University of Twente.
Faculty of Behavioural Management and Social Sciences
Department of Psychology, Health and Technology

Evaluation of a Health Platform among participants with chronic disease

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Author: Samantha Hansmann

Student Number: s1472089
Email: s.hansmann-1@stundent.utwente.nl

Supervisors: Martine Altena
Dr. Annemarie Braakman – Jansen

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Abstract

This study gives an overview of the effectiveness of the web-based intervention MijnGezondheidsPlatform (MGP) among participants with chronic disease such as diabetes mellitus, cardio vascular risk, asthma or COPD. In view of the increasing percentage of individuals suffering of chronic diseases and the potential role that eHealth related tools such as web-based intervention can play in stimulation empowerment and physical activity, the goal of this study was to examine the improvement of physical activity and self-management skills among participants using MGP in comparison to control group and whether personality is a factor that influences and activates physical activity. Combining the components technology and health define the construct known as eHealth. eHealth is a promising field that provides information and uses communicating technologies in order to improve health. Persuasive features (PSD model) used in eHealth related tools seem to be an important factor that contributes to the effectiveness and success of a web-based intervention. The current study was conducted in total with 110 participants who suffered from chronic disease during research duration. The experimental group consisted of 25 participants suffering from chronic disease, making use of a web-based intervention called "MijnGezondheidPlatform" for one year. The control group comprised 85 participants suffering from chronic disease not making use of MGP. All participants had to fill out various questionnaires, among them about physical activity (IPAQ-SF), self-management skills (PAM-13) and personality (TIPI) on five different measure moments. Only the first (baseline; T0) and last (post-test; T5) measures were taken into account for analysis. Covariation analysis revealed that there is a non-significant difference between participants with chronic diseases using the web-based intervention MGP for one year and control group. Results show despite expectations that the personality traits Extraversion, Conscientiousness and Neuroticism are not statistically significant related to physical activity. The current study found using a Spearman correlation analysis that the personality trait Neuroticism and physical activity are statistically non-significantly related but the relation has a trend into the negative. This implies that the web-based intervention MGP does not enhance level of physical activity and that only Neuroticism has a trend to be negatively related with physical activity. In particular, this means that the more Neuroticism, the more emotional unstable it is, the level of physical activity will be lower. Further research should aim at understanding the effectiveness of different persuasive features used in eHealth related tools.

Keywords: Web-based Intervention, eHealth, Physical Activity, Personality, Self-management

Introduction

Through more efficient and effective treatments and medication life expectancy has risen however birth rates have decreased. As a consequence the percentage of elderly people of the population is rising (Jansen, Spreeuwenberg, Heijmans, 2012; Giesbers et al., 2014). The impact of demographic change places new challenges and tasks for the economy, retirement and citizens. Health care and care for elderly individuals must prepare for increasing numbers of patients in need of nursing care and declining numbers for people working in health care. The percentage of chronic diseases will become even more dominant by means such as an increase in type 2 diabetes; leading to difficulties in financing the social system, retirement- and health insurance (Hurrelmann, 2001). Through standard vaccination procedures against mass diseases the immunization of the population has increased resulting in lower number occurrences of chronic diseases. The fact that currently acute illnesses can be cured faster and more effective based on pharmaceutical ingenuity causes the high proportion of chronical diseases in comparison to acute diseases (Lubkin, 2002). This especially applies to industrialized countries (Lubkin, 2002). The expectation is that the percentage of chronic diseases will grow further because of the tendency that more people will adapt an unhealthy style of living, for example through limited and insufficient physical activities and unhealthy eating (Jansen, Spreeuwenberg, Heijmans, 2012).

Chronic diseases. In the Netherlands about one third of the total population suffers from a chronic disease; this accounts for about 5.3 million chronically diseased people (Hoeyman, Schellevis & Wolters, 2008). The Netherlands report in year 2014 shows an expected increase of individuals suffering of chronic disease to 7 million in 2030 (RIVM, 2014). Furthermore, it is predicted that the percentage of "multi-morbidity" (more than one chronic disease) will also rise (RIVM, 2014). Chronic disease is defined as "progressive deterioration, with increasing symptoms, functional impairment and disability over time" (Corsini, 2002). These diseases in particular are characterized by four components: a long incubation period, a long duration of illness, a complex ethology and the resistance to cure (Powell, Caspersen, Koplan & Ford, 1989). Because of the impossibility to cure chronic disease the primary goal of treatment should be, according to Tarlov 1983, the enhancement of functioning and well-being. An important factor to achieve this goal of functioning and well-being is physical activity (WHO, 2010).

Physical inactivity was verified as one of the main risk indicators for global mortality. It accounts for about 6 % of deaths globally (WHO, 2010). According to Caspersen et al. (1985) physical activity is defined as "every effort of skeletal muscles resulting in more

energy than in resting state".The "Dutch norm of healthy movement" quotes the norms given by Kemper et al. (2000) and Ooijendijk et al. (2007*)* and these are depended on age. For younger individuals at least one hour of intensive physical activity daily is recommended (Kemper et al., 2000; Ooijendijk et al., 2007). Furthermore, grown up individuals (18-55) should be doing a minimal on five days and not less than half an hour of moderate intensive physical activity; preferably every day (Kemper et al., 2000; Ooijendijk et al., 2007). For elderly individuals the same norm as for the grown up individuals exists in relation to the duration; however quality of what is achieved during this time can be less (Kemper et al., 2000; Ooijendijk et al., 2007). Studies have presented reductions of risk in mortality when being fit or active by up to 50% (Myers, Kaykha & George, 2004). Physical activity is not the only factor for the prevention of risk but also an important indicator to enhance functioning and well-being of patients with a medical chronic condition (Tarlov, 1983).

The degree of impact in daily life is determined through five components: the type of chronic disease, seriousness of the disease but also through the age of the patient, situation of life and the presence of any physical impairment (Jansen, Spreeuwenberg, Heijmans, 2012). Impacts on daily life can be i.e. the presence of psychosocial difficulties, such as problems with sexuality or obtaining employment. Additionally patients suffering from a chronic disease experience their general health as inferior in comparison to the total population (Jansen, Spreeuwenberg, Heijmans, 2012).

Once being diagnosed with a chronic disease the patients mostly depend on professional medical care (Koch, 2006; Jansen, Spreeuwenberg, Heijmans, 2012). This causes progressive costs to the system that virtually cannot be financed (Blum, 2006). For patients with a chronical condition the most relevant parameter is the subjective quality of life (Sullivan, 2003). A cure of the disease cannot be assured; there is a shift from goal of healing to the goal of enhancing quality of life for patients (Sullivan, 2003). Success is therefore obtained when the seemingly best possible quality of life is achieved (Bullinger, 2000). In year 2008 the Dutch majority announced two different ambitions in order to handle the difficulties of health for patients with chronic disease, because of the growing importance to establish an efficient and organised health care system in connection to the chronic disease percentage (VWS, 2008). The two ambitions were the following:
(1) prevention and postponement of complications as consequences of chronic disease and
(2) enable patients with chronic condition to cope with their disease in order to achieve the best possible quality of life (VWS, 2008).

In general it is known that by eating healthy food, not smoking, being physically more active, fit and limiting alcohol consumption to a minimal degree, we can live longer, be healthier and achieve a higher quality of life. What are the key factors that can support people, especially patients with a chronic disease where healthy living is an important factor, to follow this advice and achieve quality of life?

There are different forms of interventions and therapy in order to support patients with chronic disease to achieve quality of life. Most interventions and treatments, such as CBT (Cognitive Behavioural Therapy), take place at medical treatment centres and clinical settings. In regular sessions, patients receive feedback on their health condition and health related behaviour, which can be less effective because patients can find it difficult to improve their daily life based on the feedback and advice of the treating medic. Reminders and responses of doctors and therapists with permanent and quick feedback would probably be more effective (Nes, Dulmen, Eide et al., 2012). Because of the rise of the web and the usage of smartphones a possible alternative can be found in the area of eHealth. e-Health is an area that combines the components health and internet in order to support health related behaviour and achieve quality of life for consumers. Important relevant factors that can contribute to achievement of quality of life and a healthy lifestyle for patients with chronic diseases are self-management and personality.

Self –management. Chronic disease burden high requirements and challenges on patients. Interventions supporting self-management skills among patients with chronic disease might help to gain new knowledge and perspectives. This furthermore can support the improvement of usage of efficient self-management strategies in order to enhance quality of life (Nes, Eide, Kristjánsdóttir, van Dulmen, 2013). Clark et al. (1991) defines self-management as “the individual’s ability to manage the symptoms, treatment, physical and psychological consequences and life style changes inherent in living with a chronic condition”. Furthermore Clark et al. (1991) states that “efficacious self-management encompasses ability to monitor one’s condition and to affect the cognitive, behavioural and emotional responses necessary to maintain a satisfactory quality of life”. Sometimes the construct self-management is referred to as “empowerment”. This concept contains that patients agree over their responsibility to manage and handle their condition and have the capability to solve their own problems with information received from professionals (Bodenheimer, Lorig, Holman, Grumbach, 2002). Traditional patient education contains information support and teaching technical skills; self-management in comparison involves especially problem-solving skills. The advantage of the latter is that it gives patients the

possibility to identify and solve their own problems in form of techniques that help them make decisions and actions (Bodenheimer, Lorig, Holman, Grumbach, 2002). The most important subcomponent of self-management is self-efficacy, which is defined as having the confidence in personal ability to perform certain behaviour. Self-efficacy is necessary to reach the desired goal (Bandura, 1997). This confidence in personal ability to perform according behaviour is also referred to as "self-efficacy theory" (Bandura, 1997; Bandura, 1989). In particular self-efficacy of an individual "influences the direction, intensity and persistence of behaviour" (Dishman et al, 2005). Therefore it is expected that individuals high in self-efficacy about i.e. physical activities are more likely persistent to perform certain behaviour which following makes them less vulnerable to barriers and consequently they will be more likely to follow the advised physical path. Self-management is often referred to a behaviour therapy program that aims at helping and supporting the patients to learn to apply various techniques to achieve desired behaviour, e.g. no smoking, no excessive eating or emotional out-bursting behaviour (Corsini, 2002). This can be done by focusing on three different points which are relevant for patients with chronic disease. The first one is medical management. When suffering from chronic disease it is probable to be dependent on taking medication regularly. The second set is role management. It aims at maintaining and creating new meaningful roles in the patient's life, e.g. changing daily life roles. The last set is emotional management. Changes and impacts in daily life caused by chronic disease can trigger emotions such as fear or anger. Emotional management aims at helping the patients to deal with and compensate these feelings (Lorig & Holman, 2003).

