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FACTORS PREDICTING ADHERENCE TO TREATMENT REGIMEN AMONG PATIENTS WITH CHRONIC DISEASES

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VILNIAUS UNIVERSITETAS

OLGA ZAMALIJEVA

SERGANČIŲJŲ LĖTINĖMIS LIGOMIS GYDYMO NURODYMŲ LAIKYMĄSI PROGNOZUOJANTYS VEIKSNIAI

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INTRODUCTION

Relevance of the research

A lot has changed in the healthcare system during the last century. Healthcare specialists' attitude towards health has changed gradually: moving further away from biomedical model and pathogenic approach to health, focusing more on psychological and social aspects of health, showing greater interest in patients' quality of life and their subjective evaluation of health condition. Along with this, the primary challenges that the modern healthcare is facing have also changed. Wide-spread use of antibiotics, development of vaccination programs, demographic changes in society related to population aging, changing lifestyle – all these factors stipulated the situation where chronic illnesses had surpassed infection diseases as the essential challenge for the healthcare system and public health.

Chronic diseases are long-lasting or repetitive health disorders. Needless to say, all chronic diseases require complex and long-term treatment, they account for the lion's share of all the cases of disability and become the leading cause of premature mortality. In the low- and middle-income countries 86 % of all cases of premature deaths are related to chronic conditions that not only can be prevented, but also the course of those diseases may be controlled (WHO, 2013). Some of the most widespread chronic diseases in Lithuania and worldwide are cardiovascular diseases (among which the most notable one is arterial hypertension) and type II diabetes mellitus (WHO, 2014a; WHO, 2014b). According to the statistical data of the Institute of Hygiene, in 2014 56 % of all the deaths in Lithuania were attributed to disorders of circulatory system (Causes of death register, 2015). Around half of all the strokes and cases of ischemic heart disease (Williams, 2010) and 12.8 % of all the causes of death (Perreault et al., 2010) can also be attributed to arterial hypertension. Furthermore, due to comorbidity of these conditions (Bretzel, 2007; Long & Dagogo-Jack, 2011), a chronic disease like diabetes mellitus, which accelerates the emergence and progression of atherosclerosis, is closely related to disability and mortality from cardiovascular disease. According to the National Health Insurance Fund, utmost compensation expenses, as compared to all the other chronic diseases, are related to blood pressure lowering medication, with diabetes mellitus being the second most costly illness (Valinskaitė-Barščevičienė, 2014). Those are the exact

reasons chronic diseases are considered to be a serious burden for the healthcare system and country's social economics. In order to reduce the negative impact that chronic diseases have on both individual and socioeconomic levels, measures ensuring that those are duly controlled shall be given particular consideration.

In its Global action plan (WHO, 2013), the World Health Organization describes special measures that are designed to tackle the challenges of chronic conditions and singles out 4 priority groups of diseases: cardiovascular diseases, cancers, chronic respiratory diseases and diabetes. Contrary to cancers, where the measures are focused on illness prevention, vaccination, lifestyle changes, prophylaxis and early diagnostics, or to respiratory diseases, where most attention is given to the environmental variables, e.g. air pollution, reducing exposure, preventive lifestyle changes and asthma control, in case of cardiovascular diseases and diabetes the emphasis is placed on treatment of hypertension and hyperglycemia as well as prevention of disease complications, heart attack and stroke (WHO, 2013). Healthcare specialists are constantly improving the existing methods of treatment and prevention of chronic diseases and disease related complications, as well as creating new ones, nevertheless, even when the treatment is proven to be effective by the clinical trials, it does not guarantee the successful health outcomes. According to the World Health Organization (WHO, 2003), on the average only 50 % of chronic disease patients in developed countries are adherent to treatment regimen. The occurrence of non-adherence to treatment regimen varies among patients with different diseases. Up to 80 % of patients diagnosed with arterial hypertension do not adhere to treatment regimen (Osterberg & Blaschke, 2005). Among patients with diabetes mellitus the rate of non-adherence is also one of the highest (DiMatteo, 2004a). Failure to adhere to healthcare specialists' recommendations, e.g. taking prescribed medication, occurs regardless of the nature of the disease or its severity, as well as of availability of healthcare resources, though it's assumed that in developing countries the percentage of patients with chronic diseases duly adhering to treatment regimen may be even lower (WHO, 2003). These facts show that a significant part of patients with chronic conditions does not benefit from effective prescribed treatment.

Currently it's reasonably believed that adherence to treatment regimen mediates the interrelation between chronic diseases and health. Longitudinal studies on

adherence and health outcomes show that ensuring adherence to treatment regimen among patients with hypertension significantly reduces the risk of coronary heart disease (Perreault et al., 2010), it's also proven to be an effective method for prevention of other cardiovascular diseases (Turner, Hollenbeak, Weiner, Ten Have, & Roberts, 2009). On the other hand, poor adherence to treatment regimen among patients with hypertension triples the risk of mortality (Herttua, Tabák, Martikainen, Vahtera, & Kivimäki, 2013). Also, in order to achieve good treatment results, it's crucial to maintain persistent and continuous adherence treatment to treatment regimen (Veronesi et al., 2007). Upon conducting thorough evaluation, De Geest and co-authors (2014) established that two thirds of patients suspected to have drug-resistant form of hypertension in fact did not adhere to treatment regimen. In turn, poorly managed diabetes mellitus induces serious micro- and macro-vascular, nephrological and ophthalmological complications, increases the likelihood of amputation and mortality (Norkus, Ostrauskas, & Šulcaitė, 2005; Vermeire et al., 2005). Finally, most studies have shown that insufficient treatment adherence among patients with chronic disease inevitably affects the efficiency of treatment and rehabilitation, has significant implications on person's health and results into economic and social losses for the state (Choudhry, Setoguchi, Levin, Winkelmayer, & Shrank, 2008). The economic impact of non-adherence to treatment regimen is best demonstrated by the example of type II diabetes mellitus, where the treatment of complications caused by that disease is much more expensive than controlling diabetes mellitus itself (Norkus et al., 2005). Analysis conducted by Domeikienė, Vaivadaitė, Ivanauskienė and Padaiga (2014) has shown that annual costs of treatment for type II diabetes mellitus patients with complications are almost 2.5 times higher compared to patients with no complications. Thus, in light of the role treatment adherence plays in chronic disease control and prophylaxis, as well as in prevention of disability and mortality, adherence to treatment regimen might be considered a key factor of ensuring the quality of healthcare, while importance of research in this field must be viewed as compatible to that of creating efficient treatment methods.

Despite the importance of adherence to treatment regimen, there's a lack of comprehensive studies in this field (Munro, Lewin, Swart, & Volmink, 2007; WHO, 2003), with researchers often limiting themselves to analyzing specific singled-out variables of non-adherence to treatment regimen. It's also still not clear how efficient are

the most frequently recommended methods of promoting treatment adherence or whether they have a long-lasting effect. The studies show that all the currently existing methods have significant shortcomings and lacking sufficient evidence of efficiency (Aronson, 2007; Van Dulmen et al., 2007). Moreover, according to the data of empirical studies, one of the most frequently mentioned methods of promoting adherence to treatment regimen – patient education – has little (Vermeire, et al., 2005) or no effect on better adherence to treatment regimen. Thus, in the field of managing chronic diseases that require long-term treatment it's extremely important to have comprehensive studies of adherence to treatment regimen with a focus on predictors of treatment adherence.

