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Illness Perception and Cardiovascular Risk Factors in Patients with Type 2 Diabetes: Cross-sectional Questionnaire Study

Goranka Petriček[1], Mladenka Vrcić-Keglević[1], Gorka Vuletić[2], Venija Cerovečki[1], Zlata Ožvačić[1], Lucija Murgić[3]

[1]Department of Family Medicine, Andrija Štampar School of Public Health, School of Medicine University of Zagreb, Zagreb, Croatia

[2]Department of Psychology, Faculty of Philosophy, Josip Juraj Strossmayer University of Osijek, Osijek, Croatia

[3]Health Center Zagreb-Centar, Zagreb, Croatia

Aim To investigate illness perception in patients with type 2 diabetes mellitus and its association with the degree of control over relevant cardiovascular risk factors.

Methods A cross-sectional questionnaire-based study was performed from June 2007 to March 2008. A stratified random sample of 46 Croatian general practitioners was asked to select, using systematic sampling, the first 6 patients with type 2 diabetes mellitus aged ≥18 years who visited them for consultation during the study period. Data on 250 patients included patient illness perception assessment (Brief Illness Perception Questionnaire, IPQ), cardiovascular risk factors, and socio-demographic data.

Results The patients' mean age was 63.0 ± 10.9 years and mean duration of diabetes was 9.3 ± 7.8 years. The patients' illness perception assessment on an 11-point (0 to 10) scale showed the highest median scores (interquartile range): 10 (8 to 10) for "timeline" and 8 (7 to 9) for "treatment control," followed by 7 (5 to 8) for "personal control," 7 (5 to 9) for "understanding," 5 (3 to 7) for "consequences," 6 (4 to 7) for "concern," and 5 (2 to 7) for "emotional response." The lowest score was 3 (1 to 5) for "identity." Multivariate logistic regression showed that the Brief IPQ item "concern" ($P < 0.001$) was a significant predictor of body mass index; "personal control" ($P < 0.001$) and "concern" ($P = 0.048$) were significant predictors of fasting blood glucose; "treatment control" ($P = 0.009$) was a significant predictor of total cholesterol; and "understanding" ($P = 0.010$) was a significant predictor of blood pressure.

Conclusion As patients' beliefs seem to be associated with the degree of control over cardiovascular risk factors, they should be included in routine clinical assessments.

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Correspondence to:
Goranka Petriček
Department of Family Medicine
Andrija Štampar School of Public Health
School of Medicine University of Zagreb
Rockefellerova 4
10000 Zagreb, Croatia
goranka.petricek@snz.hr

Although the quality of guidelines to diabetes care appears to be improved, a poor metabolic control over the illness has been found in as many as 30%-60% of patients with type 2 diabetes treated in routine general practice (GP) settings (1). Despite of the vital role of health care providers, the responsibility for diabetes management largely rests on the patient. Ninety-five percent of health-related decisions are to be made by patients on a daily basis, without even consulting with health care professionals (2,3). These decisions are related to diet, tobacco smoking, foot care, and exercising, adherence to daily urine or blood glucose monitoring, and drug regulation, which should all be harmonized and embedded into working, domestic, and leisure routines. Research has shown the enhancement of active participation and self-care to be the key factor responsible for the improvement of outcomes in diabetic patients (4). Furthermore, there is a growing body of evidence corroborating that the perception of the disease plays an important role in the degree of compliance (5-7).

The study on individual perceptions of illness stemmed from the research on health-threat communication (7). Different health behavior theories have been developed to describe individual response to a perceived health threat and the manner of coping with it. One of the widely adopted models is the self-regulation model introduced by Leventhal et al (8,9). The self-regulation model assumes that health-related behavioral patterns are a result of complex multi-faceted representations of illness. Cognitive representation of illness embraces 5 core dimensions (8): identity (ie, label and symptoms that a person ascribes to his or her illness); consequences (ie, expected effects and outcomes of the illness); cause (ie, causal attribution that a patient assigns to his or her illness); timeline (ie, the expected duration of illness viewed from the patient's perspective); and cure or control modalities (ie, the extent to which a patient believes he/she can recover from the illness or place it under control). Emotional representation also includes negative reactions to the illness, such as fear, anger, and distress. Other studies have provided a quantitative support as to the existence of structural relations between the 5 illness representation components described by Leventhal (8), and to the existence of links between illness perceptions and a number of psychological outcomes, such as coping, mood, functional adaptation, and compliance (9-21).

