	41.5 (4.9)	42.0 (5.7)	0.5	p=0.649	

The second research question was, if using MGP for one year increase patients' self-management. The *ANCOVA* demonstrated that the difference of self-management between the MGP- and control group is statistically significant, with $F(1,89) = 4.679$, $p = .033$.

The third research question was if self-management (independent variable) and physical activity (dependent variable) are associated with each other. The *Spearman's rank-order correlation* revealed that there is no correlation between self-management and physical activity (between post-tests), with $r_s = -.459$, $p = .214$. It is concluded, that self-management and physical activity are not associated with each other. For an overview of all correlations, see table 3. Interpretation of table 3: 1 = "Physical activity Baseline", 2 = "Self-management Baseline", 3 = "Physical activity Post-test" and 4 = "Self-management Post-test".

Table 3: *Baseline and post-test correlations among physical activity and self- management of participants (n=25)*

	1	2	3	4
Baseline				
1. Physical activity		.025	.500	-.336
2. Self-management			.069	.486*
Post-test				
3. Physical activity				-.459
4. Self-management				

*p<0.05

Conclusion/Discussion

This study aimed to evaluate the effects of using 'Mijn GezondheidsPlatform' (MGP) on patients' self-management and physical activity. It was assumed, that MGP supports patients to manage their chronic disease(s) (improves self-management), and therefore increases patients' physical activity. However, the results show that using MGP did not increase the level of physical activity in the experimental group (MGP). But, the results indicate a significant change of self-management in the experimental group (MGP) between baseline and T5 (T= 12 months). After one year, patients' self-management decreased in the MGP-group significant.

In addition to that, it was assumed that self-management correlates positive with patients' physical activity. The results show, that self-management and physical activity are not correlated with each other. This finding is not in line with previous studies, which found a positive relation between self-management and physical activity (Barlow et al., 2002; Lorig et al., 1993; Lorig et al., 2000; Saelens et al., 2000). However, in order to interpret these findings properly, it is necessary to evaluate if biases influenced the results of this study.

Previous studies emphasized the effectivity of web-based self-management programs (Barlow et al., 2002; Lorig et al., 2000; Norman et al., 2007). It was expected that using MGP increases patients' self-management. Therefore, it is striking that self-management decreased in the MGP group. It is possible, that patients' knowledge about self-management increased during the intervention, because patients were confronted with several self-management skills/ behaviors. This caused, that patients became more aware of their own self-management skills, in particular after filling in the first questionnaire (baseline). In further consequence,

patients became more critical/reflective/honest regarding their own self-management. This could explain why patients self-management scores decreased between the first measurement (baseline) and the last measurement (T= 12 months). It is also possible, that the decrease of self-management throughout the intervention was caused by a changing sample. In this context, it is striking that many participants did not completed the questionnaires. In the experimental group (MGP), 69% of the participants did not filled in the last questionnaire. It might be that several participants stopped using MGP during the intervention, because they were convinced that they had already improved their self-management skills sufficiently. If these participants stopped filling in the questionnaires, only participants with poor self-management filled in the last questionnaire (T= 12 months), which might have caused the decrease of the total self-management score.

Another bias, which might have influenced the results of this study, is the fact that this study cannot distinguish between the different chronic diseases of the participants. It was well known, that participants have either diabetes mellitus type 2, cardio-vascular disease, COPD or asthma. But, it was not known which chronic disease(s) the individual participants have. However, literature implies that different chronic diseases cause different needs and consequences/impairments for the patient. For this reason, internet-based self-management interventions should be adapted to these different needs (Barlow et al., 2002). Using only one intervention to treat several chronic conditions (e.g. MGP), can impair the effectiveness of the intervention, because patients' individual needs could be disregarded. This could explain, why in the experimental group patients physical activity did not increase.

In addition to that, if patients do not feel addressed by the e-Health intervention, the motivation to use it can decrease (problem of adherence) (Oinas-Kukkonen et al., 2008). Unfortunately, this study lacks information about patience adherence, resp. how much time patients actual used MGP. Because the log-data was not evaluated, it is difficult to draw conclusions about the relation between the intensity of using MGP (frequency, duration) and the effects on patients' self-management, resp. physical activity. Furthermore, if it were known, which patients used MGP regularly, it would be possible to examine similarities among these patients (e.g. particular chronic conditions, character traits). This would help to evaluate and adapt the design of MGP, in order to specify the target group of MGP and to increase patients' adherence.