Scientific novelty

Though it's universally recognized that adherence to treatment regimen includes not only taking the medication prescribed, but also lifestyle changes, which are considered to be crucial prerequisite for recovery and disability prevention, still most research conducted often lacks systematic approach and, for the most part, is quite fragmented (AlGhurair, Hughes, Simpson, & Guirguis, 2012; Munro et al., 2007), focusing solely on regular and proper use of medication (e.g. Haynes, Achloo, Sahota, McDonald, & Yao, 2008; Kalibatienė, Biliukas, & Kalibataitė, 2013; Mahtani Heneghan, Glasziou, & Perera, 2011; Schroeder, Fahey, & Ebharim, 2004; Vermeire et al., 2005). This research provides analysis of the wide range of treatment adherence behaviors: use of medication, health monitoring, physical activity, dietary behavior. Moreover, the use of medication is analyzed from different perspectives, i.e. discerning intentional and unintentional medication non-adherence, since thorough understanding of this phenomenon requires comprehensive analysis of different medication adherence patterns (Clifford, Barber, & Horne, 2008; Lehane & McCarthy, 2007a; Wroe, 2002). Also, this research empirically analyzes the structure of a multi-dimensional construct of adherence to treatment regimen among patients with chronic diseases, and we were unable to find studies applying similar approach.

Currently the theoretical models that prevail in health psychology and are designed to explain health-related behaviors mainly focus on patient's risk perception – perceived disease severity and perceived health risk (Day, Van Dort, & Tay-Teo, 2010; Munro et al., 2007). Apart from the traditional aspects of illness perception, this research

analyzes broader spectrum of variables, such as perceived control over the illness and perceived illness duration.

Though the importance of personality traits is not denied, not a single one of the theoretical models that are broadly applied in health psychology comprehensively analyzes the effect that personality traits have on health-related behavior. What is more, in the context of treatment adherence among patients with chronic diseases the role of personality traits is rarely analyzed, and even when it is taken into account, personality traits are usually analyzed as a standalone predictor of adherence to treatment regimen (Axelsson, Brink, Lundgren, & Lötvall, 2011; Hilliard, Brewer, Cornelius, & Van Raalte, 2014; Wheeler, Wagaman, & McCord, 2012; Williams, O`Connor, Grubb, & O`Carrol, 2011) or, on rare occasions – together with either only illness perception or only treatment perception variables (e.g. Axelsson, 2013; Axelsson, Cliffordson, Lundbäck, & Lötvall, 2013; Emilsson et al., 2011; Žugelj et al., 2010). Insufficient research of personality traits in the context of adherence to treatment regimen is exactly why the Big Five personality traits were included in this research analysis.

Although theoretical models that explain health-related behavior do not pay sufficient attention to personality traits, nevertheless other variables analyzed may often be attributed to patient-level factors (Berben, Dobbels, Emgberg, Hill, & De Geest, 2012). Social environment factors are also rarely taken into account, e.g. the theory of planned behavior distinguishes subjective norms as a significant predictor of social and health-related behavior (Ajzen, 2011; Armitage & Conner, 2001; Hagger & Chatzisarantis, 2009; McEachan, Conner, Taylor, & Lawton, 2011; Mirkuzie, Sisay, Moland, & Åstrøm, 2011). Thus, apart from patient-level variables, such micro-level factors as patient's attitude toward healthcare provider, social support and subjective norms are also included in the research analysis.

Finally, by means of structural equation modeling this research resulted into a complex analysis of predictors, encompassing a wide range of variables, which is what other studies of adherence to treatment regimen are lacking (AlGhurair et al., 2012). This analysis allowed, in the framework of a single model, not only to evaluate the significance of the same predictors in respect of several aspects of adherence to treatment regimen among patients with chronic diseases, but also to detect interconnections between predictors and establish indirect associations between

adherence to treatment regimen and micro-level, treatment-related and health condition factors. Identification of indirect prognostic associations provides not only a better understanding of factors significant to adherence to treatment regimen, but also new insights in the field of interventions promoting treatment adherence.

To this date, the occasional studies of adherence to treatment regimen conducted in Lithuania have been focusing only on mental health disorders and/or limited to regular use of medication (e.g. Danilevičiūtė et al., 2006; Kalibatienė et al., 2013). Thus it's quite reasonable to assume that this research might be the first complex (encompassing patient's cognitive and personality-related, health condition, treatment and micro-level variables) research of predictive factors of adherence to treatment regimen among patients with chronic diseases in Lithuania.

Practical significance

Identifying predictive factors of adherence to treatment regimen among patients suffering from chronic diseases will serve as groundwork for drawing up evidence-based guidelines and recommendations for healthcare specialists and health psychologists who are working in primary healthcare and rehabilitation settings and are involved in planning and carrying out programs aimed at health promotion and prevention of complications among patients with chronic conditions.

Since both modifiable and unmodifiable predictive factors are analyzed in this research, empirically supported information on how these factors relate to adherence to treatment regimen among patients with chronic diseases will not only allow to draw up guidelines as to which factors should become the focus of interventions in order to improve treatment adherence, but will also allow healthcare providers to anticipate which patients with chronic conditions are more likely to deviate from treatment regimen, and take relevant preventive actions. Also, identification of the predictive factors, especially the ones that are specific to a particular aspect of treatment adherence, will provide healthcare specialists with the opportunity to develop individualized adherence-improving interventions targeting those aspects of adherence that the patient experiences most problems with.

The aim of the research is to identify predictive biopsychosocial (sociodemographic, personality-related, cognitive, micro-level, health condition and treatment-related) factors of adherence to treatment regimen among patients suffering from chronic conditions, to detect association between those factors and to establish their indirect relationship to adherence to treatment regimen.

To accomplish the aim of the research the following **objectives** were formulated:

1. Establish the structure of the construct of adherence to treatment regimen among patients with chronic diseases.
2. Evaluate the role of sociodemographic, personality-related, cognitive, micro-level, health condition and treatment-related factors in predicting patients' adherence to treatment regimen.
3. Analyze the associations between patients' cognitive, micro-level, health condition and treatment-related factors.
4. Develop and empirically substantiate a complex prognostic model of adherence to treatment regimen among patients with chronic diseases.

Propositions to be defended:

1. The construct of adherence to treatment regimen among patients with chronic diseases is best explained by a hierarchical structure composed of two second-order factors – medication and non-medication treatment adherence. Medication treatment adherence factor is in turn composed of intentional and unintentional medication non-adherence, while non-medication treatment adherence is composed of health monitoring, physical activities and dietary behavior.
2. Intentional and unintentional medication non-adherence have both, common and differing prognostic factors. Unintentional medication non-adherence can be predicted by patients' personality-related and sociodemographic factors, while the intentional – by treatment-related and micro-level factors. At the same time both intentional and unintentional medication non-adherence can be predicted by patients' beliefs about the treatment and perceived illness duration.
3. Micro-level factors predict patients' adherence to treatment regimen, beliefs about the treatment and illness perception. Unlike social support and subjective norms, patients' attitude toward healthcare provider can only predict treatment adherence indirectly, with the relationship between attitude toward healthcare provider and treatment adherence being mediated by patient's beliefs about the treatment.
4. Health condition and treatment-related variables per se have little to none prognostic value directly predicting adherence to treatment regimen, nevertheless, most of them play a significant role in shaping patients' beliefs about the treatment and illness perception, and thus indirectly explain treatment adherence among patients with chronic conditions.