Personality. Self-management has shown to be related to personality traits. Personality is defined as individual's differences, in particular, tendencies that are patterns of feelings, actions and thoughts that are consistent over time and situation (De Bruijn, de Groot, van den Putte, & Rhodes, 2009). The five factor model (FFM) of personality is an empirical generalization about the covariation of personality traits (John, Robins, Pervin, 2008). The five factors of this model are as follows: Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness (John, Robins, Pervin, 2008).

The study of Skinner, Bruce Davis and Davis (2014) revealed that patients suffering from diabetes mellitus type II high in conscientiousness were less likely to smoke or to suffer from obesities. Furthermore they were more likely to self-monitor their blood-glucose and take their medications, which is part of self-management skills (medical management). Therefore personality seems to be related to self-management skills which seem to be related to level of physical activity.

Research done in the framework ´psychological health' has revealed the relation between personality and health (Deary et al., 2010. "Neuroticism" is referred to as the tendency to be vulnerable to feelings of depression and anxiety (De Bruijn, de Groot, van den Putte, & Rhodes, 2009). In a broader sense it can be seen as an emotional instability (John, Robins, Pervin, 2008). Furthermore individuals high in Neuroticism are more likely to be self-focused and therefore detect changes in physical status easier than individuals who are low in Neuroticism (Williams & Wiebe, 2000). Research has additionally shown that individuals high in Neuroticism would judge their health poorer than individuals who are low in Neuroticism (Clark & Watson, 1988). In the study of Shipley and Weiss et al. (2007) the results revealed that high Neuroticism was related to risk of death from COPD. Reasons for this may be health behaviour and physiological factors (Shipley & Weiss et al, 2007).

"Extraversion" is described as the tendency to be active and energetic (De Bruijn, de Groot, van den Putte, & Rhodes, 2009). The study of Rhodes et al. (2003) has revealed that individuals high in extraversion are more successful at translating their exercise intention into actual exercise behaviour and perform it. However, the target group of this study were undergraduate students. Additionally, individuals high in extraversion have shown to have more available social support and intimate close relationships. This is an important factor for coping with illness (Berkman, Glass, Brissette & Seemann, 2000).

"Openness" to experience is associated with high intellect, educational attitude and openness to new ideas (De Bruijn, de Groot, van den Putte, & Rhodes, 2009). There is however no study supporting any relation between openness to experience and health related behaviour.

"Agreeableness" is linked with generosity and associated with altruism and caring (De Bruijn, de Groot, van den Putte, & Rhodes, 2009), and associated with being friendly and compassionate (John, Robins, Pervin, 2008). There is however no study supporting any relation between Agreeableness and health related behaviour.

"Conscientiousness" is associated with being goal directed, striving for achievement (De Bruijn, de Groot, van den Putte, & Rhodes, 2009), and mostly these individuals are well organized, responsible and have an effort to control or restraint (John, Robins, Pervin, 2008). Studies have revealed that conscientiousness predicts good health habits, health outcomes and longevity (Hampson, Andrews, Barckley, Lichtenstein & Lee, 2000). Low in conscientiousness therefore predicts the likelihood of engaging in risky behaviours such as smoking, substance abuse, poor diet and poor exercise habits (Bogg & Roberts, 2004; Hampson, Andrews, Barckley, Lichtenstein & Lee, 2000). Individuals high in

conscientiousness show to be more adhere to their treatment recommendations when being diagnosed with an illness (Kenford et al., 2002) and furthermore have shown to live longer lives (Danner, Snowden &Friesen, 2002; Weiss & Costa , 2005).

Therefore especially the personality traits Extraversion, Conscientiousness and Neuroticism seem to be related to health related behaviour such as physical activity. Agreeableness and Openness to experience do not seem to have a relation with health related behaviour. Consumers have the tendencies and the wish to become more engaged in their own health care, health related behaviour and seeking appropriate information. This trend includes consumer' wish to access and manage their own personal health record (Ball, Smith & Bakalar, 2007). A possibility to keep record of personal health related behaviour is eHealth.

e-Health. The usage of the Web has risen in the past for delivering interventions; and it has become especially relevant (Lehto & Oinas-Kukkonen, 2011). Internet and technology are everywhere in the daily life of individuals; from an e-Book reader to smartphones there is presence at all times. The internet is a promising medium for facilitating patient empowerment and physical activity in order to achieve quality of life. Combining the components technology and health belongs to the construct which is known as e-Health. e-Health raises a new tendency to do more research about technologies and behavioural change interventions of individuals (Oinas-Kukkonen, 2013). Also e-Health supports information gaining, knowledge and drives precautious measures. There are many different definitions of e-Health but the most appropriate for this study is Eysenbach´s publication. He states that e-Health "refers to health service and information delivered or enhanced through the Internet and related technologies" (Eysenbach, 2001). In a broader sense e-Health is a promising emerging field of information and communication technologies in order to improve health (Alvarez, 2002). The primary goal of patients is to use the internet as a source for health information, which is given by health professionals, patient organisations and medial industries that in turn use the internet as a communication tool (Baker et al., 2005). Other reason why the internet is a modern tool is because it enables the possibility to sell and purchase health products and services, furthermore enables communications between health professionals and patients (Houston, 2004).

There are various advantages in designing computerized technology interventions in order to change behaviour. The idea of this type of intervention is also referred to as "Behaviour Change Support System"(BCSS) (Oinas-Kukkonen, 2013). Technology should here be the major part that enables individuals to change their behaviour. This is the main goal of a BCSS (Oinas-Kukkonen, 2013). Interactive information technology that is configured to

change behaviour and attitude of an individual is referred to as "persuasive technology" (Fogg, 2003). The important and isochronal challenge is the persuasive features of the system to make a BCSS and persuasive technology successful.

The Persuasive System Design Model (PSD model) consists of four categories in which persuasive features are divided into: primary task support, dialogue support, credibility support and social support (Oinas-Kukkonen, Harjumaa, 2009). "Primary task support" contains the simplification of the main task of the BCSS for the user e.g. the reduction of a complex behaviour into a set of simpler task in order to help the user to perform the targeted behaviour or personalized content or services because it has a greater capability for persuasion (Oinas-Kukkonen, Harjumaa, 2009). "Dialogue support" provides the communication feature between the user and the system, e.g. use of "reminders" and "virtual rewards" (Oinas-Kukkonen, Harjumaa, 2009). "Credibility support" makes the system more reliable such as "trustworthiness" and "expertise", in order to provide trustworthy information and showing knowledge and experience to increase the capability of persuasion (Oinas-Kukkonen, Harjumaa, 2009). "Social support" designs the system in a manner that the users are motivated by leveraging social influence (Oinas-Kukkonen, Harjumaa, 2009).

There are some possible disadvantages and obstacles, which can influence and inhibit consumer's efficient use of e-Health related tool, that have to be taken into account when considering a web based intervention. Various factors can be: environmental barriers (Viswanath, Kreuter, 2007), physical access barriers (Fox, 2008), resource related barriers (Chapman & Elstein, 2000) and individual-level barriers (Jimison, Gorman et al, 2008). For example when an e-Health tool includes an online chat group where consumers can exchange experiences, knowledge and advices to support each other the consumer should have the ability to communicate ideas clearly and furthermore effectively share information (Kamel Boulos, Wheeler, 2007). Generally it can be stated that usage of different e-Health tools can rely on skills and knowledge of the consumer, which in other hands are dependent on experiences and personality of the individual.

According to Intille (2003) and Kraft et al (2009) persuasive technology could be, especially in the area of health care software, useful in order to motivate people towards a healthier lifestyle and behaviour. Despite the beneficial facts of physical activity on patients with chronic disease it is rarely supported through counsellors (Kim & Kang, 2006).The study of Kim and Kang (2006) compared the effect of a web-based program for healthcare with printed material intervention and standard care. In the study seventy-three adults with type 2 diabetes took part at the twelve week lasting intervention. The effect of physical activity,

blood sugar and haemoglobin were measured. The web-based intervention showed a significant improvement in physical activity. Analysis between the web –based intervention and the usual intervention showed significant differences but there were no significant differences found between web-based intervention and material printed intervention (King & Kang, 2006). The positive effect for chronical disease patients with e-Health support is also a result of the research by Nes, Dulmen, Eide et al. (2012) and another study by Solomon, Wagner and Goes (2012). Primary outcomes were attitudes towards knowledge, skills and confidence in self-managing of health and health related behaviour. The web –based intervention used in this study was an online platform named "MyHealth Online", that participants in the experimental group had access to. The associated control group had access to a health educating website. The level of Patient Activation Level of participants was measures pre- and post-test using the 13-item patient activation measure. Results revealed a significant positive effect on patient's activation level in the intervention group. Participants whose baseline activation level was in last stage (stage four) had a non-significant change in comparison to the control group (Solomon, Wagner, Goes, 2012). Web-based interventions that improve patient activation level have shown to have potential to enhance self-management abilities of the participants with chronic disease.