Another limitation of this study is the poor reliability of the collected data, in particular for the experimental group. It is not known if the participants' information regarding their physical activity is reliable (e.g. on how many days they were *really* physical

active). In this context, it is important to mention that the short version of the IPAQ, which was used to assess patients' physical activity, does not measure the construct "sitting". Therefore, it is not known how much time participants spent sitting, which also influences patients overall level of MET-minutes/week (metabolic equivalent). In this context, it is also doubted if analyzing patients' *metabolic equivalent* is an adequate and reliable method to measure patients' physical activity. In one study, the metabolic equivalent regularly over-, resp. underestimated the real energy expenditures (Byrne et al., 2005). Therefore, it should be assumed that patients' actual physical-activity (MET-minutes/week) can differ from the calculated physical activity scores, which in turn impairs the reliability of the existing results.

To make sure that patients' physical activity data is reliable, other studies implemented motion sensors, which constantly assess participants' physical movements (even "sitting"). In one study, the daily physical activity of participants with chronic pulmonary disease was assessed, using "Multiaxial Accelerometers" (measures patients proper acceleration) and "Pedometers" (step counter) (Steele et al., 2003). In this study, an "excellent test-retest reliability during three standardized 6 min walk tests" was found for accelerometers (Steele et al., 2003). Using such a device could have helped to get more reliable data of patients' physical activity.

To improve the intervention, it is important to analyze which factors influence patients' motivation to use MGP. In this context, Gemert-Pijnen (2013) implies that people often do not have the necessary skills to use e-Health technologies properly. Because so many participants did not completed all questionnaires, it is recommended to analyze if participants are able (have the skills) to use MGP properly. It should be evaluated if the design of MGP is adapted to its target group (patients with chronic conditions) and contains persuasive communication elements (PSD). Further research could also investigate if a smartphone application of MGP would increase patients' general motivation to use MGP regularly (adherence). It is assumed that the advantages of a smartphone application (e.g. easy and spontaneously to use) would increase patients willingness and motivation to regularly use MGP. Finally, it is also recommended to investigate the *long-term* effectivity of MGP. It is not known if potential positive effects of using MGP will be stable over time. Therefore, it is recommended to do follow-up measurements of participants' self-management and physical activity.

References:

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.

Araújo, A. (2016). COPD and physical activity. *Revista Portuguesa de Pneumologia (English Edition)*.

Aronson, J. K. (2007). Compliance, concordance, adherence. *British journal of clinical pharmacology*, *63*(4), 383-384.

Barlow, J. H., Turner, A. P., & Wright, C. C. (1998). Long-term outcomes of an arthritis self-management programme. *Rheumatology*, *37*(12), 1315-1319.

Barlow, J., Wright, C., Sheasby, J., Turner, A., & Hainsworth, J. (2002). Self-management approaches for people with chronic conditions: a review. *Patient education and counseling*, *48*(2), 177-187.

Bodenheimer, T., Lorig, K., Holman, H., & Grumbach, K. (2002). Patient self-management of chronic disease in primary care. *Jama*, *288*(19), 2469-2475.

Byrne, N. M., Hills, A. P., Hunter, G. R., Weinsier, R. L., & Schutz, Y. (2005). Metabolic equivalent: one size does not fit all. *Journal of Applied physiology*, *99*(3), 1112-1119.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public health reports*, *100*(2), 126.

Dishman, R. K., Motl, R. W., Sallis, J. F., Dunn, A. L., Birnbaum, A. S., Welk, G. J. & Jobe, J. B. (2005). Self-management strategies mediate self-efficacy and physical activity. *American journal of preventive medicine*, *29*(1), 10-18.

Dunbar-Jacob, J., & Mortimer-Stephens, M. (2001). Treatment adherence in chronic disease. *Journal of clinical epidemiology*, *54*(12), S57-S60.

Fogg, B. J. (2009). Creating persuasive technologies: an eight-step design process. In *Persuasive* (p. 44).

Frosch, D. L., & Kaplan, R. M. (1999). Shared decision making in clinical medicine: past research and future directions. *American journal of preventive medicine*, *17*(4), 285-294.

Garcia-Aymerich, J., Lange, P., Benet, M., Schnohr, P., & Antó, J. M. (2006). Regular physical activity reduces hospital admission and mortality in chronic obstructive pulmonary disease: a population based cohort study. *Thorax*, *61*(9), 772-778.

Gemert-Pijnen, J.E.W.C. (2013). *Improving ehealth*. Eleven International, Den Haag.

Gemert-Pijnen, J. E.W.C., Nijland, N., van Limburg, M., Ossebaard, H. C., Kelders, S. M., Eysenbach, G., & Seydel, E. R. (2011). A holistic framework to improve the uptake and impact of eHealth technologies. *Journal of medical Internet research*, *13*(4), e111.