METHODOLOGY

Research participants and procedures

The study was carried out in a sample of 303 outpatients (M age = 58.2, SD = 9.5, range: 30-94; 33% – male) that volunteered to fill out the confidential questionnaire. Subjects were recruited in Vilnius University Hospital Santariskiu Klinikos and Lithuanian Diabetes Association using a non-probability convenience sampling technique. All study participants were diagnosed with hypertension, of those 137 participants were also diagnosed with diabetes, and 66 participants apart from hypertension and diabetes were diagnosed with other chronic diseases.

Research instruments

Adherence to treatment regimen questionnaire was constructed for the purpose of this research and measured 5 types of treatment adherence: unintentional medication non-adherence and intentional medication non-adherence, as well as adherence to health monitoring, physical activity and dietary requirements. The items related to medication adherence were rated on a 4-point scale from *never* (1) to *all the time* (4). Items related to health monitoring, physical activity and dietary behavior were rated on a 5-point Likert-type scale ranging from *not true at all* (1) to *very true* (5) or using a multiple choice answer options. The questionnaire consists of 25 items. Confirmatory factor analysis (CFA) confirmed 5 factor model for the Treatment adherence questionnaire ($\chi 2$ = 365.006; df = 260; p < .001; CFI =.953; TLI =.941; RMSEA = .037). All subscales have satisfactory reliability in the current sample, as Cronbach's internal consistency α ranges from .63 to .87. Higher scores on intentional and unintentional medication non-adherence subscales indicate higher levels of non-adherence, whereas higher scores on health monitoring, physical activity and dietary behavior subscales indicate higher levels of adherence.

Cognitive variables:

- **Illness perception questionnaire.** For the purpose of this study an 11 item questionnaire was constructed to assess patients' perception of illness-related day-to-day life difficulties, possibility to control the illness and illness-related health risk. The items were rated on a 5-point Likert-type scale ranging from *completely*

disagree (1) to *completely agree* (5). CFA confirmed three factor model ($\chi 2$ = 65.730; df = 38; p = .003; CFI = .972; TLI = .952; RMSEA = .049). All subscales have good reliability, as Cronbach's internal consistency α ranged from .71 to .78. Additionally, perceived illness duration was rated on a 10-point scale from *very short* (1) to *for the rest of my life* (10).

- **Treatment beliefs questionnaire.** Patients' appraisal of the benefits of and the barriers to medication and non-medication treatment were measured using a 29 item questionnaire. Participants of the research had to rate each item on a 5-point Likert-type scale ranging from *completely disagree* (1) to *completely agree* (5). CFA confirmed four factor model ($\chi 2$ = 474.019; df = 359; p <.001; CFI = .921; TLI = .911; RMSEA = .033) that included patients' beliefs about the benefits of medication treatment, barriers to medication treatment, benefits of non-medication treatment, and barriers to non-medication treatment. All subscales have satisfactory reliability, as Cronbach's internal consistency α ranged from .61 to .81. To evaluate the balance between barriers to and benefits of the treatment, total values of respective scales were subtracted and as a result 2 variables were obtained: benefit-barrier balance for medication treatment and benefit-barrier balance for non-medication treatment.

Micro-level variables:

- **Attitude toward healthcare provider.** In order to assess patients' appraisal of the competency of and the quality of communication with the healthcare provider that prescribes the treatment, an 11 item questionnaire was constructed. All items were rated on a 5-point Likert-type scale ranging from *completely disagree* (1) to *completely agree* (5). CFA confirmed only one factor ($\chi 2$ = 81.507; df = 39; p = < .001; CFI = .997; TLI = .961; RMSEA = .060). The scale has good reliability, as Cronbach's internal consistency α was .92.
- **Perceived social support and subjective norms.** 7 item scale was used to assess patients' perceived support from family and / or friends as well as subjective norms regarding treatment adherence. Subjects rated the items on a 5-point Likert-type scale ranging from *not true at all* (1) to *very true* (5). CFA confirmed two factor model ($\chi 2$ = 24.204; df = 13; p = .029; CFI = .984; TLI = .966;

RMSEA = .053). Both subscales have good reliability in the current sample, as Cronbach's internal consistency α was .72 and .75.

Personality-related variables:

- **Big Five Inventory.** In order to assess personality traits of research participants, Big Five Inventory *(BFI*) (Benet-Martinez, & John, 1998; John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008; John & Srivastava, 1999) was used. This inventory measures 5 personality traits: Extraversion, Neuroticism, Agreeableness, Openness, and Conscientiousness. According to recommendations, the factor structure of Lithuanian version of BFI was assessed using exploratory factor analysis (EFA) (Chiorri, Marsh, Ubbiali, & Donati, 2015; McCrae, Bond, & Paunonen, 1996). EFA yielded anticipated 5 factor structure (KMO = .83, Bartlett's test of sphericity $p < .001$, 50% of variance explained), however, some items have been excluded due to small factor loadings. Subscales consisting of the remaining items have satisfactory reliability, as Cronbach's internal consistency α ranged from .66 to .84.

Sociodemographic, condition- and treatment-related variables:

- Pivotal **sociodemographic** variables including age, gender, area of residence, level of education, vocational status and subjective financial status were recorded.
- Subjects also reported specifics of their **medication treatment regimen**, including information on how many different drugs were prescribed, how many times a day they are supposed to take their medication as well as the frequency of side-effects.
- Moreover, information about patients' **health condition** was collected. The subjects of this study reported type, number, and actual duration of diagnosed chronic diseases. Subjects also rated their health condition using a 10-point scale from *very poor* (1) to *perfect* (10).

Data analysis

Variables that did not meet the condition of normal distribution were transformed (Tabachnick & Fidel, 2013). Initial data analysis included descriptive statistics, Pearson's correlation coefficients, Student's t test, hierarchical linear

regression, exploratory factor analysis (EFA), confirmatory factor analysis (CFA). Secondary data analysis was conducted using structural equation modeling. The fit criteria for the EFA: KMO ≥ .60, Bartlett's test of shpericity $p < .05$, variance explained ≥ 50% (Beavers, Lounsbury, Richards, Huck, Skolits, & Esquivel, 2013; Pakalniškienė, 2012; Williams, Brown, & Onsman, 2010). The fit criteria of CFA and structural equation models was assessed using these criteria: RMSEA ≤ .06 (Hu & Bentler, 1999; Schreiber et al., 2006), CFI and TLI ≥ .90 (Hooper et al, 2008; Hu & Bentler, 1999; Lance, Butts, & Michels, 2006; Marsh, Hau, & Wen, 2004). χ^2 values were used for comparison of several models. Missing data was imputed using multiple imputation method (Fichman & Cummings, 2003; Sterne et al., 2009).

Statistical data analysis was conducted using IBM SPSS 22, IBM AMOS 22 and Mplus 6.12.