Current study – MijnGezondheidsPlatform. In view of the increasing number of individuals suffering from chronic diseases and the potential role that web-based interventions could play in stimulating empowerment, self-management skills and physical activity, it is important to learn from empirical evidence if there is a difference of physical activity between participants with chronic diseases using a web-based intervention and participants with chronic diseases not using a web-based intervention. This difference can be related to the personality of the participants with chronic diseases using web-based intervention and answer to the question whether there is a relation between the three components personality, self-management and physical activity.

In order to study this, a web based intervention named "MijnGezondheidsplattform" (MGP) was used in this study. It is an online platform where patients and healthcare worker operate together in order to achieve healthier living. Beyond patients with a chronic disease such as diabetes mellitus, cardio vascular risk, asthma or COPD this platform can be used to improve health conditions of individuals. MGP aims to support the patients with self-management in case of chronic diseases leading to an improvement of quality of life and lifestyle.

Based on the information above and in view of the major and persuasive roles that web based interventions can play, the first research question is established if physical activity is improved by users of the web based intervention that MGP can play in comparison to non-users after one year.

RQ1: Is there a difference in the level of physical activity of participants with a chronic disease making use of the web based intervention MGP for one year and participants with a chronic diseases not using MGP?

The second research question that is established is if this possible found difference in physical activity can be related to selected personality traits (Extraversion, Conscientiousness and Neuroticism) of the participants using the web-based intervention MGP after one year.

RQ2: Is Extraversion, Conscientiousness and Neuroticism (selected personality traits) positively related with level of physical activity of participants with chronic disease using the web based intervention MGP for one year?

The third research question is established if there is a mediation between the components selected personality traits (Extraversion, Conscientiousness and Neuroticism), self-management and physical activity.

RQ3: Does selected personality traits predict self-management which in turn predicts physical activity of participants with chronic diseases making use of the web based intervention MGP for one year?

Method

Design and participants

A longitudinal research design was employed. There was one independent variable (personality) with five dimensions (Extraversion, Neuroticism, Conscientiousness, Openness to Experience and Agreeableness). The dependent variables were physical activity with three levels (vigorous, moderate and low) and self-management.

In total, there were 110 participants. Participants were divided into the experimental group (user of MGP) consisting of 25 participants and control group (non-user) consisting of 85 participants. Participants were exclusively of Dutch nationality. Of the initial 81 data sets of the experimental group, 56 had to be excluded from analysis because of early termination, leaving 25 data sets. There were 21 male participants and 4 female participants. Of the initial 165 data sets of the control group, 80 had to be excluded from analysis because of early termination, leaving 85 data sets. There are 56 male participant and 29 female participants. An overview of participants and non-participants is given in Table 1 and an overview of participant's selection in Figure 1. All participants voluntarily took part at this research and

were unknown by the researcher. Participants were recruited through participation in a health care group and suffered from a chronic disease in time of research duration. All participants were of age 18-95 (Mean= 51.51; SD= 26.0) and were informed consent.

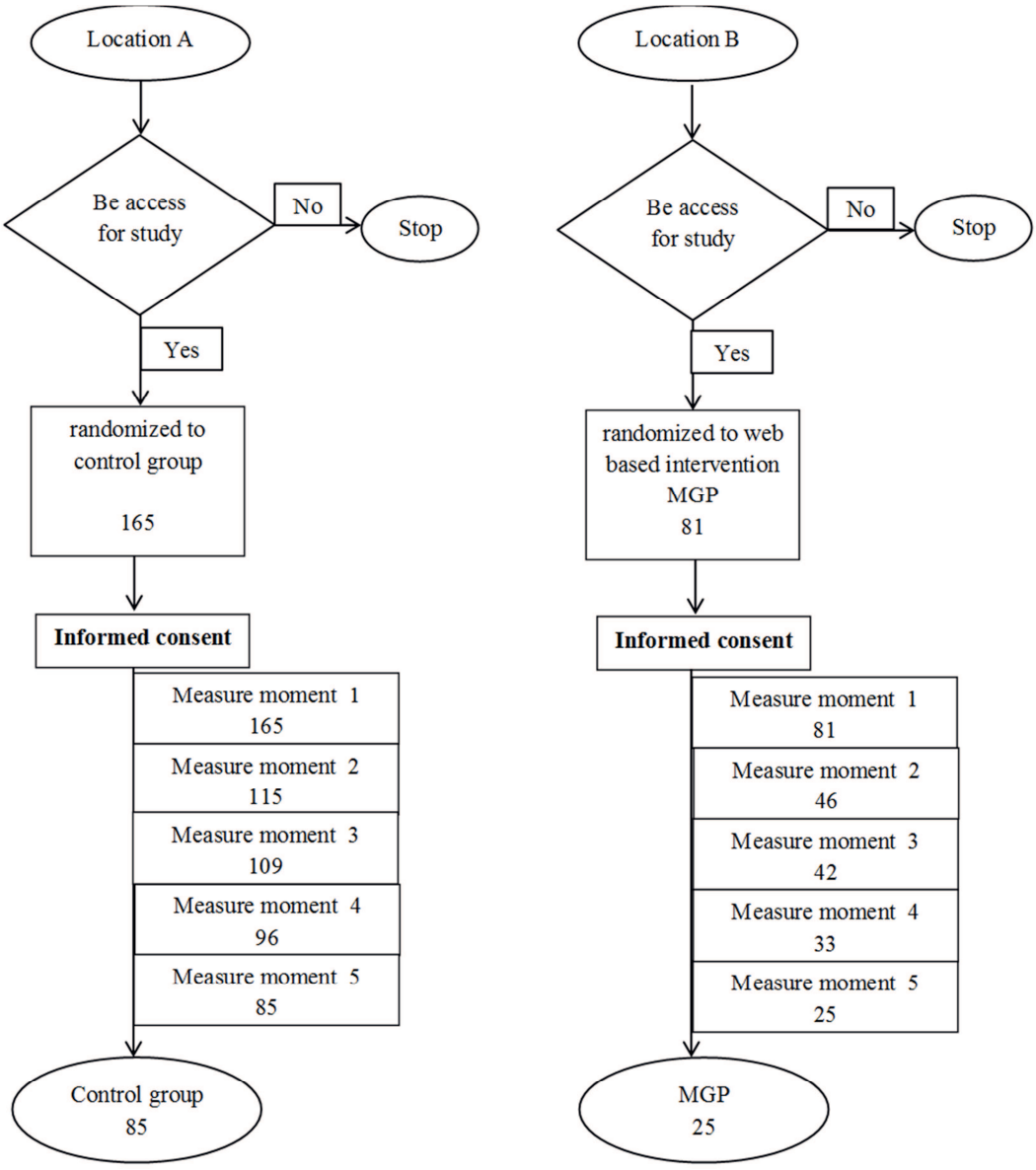


Figure 1: Flow chart of participant selection

Materials

Demographical questions e.g. age, gender, education level and relationship status, were taken by the participants. Further questionnaires taken by the participants contained: daily activities, internet use, health, physical activity, sickness absence, personality traits,

quality of life and self-management skills. In view of the research questions only questionnaires of personality, physical activity and self-management were relevant.

Personality. The questionnaire used to measure personality was the "Ten item personality inventory" (TIPI); consistent of ten items of the big Five personality dimensions with two items for each of the five dimension, e.g. Neuroticism (e.g. I see myself as, anxious, easily upset), Extraversion (e.g. I see myself as extraverted, enthusiastic), Conscientiousness (e.g. I see myself as dependable, self-disciplined), Agreeableness (e.g. I see myself as sympathetic, warm) and Open to experience (e.g. I see myself as open to new experience, complex). It was rated on a 7-point scale that ranges from 1 (disagree strongly) to 7 (agree strongly) (Gosling, Rentfrow & Swann, 2003). Items of each of the five dimensions of the TIPI had to be computed into one mean variable, leaving five variables for five dimensions of personality (e.g. Extraversion= (1 + 6R)/2). Analysis was conducted with the sum score of each of the dimensions. The total score of the TIPI has test-retest reliability (Cronbach's Alpha) of .72 (Gosling, Rentfrow & Swann, 2003). Cronbach's alpha for the subscales were .68 (Extraversion), .40 (Agreeableness), .50 (Conscientiousness), .73 (Emotional Stability/ Neuroticism) and .45 (Openness to Experience) (Gosling, Rentfrow & Swann, 2003). According to Gosling, Rentfrow & Swann (2003) TIPI provides a good construct validity of the ten items. The TIPI takes a minute to complete. The reliability (Cronbach's Alpha) of TIPI in this study was 563.

Physical Activity. The "International Physical Activity Questionnaire – Short Form" (IPAQ-SF), consistent of six items and was used to obtain comparable data on health-related physical activity. The questionnaire assesses physical activity measures across four different domains as follows: leisure time, domestic and gardening activities, work-related activity and transport-related activity. The specific types of physical activity that are assessed are: low (e.g. during the last 7 days, on how many days did you walk for at least 10 minutes at a time?), moderate (e.g. during the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.) - and vigorous (e.g. during the last 7 days, on how many days did you do physical activities like heavy lifting, digging, aerobics, or fast bicycling?) intensity activities. For each specific type of physical activity frequency (measured in days per week) and duration (time per day) were assessed. The sum score of each of the dimensions was assessed (Walking MET-minutes/week = 3.3 * walking minutes * walking days; Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days; Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days). For

Analysis the total sum score of the total physical activity was used (Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous METminutes/week scores). This was done for baseline and post-test measure moment. The IPAQ-SF takes five minutes to complete.

