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HEALTH CONDITIONS AND TEMPORAL STABILITY OF THE INTERNAL STRUCTURE OF ILLNESS REPRESENTATION IN PATIENTS WITH MYOCARDIAL INFARCTION

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Damjana Panić

University of Niš, Faculty of Philosophy, Department of Psychology, Serbia

Abstract. *The study aimed to examine the effects of health conditions – previous history of cardiovascular disease (high blood pressure, hypertension, angina pectoris), heredity, risk factors for MI (smoking, obesity, hyperlipidemia, physical inactivity), and acute/chronic stress in the previous year, and socio-demographic variables (gender, age, education, relationship, and material status) on the formation and change in the mental representation of MI. In addition, the temporal stability of the internal structure of the illness representation dimensions in MI patients, and the effect the health and socio-demographic conditions may have on it, were also examined. The results point to significant effects of health and socio-demographic factors on the formation and change of myocardial infarction representation. A significant change in the internal structure of the illness representation was already found 1.5-2 months following the event. This change can only be partially explained by the examined health and socio-demographic conditions, given that after partialization of these effects, differences in the construct's internal structure at the two measurement time points remain significant. The results are discussed according to the theoretical background and previous research findings. Future research should explore the effects of some other variables that could further explain the temporal changes in the MI representation, but also the initial representation formation.*

Key words: *Perceptions of illness, illness representations, temporal stability, myocardial infarction, health conditions.*

1. INTRODUCTION

Myocardial infarction (MI), as one of the forms of the acute coronary syndrome, belongs to cardiovascular diseases (CVD) that are considered one of the leading causes of death and a significant socio-medical and economic issue (Memon et al. 2016). Thanks to

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Corresponding author: Damjana Panić
University of Niš, Faculty of Philosophy, Ćirila i Metodija 2, 18000 Niš, Serbia
E-mail: damjana.panic@filfak.ni.ac.rs

medical advances, today a large number of people (according to some data up to 2/3, Bennett and Connell 1999) recover from MI and return to their normal lives following rehabilitation. However, in addition to somatic and functional issues, MI can have numerous psychological effects on a person, affecting their lifestyle, significantly restricting everyday functioning, and making adaptation to everyday life demands difficult (e.g., Arrebola-Moreno et al. 2014; Granados-Gámez et al. 2015). Accordingly, numerous studies have highlighted the significance of psychological factors in the post-MI recovery process (e.g., DuBois et al. 2012).

Health- and illness-related cognition has long been a topic of interest in psychological research, which resulted in numerous models and theories explaining health-related behavior (Downey and Chang 2013). In this regard, the Commonsense Model of Self-Regulation (CSM; Leventhal et al. 1980, 2016) has been developed as one of the most commonly used frameworks for understanding the psychological representation of illness and its possible effects on coping and various health-relevant outcomes. In addition, CSM enables the understanding of the importance of illness perception at various stages of MI and offers guidelines for developing intervention programs aimed at facilitating the recovery process (Petrie and Weinman, 1997).

Broadly speaking, illness representations can be considered as individual common-sense definitions of a health threat (Leventhal et al. 1998). They include people's *beliefs* and *expectations* about their own or someone else's illness, injury, symptom, sensation, and can be formed in several ways. Previous experiences with the illness, whether one's own or someone else's, certain socio-cultural beliefs about a (specific) illness, and how the media convey information about the illness(s) are factors that contribute to forming representations. Belief contents also depend on the data received from physicians and/or other health professionals and the type of diagnosis. Thus, illness representation comprises both *concrete experiences* and *abstract understanding* of the illness. Activation of illness representation implies activation of illness construct content both at the observed/appraised level (abstract and concrete) – *cognitive representation*, and at the experiential level – *emotional representation* (e.g., Dempster et al. 2015). Namely, the CSM model suggests a parallel response of a person both on the cognitive and emotional levels, which are activated relatively independently in the face of a health threat. The cognition contained in illness representation and the emotional responses trigger activity aimed at improving the illness outcome and emotion regulation. Conversely, a person appraises the effect of activities taken on the illness outcome, which can lead to changes in cognitive representation and emotional response (Broadbent et al. 2015). The critical aspect of the extended model is the assumption of two parallel processes related to a cognitive and emotional response to illness and reappraisal that indicates a dynamic process of self-regulation where a person adopts coping strategies, assesses progress, and accordingly revises coping aspects and formed illness representations (Serlachius and Sutton 2009).

According to the operationalization of the CSM model, illness representation has five basic dimensions: 1) *Identity* (the way a person describes the location and severity of somatic sensations, symptoms, and their potential meaning, i.e., the name attributed to them and how they are interconnected); 2) *Timeline* (assessment of the illness onset period, duration, course and time required to reduce symptoms); *Consequences* (functional, social and financial); 4) *Causes* (what a person believes led to the illness (e.g., exertion, stress, heredity). Various studies have identified a number of factors that can be considered causes of illness, such as *biological* (viruses, bacteria, immune system

characteristics; Heijmans 1998); *emotional* (stress, depression; Weinman et al. 1996); *environmental* (pollution, chemicals; Heijmans 1998; Heijmans & De Ridder 1998) and *psychological* factors (attitudes and other traits, excessive work; Moss-Morris et al. 2002), as well as some overlaps between them, which used to lead to difficulties in examining and interpreting this dimension of illness representation in earlier stages; 5) *Control* (how a person assesses their control over illness and healing) (Leventhal et al. 2016). Later research has pointed to another (sixth) dimension related to beliefs that make sense of illness – *Illness coherence* (Moss-Morris et al. 2002). The inclusion of this dimension in the model has been supported by the results of a meta-analysis of the self-regulation model (Foxwell et al. 2013). In addition to the above representations, which are primarily cognitive in nature, as already mentioned, the extended model includes *Emotional representations* (Leventhal et al. 2016; Moss-Morris et al. 2002) – negative emotional reactions to illness such as fear, anger, distress and their vents as responses to illness, but also to its outcomes (e.g., Evans and Norman 2009; Knibb and Horton 2008).