While researchers have often examined the relation of illness perception with psychological outcomes, its relation with cardiovascular risk factors has been studied only on rare occasions (4,22,23). We find this area important, since diabetes and cardiovascular disease often appear as "the two sides of the same coin" (24). Furthermore, in type 2 diabetes, the presence of cardiovascular risk factors at least doubles the risk of cardiovascular death (1). As with most European transitional countries, in Croatia cardiovascular disease is the leading cause of death and accounts for more than half of the overall mortality (25).

The aim of this study was to investigate the illness perception in patients with type 2 diabetes and its association with the degree of control over cardiovascular risk factors.

PARTICIPANTS AND METHODS

Sampling and study design

This cross-sectional study was conducted as a part of the scientific project "Life with a Chronic Disease: Patients' Experience," supported by the Croatian Ministry of Science, Education, and Sports. Data were collected from June 2007 to March 2008.

The target population consisted of 2317 physicians who worked in the family medicine service in Croatia in 2007 (25). A multistage stratified proportional sample design was used to draw a random sample of 46 physicians; the 5 stratification criteria were physicians' sex, vocational training, having contract with Croatian Institute of Health Insurance (25), sufficient number of patients with type 2 diabetes coming to the practice, and geographical distribution of the practices (6 Croatian regions). The selection of physicians was made using national data from Croatian National Institute of Public Health (25) and Croatian Institute of Health Insurance. All physicians who worked in the family medicine service in Croatia and had contract with Croatian Institute of Health Insurance in 2007, regardless of their vocational training, presented the initial sampling frame. In the initial stage, random sampling practices were drawn proportionally to their frequencies in 6 Croatian regions. In the second stage, proportional random sampling of practices according to physicians' age, sex, and informativity was performed.

During the study period, a consecutive patient sampling was carried out in the following manner: the first 6 patients with type 2 diabetes referring to the physician's office, aged ≥18, and recently (within <6 months) registered to have undergone their glycemic and lipid profile control, were asked to complete the questionnaire. All of the par-

ticipating patients were informed about the purpose of the study and gave their written informed consent.

Immediately after the visit, the physicians collected data on cardiovascular risk factors on the patients who agreed to take part in this study, while the patients were asked to complete the socio-demographic data, fill in the Brief Illness Perception Questionnaire (7), and put the material in the sealed box placed in the reception area of the GP's office. The Ethics Board of the Zagreb University School of Medicine approved the study.

Survey

The patients completed a self-administered questionnaire that included The Brief Illness Perception Questionnaire (Brief IPQ), a standardized instrument developed in order to assess cognitive and emotional illness representations (7). The Brief IPQ consists of 9 items. Eight items are rated on an 11-point (0-10) end-defined response scale. Five of the items assess cognitive illness representations: "consequences" (Item 1), "timeline" (Item 2), "the degree of personal control over the disease" (Item 3), "treatment control" (Item 4), and "identity" (Item 5). Two of the items assess emotional representations: "concern" (Item 6) and "emotional response" (Item 7), while one item assesses "illness understanding" (Item 8). High scores gained on these dimensions represent strongly-held beliefs about more serious consequences of the illness (Item 1), its more pronounced chronic nature (Item 2), stronger positive beliefs in controllability of the illness (Item 3 and 4), a greater number of symptoms attributed to the illness (Item 5), a higher level of patient's emotional distress arising from the illness (Item 6 and 7), and better personal understanding of the illness (Item 8).

The assessment of causal representation was made by an open-ended question, requiring of the patients to list 3 most important causal factors underlying their illness (Item 9). The instrument was translated from English to Croatian using translation-back-translation procedure done by 2 independent translations. According to the suggestion of the Brief IPQ authors, the word "illness" was replaced by the wording "type 2 diabetes" (7).

Socio-demographic data were also collected. This part comprised questions on patients' age, sex, educational level (elementary school, high school, university), life companionship (living in a family or alone), self-perceived economic status in comparison with the average one (worse than average, average, better than average).

