The effect of emotional status and health-related quality of life on the severity of coronary artery disease

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Abstract

Background: Coronary artery disease (CAD) is the most common form of heart disease and a leading cause of death worldwide. Extensive clinical and statistical studies have identified several factors that increase the risk of CAD and myocardial infarction.

Aim: To investigate the relationship between severity of CAD, anxiety, depression, and health-related quality of life (HRQoL).

Methods: A total of 225 patients (116 men, 109 women) who underwent elective coronary angiography were included. All patients were assessed for the presence of cardiovascular risk factors and ongoing medications. A biochemical examination of blood was performed in all patients before the procedure. The 225 patients were divided into three groups (a control group, and minimal and significant CAD groups) based on their Gensini score, which evaluates the severity of CAD. The Nottingham Health Profile (NHP) was used to measure HRQoL. Anxiety and depression were assessed by the Hospital Anxiety and Depression Scale (HADS).

Results: A significant positive correlation was found between HADS and Gensini scores (HADS-anxiety: $r = 0.139$, $p = 0.038$; HADS-depression: $r = 0.156$, $p = 0.019$). A significant positive correlation was also determined between NHP-total and Gensini scores ($r = 0.145$, $p = 0.029$). According to the NHP, energy ($p = 0.048$) and physical mobility status ($p = 0.021$) were better in the control group than they were in the CAD groups.

Conclusions: Our study demonstrates that anxiety, depression, and HRQoL are related to CAD severity. Therefore, emotional status and HRQoL should be evaluated during routine clinical treatment of CAD.

Key words: coronary artery disease, health-related quality of life, anxiety, depression

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INTRODUCTION

Coronary artery disease (CAD) is still the primary cause of morbidity and mortality. Many parameters and tests are used to determine atherosclerotic CAD. Mortality and morbidity occur commonly in patients with moderate or severe CAD, but factors affecting their severity and frequency, or effects on health-related quality of life (HRQoL), are unknown. During the clinical course of CAD, there are many aspects where patients' HRQoL may be affected, such as symptoms of angina and heart failure, limited exercise capacity due to the aforementioned symptoms, the physical debility caused, and psychological stress associated with the chronic stress. Treatments nowadays focus not only on improving life expectancy, symptoms, and functional status, but also HRQoL. Thus, an improvement in HRQoL is considered to be important as a primary outcome and in the determination of therapeutic benefit [1]. Epidemiologic studies have shown that depression or anxiety can predict the incidence of CAD in healthy populations [2]. Moreover, depression or anxiety can also influence the course and prognosis of known CAD [3]. Although one study reported similar psychological variables in groups of patients with chest pain who had angiographically normal or abnormal coronary arteries [4], several other studies reported that patients who had cardiovascular (CV) disease exhibited more psychiatric disorders than patients with normal coronary arteries [5–7]. Little is known about

the relation between HRQoL, psychiatric disorders such as anxiety and depression, and CAD. There has been a rapid and significant growth in the measurement of HRQoL as an indicator of health outcome in patients with CAD. We aimed to investigate the effect of anxiety, depression, and HRQoL on the severity of atherosclerotic CAD.

METHODS
Study design

The sample was derived from a population of 522 consecutive patients who underwent coronary angiography due to a positive noninvasive stress test result. In total, 297 of them were excluded because they met the exclusion criteria (n = 262) and did not fulfill the inclusion criteria (n = 35). Finally, 225 patients were enrolled, including 116 (51.6%) men and 109 (48.4%) women. The ethics committee of our university approved the protocol and this study was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained after all procedures had been fully explained.

Patients were eligible for the study if they were over 18 years old, had a coronary angiogram clear enough to enable evaluation of the cause of chest pain, and had consented to participate. The exclusion criteria were current pregnancy, cardiomyopathy, acute myocardial infarction or any revascularisation procedures (whether percutaneous transluminal coronary angioplasty or coronary artery bypass grafting), unstable angina pectoris, history of congenital heart disease, chronic renal failure, follow-up visits or medical treatment for chronic psychosis, recent medical treatment for depression, insufficient cooperation, and incomplete study forms. All patients were assessed for the presence of CV risk factors and ongoing medications. CV disease risk was determined by the Framingham risk scoring (FRS) index [8]. Gamma-glutamyl transferase activity, serum uric acid and creatinine concentrations, as well as a fasting lipid profile and fasting blood glucose, were measured in all patients before the procedure.