Although different, illness representation dimensions are not mutually independent. Many findings to date, including data from meta-analytical studies, confirm the relationship of individual dimensions (Hagger et al. 2017). Also, research shows that perception of illness can change over time due to various factors related to the illness itself, but also various interventions such as education, rehabilitation, and other aspects related to medication adherence (Astin and Jones 2006; Broadbent et al. 2009; Petrie et al. 2012).

This study had two objectives – to examine the effect of health conditions: previous history of cardiovascular diseases (high blood pressure, hypertension, angina pectoris), heredity, risk factors for MI (smoking, obesity, hyperlipidemia, diabetes, physical inactivity), and acute/chronic stress in the previous year, and socio-demographic variables (gender, age, education, relationship, and material status) on the formation of mental representation of MI immediately after the event and 1.5–2 months after MI. In addition to these factors, after 1.5–2 months, the effect of possible complications and acute stress over this period, rehabilitation, and physical (in)activity on illness representation was examined. The second goal was to check the temporal stability of the internal structure of illness representation during 1.5–2 months following MI and the effect this health and socio-demographic condition may have on it.

2. METHOD

2.1. Measures

The Illness Perception Questionnaire – Revised (IPQ-R; Moss-Morris et al. 2002) was used to assess illness representation. It comprises 38 items and is intended to measure cognitive representations – Identity, Timeline (acute/chronic), Timeline (cyclical), Consequences, Personal control, Treatment control, Illness coherence, and Causal attributions, and emotional representations involving negative emotional states such as fear, anger, and distress (Moss-Morris et al. 2002). All subdimensions except Identity were operationalized by answers arranged on a five-point Likert-type scale (1 = *I strongly agree*, 5 = *I strongly disagree*). The identity dimension was assessed by respondents choosing whether any of the 14 symptoms were related to their illness and whether they had any experience with it at all in a binary answer format (*yes/no*). The causal dimension

is operationalized within a special subtest with 18 items on potential causes of illness. In addition to the abovementioned, respondents could list additional causes of their illness.

The factor structure of illness representation dimensions has been replicated in different patient samples to a greater or lesser extent in previous research (e.g., Abubakari et al. 2012; Giannousi et al. 2010; Lau et al. 2020; Nicholls et al. 2013). In this study, no satisfactory incremental fit indices CFI = .673, TLI = .643 were obtained by testing the factor structure of the IPQ-R scale, while the absolute fit index was acceptable RMSEA = .077, 90% CI [.069 – .085].[1] Unsatisfactory CFI and TLI indices are in line with the findings of previous research (e.g., Giannousi et al. 2010; Nicholls et al. 2013) and can be explained by the complex structure of the scale itself (number of factors, item distribution, greater conceptual similarity of some factors reflected in their combined loadings of indicators/behavioral manifestations of latent variables) which is inconsistent with the Independent cluster model (ICM) on which the CFA relies, limiting the loadings of one item to one factor (e.g., Marsh et al. 2013). Therefore, the global fit model check was not the primary goal of this validation. Considering our findings and the results presented so far, we rather analyzed the measurement quality of items (factor loadings) within certain dimensions (local fit inspection) to retain existing constructs. The results show that most items adequately load the dimensions of the manifestations which they represent according to theory. Factor loading and theoretical reasons were used as a criterion for item selection. Accordingly, the following items were excluded from further analysis: 9, 11, 15, 17, 19, 23, 28, 37, and 38. The fit of this model was significantly improved (MLχ2(356) = 582.508, $p < .001$, CFI = .749, TLI = .713, RMSEA = .075, 90% CI [.064–.085]). At measurement time point one, the reliability of illness representation dimensions, measured by Cronbach's α coefficient, ranges from .530 to .850, with marginal reliability coefficients (.70 > α >. 50) determined for the following dimensions of illness representation: cyclical timeline α = .530; consequences α = .639, personal control α = .572, and treatment control α = .582. As for time point two, α coefficients range from .522 to .836, with marginal reliability coefficients determined for the dimensions: cyclical timeline α = .600, consequences α = .530; personal control α = .629, treatment control α = .522, and coherence α = .673. Marginal levels of internal consistency in these dimensions at both measurement time points can be explained by the insufficient number of items they include, but can also indicate somewhat poorer internal consistencies of the constructs themselves.

Validation of the *cause scale* as one of the dimensions of illness representation was checked exploratively, based on validation in previous works (e.g., Moss-Morris et al. 2002; Hagger and Orbell 2005; Abubakari et al. 2012) to reduce the model complexity. First, a parallel analysis was applied, suggesting the existence of three components (and four factors) (Buja and Eyuboglu 1992), and Velicer's MAP test (Velicer 1976), which indicated two factors. These different solutions were then tested by the principal component analysis (PCA). Based on the obtained findings and allowing for interpretability as one of the key criteria, the three factors were retained as more interpretable, accounting for 39.93% of the total variance. Given the content of items that load individual factors, the causal attributions in this sample can be divided into *Psychological attributions* (items 1, 8, 9, 10,

[1] Also, this model testing carried with it an indication of non-identification and problems in the convergence of model estimates as the lowest intrinsic value was close to zero (= 1.785801e-14). However, the model index and parameters values have been successfully estimated and are of adequate size (all variances are positive and the standardized values are within their limits) so the lavaan package warning has been ignored. This is most likely a consequence of the items to subjects number ratio.