Furthermore, data related to cardiovascular risk factors were collected as follows: data on participants' lifestyle, including their adherence to dietary regimens recommended by their physicians (regularly, occasionally, not at all), data on adherence to physical activity schedules recommended by their physicians (regularly, occasionally, not at all), and smoking habits (yes, no, stopped smoking after being diagnosed with diabetes), and data on objective measures of the disease status, including glycemic control (fasting blood glucose, HbA1c), lipid profile (total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, triglycerides), body mass index (BMI), and blood pressure. Data on cardiovascular risk factors were collected by physicians immediately upon patient's recruitment from their medical records (data on recent <6 months glycemic control results, lipid profile control results, and prescribed medication), and the results of physical examination and immediate interview output (data on BMI, blood pressure, and lifestyle). As regards blood testing, the most recent result obtained prior to the questionnaire completion was reported for each patient.

Cardiovascular risk factors and treatment targets recommended for patients with type 2 diabetes were obtained from the European Society of Cardiology 2007 Guidelines (25). The applicability of the Brief IPQ questionnaire was established by a pilot study.

In June 2007, the first author contacted all participating physicians by phone, and subsequently provided them with the referent questionnaires by mail. The physicians were also provided with a cover letter and a prepaid and addressed envelope. No financial or educational incentives were provided to participating physicians. After a month, the first author contacted non-responding physicians by phone again.

Statistical analysis

Descriptive statistics was performed. Nonparametric statistical procedures were used due to the fact that distributions of all relevant quantitative variables showed a significant decline from normal distribution (Kolmogorov-Smirnov test). Median Brief IPQ scales scores and interquartile ranges were calculated.

Kruskal-Wallis test was used to examine the differences in illness perception regarding the participant's life style (dietary habits, physical activity, and smoking). For those variables where significant difference was re-

vealed, post hoc test (Wilcoxson-Mann-Whitney test) was performed.

Spearman correlation was used to establish the relationship between illness perceptions and objective measures of disease status. In order to explore the relation between objective measures of disease status and subjective illness perception variables, logistic regression analysis was performed with BMI, HbA1c, fasting blood glucose, total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and blood pressure as criterion (dependent) variables, using defined variables of illness perception (the Brief IPQ questionnaire) as explanatory variables. Only variables exhibiting significant bivariate association (at the 0.05 level) with the applied criteria were included as potentially relevant predictors.

Data were analyzed using software package STATISTICA 7.1 (StatSoft Inc, Tulsa, OK, USA), and $P < 0.05$ was considered significant.

RESULTS

Out of 46 sampled general practitioners, 43 (93.5%) returned completed patient questionnaires. A total of 258 patients were approached. Questionnaires from 8 patients were not returned or were returned uncompleted; responses from 250 patients (response rate 96.9%) were available and used for statistical analysis.

Patients' characteristics

Among 250 patients included in the analysis, 128 (51.2%) were women and 122 (48.8%) were men. Mean ± standard deviation age of patients was 63.0 ± 10.9 years. Most of the patients had completed high school (n = 126, 50.4%), were retired (n = 184, 73.6%), and perceived their economic status as average (n = 122, 84.4%). Duration of their diabetes was 9.3 ± 7.8 years. The majority of patients (n = 234, 93.6%) were on a treatment consisting of a diet and oral hypoglycemic drugs, while only the minority of the patients received insulin (n = 36, 14.4%). Besides type 2 diabetes, the majority of patients reported 2 (n = 138, 55.2%) or ≥3 chronic comorbidities (n = 111, 44.4%), most frequently hypertension (n = 235, 94.0%), hyperlipidemia (n = 222, 88.8%), musculoskeletal disorders (n = 67, 26.8%), psychological disorders (n = 34, 13.6%), and coronary heart disease (n = 24, 9.6%). Therefore, besides anti-diabetic treatment, most of the patients were also treated with antihypertensive (n = 180, 72.0%) and hypolipemic drugs (n = 118, 47.2%).

Descriptive statistics pertinent to 8 items comprised by the Brief IPQ questionnaire showed that, in general, patients with diabetes tended to view their diabetes as a chronic disease (timeline) that can be well controlled with appropriate treatment (treatment control). They were rather deeply convinced that they were capable of controlling their disease on their own (personal control) and understood it well (understanding). They mostly perceived diabetes as a disease that bore no serious consequences (consequences), so that they were not deeply concerned about it (concern), and were quite emotionally detached (emotional response). They did not experience many diabetes-related symptoms (identity) (Table 1). Individual results relative of each item were distributed throughout a full scale range (0-10).