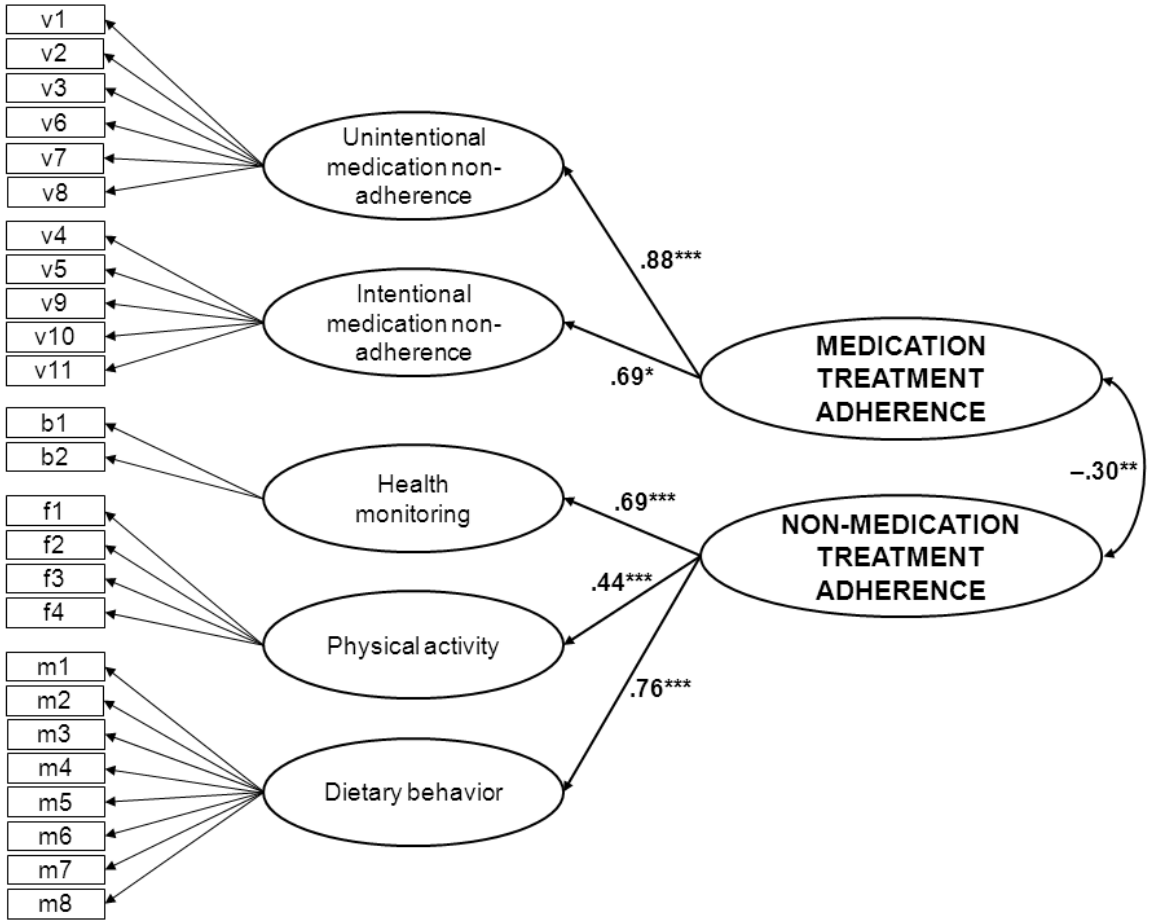
THE MAIN RESULTS

The structure of adherence to treatment regimen among patients with chronic diseases

The definition provided by World Health Organization (2003) suggests that patients' treatment adherence can be viewed as a one-dimensional construct. However, combined results of exploratory factor analysis using total scores of subscales obtained by Adherence to treatment regimen questionnaire as well as confirmatory second-order factor analysis showed that two second-order factor solution is the best fit for the data collected. Exploratory factor analysis suggested 2 factors (KMO = .60; Bartlett's test of shpericity $p < .05$; 62% of variance explained) with all variables having high factor loading ($\geq .70$) and well identified by these factors (Beavers et al., 2013). Confirmatory second-order factor analysis showed that one-factor solution is possible, as it satisfies the minimum fit criteria: RMSEA < .05, CFI > .90, TLI > .90 (Hooper et al., 2008; Marsh et al., 2004), however comparison of one and two second-order factor models showed that two second-order factor solution fits the data significantly better ($\Delta\chi^2 = 45.655$; $\Delta df = 4$; $p < .01$) than one second-order factor solution. The principal results for two second-order factor solution are presented in Figure 1.

While analyzing the structure of adherence to treatment regimen among patients with chronic diseases, we found that this phenomenon is best described by a hierarchical structure that consists of two second-order factors – medication treatment adherence and non-medication treatment adherence. Each of second-order factors consists of several first-order factors, for instance medication treatment adherence includes unintentional medication non-adherence and intentional medication non-adherence, while non-medication treatment adherence consists of health monitoring, physical activity and dietary behavior. According to these results two additional variables representing the second-order factors were constructed and used in further analysis[1].

[1] Higher scores of medication treatment adherence indicate higher levels of non-adherence, whereas higher scores on non-medication treatment adherence indicate higher levels of adherence.



Note. χ^2 = 370.369; df = 261; p < .001; RMSEA = .037; CFI = .952; TLI = .941

Figure 1. Principal results for two second-order factor solution for treatment adherence

Even though we were unable to find published studies that analyzed the structure of treatment adherence, there still is indirect evidence to support the notion of two medication and non-medication treatment adherence factors. There are quite a few studies showing that similar health-related behaviors form behavioral clusters. This tendency was confirmed when analyzing risky behavior among young individuals (e.g. Jackson, Sweeting, & Haw, 2012) and when strong relationship had been established between physical activity and nutritional patterns among adults (Chou, 2008; Poortinga, 2007; Pruncho & Wilson-Genderson, 2012). Moreover, another study showed that people who are less physically active and tend to have less adequate nutrition are also less prone to perform routine health check-ups like blood pressure and cholesterol level monitoring (Galán et al., 2006). Behavioral clusters reported by mentioned studies were not targeting patients with chronic diseases; however there still is considerable resemblance with non-medication treatment adherence factor.

Unlike other health-related behaviors, taking prescribed pills for a longer period of time is specific to chronic diseases. The notion of separation medication and non-medication treatment adherence is noticeable in the attitude of the patients as well as in the approach of the researchers in this field. The study of Broadbent, Donkin, and Stroh (2011) showed that patients view medication treatment as more important and effective compared with recommendations related to diet and physical activity, and, as a result, tend to be a couple times more likely to adhere to medication treatment regimen. This shows that patients tend to differentiate between various types of treatment recommendations. Besides, the researchers often focus only on medication taking, even when the non-medication treatment recommendations are an important part or treatment regimen (e.g. Chen, Lee, Liang, & Liao, 2014; Gascón et al., 2004; Gellad, Grenard, & Marcum, 2011; Grigoryan, Pavlik, & Hyman, 2013; Vermeire et al., 2005). Several authors treat medication taking as treatment adherence, but identify diet and physical activity recommendations as secondary prevention (Byrne, Walsh, & Murphy, 2005; Mosleh & Almalik, 2014). Thus, the separation of medication and non-medication treatment adherence, often used by other researchers, was empirically confirmed by the results of this study.

Despite substantial evidence supporting two second-order factor structure – medication treatment and non-medication treatment adherence – the question still remains if this same structure would be suitable for other types of treatment regimen. For instance, patients suffering from epilepsy are recommended to follow a regular sleep-wake schedule (Wolf, 2002), and at this point we can only assume that this behavior might manifest as a part of non-medication treatment adherence factor. Therefore, further investigation of treatment adherence structure with various types of treatment regimens is needed.