12, 17), *Biological/external attributions* (items 3, 4, 5, 6, 13, 16, 18), and *Behavioral attributions* (items 11, 14, 15). Items 2 and 7 did not show substantive loadings in any factor and were excluded from further analysis. The three-factor solution was mainly determined in other studies on different samples as well (e.g., Hagger and Orbell 2005; Abubakari et al. 2012), with item distribution by factors being partially comparable. The reliability of thus determined cause subscales measured by the α coefficient is below the acceptable level (α < .07) for the second and third components (Biological/external attributions and Behavioral attributions) at both time points. The lower α coefficient for the Biological/external attributions can be understood based on heterogeneous attributions representing the manifestations of this variable. The Behavioral attributions component comprises only three items, which may also affect lower reliability. Certainly, these results will be taken into account when interpreting the results.

To assess the health conditions that may affect the formation and change of the mental representation of MI, a purpose-designed questionnaire was used, in which assessed variables were operationalized on a binary scale (*yes/no*). The same questionnaire was also used to collect data about the socio-demographic characteristics of the respondents (gender, age, education, material, relationship status).

2.2. Sample

The sample consisted of 114 first-time MI patients who were hospitalized (M = 54.90, SD = 11.23, 78.1% male). As for demographic characteristics, the sample structure was predominantly made up of respondents with a secondary education (65.8%), who were married (85.1%), and who described their material status as medium (*neither good nor bad*, 64.9%). After 1.5–2 months, 67 respondents accepted to participate in measurement time point two (57.77% response rate). The data were collected at the Cardiology Clinic of the University Clinical Center in Niš and at the Institute for Cardiovascular Diseases Dedinje to a lesser extent.

2.3. Data Collection Process

The first examination (T1) of the patients was performed during hospitalization due to the first MI, for a period from one to several days, depending on when the physician assessed the patient's condition was stable enough to participate in the study. The second examination (T2) was performed 1–2 months following the MI. The patients were contacted by the researcher one month after the first examination (T1), and the questionnaire battery was sent by mail or e-mail to those who agreed to participate in the second phase. As data were collected during the Covid-19 pandemic, the chosen method was one which the respondents considered less risky for their health condition or which was available to them. The completed questionnaires were usually delivered to the researcher a few days to two weeks from when the respondent received the test battery.

2.4. Data Analysis

In order to analyze the differences in the illness representation dimensions in MI patients according to health and socio-demographic conditions the Student’s t-test was used, while Cohen’s d was used as a measure of the effect size. Pearson’s correlation coefficient was used to identify the correlation between the variables. The test of

differences between matrices as proposed by Jennrich (1970) was performed in the psych R package (Revelle 2021). Fisher's z test was used for examine differences between correlation coefficients at two measurement time points.

3. RESULTS

Table 1 Descriptive statistics for health condition measures (N = 114)

Risk Factors	Frequency	Percentage
Problems with high blood pressure	54	42.9
Diagnosed hypertension	40	31.7
Diagnosed angina pectoris	14	11.1
Hereditary factors (cardiovascular disease: hypertension, angina pectoris, myocardial infarction in the family)	72	57.1
Smoking	77	61.1
Obesity	46	36.5
High cholesterol	42	33.3
Diabetes	15	11.9
Physical inactivity	77	61.1
Chronic stress (at work, at home) in the previous year	45	35.7
Acute stress (illness/death of loved ones, divorce, job loss) in the previous year	41	32.5

The most prominent[2] risk factors were smoking and physical inactivity (61.1%), as well as hereditary factors (57.1%).

Table 2 Mean differences in illness representations according to health conditions in T1

Illness representations	Health conditions		*M* (*SD*)	*t*(*df*), *p*	Cohen's *d*, 95% CI
Illness coherence	Higher blood pressure	Yes	3.31 (0.96)	2.101(111),	0.396
		No	2.95 (0.84)	$p < .05$	[0.022, 0.768]
Illness coherence	Hypertension	Yes	3.37 (1.08)	2.178(106),	0.434
		No	2.97 (0.81)	$p < .05$	[0.038, 0.828]
Identity	Angina pectoris	Yes	5.64 (2.24)	2.445(107),	0.700
		No	4.08 (2.22)	$p < .05$	[0.130, 1.267]
Emotional representations	Diabetes	Yes	3.33 (0.99)	2.397(111),	0.655
		No	2.76 (0.84)	$p < .05$	[0.113, 1.264]
Emotional representations	Smoking	Yes	2.71 (0.91)	-2.321(111),	-0.469
		No	3.11 (0.75)	$p < .05$	[-0.868, -0.067]
Consequences	Acute stress	Yes	3.11 (0.76)	-2.438(107),	-0.482
		No	3.46 (0.71)	$p < .05$	[-0.874, -0.088]
Biological/external attributions	Smoking	Yes	2.05 (0.56)	-2.815(111),	-0.568
		No	2.37 (0.61)	$p < .01$	[-0.970, -0.164]
Behavioral attributions	Diabetes	Yes	2.27 (0.94)	-2.481(111),	-0.688
		No	2.85 (0.84)	$p < .05$	[-1.237, -0.686]
Behavioral attributions	Smoking	Yes	2.97 (0.76)	3.719(111),	0.751
		No	2.35 (0.94)	$p < .001$	[.341, -1.157]

Note. Only significant effects are shown.