Self-management. Self-management was measured using the PAM-13 (Patient Activation Measure), consistent of 13 items. The questionnaire assesses four different levels of self-management: level 1 (patients believe that their role is important), level 2 (patients have confidence and knowledge to take action), level 3 (taking action) and level 4 (staying on course under stress); rated on a 4-point Likert scale, ranging from totally disagree to totally agree and "non-applicable" (Hibbard & Mahoney, 2010). Level one was measured with two items (e.g. When all is said and done, I am the person who is responsible for managing my health condition.), level two with six items (e.g. I know what each of my prescribed medications do.), level three with three items (e.g. I know the different medical treatment options available for my health condition.) and level four with two items (e.g. I am confident I can figure out solutions when new situations or problems arise with my health condition.). For analysis the total sum of self-management was assessed (Total Sum Self-Management= Item 1 + Item2 …+ Item 13). This was done for baseline and post-test measure moment. The PAM-13 takes five minutes to complete. The reliability (Cronbach's Alpha) of PAM-13 in this study was .718.

Web-based intervention – MijnGezondheidsplatform. "MijnGezondheidplatform" (MGP) is an online web-based intervention name, used in this study by the experimental group. It is an online platform where patients and healthcare work together in order to achieve healthier living. Especially beyond patients with a chronic disease such as diabetes, cardio vascular risks, asthma or COPD this platform is used. Goal of MGP is to support the patients with self-management of chronic disease, improvement of quality of life and lifestyle. Parts that are reflected in MGP are: the health file, an individual treatment plan, measurement values, communication possibility with the care provider, online coaching and personalized information on health (see Appendix A).

Procedure

Patients who were part of the care group (Practice support South-east Brabant; Location B= 25 participants); and gave the permission to be accessed for scientific research got an e-mail with information, calling for participation and a link to "MijnGezondheidsPlattform" and the questionnaires in order to take part; forming the

experimental group (user of MGP). All participants got an individual account. The control groups (non-user of MGP), a similar group of patients from housing practices (Location A= 85 participants), were approached via letter, containing an invitation and an information letter with a link to the questionnaires. All participants have given informed consent. During the research, participants of both the experimental group and control group had to fill in the online questionnaires at five moments. Only the measurements of the first (baseline) and last measure moment (after one year; post-test) of experimental and control group were used for analysis.

Analysis

Excel and SPSS (IBM® SPSS® Statistics Version 23.0; IBM, 2016) are statistical packages that were used to analyse the data. Four data files (Control group – baseline; Control group – post- test, experimental group – baseline; experimental group – post-test) were exported from Excel to SPSS. Another data file with response IDs gave the opportunity to link participants from baseline measures to post-test measures. This gave the opportunity to arrange and select participants who stopped early with the study and additionally to link baseline measures of the participant with the adequate post-test measures of the same participant, assuring anonymity. Participants with early termination were following excluded from the data, leaving 25 data sets for the experimental group and 85 for the control group. Baseline (T0-baseline) and Post-test (T5 – after one year) measures of experimental- and control group were exported to one final SPSS data and a condition for the group was added (experimental =0; control = 1). Because of high amount of early termination the resulted data sets were used for analysis and incomplete data were not excluded but missing variables were marked. This was additionally done with extreme values i.e. there was one participant who stated to have been 42.000 hours physically active which seems impossible. Data as such were named as typing errors being deleted and marked as missing. Furthermore were values recoded to 999 when participants scored a 5 (not applicable) on the PAM-13. This was done because this score defines that the statement is not applicable for the participant and therefore would displace the average when being coded with a 5 because of the used Likert scale (a 5-point Likert scale, ranging from totally disagree to totally agree and “non-applicable”). In general missing values of questionnaires were therefore not taken into analysis, this is the reason why number of participants can deviate from 25 (n=25) among analysis. Analysis was conducted with sum scores of Extraversion, Neuroticism, Conscientiousness, Physical Activity and Self-management. Results of a histogram with a normal distribution line revealed

that data is not normally distributed and is slightly to the left. To gain insight over the sample and data, descriptive statistics were conducted in order to gain knowledge about frequencies, averages and median (Table 1). Spearman correlation analysis was employed to gain information about the relation between baseline components physical activity, self-management and selected personality traits (Table 3). Furthermore a paired t-test was conducted in order to gain information about the significance between physical activity of baseline and post-test measures within the experimental and control group. The same was done for self-management (Table2). For details of the sample and data see Table 1, Table 2 and Table 3.

In order to answer RQ1 “if there is a difference of level in physical activity of participants with a chronic disease making use of the web based intervention MGP for one year and participants with a chronic diseases not using MGP”, a covariation analysis (ANCOVA) was conducted with the baseline and post-test measurements of physical activity of the experimental group and control group. The covariate variable, the controlling variable was the baseline level of the experimental- and control group.

In order to answer RQ2 “if Extraversion, Conscientiousness and Neuroticism (selected personality traits) are positively related with physical activity of participants with chronic disease using the web based intervention MGP for one year”, a Spearman correlation analysis is conducted to ascertain the relation of physical activity (dependent variable) with Extraversion, Neuroticism and Conscientiousness (independent variable). In case of a found significant relation or a mentionable trend further analysis between the selected personality trait and physical activity after one year should be conducted.

In case of a significant correlation between the selected personality traits and physical activity (RQ2) further analysis should be conducted in order to answer RQ3 “if selected personality traits predict self-management which in turn predicts physical activity of participants with chronic diseases making use of the web based intervention MGP for one year”.

Results

Baseline Characteristics. In total 25 (21 male; 4 female) participants were in the experimental group and 85 (56 male; 29 female) participants in the control group. Participants of both conditions seem to be of equally level educated (p=0.605). Median score

of the experimental group of physical activity in baseline is 720.0 and from the control group much lower with 360.0 but they seem to be statistically identical (p=1.000) (Table 1).

Table 1: *Baseline Characteristics of Participants and Non-participants*

Characteristics	MGP (N=25)	Control Group (N=85)	MGP vs Control p
Age, mean (SD), years	52.6 (27.2)	50.4 (27.1)	0.272
Gender			
Man, N	21	56	0.792
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)	
Total	25 (100)	85 (100)	0.605
Personality, mean (SD)			
Extraversion	4.56 (1.40)	4.35(1.27)	0,486
Agreeableness	5.27 (0.98)	5.54 (1.05)	0,445
Conscientiousness	5.04 (1.03)	5.58 (0.957)	0,441
Openness to Experience	4.92 (1.05)	4.63 (1.21)	0,355
Neuroticism	5.46 (0.74)	5.10 (1.25)	0,429
Physical activity, Median (Interquartile range)	720.0 (0.0-1344.5)	360.0 (0.0-1095.0)	1.000
Self-management, Mean (SD)	45.0 (3.8)	41.5 (4.9)	0.388

Baseline and Post-test Characteristics of physical activity and self-management.

The baseline and post-test characteristics of physical activity and self-management of experimental and control group are represented in Table 2. It reveals that there is a non-significant difference in level of physical activity and self-management within the experimental and control group is. There is a non-significant difference in level of physical activity (p=0.160) and a significant difference of self-management (p=0.033) between MGP- and control group.

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

Characteristics	Baseline (T0)	Post-test (T5)	T5-T0	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	

*p<0.5

Correlation Analysis. Spearman correlations were employed between the baseline components physical activity (1), self-management (2), Extraversion (3), Conscientiousness (4) and Neuroticism (5) in order to gain information about the relation between these components. It reveals that the correlation between Neuroticism and level of baseline physical activity is not significant (p<0.05) but it has a trend into the negative (r= -.584; p=0.099) (Table 3).

Table 3: *Baseline correlations among physical activity, self- management and selected* [a] *personality variables of participants (n=25)*

	1	2	3	4	5
Baseline					
1. Physical activity		.025	.017	.068	-.584
2. Self-management			.231	.070	-.056
3. Extraversion				.456*	.129
4. Conscientiousness					.030
5. Neuroticism					

*p<0.05

[a] Only personality variables included which are relevant for this study : Extraversion , Conscientiousness and Neuroticism

Difference in physical activity between experimental- and control group. A one way ANCOVA was conducted to determine a non-statistically significant difference between

physical activity post-test and physical activity post-test controlled by baseline level (F(2/15)=2.185; p=0.160). Therefore using MGP for a year does not increase significant the level of physical activity.

Correlation analysis between selected personality traits and physical activity.