Nottingham Health Profile

Health-related quality of life was assessed by the Nottingham Health Profile (NHP). This contains 38 items divided into six dimensions: NHP-energy, NHP-pain, NHP-emotional reactions (ER), NHP-sleep, NHP-social isolations (SI), and NHP-physical mobility (PM). All the parameters are summed as NHP-total. The respondent answers "yes" if the statement adequately reflects the current status or feeling, or "no" otherwise [9]. Dimension scores range from 0 (no problems) to 100 (maximum problems). The Turkish version was administered; this has been shown to be valid and cross-culturally equivalent to the original profile [10].

Hospital Anxiety and Depression Scale

Psychological testing was conducted using the Hospital Anxiety and Depression Scale (HADS) and the test results were evaluated by a clinical psychologist. It was selected for use in the present study because it is considered to be one of the best questionnaires for assessing depression and anxiety in patients. The HADS is a self-rating scale used to assess the risk, and to measure the level, of depression and anxiety. It contains 14 questions: seven related to depression and seven to anxiety [11]. Aydemir et al. [12] have established the validity and reliability of the Turkish version and determined cut-off points for the depression subscale and anxiety subscale as 7/8 and 10/11, respectively.

Assessment of the severity of CAD

Before diagnostic coronary angiography, all patients underwent either stress electrocardiography or myocardial perfusion scintigraphy. Selective coronary angiography was performed by the femoral approach using the Judkins technique. Angiographic images were obtained by the General Electric Innova 3100 angiographic system (Buc Cedex, France). Multiple views were obtained with visualisation of the left anterior descending (LAD) and left circumflex coronary artery in at least four projections, and the right coronary artery in at least two projections. Coronary angiograms were recorded on compact discs in DICOM format. Each angiogram was interpreted by two cardiologists who were unaware of the results. Any differences were resolved by a third cardiologist. The extent and severity of the CAD were evaluated by the Gensini score [13]. In this scoring system, a severity score is derived for each coronary stenosis based on the degree of luminal narrowing and its topographic importance. Reduction in the lumen diameter and the roentgenographic appearance of concentric lesions and eccentric plaques are evaluated. Reductions of 1–25%, 26–50%, 51–75%, 76–90%, 91–99%, and total occlusion are scored as 1, 2, 4, 8, 16, and 32, respectively. Each principal vascular segment is assigned a multiplier that represents its functional importance in maintaining myocardial supply. Multipliers were 5 for the left main coronary artery, 2.5 for the proximal segment of the LAD and circumflex artery, 1.5 for the mid-segment of the LAD, 1 for the right coronary artery, the distal segment of the LAD, the posterolateral artery, and the obtuse marginal artery, and 0.5 for other segments. The 225 patients were divided into three groups according to their Gensini score: normal coronary arteries (Gensini score 0, n = 78, control group), minimal CAD (Gensini score 1–19, n = 54), and significant CAD (Gensini score ≥ 20, n = 93) [13].

Statistical analysis

All analyses were performed with the Statistical Package for the Social Sciences version 15.0 (SPSS Inc., Chicago, IL, USA). We used the Kruskal-Wallis test to account for the differences among the groups, but in order to analyse the specific sample pairs for significant differences we used the Conover-Inman test. Spearman's rho test was used in order to detect whether there was a correlation among the

Table 1. Baseline characteristics for the severity of coronary artery disease

	Controls	Minimal CAD	Significant CAD	P
Age [years]	54.0 (48.0–59.0)	60.0 (52.5–68.5)	61.5 (54.0–69.0)	< 0.001
Body mass index [kg/m²]	27.4 (24.7–30.4)	29.1 (25.1–32.2)	28.7 (25.6–30.7)	0.941
NHP-Total (0–600)	109.2 (54.3–198.7)	138.4 (103.9–245.8)	154.5 (63.3–298.8)	0.059
NHP-E (0–100)	24.0 (0.0–39.2)	36.8 (0.0–63.2)	39.2 (0.0–76.0)	0.048
NHP-P (0–100)	10.5 (0.0–32.7)	21.5 (7.4–39.4)	14.1 (0.0–49.7)	0.507
NHP-ER (0–100)	35.2 (10.1–55.8)	25.4 (9.5–60.1)	30.3 (9.8–62.7)	0.888
NHP-S (0–100)	16.1 (0.0–42.0)	33.2 (12.6–58.7)	28.0 (0.0–65.1)	0.104
NHP-SI (0–100)	0.0 (0.0–21.1)	0.0 (0.0–22.0)	0.0 (0.0–42.1)	0.227
NHP-PM (0–100)	11.2 (0.0–30.7)	22.0 (11.2–31.2)	20.0 (0.0–34.7)	0.021
HADS-Anx (0–21)	6.0 (3.5–9.0)	7.0 (4.0–9.0)	7.0 (4.0–11.0)	0.459
HADS-Dep (0–21)	4.0 (2.0–6.5)	5.0 (3.0–7.5)	5.5 (3.0–9.0)	0.322
FBG [mg/dL]	98.9 (90.9–109.9)	103.7 (92.6–128.4)	107.2 (94.1–130.0)	0.162
LDL-C [mg/dL]	136.7 (121.0–158.3)	136.5 (112.7–159.3)	123.4 (103.0–145.4)	0.957
TC/HDL-C ratio	4.4 (3.5–5.5)	4.5 (3.5–5.3)	4.7 (4.0–5.9)	0.005
Triglyceride [mg/dL]	132.0 (96.1–163.0)	142.5 (111.4–191.4)	127.5 (91.8–205.9)	0.268
Uric acid [mg/dL]	4.7 (3.7–5.6)	5.6 (4.5–6.7)	5.5 (4.8–6.9)	0.001
GGT [U/L]	20.3 (15.2–28.0)	26.8 (17.0–38.9)	20.9 (15.1–37.4)	0.077
MDRD Cr Cl [mL/min/1.73 m²]	108.0 (95.5–120.0)	91.5 (80.5–117.0)	92.5 (79.0–107.0)	0.003
C-reactive protein [mg/L]	2.6 (1.2–5.2)	2.2 (1.6–4.8)	3.6 (1.8–10.8)	0.182