[2] The term most prominently refers to more than 50% of the respondents.

People who have previously had high blood pressure or have been diagnosed with hypertension also have a higher level of illness coherence, i.e., understanding of MI. Respondents with pre-existing angina pectoris conditions describe MI with a greater number of symptoms (identity dimension). Those who have diabetes have a stronger emotional representation of the illness and attribute MI less to behavioral attributions compared to those who do not. Smoking has a significant effect on the emotional representation of the illness and the causal attribution related to biological/external and behavioral attributions. Smokers also have a less marked emotional representation of the illness compared to non-smokers and attribute MI less to biological/external attributions and more to behavioral attributions. Acute stress in the past year (illness, death of loved ones, divorce, loss of job) contributes to a reduced perception of the severity of MI consequences. All the effect sizes were medium.

As for the socio-demographic variables, the effect of gender on all cause dimensions was determined, with more pronounced psychological causal attributions in women ($t(df)$ = -2.134 (111), $p < .05$, d = -0.483, 95% CI [-0.093, -0.034], and biological/external causal attributions ($t(df)$ = 2.378(112), $p < .05$, d = 0.538, 95% CI [0.088, 0.986]) and behavioral causal attributions ($t(df)$ = 2.144(112), $p < .05$, d = 0.485, 95% CI [0.036, 0.932]) in men. The effect of age on treatment control (r = -.352, $p < .001$), the effect of education on the perception of the acute/chronic timeline of the illness (F(4, 107) = 2.717, $p < .05$), and the effect of material status on the perception of the consequences (F(4, 106) = 3.986, $p < .01$), psychological (F(4, 106) = 2.624, $p < .05$), and behavioral causal attributions (F(4, 106) = 2.937, $p < .05$) were also determined. Due to the insufficient number of respondents in certain groups, it was not possible to determine which groups these differences refer to, but rather only a global significant effect was found.

Table 3 Mean differences in illness representations according to the health conditions in T2

Illness representation dimensions	Registered variables		*M* (*SD*)	*t*(*df*), *p*	Cohen's *d*, 95% CI
Consequences	Diabetes	Yes	4.09 (0.81)	2.603(64),	0.778
		No	3.44 (0.84)	$p < .05$	[0.024, 1.526]
Identity	Smoking	Yes	3.47 (2.66)	-2.103(64),	-0.572
		No	4.95 (2.39)	$p < .05$	[-1.111, -0.028]
Timeline (acute/chronic)	Smoking	Yes	3.07 (0.90)	-2.566(64),	-0.698
		No	3.63 (0.51)	$p < .05$	[-1.241, -0.149]
Timeline (cyclical)	Smoking	Yes	2.52 (0.78)	-2.672(64),	-0.726
		No	3.09 (0.78)	$p < .01$	[-1.271, -0.176]
Consequences	Smoking	Yes	3.30 (0.80)	-3.561(64),	-0.968
		No	4.07 (0.76)	$p < .001$	[-1.523, -0.406]
Behavioral attribution	Smoking	Yes	2.87 (0.72)	2.628(64),	0.714
		No	2.35 (0.74)	$p < .05$	[0.165, 1.259]
Illness coherence	Chronic stress	Yes	3.68 (0.72)	2.214(63),	0.535
		No	3.26 (0.84)	$p < .01$	[0.030, 1.035]
Timeline (cyclical)	Complications	Yes	3.50 (0.59)	3.001(63),	1.201
		No	2.60 (0.79)	$p < .01$	[0.385, 2.008]
Consequences	Complications	Yes	4.23 (0.64)	2.509(63),	1.004
		No	3.43 (0.81)	$p < .05$	[0.197, 1.804]
Emotional representations	Complications	Yes	3.71 (0.95)	2.997(63),	1.199
		No	2.71 (0.82)	$p < .01$	[0.383, 2.006]
Consequences	Cardiac rehabilitation	Yes	3.00 (0.66)	-2.404(64),	-0.794
		No	3.64 (0.83)	$p < .05$	[-1.453, -0.129]

Note. Only significant effects are shown.

A significant difference was found in the perception of the consequence severity given pre-existing diabetes, with people with diabetes perceiving more severe consequences of MI 1.5–2 months after the event. People who were smokers when they had their MI describe it with fewer symptoms, have a lower perception of the chronic and cyclical course of the illness and its consequences, and attribute MI more to behavioral factors after 1.5–2 months. The presence of chronic stress during MI increases the level of coherence 1.5–2 months after the MI. Complications 1.5–2 months after the MI have been found to have an effect on a more pronounced perception of the cyclical course of the illness, of more severe consequences and emotional representation, while participation in a rehabilitation program reduces the severity of the perceived consequences.

As for socio-demographic variables, women have a more pronounced emotional representation of the illness ($t(df)$ = -2.296(65), $p < .05$, d = -0.731, 95% CI [-1.366, -0.092],) and like at time point one, a psychological causal attribution ($t(df)$ = -3.978(65), $p < .001$, d = -1.267, 95% CI [-1.924, -0.602]). The relationship status has a significant effect on perception of consequences ($F(4, 62) = 3.640$, $p < .05$), material status on psychological causal attributions ($F(3, 61) = 2.781$, $p < .05$), age on perception of the cyclical timeline of the illness ($r = .265$, $p < .05$) and coherence ($r = -334$, $p < .01$), and education on the cyclical timeline ($F(4, 60) = 2.637$, $p < .05$) and consequences of the illness ($F(4, 60) = 2.999$, $p < .05$).

