A multidimensional model of depression in coronary artery disease patients

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Introduction. Depression is a recognized independent risk factor for coronary artery disease (CAD) [1] and has significant negative effects on quality of life, morbidity, and mortality [2,3]. One of the symptoms of depression is fatigue. Fatigue is a common problem among healthy subjects and patients. Fatigue might be general fatigue, physical fatigue or mental fatigue. Different factors such as work load, shift work, environmental temperature, eating habit, sleep disturbances, circadian rhythms psychological factors and different chronic diseases have influence on the human body [4]. Patients with chronic heart failure are very sensitive to these factors and very often are displaying fatigue [5]. Fatigue and heart failure have interrelation; an increase of heart failure symptoms increases fatigue; while an increased fatigue have negative impact on the heart function and increases the level of heart failure.

One of the natural measures to decrease fatigue is a night sleep which has a restorative function [6, 7]. Short or disturbed sleep is a major factor of daytime fatigue. Some authors show a positive effect of day-time sleep for reduction of fatigue [8, 9]. Some sleep disturbances or sleep apnea have a direct positive effect on fatigue [10]. The studies of the relation between fatigue and sleep quality in patients with heart failure were initiated [11,12]. The relation between sleep quality and different factors (gender, age, body mass index, fatigue, fatigue during physical exercise, physical fitness, NYHA functional class, medication, dyspnea) was investigated in patients with heart failure [11]. Another investigation evidently demonstrates that in addition to functional status and ongoing fatigue, poorer quality of life in heart failure is independently related to the severity of sleep-disordered breathing [12]. These studies show that level of fatigue depend on the stage of CAD, sleep quality, oxygen consumption, energy and utilization of metabolites as well as on the central regulatory system [13] which is controlling the body functions through autonomic nervous system [14].

The purpose of this research was to develop a model describing the interrelations among cardiovascular disease, fatigue, and poor sleep quality as determinants of depression in patients with CAD. Structural equation modelling was adopted to illustrate the complexity of relations among variables in the proposed model. It was hypothesized that depression would be positively associated with fatigue directly and/or indirectly through the potential mediators of NYHA class, age and poor sleep quality.

Contingent and Methods. A total of 1180 patients (74.5% men and 25.5% women; mean age 58±9 years) agreed to participate in the study. All

study patients were diagnosed with CAD. A total of 905 (76.7%) patients had NYHA functional class II and 194 (16.4%) patients – class III.

All patients were evaluated for demographic characteristics, for past and current diagnosis and treatments, NYHA functional class, angina pectoris class, fatigue, and symptoms of depression and anxiety. Symptoms of depression and anxiety were evaluated using the Hospital Anxiety and Depression Scale. Fatigue was measured using the Multidimensional Fatigue Inventory (MFI-20) [15, 16]. The MFI-20 is a 20-item, self-report questionnaire composed of 5 subscales: general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue. Exercise capacity (physical fitness) in watts was evaluated using standardized exercise testing by a computer-driven bicycle ergometer. The Pittsburgh Sleep Quality Index was used as a measure for patient's sleep quality.

Statistical analysis. Structural equation modelling was used to test the hypotheses exploring the proposed relations among cardiovascular disease, sleep quality, and fatigue. The hypothesized model was tested using Bentler's structural equations program using SPSS (version 21.0) for descriptive statistics (mean, standard deviation) and AMOS 21.0 statistical software for Structural Equation Modelling (SEM) with the maximum likelihood method of estimation [17, 18]. The model was assessed using multiple fit criteria: χ^2 goodness-of-fit statistic, the ratio of χ^2 to the degrees of freedom (χ^2/df), the Comparative Fit Index (CFI) and the root mean square error of approximation (RMSEA). A statistically nonsignificant χ^2 ($p > 0.05$) is suggestive of a good match between the data and the hypothesized model. A CFI value > 0.90 is considered evidence of a good-fitting model.

Results. Using SPSS Amos, structural equation modelling was performed to develop path diagrams of the factors that contribute to depression (Fig. 1).