TABLE 1. Descriptive statistics for the 8 items of the Brief Illness Perception Questionnaire (the Brief IPQ) completed by patients with diabetes mellitus type 2

Brief IPQ items*	Median (interquartile range)
Consequences	5 (3-7)
Timeline	10 (8-10)
Personal control	7 (5-8)
Treatment control	8 (7-9)
Identity	3 (1-5)
Concern	6 (4-7)
Emotional response	5 (2-7)
Understanding	7 (5-9)

*According to Broadbent et al (7).

According to patients' beliefs, the main causes of diabetes were stress (n = 180, 72.0%), diet (n = 139, 55.6.0%), heredity (n = 113, 45.2%), family problems or worries (n = 52, 20.8%), pure chance or "bad luck" (n = 33, 13.2%), and patterns of behavior and lifestyle (n = 29, 11.6%).

Patients' lifestyle

The investigation into the lifestyle of type 2 diabetes mellitus patients showed that, although one third of ex-smokers among them (n = 48, 19.2%) quitted smoking after their diabetes was diagnosed, two thirds (n = 89, 35.6%) still smoked. Less than half of the patients (n = 107, 42.8%) regularly abided to the recommended dietary regimens, and only 114 patients (45.6%) regularly engaged into the recommended physical activity schedules. Further analyses were performed to examine possible differences in illness perception according to the participants' lifestyle (dietary habits, physical activity, and smoking) (Tables 2 to 4).

Recommended dietary regimens

Significant differences between illness understanding and personal control over it were established; the patients who failed to adhere to the recommended dietary regimens reported poorer illness understanding and poorer personal control over it than those in the remaining 2 patient groups (Table 2). Specifically, the patients who failed to adhere to the recommended dietary regimens reported poorer illness understanding than those who adhered regularly (Wilcoxon-Mann-Whitney, Z = -2.54, *P* = 0.011) or only occasionally (Wilcoxon-Mann-Whitney, Z = -2.70, *P* = 0.007). The patients who failed to adhere to the recommended dietary regimens reported poorer personal control over ill-

TABLE 2. Descriptive statistics (median scores and interquartile ranges) for the 8 Brief Illness Perception Questionnaire (the Brief IPQ) items in 3 groups of patients according to their adherence to the recommended diabetic diet (regularly, occasionally, and not on diet), with test of difference between groups of patients

Brief IPQ items	Regularly on diet (n = 107)	Occasionally on diet (n = 122)	Not at all on diet (n = 21)	*P**
Consequences	5 (3-8)	5 (3-7)	5 (8-10)	0.615
Timeline	10(8-10)	10 (8-10)	10 (8-10)	0.899
Personal control	7 (5-8)	7 (5-8)	5 (4-7)	0.019
Treatment control	8 (7-9)	8 (7-9)	7 (5-9)	0.124
Identity	3 (1-5)	4 (1-5)	3 (2-4)	0.978
Concern	6 (4-7)	6 (4-7)	6 (4-7)	0.804
Emotional response	5 (1-8)	5 (2-7)	3 (1-7)	0.450
Understanding	7 (5-9)	7 (5-9)	4 (4-7)	0.023

*Kruskal-Wallis test.

TABLE 3. Descriptive statistics (median scores and interquartile ranges) for the 8 Brief Illness Perception Questionnaire (the Brief IPQ) items in 3 groups of patients described by their adherence to the recommended physical activity schedules (regularly, occasionally, and not physically active), with test of difference between groups of patients

Brief IPQ items	Regularly physically active (n = 114)	Occasionally physically active (n = 79)	Not physically active (n = 57)	*P**
Consequences	5 (3-7)	5 (3-8)	6 (4-7)	0.979
Timeline	10 (9-10)	10 (7-10)	10 (8-10)	0.284
Personal control	7 (6-9)	7 (5-8)	5 (4-8)	0.001
Treatment control	8 (7-9)	8 (6-9)	8 (6-9)	0.654
Identity	3 (1-5)	4 (2-5)	3 (2-5)	0.748
Concern	6 (4-7)	6 (4-8)	6 (4-7)	0.450
Emotional response	5 (1-7)	5 (2-7)	4 (2-7)	0.838
Understanding	7 (5-9)	7 (5-8)	6 (4-7)	0.007

*Kruskal-Wallis test.