Table 4 Intercorrelations between illness representations in T1

	Variables	1	2	3	4	5	6	7	8	9	10	11
1.	Identity (T1)	–										
2.	Timeline (acute/chronic) (T1)	.108	–									
3.	Timeline (cyclical) (T1)	.206 *	.076	–								
4.	Consequences (T1)	.078	.217 *	.079	–							
5.	Personal control (T1)	.023	-.198 *	.156	.001	–						
6.	Treatment control (T1)	.016	-.408 ***	.010	-.115	.266 **	–					
7.	Illness coherence (T1)	-.095	.214 *	-.277 **	-.051	-.139	-.117	–				
8.	Emotional representations (T1)	.296 **	.071	.237 *	.222 *	-.047	.085	-.299 **	–			
9.	Psychological attributions (T1)	.097	.087	.191 *	.055	.030	.096	-.058	.484 ***	–		
10.	Causal – External-biological attributions (T1)	.083	.040	.103	.219 *	-.017	-.095	-.072	.105	.255 **	–	
11.	Behavioral attributions (T1)	-.046	.134	.096	.157	.118	-.091	-.179	-.101	.123	.188 *	–

* $p < .05$; ** $p < .01$; *** $p < .001$.

The results indicate significant intercorrelations between the dimensions of illness representations. The more people describe MI with more symptoms (identity dimension), the more they will perceive the course of their illness as variable (cyclical timeline dimension), and have a higher level of negative illness-related emotions – fear, anger, distress (emotional representation of the illness). The more people believe that the illness will last longer (chronic timeline dimension), the more severe the perception of the illness consequences (consequences dimension), and the lower the level of perceived control, both personal and of the treatment. On the other hand, the less people understand the

illness (coherence dimension), the more they will perceive its course as acute and variable (the cyclical timeline dimension) and have a stronger emotional representation (fear, anger, distress). Emotional representation itself is associated with a more severe perception of the illness consequences and more frequent attribution of MI causes to psychological attributions (attributions related to personality, attitudes, emotions, and behavior). On the other hand, the perception of more severe consequences is associated with greater attribution of MI causes to external or biological attributions (bacteria/viruses, eating habits, circumstances, aging, an altered immune response).

Changes after 1.5–2 months are registered in the cognitive dimensions related to the cyclical timeline perception ($F(1, 66) = 15.711$, $p < .001$, $p\eta^2 = .192$), personal control ($F(1, 66) = 4.216$, $p < .05$, $p\eta^2 = .060$), coherence ($F(1, 66) = 5.519$, $p < .05$, $p\eta^2 = .077$), and causal biological/external attributions ($F(1, 66) = 7.844$, $p < .01$, $p\eta^2 = .106$). Patients begin to perceive the timeline of their illness as less cyclical, i.e., less unpredictable, the level of understanding the illness increases (change in coherence), the level of perceived personal control decreases, and attributing the MI cause to external/biological attributions increases compared to the period immediately after the MI.

Table 5 Intercorrelations between illness representations in T2

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Identity (T2)	–										
2. Timeline (acute/chronic) (T2)	.191	–									
3. Timeline (cyclical) (T2)	.382**	.118	–								
4. Consequences (T2)	.421***	.452***	.305*	–							
5. Personal control (T2)	.001	.028	.022	.097	–						
6. Treatment control (T2)	-.155	-.303*	.011	-.015	.607***	–					
7. Illness coherence (T2)	.043	.032	-.368**	-.056	.137	.224	–				
8. Emotional representations (T2)	.319**	.036	.334**	.281*	-.046	-.209	-.326**	–			
9. Psychological attributions (T2)	.295*	.091	.261*	.360**	-.012	-.166	-.019	.424***	–		
10. Causal – External-biological attributions (T2)	.277*	.066	.287*	.254*	-.028	-.215	-.016	.195	.436***	–	
11. Behavioral attributions (T2)	-.006	.170	-.116	.114	.066	-.052	.146	.108	.401***	.206	–

* $p < .05$; ** $p < .01$; *** $p < .001$.

The intercorrelations of the illness representation dimensions at time point two generally corresponded to the initially determined intercorrelations, with several changes in the interrelationships. The perception of more symptoms within the identity dimension was still associated with a higher level of perception of the cyclical timeline and a higher level of emotional representation of the illness (fear, anger, distress), but also with *a higher perception of severity of consequences and attribution of causes to psychological and external/biological factors*, which was a new finding compared to the initial measurement time point. There was still a positive correlation between perception of the chronic illness timeline and the consequence dimension, and a negative one with the perception of control of the illness, *but this time correlation was obtained only in the case of perceived treatment control*. Stable intercorrelations were also found between the

perception of the cyclical timeline of the illness and increased attribution of the MI cause to psychological attributions, a stronger emotional representation, and reduced illness understanding (the coherence dimension). Another analyzed association was that of the perception of the cyclical illness timeline with *biological/external causal attributions*, but also with the perception of *higher levels of consequences that had not been initially found*. The association between emotional representation and more frequent attribution of the cause of the illness to psychological attributions was also confirmed. The correlation was confirmed between the perception of consequences and emotional representation, as well as the cause in relation to biological/external attributions. In addition, a correlation between consequences and psychological causal attributions was obtained. It seems that the stronger the perceived consequences, the greater the number of causes observed on the basis of MI occurrence. A negative correlation between the coherence and emotional representation dimensions was also confirmed.