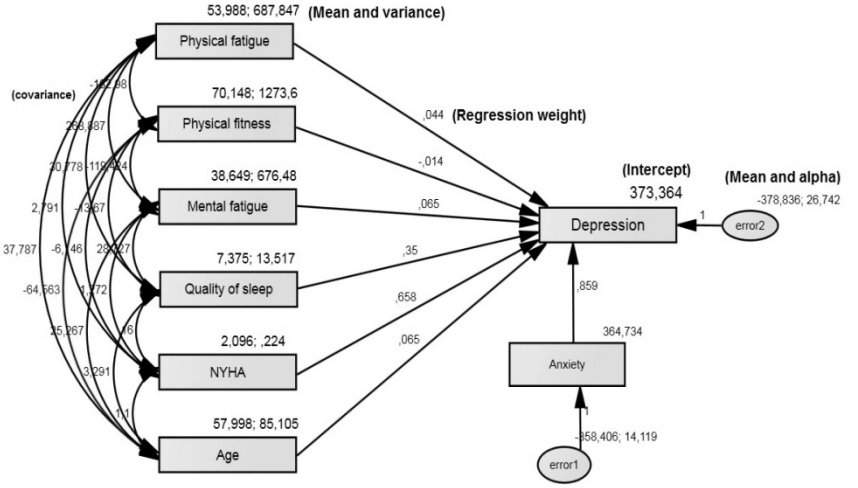

Fig. 1. Model with unstandardized estimates

The model contains all subclasses of fatigue scale, sleep quality parameters, NYHA functional class and age. Covariation matrix was calculated and regression weight coefficients were established. Taking into account the common coefficients (CFI and RMSEA) the number of model's parameters was decreased up till 6. Additionally the items of anxiety scale were added. The general assessment of the model: number of distinct sample moments – 44, number of distinct parameters to be estimated – 40, $\chi^2 = 491.4$, degrees of freedom – 6 and probability level – 0.0001. Multiple correlation with depression was expressed moderately 0.458, CFI = 0.77, and RMSEA = 0.21 ($p > 0.05$). Our data demonstrate that relations among the model's parameters are not strongly established. However the strongest relation was found between depression and sleep quality (0.35) and depression and NYHA class (0.66, $p = 0.06$). The negative relation was found between depression and physical fitness ($p < 0.0002$).

Table 1. Regression weights and their assessment.

Variable	effects	Variables	Estimate	S.E.	C.R.	p
Depression	<---	Physical fatigue	0.044	0.007	6.657	p<0.001
Depression	<---	Physical fitness	-0.014	0.005	-3.027	0,002
Depression	<---	Mental fatigue	0.065	0.006	10.158	p<0.001
Depression	<---	Quality of sleep	0.350	0.044	7.918	p<0.001
Depression	<---	NYHA class	0.658	0.353	1.866	0,062
Depression	<---	Age	0.065	0.017	3.809	p<0.001
Depression	<---	Anxiety	0.859	0.040	21.431	p<0.001

Table 2. Total Effects (standardized estimation)

	Anxiety	Age	NYHA	Quality of sleep	Mental fatigue	Physical fitness	Physical fatigue
Depression	0.459	0.085	0.044	0.183	0.242	-0.071	0.163

Non-standardized (Table 1) and standardized (Table 2) coefficients (beta) reflecting relative input into the total dispersion of depression, taking into account interrelation between variables, revealed the level and dependence of depression from other variables.

Conclusions. The minimalized model for depression risk factors in CAD patients was developed. The model revealed common regularities having relation with the development of depression in CAD patients. This model is superior over other correlation methods such as regression as multiple variables are analyzed simultaneously. With the development of SEM, medical researchers now have powerful analytic tools to examine complex causal models.

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The model for relation of depression from age, fatigue, physical fitness and NYHA functional class was developed using data of 1180 CAD patients. The intercorrelation matrix for variables was used for calculation of weight coefficients demonstrating that the most important risk factors for depression are age, mental fatigue, and sleep quality. Physical fitness has negative relation.