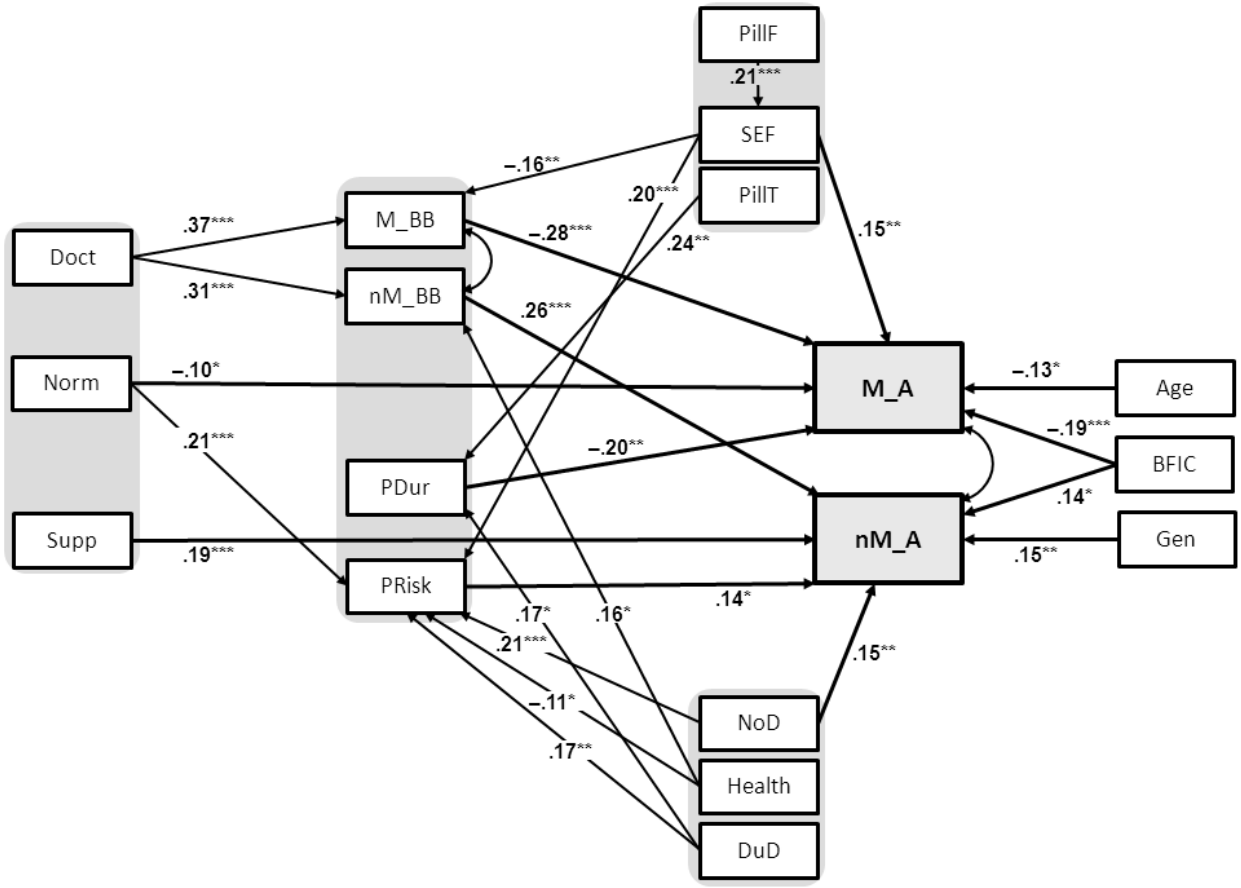
Predicting various factors of treatment adherence

Further analysis of this study was focused on identifying predictors of first- and second-order factors of treatment adherence. Using structural equation modeling, 3 models were evaluated. The first model, the results of which are presented in Figure 2, shows significant predictors of second-order medication and non-medication treatment adherence factors. Second model shows the results and significant pathways predicting

first-order factors of medication treatment adherence (Figure 3), and the third one – first-order factors of non-medication treatment adherence (Figure 4).

Prognostic model of medication and non-medication treatment adherence factors

The final structural model of medication and non-medication treatment adherence predictors satisfies all fit criteria: χ^2 = 80.193; df = 72; p = .238; RMSEA = .019; CFI = .976; TLI = .968.



Note. * p < 0.05; ** p < 0.01; *** p < 0.001. *M_A* – medication treatment adherence; *nM_A* – non-medication treatment adherence; *Age* – age; *Gen* – gender; *BFIC* – conscientiousness; *PillT* – number of different drugs prescribed; *PillF* – number of doses per day; *SEF* – frequency of side-effects; *NoD* – number of chronic diseases; *Health* – subjective appraisal of health condition; *DuD* – actual duration of chronic disease; *M_BB* – benefit-barrier balance for medication treatment; *nM_BB* – benefit-barrier balance for non-medication treatment; *PDur* – perceived illness duration; *PRisk* – perceived illness-related health risk; *Doct* – attitude toward healthcare provider; *Norm* – subjective norms; *Supp* – perceived social support.

Figure 2. Prognostic model for medication and non-medication treatment adherence

The results of this model show that both medication and non-medication treatment adherence is predicted by benefit-barrier balance of treatment. This result coincides with theoretical assumptions of several cognitive models (Bandura, 2004;

Champion & Sugg Skinner, 2008; Floyd, Prentice-Dunn, & Rogers, 2000) and indicates that patients appraise the expected benefit and barriers related to behavior and are more prone to engage in it if the benefit exceed the effort required to overcome the barriers. What is more, both second-order factors are predicted by aspects of illness perception, however, the results show that subjects are more adherent to medication treatment regimen if they perceive their illness as long-lasting, but are more adherent to non-medication treatment regimen if they perceive more health risk. These findings partially contradict the premise of health belief model, protection-motivation and social cognitive theory that risk perception would be equally relevant for all types of adherence behaviors (Munro et al., 2007). There is no doubt that risk perception is very important for initiation of behavior, but as assumed by some researchers, the importance of it may be fading if particular behavior is routine and maintained for a longer period of time (Schwarzer, 2008), which might be the case for medication treatment adherence. As opposed to non-medication treatment adherence, where risk perception still plays a significant role, better medication treatment adherence is predicted by longer perceived illness duration. The importance of perceived illness duration is stressed by self-regulation theory (Diefenbach & Leventhal, 1996; Leventhal, Leventhal, & Contrada, 1998, Petrie & Weinman, 2005) and supported by other empirical findings (Bucks et al., 2009; Chen et al., 2014; Lamiani et al., 2015; Mann, Ponieman, Leventhal, & Halm, 2009) indicating that patients who perceive their disease as chronic also treat taking medication as a long-term commitment.

Further analysis revealed patients' conscientiousness to be a common predictor for both medication and non-medication treatment adherence. Not only conscientiousness had been identified as a predictor of better health and longevity in general population (Turiano et al., 2011; Bogg & Roberts, 2013; Goodwin & Friedman, 2006), but it also had been associated with medication treatment adherence by several recent studies (Axelsson et al., 2011; Axelsson, 2013; Axelsson et al., 2013; Bruce, Hancock, Arnett, & Lynch, 2010; Emilsson et al., 2011; Wheeler et al., 2012). Mounting evidence suggests that personality traits, especially conscientiousness, should be explicitly and comprehensively analyzed by theoretical models explaining health-related behaviors.