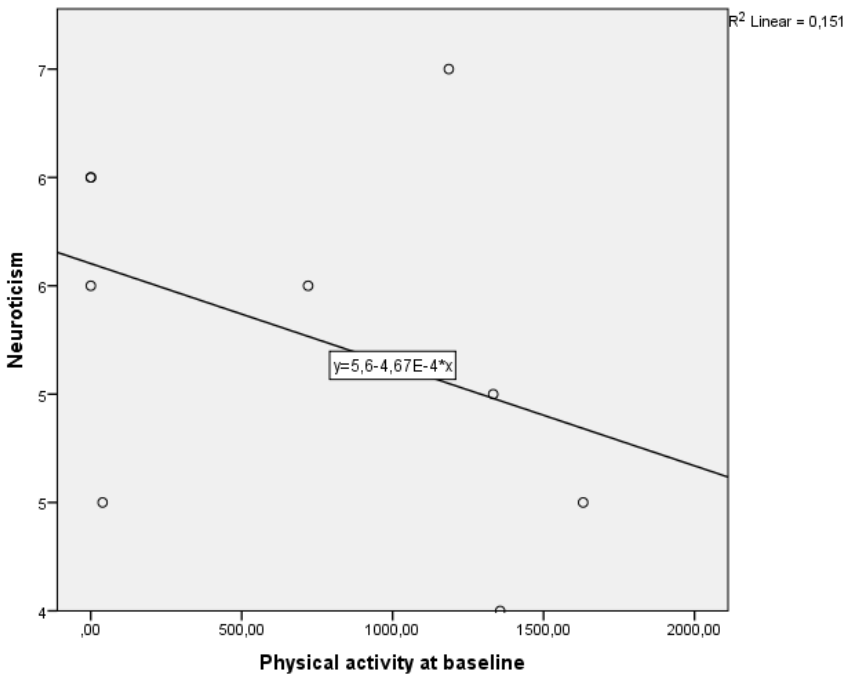


Figure 2: Correlation between Neuroticism and physical activity among the experimental group

A Spearman correlation showed a statistically non-significant correlation between physical activity and Extraversion (r=0.017, N=9; p =0.965), a statistically non-significant correlation between physical activity and Conscientiousness (r=0.068, N=9; p=0.861), and a statistically non-significant correlation between physical activity and Neuroticism (r=-.584, N=9: p =0.099) (Figure 2). Therefore there is no significant relation between Extraversion, Conscientiousness and Neuroticism and physical activity. Results show that the relation between Neuroticism and physical activity has a trend into the negative. Therefore there is a trend that the more emotional unstable an individual is the lower the level of physical activity.

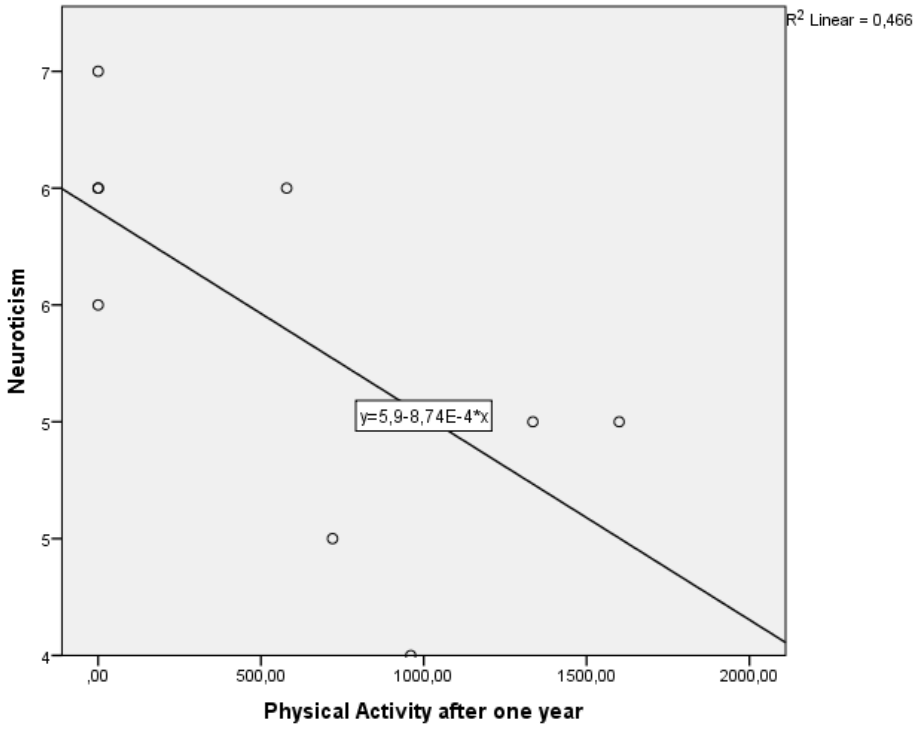


Figure 3: Correlation between Neuroticism and post-test physical activity among the experimental group

A Spearman correlation showed a statistically significant negative correlation between post-test physical activity and Neuroticism (r=-.712, N=10: p=0.021) (Figure 3). Therefore it reveals that the more emotional unstable an individual is the lower the level of physical activity when using MGP after one year.

Conclusion and Discussion

The results provide reasons to conclude, that there is no difference in health improvement through physical activity between participants with chronic disease making use of the web based intervention MGP for one year and participants not making use of MGP. Therefore it can be concluded that making use of MGP does not influence the level of physical activity. Furthermore the personality traits Extraversion and Conscientiousness and Neuroticism do not correlate significantly with physical activity among participants with chronic disease making use of MGP for one year. The personality trait Neuroticism has shown to correlate non-significantly with physical activity but it has a trend into the negative. Because of this non-significant correlation between the selected personality traits and the

level of physical activity, analysis in order to ascertain the relation between the three components: personality, self-management and physical activity was not conducted.

Although research has shown that web-based interventions can be an effective alternative to more traditional treatments through the possibility to support patient with permanent and quick feedback, reminders and responses of therapists (Nes, Dulmen, Eide et al., 2012), this outcome of the study does not support the previous. The study of Kim and Kang (2006) compared the effect of web-based programs for healthcare with printed material intervention and usual care. It has found no difference between web-based intervention and paper printed intervention.

Furthermore it was expected that selected personality traits, in particular Extraversion, Conscientiousness and Neuroticism are related to physical activity. This has not fully been confirmed through analysis. Although research strongly supports the connection between the three selected personality traits and health related behaviour such as physical activity (Bogg & Roberts, 2004; Hampson, Andrews, Barckley, Lichtenstein & Lee, 2000; Rhodes et al, 2003), in this study only the trait Neuroticism has shown to have a non-significant trend to be negatively related to the level of physical activity. No conclusion can be made about the causality of the components; therefore it cannot be summarized which variables cause's changes to the other one. Research has shown that individuals high in Neuroticism are related with low health related behaviour such as physical activity (Clark & Watson, 1988; Shipley & Weiss et al, 2007). The findings of this study imply a non-significant correlation between Neuroticism and physical activity with a trend into the negative. A significant negative correlation was found among participants when using MGP after one year. Therefore, the more emotional instable an individual is, the less physical active he tends to perform when making use of MGP. From this it could be concluded that when being motivated to perform health related behaviour such as more physical activity through usage of the web-based intervention MGP, participants who are high in Neuroticism have a significant lower level of physical activity when making use of MGP. However no concrete conclusion can be drawn about a true found effect because of low statistical power in this study. In the study of Shipley & Weiss et al (2007) the participants did not suffer of chronic disease therefore it is possible that there is a difference between the relation of Neuroticism and physical activity among patients with chronic disease and in comparison to "healthy patients" or none at all because tendentiously human physical activity is linearly spread throughout population. In comparison research has shown that individuals being high in Extraversion and Conscientiousness reveal a more health related behaviour. This however has to be confirmed through further research.

It is therefore recommended to examine the causality between the selected personality traits and physical activity to provide substantiated assumptions about the variables that have cause on another component within the investigated system.

Generally the idea behind the current study was promising, however the realization points to the needs for finding methods of improvements. The current studies strength is that the use of a web-based intervention MGP in order to support healthier living is in line with the fitness health generation. Furthermore an advantage of MGP is that it provides data about user's conditions and information as support for better treatment of chronic disease. Therefore users can inform themselves over their chronic disease and advices for specific behaviours in daily life. Further they can track medical related information about their conditions and in case needed they have access to coaches that can provide help. Through an increasing amount of individuals using this application, it can provide objective measures and trends for particular relations.

There are some potential problems and limitations that might have influenced the data and led to falsified results. At first the manner how participants were selected could have led to a selection bias because individuals were recruited based on their care group and location. Only location B was given the opportunity to make use of MGP and location A was selected as control group. Therefore the likelihood of being retained in the study was different from what would have been if enrolled within the entire target population. Therefore results would be more meaningful and representable when a selection bias would have been less strict. Concrete conclusion could have been done over differences in age, nationality and place of living and could have been put in relation to each other. In addition many participants had stopped earlier than expected leaving fewer participants over than needed to receive valid and reliable results. In particular, the experimental group started with 81 participants and for the last measure moment only 25 participants were left. The first measure moment control group had 165 participants and in the last measure moment only 85 participants were left. Due to a low sample of participants in the experimental and control group it is probable that the sample is not representative of the exposure-outcome distribution in the overall population of individuals with chronic disease. Consequently measures of correlation and association are potentially biased. Because of early termination of the participants it could be a possibility to first examine the effects on a shorter duration (e.g. 12 weeks) in order to achieve reliable measures and then examine the long term effects in a study with long duration (e.g. 5 years).

Additionally a lot of information and many questionnaires were incomplete. Especially the IPAQ-SF, measuring physical activity, had many missing values, which could

have influenced the analysis. Through high amount of early termination analysis was conducted with missing values, which were marked and redefined. This is the reason why analysis for RQ2, the relation between selected personality traits and physical activity, has been conducted with only 9 participants (n=9). Consequently this low sample has low statistical power which therefore has a reduced chance of detecting a true effect and additionally a reduced likelihood that a resulting statistical result reflects a true effect. Therefore findings are questionable as such it is recommended to use a more representative sample that has more statistical power.