Although there were a number of individual stable intercorrelations[3] of illness representation dimensions at the two measurement time points, a significant difference was found in the total intercorrelation structure ($\chi 2(55) = 79.698$, $p = .016$). After partialization of the effect of health-related and socio-demographic variables in which the illness construct is formed at T1 and T2, the congruence of internal structures of the MI illness representation at two time points was checked again. It turned out that, although smaller, the difference was still significant ($\chi 2(55) = 77.007$, $p = .027$). However, there are associations between the individual dimensions of illness representations that proved to be stable after the partialization of these effects: namely, the link between perception of the chronic illness timeline and treatment control ($z = -.589$, $p > .05$), as well as chronic illness timeline and consequences ($z = 1.182$, $p > .05$); coherence and perception of the cyclical timeline ($z = .105$, $p > .05$), coherence and emotional representation ($z = -.074$, $p > .05$), emotional representation and psychological causal attributions ($z = 1.546$, $p > .05$), and psychological and biological/external causal attributions ($z = -1.414$, $p > .05$). On the other hand, the relations between identity and the cyclic illness timeline ($z = -1.232$, $p > .05$), identity and the emotional representation of the illness ($z = -.162$, $p > .05$), emotional representation and the cyclic illness timeline ($z = -.674$, $p > .05$), emotional representations and consequences ($z = .401$, $p > .05$), consequences and external/biological causal attributions ($z = -.236$, $p > .05$), psychological attributions and cyclic illness timeline ($z = -.463$, $p > .05$), and biological/external and behavioral attributions ($z = .346$, $p > .05$) proved to be time-stable but dependent on health conditions and socio-demographic variables (see Tables 1 and 2 in Appendix).

4. DISCUSSION

The main goal of this research was to examine the effect of health and socio-demographic conditions on the formation and change of mental representation of MI, the temporal stability of the internal structure of the illness representation dimensions making up this construct, and the effect the health and socio-demographic conditions may have on it.

[3] The relationship is considered stable if there were no significant differences between the correlation coefficients at two measurement time points, i.e., $z > .05$.

Significant effects of previous cardiovascular diseases (high blood pressure, hypertension, angina pectoris), risk factors for MI (diabetes, smoking), and acute stress as health conditions on the mental representation of the MI, i.e., on its dimensions immediately after the event itself, were determined. The results showed that people who previously had angina pectoris described their MI with more symptoms than those who did not. There are also differences in the coherence dimension, which primarily refers to understanding the illness itself, with respondents who previously had high blood pressure and were diagnosed with hypertension having higher average scores than those who did not. These individuals probably map their existing representations about previous cardiovascular diseases onto the infarction representation. In this case, they report more MI symptoms and have a clearer picture of the illness itself. The significant effects of having experience with cardiovascular diseases on current MI representation are in line with the CSM model assumption that apart from belief, illness representation is formed from concrete illness experience (Levental et al. 2016). Those who had some acute stress in the period one year before their MI (illness/death of loved ones, divorce, loss of job) also reported lower scores on the consequences dimension than those who were not exposed to this type of stressor in the previous year. Exposure to an acute stressful event appears to contribute to habituation with respect to the severity of life events and the consequences associated with them. However, neither the effects of previous cardiovascular disease history nor acute stress was proven significant for the illness representation dimensions 1.5-2 months after the MI, which indicates their significant contribution at the given moment, but not in the long run.

Diabetes and smoking as risk factors for MI have significant effects on the emotional representation of the illness, with people who had diabetes before MI associating more stress, anger, and distress with MI than those without diabetes, with smokers tending to have a less emotional representation of the illness. Diabetes can significantly contribute to post-MI complications, including an increased chance of recurrence (e.g., Boord et al. 2001; Ritsinger et al. 2014), which is likely to increase the level of negative feelings currently attributed to MI. This corroborates the finding that a previous history of diabetes has a long-term effect on the perception of severe MI consequences. Unlike diabetes, smoking is more related to personal choices and control, in the sense that one can give up the habit more easily than they can keep diabetes under control, which may be a potential explanation for the less pronounced negative emotions smokers associate with MI. People with diabetes are likely to perceive behavioral risk factors for developing MI as less significant compared to those without diabetes, which is understandable since the onset of diabetes as a risk factor for MI is most often not associated with factors that load this dimension. The correlation between diabetes and emotional representation of the illness was also found in a sample of Chinese patients who survived an MI. Still, no association between diabetes and causal behavioral attributes was found. In contrast, diabetes was predictive relative to physical factors such as cholesterol and obesity, with which it most often occurs (Yan et al. 2011). Smokers tend to attach more importance to behavioral attributions for MI, including smoking, which is also in line with previous findings (e.g., Grace et al. 2005; Yan et al. 2011), and less to biological/external attributions compared to non-smokers. Interestingly, smoking stands out as a risk factor that achieves significant longitudinal effects on most dimensions of illness representation. Smokers have been found to describe fewer symptoms associated with MI, perceive a shorter timeline and a less variable course of the illness, less severe consequences and more behavioral reasons responsible for MI, including smoking, 1.5–2 months after the

MI. It may be that they understand the importance of smoking as a risk factor for MI and hence quit it in the period between the first and the second examination, which was reflected in the effect of this variable on numerous dimensions of illness representation. Still, it should certainly be checked in future research as this study did not collect data that could corroborate it. People who had some illness complications between the two measurements had a more pronounced perception of the varied course of the illness, perceived more severe consequences and associated more negative feelings with the illness, which is understandable. In contrast, people who participated in the rehabilitation program reported lower perception of severe consequences which is in line with previous findings (e.g., Janssen et al. 2013). The findings so far have determined the predictive role of the perception of severe consequences for attending rehabilitation programs (e.g., French et al. 2006), so the results speak of the mutual effect of consequences and attending rehabilitation. The more severe the consequences perceived by a person following MI, the greater the chance of them participating in a rehabilitation program. On the other hand, participating in a rehabilitation program reduces the severity of the perception of the illness. Rehabilitation includes, among other things, education about the illness, and numerous studies have so far found positive changes in illness representation after educational interventions (e.g., Broadbent et al. 2009).