Several studies suggested a direct impact of patient-provider relationship quality (DuMontier, Rindfleisch, Pruszynski, & Frey, 2013; Gascón, Sánchez-Ortuño, Llor, Skidmore, & Saturno, 2004; Gherman et al., 2011; Haskard Zolnierek & DiMatteo, 2009; Osterberg & Balschke, 2005) and healthcare providers epistemic authority (Bar-Tal, Stasiuk, & Maksymiuk, 2013; Stasiuk, Maksymiuk, & Bar-Tal, 2014) on patients' behavior, however, in contrast to what was expected, the results of this study revealed no direct link between patients' attitude toward healthcare provider and treatment adherence. Yet this result does not undermine the role of healthcare provider in the context of treatment adherence, but rather unveils the mechanisms that underlie provider-adherence relationship, showing that patients' appraisal of the healthcare provider contributes to his or her beliefs regarding treatment.

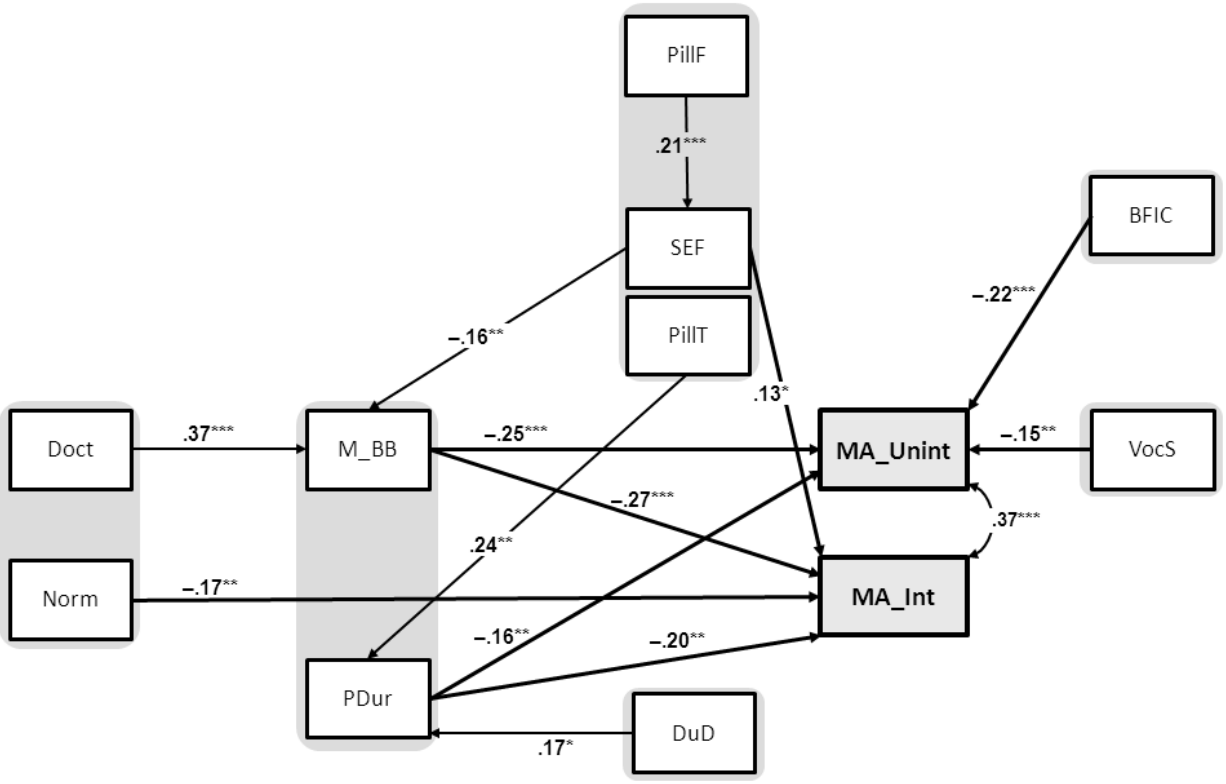
Furthermore, according to the results yielded, benefit-barrier balance, as well as relevant aspects of illness perception, can be predicted by treatment- and condition-related variables. This supports the assumption that beliefs and perceptions are shaped by personal experience (Ajzen & Fishbein, 2000; Hagger & Orbell, 2003; Leventhal, Diefenbach, & Leventhal, 1992; Leventhal et al., 1998). The results show that less frequent medication side-effects predict more positive benefit-barrier balance for medication treatment beliefs, while better subjective appraisal of health condition predict more positive benefit-barrier balance for non-medication treatment. Also, more frequent the medication side-effects, longer the actual duration of disease, greater the number of chronic diseases, and worse the subjective appraisal of health condition results in greater perceived illness-related health risk. Meanwhile, longer perceived illness duration is predicted by longer actual duration of chronic disease and greater number of different drugs prescribed. Besides, only frequency of medication side-effects, but none of condition related variables were directly linked to medication adherence, and only number of chronic diseases predicted non-medication adherence directly. Summing up, it is doubtful that condition and treatment variables per se are able to predict treatment adherence, but rather indirectly they still play a significant part in the context of treatment adherence by framing patients' beliefs and perceptions.

The role of perceived social support, subjective norms and some other variables will be discussed in more detail in the next section.

Prognostic models of first-order medication and non-medication treatment adherence factors

In this section we will only discuss specific results and differences that emerged when analyzing predictors of first-order factor and therefore were not covered by the previous section.

The final structural model of predictors for first-order factors of medication treatment adherence satisfies all fit criteria: χ^2 = 30.760; df = 31; p = .478; RMSEA < .001; CFI = 1.000; TLI = 1.002.



Note. * p < 0.05; ** p < 0.01; *** p < 0.001. *MA_Unint*– unintentional medication non-adherence; *MA_Int* – intentional medication non-adherence; *VocS* – vocational status; *BFIC* – conscientiousness; *PillT* – number of different drugs prescribed; *PillF* – number of doses per day; *SEF* – frequency of side-effects; *DuD* – actual duration of chronic disease; *M_BB* – benefit-barrier balance for medication treatment; *PDur* – perceived illness duration; *Doct* – attitude toward healthcare provider; *Norm* – subjective norms.

Figure 3. Prognostic model for first-order factors of medication treatment adherence

Intentional medication non-adherence is considered to be a thoughtful and deliberate decision to discontinue or alter the dosage of medication, while unintentional medication non-adherence is a more passive and often linked to forgetfulness (Clifford et al., 2008; Iihara et al., 2014; Lehane & McCarthy, 2007a; Molloy et al., 2014; Wroe,

2002). As shown by the results of this research (Figure 3.), these aspects of medication treatment adherence share common and have distinctive predictors.