TABLE 4. Descriptive statistics (median scores and interquartile ranges) for the 8 Brief Illness Perception Questionnaire (the Brief IPQ) items in 3 groups of patients according to their smoking habits (smoking, not smoking, quit smoking), with test of difference between groups of patients

Brief IPQ items	Smoking (n = 89)	Not smoking (n = 110)	Quit smoking (n = 48)	*P**
Consequences	6 (4-7)	5 (3-7)	5 (4-7)	0.431
Timeline	10 (8-10)	10 (8-10)	10 (8-10)	0.607
Personal control	7 (5-8)	7 (5-8)	8 (5-10)	0.250
Treatment control	7 (6-9)	8 (7-9)	8 (6-10)	0.170
Identity	4 (2-5)	3 (1-5)	4 (2-6)	0.697
Concern	6 (4-7)	6 (4-8)	5 (3-7)	0.398
Emotional response	5 (3-7)	5 (1-7)	5 (1-8)	0.477
Understanding	7 (4-8)	7 (5-8)	8 (5-10)	0.039

*Kruskal-Wallis test.

ness than those patients who adhered regularly (Wilcoxon-Mann-Whitney, Z = -2.60, *P* = 0.009) or only occasionally (Wilcoxon-Mann-Whitney, Z = -2.25, *P* = 0.024). There was no significant difference in the degree of reported illness understanding and personal control over illness, between the groups of patients who adhered to the recommended dietary regimens.

Recommended physical activity

Physically inactive patients reported significantly poorer illness understanding and poorer personal control over it than the other 2 patient groups, which scored almost equally (Table 3). Specifically, physically inactive patients reported poorer illness understanding than those patients who were regularly (Wilcoxon-Mann-Whitney, Z = -3.69, *P* < 0.001) and those who were occasionally physically active (Wilcoxon-Mann-Whitney, Z = -2.97, *P* = 0.003). The physically inactive patients reported poorer personal control over illness than those who were regularly (Wilcoxon-Mann-Whitney, Z = -2.60, *P* = 0.009) and occasionally physically active (Wilcoxon-Mann-Whitney, Z = -2.25, *P* = 0.024). There was no significant difference in the degree of reported illness understanding and personal control over illness between the group of patients who were regularly and those who were occasionally physically active.

Smoking

Patients who had quitted smoking reported significantly better understanding of the illness than current smokers and patients who had never smoked, who scored almost equally. All other variables related to illness perception showed no significant tobacco use-based differences (Table 4). Specifically, patients who had quitted smoking reported better illness understanding than current smokers (Wilcoxon-Mann-Whitney, Z = -2.01, *P* = 0.045) and the patients who had never smoked (Wilcoxon-Mann-Whitney, Z = -2.45, *P* = 0.014). There was no significant difference in the degree of reported illness understanding between the current smokers and the patients who had never smoked.

Objective measures of the disease status

Descriptive statistics pertaining to the objective measures of the disease status showed that the majority of patients with type 2 diabetes did not reach recommended treatment targets in terms of glycemic control level, lipid status, blood pressure, and BMI (Table 5).

The correlations between illness perception rating and objective measures of disease status were examined as well (Table 6). The patients who considered themselves to be in control of their illness, achieved significantly more favorable (ie, lower) total and low-density lipoprotein cholesterol and blood pressure levels than those who did not see themselves as being in control of the disease (Table 6). Patients who perceived to have greater treatment control over illness managed to achieve significantly more favorable (ie, lower) fasting blood glucose, HbA_{1c}, and total and low-density lipoprotein cholesterol levels than those who perceived to have less treatment control. The patients who were more concerned about their illness presented with significantly higher fasting blood glucose and HbA_{1c}, but, lower BMI values than those less concerned. Patients with a more pronounced emotional response had significantly higher level of HbA_{1c} and lower BMI values than those with less pronounced emotional response. Patients who reported better illness understanding had significantly lower diastolic pressure and low-density lipoprotein cholesterol lev-

TABLE 5. Descriptive statistics for the objective measures of disease status registered in patients with diabetes mellitus type 2*