Data is presented as median (25th to 75th percentile); The control group was identified as the patients with normal coronary arteries; CAD — coronary artery disease; NHP — Nottingham Health Profile, E — energy; P — pain; ER — emotional reaction; S — sleep; SI — social isolation; PM — physical mobility; HADS — Hospital Anxiety and Depression Scale; Anx — anxiety; Dep — depression; FBG — fasting blood glucose; LDL-C — low density lipoprotein cholesterol; TC — total cholesterol; HDL-C — high density lipoprotein cholesterol; GGT — gamma-glutamyl transferase; MDRD Cr Cl — Modification of Diet in Renal Disease creatinine clearance

independent variables. The χ^2 test was used to investigate whether distributions of categorical variables differed within groups. Patients' characteristics are summarised as median and quartiles, mean ± standard deviation or as percentages. Adjustment was made according to total cholesterol (TC)/high density lipoprotein-cholesterol (HDL-C) ratio, fasting blood glucose, uric acid, Modification of Diet in Renal Disease creatinine clearance, C-reactive protein, NHP-total, diabetes mellitus and hypertension. A p value of less than 0.05 was considered statistically significant.

RESULTS

Of the 225 patients, 65.3% (n = 147) had CAD, 63.1% (n = 142) had hypertension, 30.2% (n = 68) had diabetes mellitus, 67.6% (n = 152) had hyperlipidaemia, 32.4% were current smokers (n = 73), 18.2% (n = 41) were ex-smokers, 66.2% (n = 149) had a positive family history for CAD, and 80.7% (n = 88) of the female patients were postmenopausal. Furthermore, 19.1% (n = 43) of the subjects had graduated from university, 18.3% (n = 41) from high school, and 47.5% (n = 107) from primary school, while the others were (n = 34) illiterate. General features including age, body mass index, NHP, HADS, and

the results of the blood samples are shown in Table 1. The differences between the groups are set out in Table 2. Although there was a statistically significant positive correlation between FRS and NHP and its subdivisions (p < 0.05), no significant correlation was determined between FRS and HADS (p > 0.05) (Table 3).

TC/HDL-C ratio, serum uric acid, gamma-glutamyl transferase levels, and smoking rate were higher in males than they were in females (p < 0.001). On the other hand, HDL-C levels were higher in females (p < 0.001). In the group of patients with CAD, mean Gensini scores were 35.7 ± 38.4 in males and 17.8 ± 31.1 in females. According to these results, CAD was more severe in men than in women (p < 0.001).

Moreover, a statistically significant positive correlation was found between the severity of CAD, which was calculated by Gensini score, and serum uric acid levels (r = 0.277, p < 0.001). As shown in Figure 1, the mean NHP-total scores were higher in women than in men (228.9 ± 14.2, 157.7 ± 125.1, respectively, p < 0.001). As a result, the HRQoL of the females was worse than that of the males.

Gensini score and NHP total score showed a statistically significant positive correlation (r = 0.145, p = 0.029).