Another point is the validity of data because data was not taken face to face but online. The probability seems high that participants have delivered less precise data about their physical activity. This might have been the case because taking questionnaires face to face gives participants less time to think about what to say and therefore it is more likely that they do not cheat. Additionally it could be asked for further details when needed. Because of self-reported behaviour which is subjective, common method variances could have had impact on the results which is also a reason why self-report questionnaires do not provide necessarily valid information. Honesty/image management of participant's intention to maintain a particular (positive) image may deliver deviations and is dependent upon personality. Therefore participants can adjust their response e.g. of physical activity in order to maintain their image of improving their health. A solution for this would be objective measurements in order to prevent this influence. Making use of accelerometers for smartphones or Polar or Garmin Fitness tracker to gather valid objective measurements about physical activity of participants is recommended. Latter fitness tracker even provides the possibility to measure pulse frequency, distance and footsteps which can provide further information about the health condition of the participants (Garmin, 2016).

Regarding the sample it is notable that there are especially more male participants in the experimental group than female participants. In the experimental group there are only four female participants. This could have falsified the results. The study of Azevedo et al (2007) examined the gender difference in leisure time physical activity and findings support the statement that male participants are more active than the female counterparts. Physical activity in leisure time was accessed with the long version of IPAQ among 1344 Brazil men and 1756 Brazil women. To gain more reliable data it needs to be ensured that there is a balance with respect to an equal share in gender. As physical activity execution is different between male and female there is a need for a representative sample. The results of this study are based on a strongly male dominated sample; as female physical activities differ

significantly from male's physical activities the results will strongly be influenced and change the resulting average based on statistical "female activities" average to a more representative result.

The usage accountability of MGP among the experimental group was not measured. Therefore there is no valid conclusion how regularly participants made use of the web-based intervention MGP. Consequently it is possible that participants selected to the experimental group have made no or very little use of MGP and consequently their data should be excluded. As this was not done, this could have led to impreciseness of the results because of missing data and credibility. It is therefore recommended to make use of a Data log file in order to re-examine the usage of MGP of the participants.

According to Gosing, Rentfrow and Swann (2003) the "ten-item measure of the Big Five dimensions is especially offered for situation when short measures are needed" and when "personality is not topic of interest". It can however be used when researches can tolerate psychometric properties which are associated with brief measures such as the TIPI. In the current study personality is of main interest and thus it is possible that a more item measure would have provided more reliable and valid measures that could have led to different results. This is not the case making it possible that there is little variance in personality traits. Consequently it cannot be made any prediction or statement about the real personality of the participants as personality traits have been defined through only two items and a personality trait is made of many multi different attributes. It is recommended to make use of a long version of a multi item personality test in order to gather precis information about the individual's personality.

The questionnaire IPAQ-SF, in order to measure physical activity, was conducted without the construct "sitting" which could have provided more information about status quo of the participants. Even though the difference of physical activity has shown to be non-significant, a difference of the "sitting" level could have already shown an effect. In particular, when the "sitting" level of the participants is lower in post-test measure than in baseline level this could have already have an immense impact for patients with chronic disease where physical activity is difficult to exercise.

The web-based intervention used in this study "MijnGezondheidsPlatform" and its design need to be considered. The PSD model provides persuasive features that should make a Behaviour Change Support System (BCSS) successful. The four categories in which the features are divided into, represent different possibilities to invent and design a web-based intervention in such a way that makes it useful, effective and supportive for the consumer.

"Primary task support" deals with the simplification of the main task. A complex behaviour is reduced to a simpler task in order to help the consumer to perform the targeted behaviour (Oinas-Kukkonen, Harjumaa, 2009). This is not done in this study. Improvement of physical activity is one goal of the web-based intervention but it is not reduced into sub-goals, which are easier to reach. Users should have the possibility to reach small sub-goals such as 10 more minutes of physical activity than the month before. Advantages of this would be positive reinforcement and motivation of participants reaching their sub-goal one at the time and finally the main goal. According to Oinas-Kukkonen and Harjumaa (2009) the possibility of consumers to personalize services would enhance the capability of persuasion. MGP does not provide the possibility to be personalized by consumers or to set up sub-goals. Not making use of these different persuasive features in the web-based intervention could have had an impact on post-test measures. For further research it is recommended to include measures about the particular chronic disease of the participants, in order to specify more on the daily consequences of these patients. Furthermore it can provide more information about the relation between particular chronic diseases and the effectiveness of MGP. Because of high early termination and high amount of missing values it is recommended to further examine the design of the web-based intervention MGP. Questionnaires about needs, user requirements, good and bad things could be a possibility to develop MGP in order to be more effective. Persuasive features such as reminders, feedbacks, personalized service and sub-goals could be potential factors. In addition to that providing access for MGP on smartphones through an app and online for the computer could support the effective usage for consumers on a daily basis.

Beyond this, general possible disadvantages of e-Health related tools should be considered, such as: environmental barriers (Viswanath, Kreuter, 2007), physical access barriers (Fox, 2008)), resource related barriers (Chapman & Elstein, 2000) and individual-level barriers (Jimison, Gorman et al, 2008). In particular, different skills are needed when using a web-based intervention properly. Generally it needs to be clear that user's skill and knowledge are prerequisites for an effective tool use and as such the e-Health tool need to be designed in a way that accounts for the user's necessities. For example, internet skills, tool skills, ability to communicate ideas and share information but also factors such as physical access to a computer should have been taken into account. The fact that consumers only had access to MGP online via a computer also could have influenced the usage of the web-based intervention because with the rise of the web, especially smartphones are the daily companion. Smartphones provide the possibility that they track much information and are in

daily use by a major part of the population. Therefore it is possible that participants would make more use of MGP, can be reminded to use it regularly and have an easy and fast way of entering their data. These factors were however not considered in this study and therefore could have had impact on the usage of the web-based intervention MGP of users and consequently could have falsified found results.

These findings of the current study should be interpreted cautiously. After all, the current study provides a basis for further and extended research. It is recommended to examine specifically the dependency of age, gender and nation in relation to chronic diseases in order to show differences and to conclude best recommendations for different groups as age or gender specifications.

References

Alvarez, R.C. (2002). The promise of e-Health – a Canadian Perspective. eHealth Int; 17;1(1):4. Medline:12459044. [PMC:12459044] doi:10.1186/1476-3591-1-4.

Azevedo, M. R., Araújo, C. L. P., Reichert, F. F., Siqueira, F. V., da Silva, M. C., & Hallal, P. C. (2007). Gender differences in leisure-time physical activity. *International journal of public health*, *52*(1), 8-15.

Baker, L., Rideout, J., Gertler, P., Raube, K. (2005). Effect of an Internet-based system for doctor-patient communication on health care spending. *J Am Med Inform* Assoc;12(5):530.Medline: 15905484. doi: 10.1197/jamia.M1778.

Ball, M.J., Smith, C., Bakalar, R.S., (2007). Personal health records: empowering consumers. *J Healthc Inf Manag* ;21(1):76-86. Medline: 1729992.

Bandura, A. (1997). Self efficacy; The Exercise of Control. New York. NY:WH Freemann Co. In: 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.

Bandura, A. (1989). Human agency in social-cognitive theory. Am Psychol ; 44:1175-84. In: 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.

Berkman, L.F., Glass, T., Brissette, I., & Seeman, T.E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science and Medicine,51, 843–857.*

Blum, K. (2006): Krankenhausversorgung. In: Hurrelmann, K./Laaser, U./Razum, O. (Hg.): Handbuch Gesundheitswissenschaften. Weinheim/München: Juventa, 901-924 In: Prinzen, L., (2008). Bewältigungsarbeit chronisch erkrankter Menschen beim Übergang vom Krankenhaus in die häusliche Weiterversorgung. Bielefeld.

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

Bogg, T., & Roberts, B.W. (2004). Conscientiousness and health- related behaviors: A meta-analysis of the leading behavioural contributors to mortality. *Psychological Bulletin, 130, 887-919.*

Bullinger, M. (2000): Lebensqualitätsforschung aus medizinpsychologischer und soziologischer Perspektive. Göttingen: Hogrefe. In: : Prinzen, L., (2008). Bewältigungsarbeit chronisch erkrankter Menschen beim Übergang vom Krankenhaus in die häusliche Weiterversorgung. Bielefeld.

Caspersen, C.J., Powell, K.E., Christensen, G.M., (1985). Physical activity, exercise and physical fitness: definitions and distinctions for health-related research. *Public Health Reports*; 100: 126-131

Chapman G, Elstein A. (2000). Cognitive processes and biases in medical decision making. In: Chapman G, Sonnenberg F, editors. Decision Making in Health Care: Theory, Psychology, and Applications. New York, NY: Cambridge University Press:183.

Clark, N.M., Becker, M.H., Janz, N.K., Lorig, K., et al. (1991). Self-management of chronic disease by older adults: a review and questions for research. *J Aging Health*3:3-27

Clark, L.A., Watson, D. (1988).Mood and the mundane: Relations between daily life events and self-reported mood. *Journal of Personality and Social Psychology*, 56, pp. 958–964. In: Williams, P.G., Wiebe, D. (2000) Individual Differences in self-assessed health: Gender, neuroticism and physical symptom reports. *Personality and Individual Differences*. doi:10.1016/S0191-8869(99)00140-3

Corsinis, R.J. (2002). The dictionary of psychology. Brunner-Routledge. New York.

Danner, D.D., Snowden, D.A., & Friesen, W.V. (2001). Positive emotions in early life and longevity: Findings from the nun study. *Journal of Personality and Social Psychology, 80, 804-813*.