All explored socio-demographic variables have an effect on specific dimensions of illness representation at both time points, which is also in line with previous findings (e.g., Yan et al. 2011), but given the insufficient number of respondents in certain categories of education, their age, relationship, and material status, it was not possible to determine the differences related to certain categories of these variables, and only the gender-related effects will be commented on. Immediately after an MI, women have a more pronounced emotional representation of the illness and are more likely to attribute the cause to psychological attributions (stress, personality, attitudes), both at the moment and in the long run, with these two dimensions of illness representation being intercorrelated both in this and other previous studies (e.g., Moss-Moris et al. 2002). In addition, this study showed that their intercorrelation does not depend on the examined context in which it occurs. This potentially means that the gender effect may be suppressed by the effects of other health or socio-demographic variables. Men tend more to attribute the occurrence of MI to external and behavioral attributions immediately after MI, that is, to look for the illness causes outside of themselves, unlike women. Findings on gender differences in the attribution of MI causes are mostly in line with those previously found (e.g., Al-Smadi et al. 2016) and can generally be understood in the context of more pronounced emotional expressiveness (e.g., Hatfield et al. 2009), but also reflexivity and introspectiveness (e.g., Sauter et al. 2010), which is more often associated with females. However, findings on illness cause attribution with respect to gender are not unequivocal. There are data showing that women tend more to attribute CVD causes to factors over which they have no direct control, such as heredity (e.g., Grace et al. 2005).

It was also found that the dimensions of the psychological representation of an MI are intercorrelated both immediately after the event and later, 1.5–2 months after it. These findings confirm the view that although they differ from each other, the illness representation dimensions are not necessarily independent but may be related in different ways (Leventhal et al. 2016) and that they interact as soon as a person experiences the initial symptoms. However, the individual dimensions of illness representations and their intercorrelations may change later, over the course of the illness, the onset of new

symptoms and responses to treatment (Weinman et al. 1996), as shown in this study. After 1.5–2 months, patients begin to perceive the timeline of their illness as less cyclical, i.e., the course of the illness as less unpredictable, their level of understanding of the illness itself (change in coherence) increases, the level of perceived personal control decreases, and the level of attributing causes of the MI to external/biological attributions increases compared to the period immediately after it. The results support the findings presented so far that illness perception can change over time (Astin and Jones 2006; Bijsterbosch et al. 2009; Broadbent et al. 2009; Petrie et al. 2002, 2012) and show that this time can be relatively short. The determined changes in the dimensions of illness representation between the two measurement time points are mostly in line with the results obtained so far (e.g., Janssen et al. 2013). What has been shown so far is that within illness representation, beliefs about the cause of the illness are most susceptible to change, and thus represent an important aspect for assessment and interventions in terms of health education (Broadbent et al. 2015). However, in this study, individuals attributed the cause of the MI more to factors over which they have no direct control, with the effect being more pronounced in men in the long run. From the point of view of previous findings, this is not necessarily adaptive. It is believed that if the cause of the illness is attributed to internal factors over which a person has control, there is a greater chance of making behavioral changes that may contribute to better functioning after MI and keep down the restrictions (Broadbent et al. 2009). In this regard, the implications stemming from this finding relate to the importance of education about the causes and risk factors for MI.

Changes in the individual dimensions of illness representations also contribute to changes in their intercorrelations. Although the initial correlations between individual dimensions of illness representation were largely repeated at the second measurement, significant differences between the structures of intercorrelations of illness representation dimensions at the two measurement time points were found, indicating the dynamism of their interrelationships. These temporal changes in the internal structure of MI representation in the period of 1.5–2 months from the event can partly be explained by the explored health conditions in which MI representation is formed and changed, as well as socio-demographic variables. However, these are certainly not the only variables that have an effect on the differences in the internal structures of the psychological construct of MI at the two time points. Differences in internal structures, although smaller, are present even after the partialization of the effects of the health and socio-demographic conditions, while the relations between individual representation dimensions prove to be stable over time. Namely, the correlations between perceptions of a longer timeline, i.e., the chronic course of the illness and the perception of lower treatment control and consequences, and perception of the variable course of the illness and less illness coherence have proven to be stable and independent of health and socio-demographic conditions. More pronounced attribution of negative emotions to the illness is firmly associated with a lower level of understanding of the illness. Moreover, stronger negative emotions associated with MI have been shown to be consistently associated with causal psychological attribution that also consistently correlates with biological/external causal attribution. On the other hand, health and socio-demographic conditions can explain the stable relationship between describing MI with more symptoms and perception of a varied illness course as well as stronger emotional representation, but also the relationship between perceiving more severe MI consequences and a stronger emotional representation of the illness and more pronounced attribution of cause to biological/external attributions. What also depends on

the context are the relations between psychological causal attributions and cyclic illness timeline and biological/external attributions and behavioral attributions. After the partialization of the effect of the health conditions and socio-demographic variables, temporal stability among these relations was not found.