Hibbard, J. H., Stockard, J., Mahoney, E. R., & Tusler, M. (2004). Development of the Patient Activation Measure (PAM): conceptualizing and measuring activation in patients and consumers. *Health services research*, *39*(4p1), 1005-1026.

Holman, H., & Lorig, K. (2004). Patient self-management: a key to effectiveness and efficiency in care of chronic disease. *Public health reports*, *119*(3), 239.

IBM Corporation 1989. (2013). Version 22.0.0.0

Kelders, S. M., Kok, R. N., Ossebaard, H. C., & Van Gemert-Pijnen, J. E. (2012). Persuasive system design does matter: a systematic review of adherence to web-based interventions. *Journal of medical Internet research*, *14*(6), e152.

Lorig KR, Holman H. Self-management education: history, definition, outcomes, and mechanisms. *Ann Behav Med.* 2003*;* 26*:* 1-7.

Lorig, K. R., Mazonson, P. D., & Holman, H. R. (1993). Evidence suggesting that health education for self-management in patients with chronic arthritis has sustained health benefits while reducing health care costs. *Arthritis & Rheumatism*, *36*(4), 439-4

Lorig, K. R., Sobel, D. S., Ritter, P. L., Laurent, D., & Hobbs, M. (2000). Effect of a self-management program on patients with chronic disease. *Effective clinical practice: ECP*, *4*(6), 256-262.

McKay, H. G., King, D., Eakin, E. G., Seeley, J. R., & Glasgow, R. E. (2001). The diabetes network internet-based physical activity intervention a randomized pilot study. *Diabetes care*, *24*(8), 1328-1334.

Norman, G. J., Zabinski, M. F., Adams, M. A., Rosenberg, D. E., Yaroch, A. L., & Atienza, A. A. (2007). A review of eHealth interventions for physical activity and dietary behavior change. *American journal of preventive medicine*, *33*(4), 336-345.

Oinas-Kukkonen, H. and M. Harjumaa. (2008). "Towards Deeper Understanding of Persuasion in Software and Information Systems" in *Proceedings of The First International Conference on Advances in Human-Computer Interaction (ACHI 2008),* electronic publication, ISBN 978-0-7695-3086-4, pp. 200-205.

Oinas-Kukkonen, H., & Harjumaa, M. (2009). Persuasive systems design: Key issues, process model, and system features. *Communications of the Association for Information Systems*, *24*(1), 28.

Petermann, F., & Ehlebracht-König, I. (2004). Compliance in der Behandlung

Rheumakranker: Ein Marathonlauf. *Aktuelle Rheumatologie*, *29*(02), 67-74.

Rubin, R. R., & Peyrot, M. (1999). Quality of life and diabetes. *Diabetes/metabolism research and reviews*, *15*(3), 205-218.

Saelens, B. E., Gehrman, C. A., Sallis, J. F., Calfas, K. J., Sarkin, J. A., & Caparosa, S. (2000). Use of self-management strategies in a 2-year cognitive-behavioral intervention to promote physical activity. *Behavior Therapy*, *31*(2), 365-379.

Steele, B. G., Belza, B., Cain, K., & Warms, C. (2003). Bodies in motion: monitoring daily activity and exercise with motion sensors in people with chronic pulmonary disease. *Journal of rehabilitation research and development*, *40*(5), 45.

United Nations (2012). U.N. Department of Economic and Social Affairs, Population Division. *Population ageing and development. Population Facts, no*. 2012/4.

WHO (2014). *Global status report on noncommunicable diseases 2014.* World Health Organization.

World Health Organization, WHO (2016). U.N. Department of international public health, Health topics. *Noncommunicable diseases*. 2016/2.

Appendix:

Figure 4: *International Physical Activity Questionnaire – Short Form*

8. LICHAMELIJKE ACTIVITEIT (IPAQ-SF)

Dit onderdeel van de vragenlijst gaat over uw lichamelijke activiteit. Neem in uw gedachten een normale week van de afgelopen 3 maanden. Wilt u aangeven **hoeveel dagen per week** u de onderstaande activiteiten verrichte en **hoeveel uren en/of minuten** u daar dan **gemiddeld** op zo'n dag mee bezig was. Denkt u aan lichamelijke activiteiten die u doet op het werk, in en rond het huis, om van de ene naar de andere plaats te komen en activiteiten in uw vrije tijd voor recreatie, training of sport.

De eerste vragen gaan over <u>zware</u> lichamelijke activiteiten. Dit zijn activiteiten die veel lichamelijke inspanning kosten en voor een veel snellere ademhaling zorgen. Denk alleen aan de activiteiten die u <u>tenminste 10 minuten per keer</u> heeft verricht.