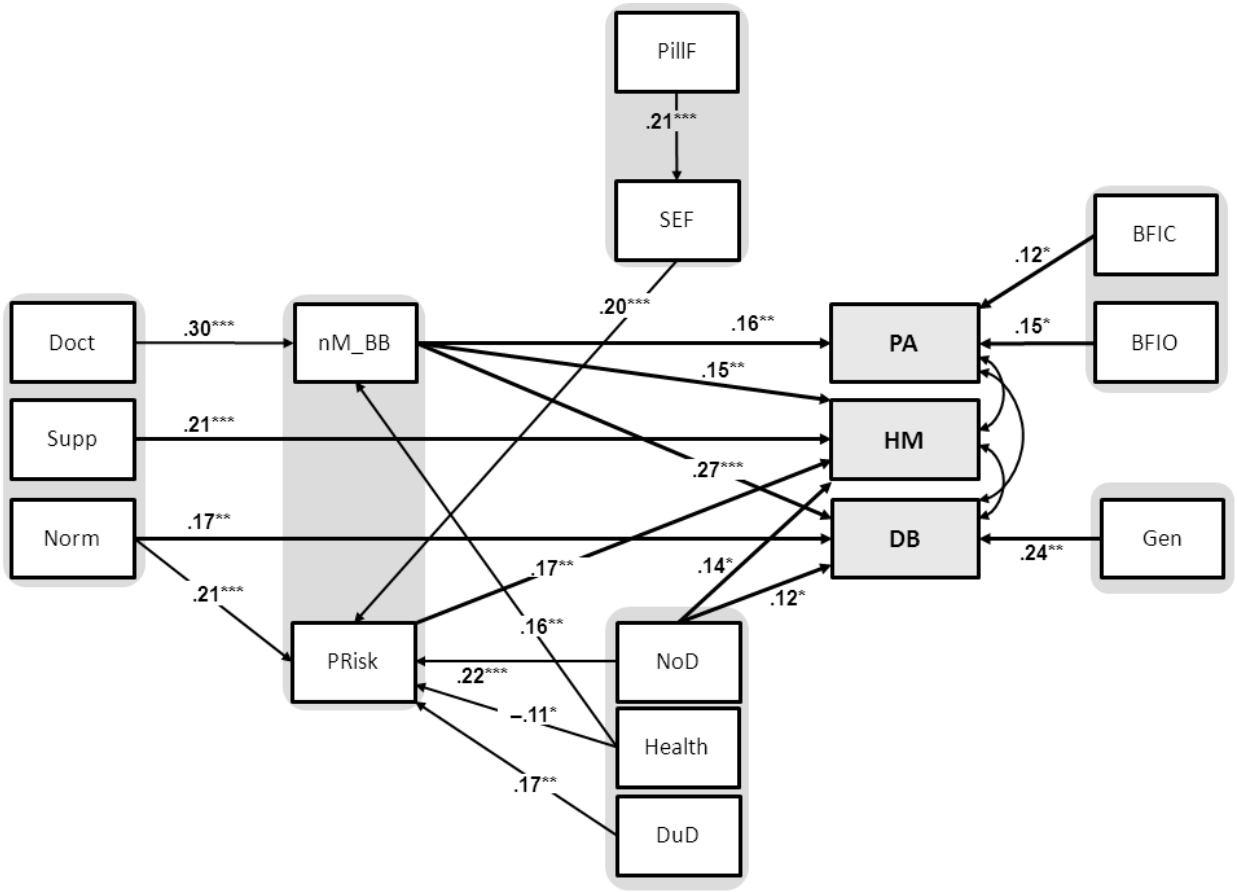
Intentional medication non-adherence is predicted by medication side-effects and subjective norms. Frequent and unpleasant side-effects of medication are often associated with insufficient levels of medication treatment adherence (Barbosa, Balp, Kulich, Germain, & Rofail, 2012; Gellad et al., 2011) and show that patients experiencing side-effects tend to purposely avoid medication. Whereas, established prognostic relationship between subjective norms and intentional medication non-adherence is supported by theory of planned behavior (Armitage & Conner, 2001; Hagger & Chatzisarantis, 2009; McEachan et al., 2011) and once again stresses the importance of social context of the patients, showing that perceived expectations of significant others can discourage the patient from deliberately altering medication regimen.

On the other hand, unintentional medication non-adherence is predicted by patients' conscientiousness and vocational status. It is often concluded that medication treatment adherence is predicted by patients' age (Brown & Park, 2003; Neupert, Patterson, Davis, & Allaire, 2011; Wroe, 2002), which is also the case in this research when predicting second-order medication treatment adherence factor (Figure 2), indicating that the older the patient, the more likely it is that he or she will adhere to medication treatment regimen. But further analysis of first-order factors revealed that vocational status becomes significant when predicting unintentional medication non-adherence. This result supports the assumption proposed by Park et al. (1999) and shows that not the age per se that is the factor of medication adherence, but rather distracting and busy schedule of working patients, interfering with proper medication taking. Moreover, higher scores on conscientiousness scale directly predict lower levels of unintentional medication non-adherence, and since conscientiousness is not only described by self-discipline, aiming for achievement and impulse control, but is also related to planning and being organized (Costa & McCrae, 2012), careful planning and organizing daily routines in order to match them to medication treatment requirements helps patients overcome challenges of having a busy working schedule and remember about medication.

Having in mind the conceptual differences between intentional and unintentional medication non-adherence, one might expect that unintentional medication non-adherence would not be related to patients' beliefs and perceptions (de Vries et al., 2014; Lehane & McCarthy, 2007a, 2007b; Wroe, 2002). However, the results of this study contradict this assumption and lead to a conclusion that both first-order factors of medication treatment adherence – intentional and unintentional – are predicted by benefit-barrier balance for medication treatment and perceived illness duration. On the one hand, we can assume that, due to social desirability, patients partially report intentional non-adherence as being unintentional to avoid judgment. On the other hand, we can entertain the idea that intentional as well as unintentional medication non-adherence is determined by cognitive appraisal processes, but in the case of unintentional behavior appraisal is automatic and does not require much cognitive resources, as proposed by the authors of the theory of planned behavior (Ajzen, 2002; Ajzen, 2011; Ajzen & Fishbein, 2000).

Finally, as shown in Figure 3, higher number of doses per day predict more frequent medication side-effects, which in turn is related not only to intentional medication non-adherence, but also to benefit-barrier balance for medication treatment. This indirect relationship may help explain why technical interventions that employ regimen simplification and reduction of the number of daily doses (Dasgupta et al., 2014; Van Dulmen et al., 2007) have been consistently successful in terms of increasing medication treatment adherence.

The final structural model of predictors for first-order factors of non-medication treatment adherence satisfies all fit criteria: $\chi^2 = 67.635$; df = 53; p = .085; RMSEA = .030; CFI = .951; TLI = .931.



Note. * p < 0.05; ** p < 0.01; *** p < 0.001. *PA* – physical activity; *HM* – health monitoring; *DB* – dietary behavior; *Gen* – gender; *BFIC* – conscientiousness; *BFIO* – openness; *PillF* – number of doses per day; *SEF* – frequency of side-effects; *NoD* – number of chronic diseases; *Health* – subjective appraisal of health condition; *DuD* – actual duration of chronic disease; *nM_BB* – benefit-barrier balance for non-medication treatment; *PRisk* – perceived illness-related health risk; *Doct* – attitude toward healthcare provider; *Norm* – subjective norms; *Supp* – perceived social support.

Figure 4. Prognostic model for first-order factors of non-medication treatment adherence

The results presented in Figure 4 show that benefit-barrier balance is the only common predictor for all first-order factors of non-medication treatment adherence. And since these first-order factors are predicted by various variables, they will be presented separately.