Deary, I.J., Weiss, A., & Batty, G.D. (2010). Intelligence and personality as predictors of illness and death: How Researchers in Differential Psychology and Chronic Disease Epidemiology are collaborating to understand and address health inequalities. *Psychological Science in the Public Interest, 11(2), 53-79.*

De Bruijn, G.,J., de Groot, R., van den Putte, B., & Rhodes, R. (2009). Conscientiousness, Extraversion and Action Control: Comparing Moderate and vigorous Physical Activity. *Journal of Sport & Exercise Psychology*, 31, 724-742

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.

Eysenbach, G. (2001). What is e-health? J Med Internet. 18;3(2):e20. Medline: 21578027. Doi:10.2196/jmir.3.2e20

Fogg, B. J. (2003). Persuasive Technology: Using Computers to Change What We Think and Do. San Francisco: Morgan Kaufmann Publishers. In: Oinas-Kukkonen, H., Harajumaa, M., (2009). Persuasive Systems Design; Key Issues, Process Model, and System Features, *Communication of the Association for Information Systems: Vol. 24, Article 28.*

Fox S.(2008) The engaged e-patient population. Washington, DC: Pew Internet & American Life Project.

Garmin (2016) . Product homepage. https://buy.garmin.com/de-DE/DE/sport-training/fitness/vivosmart-hr-/prod548743.html

Giesbers H (RIVM), Verweij A (RIVM), Beer J de (NIDI). Bevolking: Wat zijn de belangrijkste verwachtingen voor de toekomst? In: Volksgezondheid Toekomst Verkenning*, Nationaal Kompas Volksgezondheid*. Bilthoven: RIVM, <http://www.nationaalkompas.nl> Nationaal Kompas Volksgezondheid\Bevolking, 17 maart 2014

Gosling, S. D., Rentfrow, P. J., & Swann, W. B., Jr. (2003). A Very Brief Measure of the Big Five Personality Domains. *Journal of Research in Personality, 37, 504-528.*

Hampson, S.E., Andrews, J., Barckley, M., Lichtenstein, E., &Lee, M.L. (2000). Conscientiousness, perceived risk, and risk-reduction behaviors: A preliminary study. *Health Psychology, 19, 496-500.*

Hoeymans, N., Schellevis, F.C., Wolters, I. (2008). Hoeveel mensen hebben één of meer chronische ziekten? In: Volksgezondheid Toekomst Verkenning*, NationaalKompas Volksgezondheid*. Bilthoven: RIVM.

Houston, T.K., Sands, D.Z., Jenckes, M.W., Ford, D.E. (2004). Experiences of patients who were early adopters of electronic communication with their physician: satisfaction, benefits, and concerns. *Am J Manag Care*;10(9):601-608 .Medline: 15515992.

Hurrelmann, K. (2001): Wie lässt sich die Rolle des Patienten stärken? In: v. Reibnitz, C./Schnabel, P.-E./Hurrelmann, K. (Hg.): Der mündige Patient – Konzepte zur Patientenberatung und Konsumentensouveränität im Gesundheitswesen. Weinheim/München: Juventa, 35-45 150 In : Prinzen, L., (2008). Bewältigungsarbeit chronisch erkrankter Menschen beim Übergang vom Krankenhaus in die häusliche Weiterversorgung. Bielefeld.

IBM (2016). Product homepage. http://www.ibm.com/analytics/us/en/technology/spss/ on 3.06.2016

Intille, S. S. (2003). "Ubiquitous Computing Technology for Just-in-Time Motivation of Behavior Change" *in Proceedings of the UbiHealth 2003: The 2nd International Workshop on Ubiquitous Computing for Pervasive Healthcare Applications* , http://www.healthcare.pervasive.dk/ubicomp2003/papers/ (current Sep 19, 2008). In: Oinas-Kukkonen, H., Harajumaa, M., (2009). Persuasive Systems Design; Key Issues,

Process Model, and System Features, *Communication of the Association for Information Systems: Vol. 24, Article 28.*

Jansen, D., Spreeuwenberg, P., Heijmans, M., (2012). Ontwikkelingen in de zorg voor chronisch zieken. Rapportage 2012. Nivel

Jimison H, Gorman P, Woods S, Nygren P, Walker M, Norris S, et al. (2008) Barriers and drivers of health information technology use for the elderly, chronically ill, and underserved. *Evid Rep Technol Assess* (175):1-1422.

John, O.P., Robins, R.W., Pervin, L.A. (2008) Handbook of Personality. Theory and Research. *The Guilford Press*. New York.

Kamel Boulos MN, Wheeler S. (2007). The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education. *Health Info Libr J* ;24(1):2-23.

Kemper, H.G.C., Ooijendijk, W.T.M., Stiggelbout, M., (2000)Consensus over de Nederlandse Norm voor Gezond Bewegen. Tijdschr Soc Gezondheidsz; 78: 180-183. Out: Wendel-Vos GCW (RIVM). Normen van lichamelijke (in)activiteit. In: Volksgezondheid Toekomst Verkenning, *Nationaal Kompas Volksgezondheid*. Bilthoven: RIVM verkregen via: http://www.nationaalkompas.nl/gezondheidsdeterminanten/leefstijl/lichamelijke-activiteit/normen-van-lichamelijke-in-activiteit/ op 4.03.2016

Kenford, S.L., Smith, S.S., Wetter, D.W., Jorenby, D.E., Fiore, M.C., & Baker, T.B. (2002). Predicting relapse back to smoking: Contrasting affective and physical models of dependence. *Journal of Consulting and Clinical Psychology, 70, 216-227.*

Kim, C.J., Kang, D.H. (2006). Utility of a web-based intervention for Individuals with Type 2 Diabetes: The Impact on Physical Activity Levels and Glycemic Control. CIN.

Koch, S. (2006): Ortsungebundener Datenzugriff und Dokumentation in der kooperativen medizinischen Betreuung. *International Journal of Computerized Dentistry*, 9(3), 219-226. In : Prinzen, L., (2008). Bewältigungsarbeit chronisch erkrankter Menschen beim Übergang vom Krankenhaus in die häusliche Weiterversorgung. Bielefeld.

Kraft, P., F. Drozd, and E. Olsen. (2009). "Digital Therapy: Addressing Willpower as Part of the Cognitive-Affective Processing System in the Service of Habit Change," *Communications of the Association for Information Systems, in this issue.* In: Oinas-Kukkonen, H., Harajumaa, M., (2009). Persuasive Systems Design; Key Issues, Process Model, and System Features, *Communication of the Association for Information Systems: Vol. 24, Article 28.*

Lehto, T., Olinas-Kukkonen, H. (2011). Persuasive Featured in Web-based Alcohol and Smoking Interventions: A Systematic Review of the Literature. *J Med Internet R*es 2011;13(3):e46

Lorig, K. R., & Holman, H. R. (2003). Self-management education: history, definition, outcomes, and mechanisms. *Annals of behavioral medicine*, *26*(1), 1-7.

Lubkin, I.M. (2002): Chronisch Kranksein. Implikationen und Interventionen für Pflege und Gesundheitsberufe. Bern: Huber. In : Prinzen, L., (2008). Bewältigungsarbeit chronisch erkrankter Menschen beim Übergang vom Krankenhaus in die häusliche Weiterversorgung. Bielefeld.

Myers, J., Kayka, A., George, S., et al (2004). Fitness versus physical activity patterns Iin predicting mortality in men. *Am J Med*; 117:912-8

Nes, A.G., Eide, H., Kristjánsdóttir, O.B., van Dulmen, S. (2013). Web-based, self-management enhancing interventions with e-diaries and personalized feedback for persons with chronic illness: A tale of three studies. Patient Education and Counselling 93; 451-458

Nes, A.A.G., Dulmen van, S., Eide, E., Finset, A., Krisjánsdóttir, O.B., Steen, I.S., Eide, H. (2012).The development and feasibility of a web-based intervention with diaries and situational feedback via smartphone to support self-management in patients with diabetes type 2. *Diabetes research and clinical practice 97:385-393*

Oinas-Kukkonen, H., (2013). A foundation for the study of behaviour change support systems. *Personal and ubiquitous computing* 17 (6):1223-123

Oinas-Kukkonen, H., Harajumaa, M., (2009). Persuasive Systems Design; Key Issues, Process Model, and System Features, *Communication of the Association for Information Systems: Vol. 24, Article 28.*

Ooijendijk, W.T.M., Hildebrandt, V.H., Hopman-Rock, M., (2007) Bewegen in Nederland 2000-2005. In: Hildebrandt VH, Ooijendijk WTM, Hopman-Rock M. (Red.). Trendrapport Bewegen en gezondheid 2004/2005. Hoofddorp/Leiden: TNO. Out: Wendel-Vos GCW (RIVM). Normen van lichamelijke (in)activiteit. In: Volksgezondheid Toekomst Verkenning, *Nationaal Kompas Volksgezondheid*. Bilthoven: RIVM verkregen via: http://www.nationaalkompas.nl/gezondheidsdeterminanten/leefstijl/lichamelijke-activiteit/normen-van-lichamelijke-in-activiteit/ op 4.03.2016

Powell, K.E., Caspersen, C.L., Kopla, J.P., &Ford, E.S. (1989). Physical activity and chronic diseases. *The American journal of clinical nutrition*. 49(5),999-1006.