1. Als u denkt aan de afgelopen 7 dagen, op hoeveel dagen heeft u dan _____ dagen per week zware lichamelijke activiteiten verricht zoals zware lasten tillen, spitten, aerobics of wielrennen?

☐ ik heb geen zware lichamelijke activiteiten verricht *(sla de volgende vraag over)*

2. Op de dagen dat u zware lichamelijke activiteiten heeft verricht, hoeveel _____ uren en _____ minuten per dag tijd heeft u daar dan gewoonlijk aan besteed?

De volgende vragen gaan over matig intensieve lichamelijke activiteiten. Dit zijn activiteiten die ervoor zorgen dat uw ademhaling iets sneller gaat dan normaal. Denkt u weer alleen aan de activiteiten die u tenminste 10 minuten per keer heeft verricht.

3. Als u denkt aan de afgelopen 7 dagen, op hoeveel dagen heeft u dan _____dagen per week matig intensieve lichamelijke activiteiten verricht zoals bijvoorbeeld het dragen van lichte lasten, fietsen of zwemmen in een normaal tempo?

☐ ik heb geen matig intensieve lichamelijke activiteiten verricht *(sla de volgende vraag over)*

4. Op de dagen dat u matig intensieve lichamelijke activiteiten heeft _____ uren en ____ minuten per dag verricht, hoeveel tijd heeft u daar dan gewoonlijk aan besteed?

De volgende twee vragen gaan over wandelen. Denk hierbij aan bijvoorbeeld wandelen op het werk en thuis, wandelen om van de ene naar de andere plaats te komen en al het andere wandelen dat u deed tijdens recreatie, sport of vrijetijdsbesteding.

5. Als u denkt aan de afgelopen 7 dagen, op hoeveel dagen heeft u dan _____dagen per week tenminste 10 minuten per keer gewandeld?

☐ ik heb niet gewandeld *(sla de volgende vraag over)*

6. Op de dagen dat u ten minste 10 minuten per keer heeft gewandeld, hoeveel tijd heeft u daar dan gewoonlijk aan besteed?

____ uren en ____ minuten per dag

|}

Figure 5: *Patient Activation Measure 13*

10. Zelfmanagement (PAM 13)

Hieronder staan enkele uitspraken die mensen soms doen over hun gezondheid. Geef voor elke uitspraak aan, in hoeverre u het ermee eens of oneens bent. Doe dit door het antwoord te omcirkelen dat het meest op uw persoonlijke situatie van toepassing is. *We willen dus weten wat u zelf vindt en niet wat u denkt dat de dokter of onderzoeker wil horen.*

	helemaal niet mee eens	niet mee eens	mee eens	helemaal mee eens	nvt
Uiteindelijk ben ik zelf verantwoordelijk voor mijn gezondheid.	O	O	O	O	O
Een actieve rol op me nemen in de zorg voor mijn gezondheid, heeft de meeste invloed op mijn gezondheid.	O	O	O	O	O
Ik heb er vertrouwen in dat ik kan bijdragen aan het voorkomen of verminderen van problemen met mijn gezondheid.	O	O	O	O	O
Ik weet wat elk van mijn voorgeschreven medicijnen doet.	O	O	O	O	O
Ik heb er vertrouwen in dat ik kan beoordelen of ik naar de dokter moet gaan of dat ik een gezondheidsprobleem zelf kan aanpakken.	O	O	O	O	O
Ik heb er vertrouwen in dat ik een dokter mijn zorgen durf te vertellen, zelfs als hij of zij daar niet naar vraagt.	O	O	O	O	O
Ik heb er vertrouwen in dat het mij lukt om medische behandelingen die ik thuis moet doen uit te voeren.	O	O	O	O	O
Ik begrijp mijn gezondheidsproblemen en wat de oorzaken ervan zijn.	O	O	O	O	O
Ik weet welke behandelingen er zijn voor mijn gezondheidsproblemen.	O	O	O	O	O
Ik heb veranderingen in mijn leefstijl (zoals gezond eten of bewegen) kunnen volhouden.	O	O	O	O	O
Ik weet hoe ik gezondheidsproblemen kan voorkomen.	O	O	O	O	O
Ik heb er vertrouwen in dat ik zelf oplossingen kan bedenken voor nieuwe problemen met mijn gezondheid.	O	O	O	O	O
Ik heb er vertrouwen in dat ik veranderingen in mijn leefstijl (zoals gezond eten en bewegen) kan volhouden, zelfs in tijden van stress.	O	O	O	O	O