Apart from benefit-barrier balance, more regular health monitoring is predicted by higher levels of social support from close relatives and friends, perceived risk, and presence of comorbid conditions that is reflected by the number of chronic diseases the patient has. It is almost obvious that if a patient perceives the illness as a bigger health threat, he or she would be more likely to regularly check their health status, which would allow a timely detection of any negative health changes and probably

initiation of preventive action. This result is also supported by other theoretical models of health behavior (Munro et al., 2007). The results related to the number of chronic diseases are supported by other research showing that comorbid conditions increase the likelihood of proper health monitoring (e.g. Adams et al., 2003). Also, as discussed earlier, the number of chronic diseases contributes to patients' risk perception as well. What is more, analysis conducted by Van Houtum, Rijken, Heijmans, & Groenewegen (2014) showed that patients mostly expect help and support from their family and friends when it comes to health monitoring, especially regarding doctoral appointments, which coincides with the results of this research.

According to the results of this research, more appropriate levels of physical activity are predicted by personality traits – higher scores on openness and conscientiousness scales. Even though majority of research points toward extraversion being the trait related to physical activity (Rhodes & Smith, 2006; Wheeler et al., 2012; Žugelj et al., 2010), Hillard and colleagues (2014) showed that patients that are more open to experience are also more likely to engage in sport rehabilitation after reconstructive surgery, which can be explained by their interest in new or diverse activities. Meanwhile being dutiful and achievement oriented (Costa & McCrae, 2012) helps patients with greater conscientiousness maintain proper levels of physical activity over time.

In addition to benefit-barrier balance for non-medication treatment, more appropriate levels of dietary behavior are predicted by female gender, greater number of chronic diseases and subjective norms that affirm strict adherence to treatment regimen. Although greater number of chronic conditions is usually associated with poor treatment adherence due to greater burden on the patient (WHO, 2003), some studies show that when patients with hypertension are diagnosed with comorbid diabetes, their adherence to treatment regimen improves (Briesacher, Andrade, Fouayzi, & Chan, 2008). Since all subjects in the present research were diagnosed with hypertension and many had comorbid diabetes, yielded positive relationship between number of chronic diseases and dietary behavior is more than likely. Apart from this, the results indicating that male patients are less adherent to dietary recommendations match results from some other studies (Chung et al., 2006; Mattioli, Pennella, Pedrazzi, & Farinetti, 2013; Szymczyk, Wojtyna, Lukas, Kępa, & Pawlikowska, 2013). This may be related to the fact that

women usually have more experience with diets and, as homemakers, are more responsible for food choices and preparations. Finally, results of this research show that not only intentional medication non-adherence, but also dietary behavior can be actuated by perceived social pressure of significant others in the form of subjective norms, which coincides with results from other research (Didarloo, Shojaeizadeh, Gharaaghaji, Niknami, & Khorami, 2014; Kothe & Mullan, 2015; Rich Brandes, Mullan, & Hagger, 2015). Other studies also show that patients exhibit better adherence to dietary recommendations when other family members not only suggest, but also adhere and maintain similar dietary principals (Chung, Lennie, Mud-Martin, & Moser, 2015). These results partially correspond with established gender differences, because we can assume that if patients' family does not take into account or agree with dietary restrictions required by the treatment while patient is not solely responsible by food choices and preparations in the household, this might negatively affects patients' dietary behavior.

CONCLUSIONS

1. Adherence to treatment regimen among patients with chronic diseases is best explained by a hierarchical structure of two second-order factors: medication and non-medication treatment adherence. Medication treatment adherence factor is composed of first-order intentional and unintentional medication non-adherence factors, while non-medication treatment adherence is composed of health monitoring, physical activities and dietary behavior factors.
2. Patients' beliefs about the treatment, reflected in benefit-barrier balance for treatment, predict adherence to treatment regimen. Patients, who think that the prescribed treatment is more effective and useful for their health and / or see less barriers to maintaining treatment requirements, tend to better adhere to treatment recommendations.
   2.1. Benefit-barrier balance for medication treatment allows predicting adherence to medication treatment and the factors it is composed of.
   2.2. Benefit-barrier balance for non-medication treatment allows predicting adherence to non-medication treatment and the factors it is composed of.
3. Certain aspects of patients' illness perception predict adherence to treatment regimen. The patients perceiving their illness as long-lasting tend to be more adherent to medication treatment regimen, i.e., these patients are less prone to discontinue medication treatment intentionally, to forget to take or take less medication than was prescribed without consulting the healthcare provider. At the same time, patients who perceive their illness as posing a greater risk to their health tend to be more adherent to non-medication treatment regimen and more regularly monitor their health condition either by themselves or with the assistance of a healthcare provider.
4. Personality traits like conscientiousness and openness predict specific aspects of treatment adherence. Greater conscientiousness predicts better levels of adherence to both medication and non-medication treatment, patients with higher scores on conscientiousness scale maintain higher levels of physical activity and are less likely to forget to take or be careless with medication prescribed. Scoring higher on openness to experience is also related to preferable levels of physical activity.

5. Sociodemographic factors, such as age, vocational status and gender of patients with chronic diseases, also predict specific aspects of adherence to treatment regimen. Women are more adherent to non-medication treatment and are more likely to follow dietary recommendations. On the other hand, the older patients are better adhering to medication treatment, while unemployed or retired patients are less forgetful with taking prescribed medication.
6. Such micro-level factors as perceived social support, subjective norms and patient's attitude towards healthcare provider both directly and indirectly predict patients' adherence to treatment regimen.
    6.1. Patients who feel that they receive greater social support from close relatives and friends tend to better adhere to non-medication treatment regimen and monitor their health more regularly.
    6.2. When patients with chronic conditions believe that their significant others expect stricter adherence to treatment regimen, they adhere to medication treatment recommendations better, are less likely to intentionally stop taking the medication or reduce the dosage prescribed, exhibit better adherence to dietary recommendations and perceive their illness as posing a greater risk to their health.
    6.3. Patient's attitude toward healthcare provider is not related to the treatment adherence directly, though better subjective appraisal of healthcare provider leads to patient's appraisal of the prescribed treatment as more effective and / or presenting less barriers, thus forming positive benefit-barrier balance, which in turn predicts all the aspects of treatment adherence.
7. Medication and non-medication treatment adherence is predicted, both directly and indirectly, by treatment-related and health condition factors.
    7.1. Patients experiencing more frequent medication side-effects, which in turn are related to higher numbers of doses per day, exhibit poorer adherence to medication treatment regimen, they are also more likely to intentionally stop taking the medication or reduce the dosage prescribed. Moreover, more frequent medication side-effects predict higher level of perceived health risk, which in turn is directly related to non-medication treatment adherence. Higher number of

different drugs prescribed, which predicts longer perceived illness duration, is only indirectly related to medication treatment adherence.

7.2. Subjective appraisal of health condition and actual duration of chronic disease are not directly associated with aspects of adherence to treatment regimen, however these variables predict other factors relevant to treatment adherence like perceived illness-related health risk and benefit-barrier balance for non-medication treatment, i.e. longer actual duration of chronic disease and poorer subjective health condition predict greater perceived health risk, while better subjective health condition predicts a more positive benefit-barrier balance for non-medication treatment. Patients, who apart from hypertension were diagnosed with comorbid diabetes or other conditions, are more adherent to non-medication treatment, follow the dietary restrictions better, monitor their health condition more regularly, and perceive greater illness-related health risk

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