Rhodes, R.E., Courneys, K.S., & Jones, L.W. (2003). Translating Exercise Intentions into Behavior: Personality and Social Cognitive Correlates. *Journal of Health Psychology*

RIVM. (2014). RIVM forecasting study: a healthier Netherlands with more people living with a chronic disease. Via http://www.rivm.nl/en/Documents_and_publications/Common_and_Present/Newsmessages/2014/RIVM_forecasting_study_a_healthier_Netherlands_with_more_people_living_with_a_chronic_disease on 2.06.2016

Shipley, B. A., Weiss, A., Der, G., Taylor, M. D., & Deary, I. J. (2007). Neuroticism, extraversion, and mortality in the UK Health and Lifestyle Survey: a 21-year prospective cohort study. *Psychosomatic Medicine*, *69*(9), 923-931.

Skinner, T. C., Bruce, D. G., Davis, T. M. E., & Davis, W. A. (2014). Personality traits, self-care behaviours and glycaemic control in Type 2 diabetes: The Fremantle Diabetes Study Phase II. *Diabetic Medicine*, *31*(4), 487-492.

Solomon, M., Wagner, S.L., Goes, J. (2012). Effects of a web-based intervention for adults with chronic conditions on Patient Activation: Online randomized Trial. *Journal of Medical Internet Research*. Vol 14, No1

Sullivan, M. (2003): The new subjective medicine: taking the patient´s point of view on health care and health. Social Science & Medicine, 56(7), 1595-1604

Tarlov, A.R. (1983). Shattuck lecture: the increasing supply of physicians, the changing structure of the health system, and the future practice of medicine. *N Engl J Med*. 308:1235-1244. In: Stewart, A. L., Hays, R. D., Wells, K. B., Rogers, W. H., Spritzer, K. L., & Greenfield, S. (1994). Long-term functioning and well-being outcomes associated with physical activity and exercise in patients with chronic conditions in the Medical Outcomes Study. *Journal of clinical epidemiology*, *47*(7), 719-730

Viswanath K, Kreuter MW. (2007). Health disparities, communication inequalities, and eHealth. Am J Prev Med 2007 May;32(5 Suppl):S131-S133.

VWS, (2008). Programmatische aanpak van chronische ziekten. Den Haag.

Weiss, A., & Costa, P.T., Jr. (2005). Domain and facet personality predictors of all-cause mortality among Medicare patients aged 65-100. Psychosomatic Medicine, 67,724-733. In: John, O.P., Robins, R.W., Pervin, L.A. (2008) Handbook of Personality. Theory and Research. *The Guilford Press*. New York.

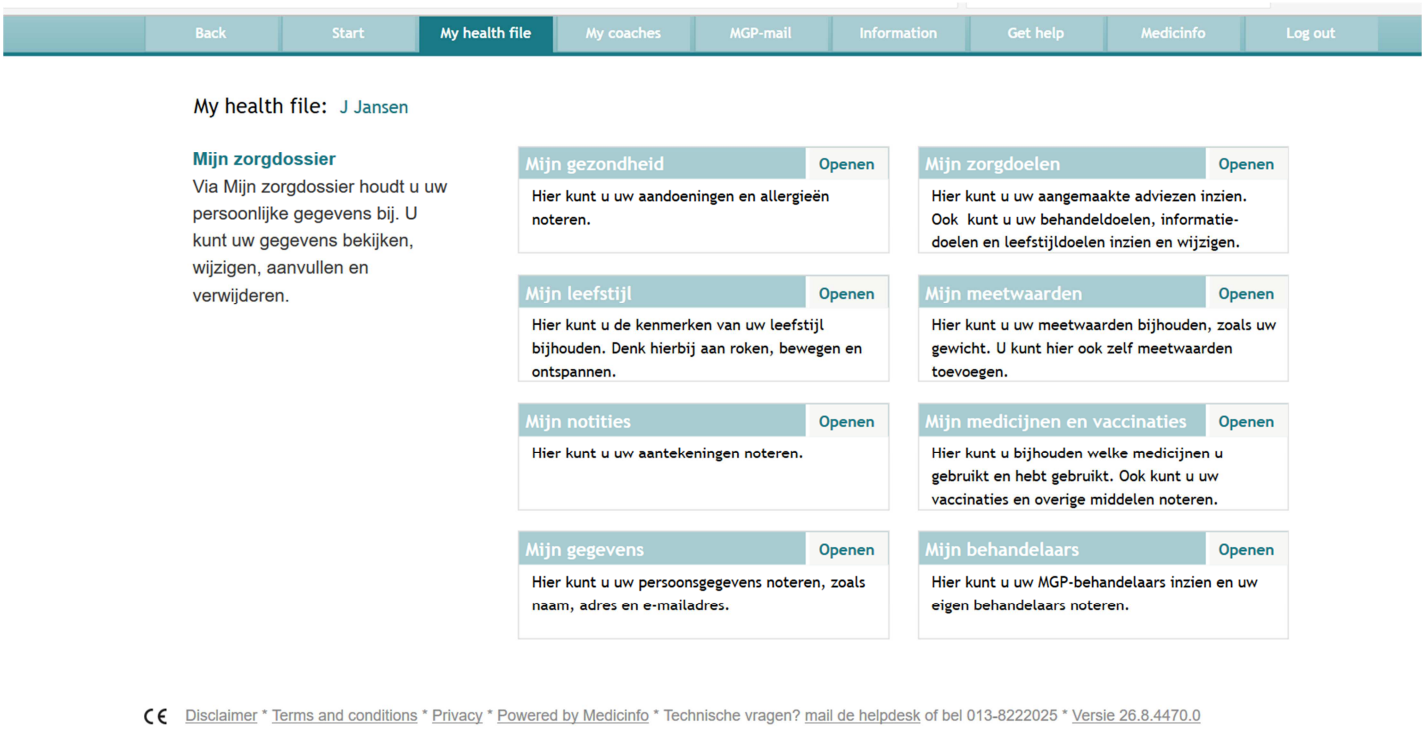
WHO, World Health Organization. (2010) Global Recommendations on Physical Activity for Health. Geneva.

Williams, P.G., Wiebe, D. (2000) Individual Differences in self-assessed health: Gender,

neuroticism and physical symptom reports. *Personality and Individual Differences*. doi:10.1016/S0191-8869(99)00140-3

Appendix

Apendix A – MijnGezondheidPlatform Screenshot and Commands Explanation



Command	Explanation
Mijn Zorgdossier : (My health file)	Contains all measurements and data about the health of the user. This page has eight subfiles.
'Mijn gezondheid' ('My health')	This allows users to be aware of their diseases and allergies
'Mijn leefstijl' ('My lifestyle')	This allows users to keep overview about their lifestyle
'Mijn notities' ('My notes')	This allows users to keep track of notes
'Mijn gegevens' ('My personal data')	Here are personal data of the user (name, date of birth, etc)
'Mijn zorgdoelen' ('My health goals')	This allows users to define their goals around their health
'Mijn meetwaarden' ('My measurements')	This allows users to keep track of all their measurement values and realize (for example, blood pressure or lab values)
'Mijn medicatie en vaccinaties' ('My medication and vaccinations')	This allows users to keep overview about their medication and vaccinations
Mijn behandelaars (My therapists)	This allows users to keep an overview of their

	therapists
Mijn coaches (My coaches)	Contains three coaches for: stop smoking coach, a Move Coach and a power coach. Each coach contains a 12-week program
MGP – mail	Can be used to communicate with therapists (doctor/practice supporter) ; for questions
Informatie (Information)	Contains links to more information on various subjects that are relevant for the user
Help	Contains a brief guide to the functionalities of MGP

Appendix B – Ten –Item – Personality Inventory – (TIPI)

Here are a number of personality traits that may or may not apply to you. Please write a number next to each statement to indicate the extent to which *you agree or disagree with that statement*. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

Disagree Strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
1	2	3	4	5	6	7

I see myself as:

1. _____ Extravert, enthusiastic.

2. _____ Critical, quarrelsome.

3. _____ Dependable, self-disciplined.

4. _____ Anxious easily upset.

5. _____ Open to new experiences, complex.

6. _____ Reserved, quiet.

7. _____ Sympathetic, warm.

8. _____ Disorganized, careless.

9. _____ Calm, emotionally stable.

10. _____ Conventional, uncreative

Appendix C – International Physical Activity Questionnaire- (IPAQ- SF)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities. → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking →***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

Appendix D – Patient Activation Measure – (PAM-13)

Below are some of the statements that people sometimes do about their health. Specify for each statement what extent do you agree or disagree. Do this by pressing the answer to encircle the answer that applies at best to your personal situation. We want to know what you think and not what you think that the doctor or researcher wants to hear.

	totally disagree	disagree	agree	Totally agree	Non-applicable
When all is said and done, I am the person who is responsible for managing my health condition.	0	0	0	0	0
Taking an active role in my own health care is the most important factor in determining my health and ability to function.	0	0	0	0	0
I am confident that I can take actions that will help prevent or minimize some symptoms or problems associated with my health condition.	0	0	0	0	0
I know what each of my prescribed medications do.	0	0	0	0	0
I am confident that I can tell when I need to go get medical care and when I can handle a health problem myself.	0	0	0	0	0
I am confident I can tell my health care provider concerns I have even when he or she does not ask.	0	0	0	0	0
I am confident that I can follow through on medical treatments I need to do at home.	0	0	0	0	0
I understand the nature and causes of my health condition(s).	0	0	0	0	0
I know the different medical treatment options available for my health condition.	0	0	0	0	0
I have been able to maintain the lifestyle changes for my health that I have made.	0	0	0	0	0
I know how to prevent further problems with my health condition.	0	0	0	0	0
I am confident I can figure out solutions when new situations or problems arise with	0	0	0	0	0

my health condition.					
I am confident that I can maintain lifestyle changes like diet and exercise even during times of stress.	0	0	0	0	0