Objective measures of disease status	Median (min-max)	Interquartile range	Target values†
BMI (kg/m^2)	28 (21-46)	25-30	<25
HbA_{1c}(%)	7.0 (4.9-38.3)	6.5-7.6	≤6.5
Fasting blood glucose (mmol/L)	7.1 (4.8-14.8)	6.4-7.8	<6.0
Triglyceride (mmol/L)	2.0 (0.7-9.4)	1.6-2.2	<1.7
Total cholesterol (mmol/L)	5.2 (3.8-8.9)	4.9-6.2	<4.5
HDLC (mmol/L)	0.8 (0.1-1.8)	0.8-0.9	>1.0 men; >1.2 women
LDLC (mmol/L)	3.2 (1.2-5.0)	2.5-3.5	≤1.8
Systolic blood pressure (mmHg)	140 (110-180)	130-150	<130
Diastolic blood pressure (mmHg)	80 (60-110)	70-90	<80

*Abbreviations: BMI – body mass index; HbA_{1c} – glycated hemoglobin; HDLC – high-density lipoprotein cholesterol; LDLC – low-density lipoprotein cholesterol.
†According to the European Society of Cardiology Guidelines 2007.

TABLE 6. Correlations between the 8 items of the Brief Illness Perception Questionnaire (the Brief IPQ) and objective measures of disease status in patients with diabetes mellitus type 2*

Brief IPQ items	Correlation coefficient and statistical significance	Objective measures of disease status								
		BMI (kg/m²)	HbA1c (%)	fasting blood glucose (mmol/L)	total cholesterol (mmol/L)	triglycerides (mmol/L)	HDLC (mmol/L)	LDLC (mmol/L)	systolic blood pressure (mmHg)	diastolic blood pressure (mmHg)
Consequences	Spearman ρ	-0.121	-0.029	0.006	0.006	0.057	-0.072	0.058	0.071	0.055
	P	0.057	0.644	0.919	0.929	0.374	0.255	0.360	0.261	0.390
Timeline	Spearman ρ	0.008	-0.025	-0.090	-0.088	-0.096	-0.015	-0.150	-0.073	-0.049
	P	0.899	0.692	0.158	0.164	0.132	0.809	0.018†	0.249	0.440
Personal control	Spearman ρ	-0.101	-0.119	-0.101	-0.211	-0.069	-0.026	-0.152	-0.186	-0.193
	P	0.112	0.059	0.113	0.001†	0.275	0.685	0.016†	0.003†	0.002†
Treatment control	Spearman ρ	0.044	-0.198	-0.151	-0.127	-0.038	-0.027	-0.203	0.000	-0.028
	P	0.491	0.002†	0.017†	0.045†	0.547	0.667	0.001†	0.996	0.657
Identity	Spearman ρ	-0.143	0.050	0.059	0.034	0.110	0.021	0.008	0.013	0.023
	P	0.024†	0.436	0.351	0.589	0.082	0.746	0.894	0.839	0.714
Concern	Spearman ρ	-0.127	0.166	0.177	0.004	0.001	-0.079	0.049	0.031	-0.028
	P	0.045†	0.009†	0.005†	0.949	0.988	0.215	0.444	0.623	0.664
Emotional response	Spearman ρ	-0.136	0.167	0.114	0.054	0.066	-0.066	0.091	0.076	0.007
	P	0.032†	0.008†	0.071	0.394	0.298	0.299	0.151	0.235	0.907
Understanding	Spearman ρ	-0.113	-0.019	-0.060	-0.091	-0.007	0.037	-0.148	-0.110	-0.169
	P	0.073	0.762	0.344	0.150	0.915	0.563	0.019†	0.083	0.007†

*Abbreviations: BMI – body mass index; HbA_{1c} – glycated hemoglobin; HDLC – high-density lipoprotein cholesterol; LDLC – low-density lipoprotein cholesterol.
†Significant correlations.

els than those who reported worse illness understanding. The patients who expected their illness to be a long-term one had significantly more favorable low-density lipoprotein cholesterol levels than those expecting the illness to cease sooner.

Multivariate logistic regression

Only a few Brief IPQ items were significant predictors of the levels of some cardiovascular risk factors: BMI, fasting blood glucose, total cholesterol, and blood pressure. Patients' concern about illness (concern) was a significant predictor of BMI; patients' perception of personal control over illness and concern about illness (personal control and concern) were significant predictors of fasting blood glucose level; patients' perception that treatment can control illness (treatment control) was a significant predictor of total cholesterol; and patients' understanding of illness (understanding) was a significant predictor of blood pressure (Table 7).