To sum up, the results indicate significant effects of health and socio-demographic conditions on the formation and change of the mental representation of an MI and help understand the relationship dynamics between the dimensions of the mental representation of MI better. A significant change in the internal structure of this construct was found already 1.5–2 months following the event. This can only be partially explained by the examined health and socio-demographic conditions, given that after partialization of these effects, differences in the representation's internal structure at the two time points remain significant. Although the strengths of this research lie in the inclusion of a number of health conditions and socio-demographic factors in examining illness perception of MI, the findings show that future studies need to examine the effects of some other variables that could further explain temporal changes in MI perception and formation of initial representations. Mapping these factors can contribute to designing educational programs aimed at changing the illness representation to achieve more adaptive effects on various health-relevant outcomes of MI. Besides the strengths, noteworthy limitations of this research are the measured properties of the Revised Illness Perception Questionnaire that have not proved quite satisfactory in this research. Also, missing data at measurement time point two potentially contribute to insufficient statistical power for detecting additional effects, which requires that these findings be subjected to further replication and verification.

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APPENDIX

Table 1 Intercorrelations between illness representations in T1 when effects of the health and socio-demographic variables are excluded

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Identity (T1)	–										
2. Timeline (acute/chronic) (T1)	.145	–									
3. Timeline (cyclical) (T1)	.191*	.105	–								
4. Consequences (T1)	.147	.232*	.141	–							
2. Personal control (T1)	.070	-.186*	.156	-.006	–						
3. Treatment control (T1)	.054	-.389***	.042	-.065	.264**	–					
7. Illness coherence (T1)	-.063	.095	-.266**	-.149	-.123	-.112	–				
8. Emotional representations (T1)	.292**	.108	.203*	.213*	-.043	.070	-.296**	–			
9. Psychological attributions (T1)	.057	.123	.166	.163	-.018	.022	-.029	.525***	–		
10. Causal – External-biological attributions (T1)	.139	.060	.098	.294**	.022	-.097	-.059	.080	.296**	–	
11. Behavioral attributions (T1)	-.048	.143	.151	.178	.136	-.120	-.193*	.012	.192*	.244*	–

*$p < .05$; **$p < .01$; ***$p < .001$.

Table 2 Intercorrelations between illness representations in T2 when effects of the health and socio-demographic variables are excluded

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Identity (T2)	–										
2. Timeline (acute/chronic) (T2)	.138	–									
3. Timeline (cyclical) (T2)	.245	0.001	–								
4. Consequences (T2)	.215	.405**	.127	–							
5. Personal control (T2)	-.015	.043	.012	.254*	–						
6. Treatment control (T2)	-.143	-.307*	.044	.148	.607***	–					
7. Illness coherence (T2)	.149	.176	-.282*	.131	.150	.152	–				
8. Emotional representations (T2)	.220	.016	.187	.170	.070	-.121	-.285*	–			
9. Psychological attributions (T2)	.270*	.101	.126	.353**	.111	-.086	.021	.322*	–		
10. Causal – External-biological attributions (T2)	.232	-.005	.227	.108	-.028	-.215	.059	.177	.486***	–	
11. Behavioral attributions (T2)	.057	.300*	.045	.341**	.047	-.063	.075	.177	.502***	.295*	–

*$p < .05$; **$p < .01$; ***$p < .001$

ZDRAVSTVENI KONTEKST I TEMPORALANA STABILNOST INTERNE STRUKTURE KONSTRUKTA BOLESTI KOD OSOBA SA INFARKTOM MIOKARDA

U ovom istraživanju nastojali smo da ispitamo efekte zdravstvenog konteksta – prisustvo prethodne istorije kardiovaskularnih bolesti (povišen pritisak, hipertenzija, angina pektoris), hereditet, riziko faktori za nastanak infarkta miokarda (pušenje, gojaznost, hiperlipidemija, fizička neaktivnost) prisustvo akutnog/hroničnog stresa u prethodnoj godini i socio-demografskih varijabli (pol, starost, obrazovanje, partnerski i materijani status) na formiranje i promenu psihološke reprezentacije infarkta. Proverena je i vremenska stabilnost interne strukture dimenzija reprezentacije bolesti koje ovaj konstrukt čine, te efakt koji pomenuti zdravstveni i socio-demografski kontekst može imati na nju. Rezultati ukazuju na značajne efekte zdravstvenog i socio-demografskog konteksta na formiranje i promenu psihološke reperezentacije srčnog udara.

Utvrđena je značajna promena u internoj strukturi ovog konstrukta već nakon 1,5–2 meseca od samog događaja, koja se samo delimično može objasniti ispitivanim zdravstvenim i socio-demografskim kontekstom, s obzirom na to da nakon paricjalizacije ovih efekata razlike u internoj strukuri konstrukta u dva trenutka merenja ostaju i dalje značajne. Rezultati su sagledani u konteksu dosadašnjih teorijskih saznanja i empirijskih nalaza. U budućim istraživanjima je potrebno proveriti efekte nekih drugih varijabli kojima bi se dodatno mogle objasniti vremenske promene u reperezentaciji IM, ali i fomiranje inicijalne reprezentacije.

Ključne reči: *percepcija bolesti; reprezentacija bolesti; vremenska stabilnost, infarkt miokarda, zdravstveni kontekst.*