DISCUSSION

This study demonstrated that the illness perception in patients with type 2 diabetes treated in the primary care settings was associated with the degree of control established over certain cardiovascular risk factors. Specifically, significantly better adherence to the recommended life style was associated with higher degree of personal control over the illness (dietary regimens and physical activity schedules) and better illness understanding (dietary regimens, physical activity schedules, and smoking cessation). Furthermore, significantly more favorable values of objective disease status measures were found in patients who believed to be in control of their illness (total and low-density cholesterol, systolic and diastolic pressure) and who had greater treatment control over illness (fasting blood glucose, HbA_{1c}, total and low-density lipoprotein cholesterol), better understanding of illness nature (diastolic pressure and low-density lipoprotein cholesterol), and viewed it as a chronic condition (low-density lipoprotein cholesterol).

Illness perception, as assessed with the Brief IPQ questionnaire, was the ability of patients to see their diabetes as a chronic disease that can be well-controlled under appropriate treatment. They were convinced that they were capable of putting the disease under control on their own and that they understood the nature of their condition. The substantial proportion of the patients was of

TABLE 7. Multivariate logistic regression models on the association between objective measures of disease status as criterion (dependent) variables and the selected items of the Brief Illness Perception Questionnaire (Brief IPQ) as explanatory variables*

Criterion variable	Predictor variable	P†	Estimated odds ratio	95% CI for odds ratios
BMI (kg/m^2)	Identity	0.785	1.019	0.888-1.171
	Concern	<0.001	1.230	1.098-1.377
	Emotional response	0.447	1.046	0.931-1.176
HbA_{1c} (%)	Personal control	0.119	1.065	0.984-1.152
	Concern	0.169	1.080	0.968-1.204
	Emotional response	0.263	1.062	0.956-1.180
Fasting blood glucose (mmol/L)	Personal control	<0.001	1.308	1.154-1.483
	Concern	0.048	1.146	1.001-1.313
Total cholesterol (mmol/L)	Personal control	0.519	1.123	0.789-1.599
	Treatment control	0.009	1.554	1.116-2.165
LDLC (mmol/L)	Timeline	0.332	1.049	0.952-1.155
	Personal control	0.796	1.019	0.883-1.176
	Treatment control	0.179	1.097	0.958-1.256
	Understanding	0.572	0.967	0.861-1.086
Blood pressure (mm Hg)	Personal control	0.886	1.007	0.911-1.114
	Understanding	0.010	1.147	1.033-1.274

*Abbreviations: BMI – body mass index; HbA_{1c} – glycated hemoglobin; LDLC – low-density lipoprotein cholesterol.
†Multivariate regression.

the opinion that the disease they suffered from bore no serious consequences, so that they were not deeply concerned and deeply emotional about it. Patients reported to have experienced only a few diabetes symptoms.

The Brief IPQ perception scores obtained in our study were similar to those found in the studies on patients with diabetes conducted in Australia and the USA (4,7). Furthermore, the research shows that the vast majority of US patients with diabetes believe that their diabetes is a chronic illness beyond known cure (18,19). The importance of the illness timeline was shown by Meyer et al (26) in a study that disclosed the hypertensive patients' belief that hypertension was an easily-treatable acute condition, thus yielding fairly high drop-out rates during the course of treatment. This belief about the disease course was revealed to be a potentially important predictor of the decision to self-manage the actual chronic illness. Other possible aspects of the belief on disease course, such as likelihood of developing diabetes complications, were related to the item intended to measure the consequences of diabetes (26). For example, Quatromoni et al (27) found fatalistic attitude of Caribbean Latinos toward the course of their diabetes and little understanding of the long term consequences. In our study, patients reported to have experienced only a few diabetes symptoms, which could be explained by the fact that the mean illness duration was only 9.3 years, while the development of diabetes complications usually takes a few decades. Furthermore, most of our patients were on a diet treatment or used oral drugs, so that they only rarely experienced serious hypo- or hyperglycemia occurrences typical of improper insulin dose administration. Previous research on beliefs of patents with diabetes has shown the higher perceived disease control and self-efficacy levels to be related to better self-reported adherence to diet, medication, and exercise schedules, as well as to better metabolic control (18,23). It was pointed out that a certain level of knowledge on disease is necessary, but should be combined with other factors, including attitudes and motivation, which are likely to be of much greater importance when it comes to more favorable disease outcomes (28). De Weerdt et al (28) showed that internal locus of control (which reflects personal degree of control over the illness) and sufficient level of knowledge were the prerequisites for attaining a high level of self-care and/or good metabolic control.

The majority of patients with diabetes in our study did not reach recommended treatment targets of objective measures of disease status, which highlights the importance of effective clinical interventions oriented toward the resolution of this problem (25). Exploring patients' illness beliefs may be one of the ways to address this problem.

Multivariate logistic regression showed that concern was a significant predictor of BMI; the degree of personal control

over the disease and the degree of concern about it were good predictors of fasting blood glucose levels, while treatment control predicted total cholesterol and the degree of illness understanding predicted blood pressure values.

Similar to our findings, Broadbent et al (7) showed that a higher degree of perceived personal control over the disease was associated with better metabolic control (fasting blood glucose, HbA_{1c}). Bradley (29) found the higher level of perceived control over diabetes to be associated with better glycemic control, lower body weight, and better psychological adjustment. On the other hand, some studies showed stronger identity and treatment control beliefs to be associated with poorer metabolic control (7,23). Possible reasons for positive influence of treatment control beliefs on metabolic control and lipid status, disclosed in our study, could be explained by the continuing physician-patient relation, which reflects a long tradition of the primary health care system in Croatia, where patients register with a single physician who knows the patient and his or her family well and provides comprehensive and continuing personal care (30). Recent research has confirmed a strong positive relation between the continuity of the primary health care in Croatia and patients' ability to understand and cope with their illness (31).

Significantly lower BMI values, but poorer metabolic control (in terms of both less favorable fasting blood glucose and HbA_{1c} levels) were revealed in those of our patients who were more deeply concerned about their illness and those with a more pronounced emotional response (the latter having less favorable HbA_{1c} values). This negative influence of emotions on metabolic control is in accordance with the findings of other studies and emphasizes the importance of addressing the emotional representations of the illness (7). While working with their patients, physicians should use the bio-psychosocial model and, besides exploring biomedical nature of an illness, always ask their patients about illness-related emotions and the context they live in.

One of the strongest associations found in our study was that between cardiovascular risk factors and patients' beliefs about the degree of personal and treatment control established over the disease and the degree of understanding of the illness nature. However, it is to be noted that these patients managed to establish a high level of treatment control over their disease, but only moderate personal control beliefs and illness understanding. We think that this gap should be filled by general practitioners' intervention. Namely, within the frame of their everyday practice, general practitioners should always bear in mind the importance of patients' perception of illness control and increase patients' understanding of their illness.

Limitations of the study include its cross-sectional design, due to which the illness perceptions and cardiovascular risk factors were assessed at the same time. The results, therefore, only give evidence on inter-variable relations and offer some explanations, but do not really reveal the causal relationships. Furthermore, the study can be biased by the fact that certain degree of cardiovascular risk might trigger differences in patients' awareness. There exists a need for a longitudinal, interventional study which would allow for obtaining more information on changes in subjective illness perceptions and investigating the causal background underpinning illness perceptions and their links to cardiovascular risk factors; such a study is already planned to be performed in the course of our research. The potential to generalize our findings is limited due to possible selectivity bias; only patients who were well enough to visit GP offices and willing to participate in this study were included into it. Furthermore, most of our patients were middle-aged or elderly, retired, had completed only high school, had the mean duration of diabetes of 9.3 years, and were mostly diagnosed with 2-3 comorbidities, all of which could also influence the study outcome.

Despite these limitations, the results of the study emphasize the importance of addressing patients' illness perceptions as a starting point for further interventions targeted at self-management improvements and optimization of treatment outcomes.

Our study brings a new insight into the corpus of knowledge on the illness perception in patients with type 2 diabetes and its association with the degree of control established over cardiovascular risk factors. Although there is a substantial literature on the illness perceptions of patients with type 2 diabetes, our study makes a novel contribution by relating illness perceptions to several cardiovascular risk factors, while in other studies, illness perceptions were only related to certain risk factors or HbA1c as the measure of diabetes control. Furthermore, in our study only some illness perception dimensions were found to be significant predictors of cardiovascular risk factors (concern of BMI; personal control and concern of fasting blood glucose; treatment control of total cholesterol; and understanding of blood pressure) proving that individual illness perceptions are related to health care outcomes and cannot be neglected in everyday general practitioner practice.

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