Table 2. Statistical differences in variables characterising demographic, clinical, biochemical and emotional status between the groups of patients differing in severity of coronary artery disease

	Control-minimal CAD (p)	Control-significant CAD (p)	Minimal-significant CAD (p)
Age	< 0.001	< 0.001	0.685
Body mass index	0.649	0.904	0.565
NHP-Total	0.042	0.028	0.895
NHP-E	0.046	0.020	0.976
NHP-P	0.249	0.610	0.463
NHP-ER	0.749	0.562	0.850
NHP-S	0.110	0.036	0.813
NHP-SI	0.165	0.108	0.992
NHP-PM	0.007	0.052	0.283
HADS-Anx	0.929	0.211	0.302
HADS-Dep	0.211	0.145	0.986
FBG	0.124	0.005	0.361
LDL-C	0.957	0.753	0.738
TC/HDL-C ratio	0.922	0.003	0.011
Triglyceride	0.287	0.005	0.150
Uric acid	0.006	< 0.001	0.456
GGT	0.083	0.367	0.285
MDRD Cr Cl	0.193	< 0.001	0.063
C-reactive protein	0.238	0.002	0.103

Abbreviations as in Table 1; The differences are presented as the a posteriori P levels for the multiple comparisons between the individual groups. A p value of less than 0.05 was considered statistically significant following the use of the Kruskal-Wallis test and the Conover-Inman test for pairwise multiple comparisons. The control group was identified as the patients with normal coronary arteries

Table 3. Correlation between Framingham risk score and health related quality of life and emotional status

	r	p
NHP total	0.240	< 0.001
NHP Energy	0.150	0.027
NHP Pain	0.263	< 0.001
NHP Emotional reaction	0.043	0.531
NHP Social isolation	0.134	0.049
NHP Sleep	0.267	< 0.001
Physical mobility	0.259	< 0.001
HADS-Anxiety	0.063	0.357
HADS-Depression	0.108	0.110

NHP — Nottingham Health Profile; HADS — Hospital Anxiety and Depression Scale

The NHP-E and NHP-PM scores were 36.3 ± 37.6 and 19.7 ± 19.6 in the control group, 50.2 ± 38.7 and 29.2 ± 22.5 in the minimal CAD group, and 49.7 ± 37.3 and 26.3 ± 24.3 in the severe CAD group, respectively. The control group had significantly lower NHP-E and NHP-PM scores than the other groups ($p = 0.048$, $p = 0.021$, respectively) (Table 1). After adjustment for covariates (TC/HDL-C ratio, fasting blood glucose, uric acid, Modification of Diet in Renal Disease creatinine clearance, C-reactive protein, NHP-total, diabetes mellitus, and hypertension), the relationship of CAD to NHP maintained its significance ($p = 0.039$; adjusted OR = 1.004; 95% CI 1.000–1.007). In the patients with anxiety, mean Gensini scores were 38.9 ± 46.1 and mean NHP-total scores were 321.5 ± 118.4. These scores were higher than those of the controls, who had no anxiety (22.5 ± 30.4, 143.0 ± 111.5, respectively; $p = 0.028$, $p < 0.001$, respectively). Likewise, in the patients with depression, mean Gensini scores were 31.3 ± 39.7 and mean NHP-total scores were 276.5 ± 137.7. These scores were higher than those of the controls, who had no depression (24.3 ± 33.4, 138.0 ± 109.2, respectively; $p = 0.165$, $p < 0.001$, respectively). According to Spearman's analysis, there was a significant correlation between Gensini score and HADS anxiety and depression scores ($r = 0.139$, $p = 0.038$; $r = 0.156$, $p = 0.019$, respectively). In addition, there was a positive statistically significant correlation between NHP and HADS scores ($p < 0.001$). A significant positive correlation was also found between serum triglyceride levels and HADS-anxiety scores ($r = 0.145$, $p = 0.031$).

DISCUSSION

HRQoL is a subjective and multidimensional concept that is composed of a range of domains, generally including physical, social, emotional, mental, and functional health. CAD is one of the chronic diseases that impair the patients' functional capacity and HRQoL [14]. Low socio-economic status is a well-known risk factor for CAD, but the evidence concerning social network has been less consistent. Two dimensions of low social support (low social integration and low emotional attachment) have been reported to be predictive of coronary morbidity, independently of other classical risk factors [15]. Similarly, there was a relationship between HRQoL and the severity of CAD in our study. The Gensini scores showed a positive correlation with NHP total scores. The control group had significantly lower NHP-E and NHP-PM scores than did the mild and severe CAD groups. Therefore, poorer levels of HRQoL were detected in the CAD groups in terms of NHP-E and NHP-PM. NHP-pain, NHP-ER, NHP-SI, and NHP-sleep scores were also lower in the control group than they were in the CAD groups, but the difference was not statistically significant. These findings suggest that the subjective HRQoL should be considered along with the clinical severity of the disease in the evaluation of CAD. Therefore,
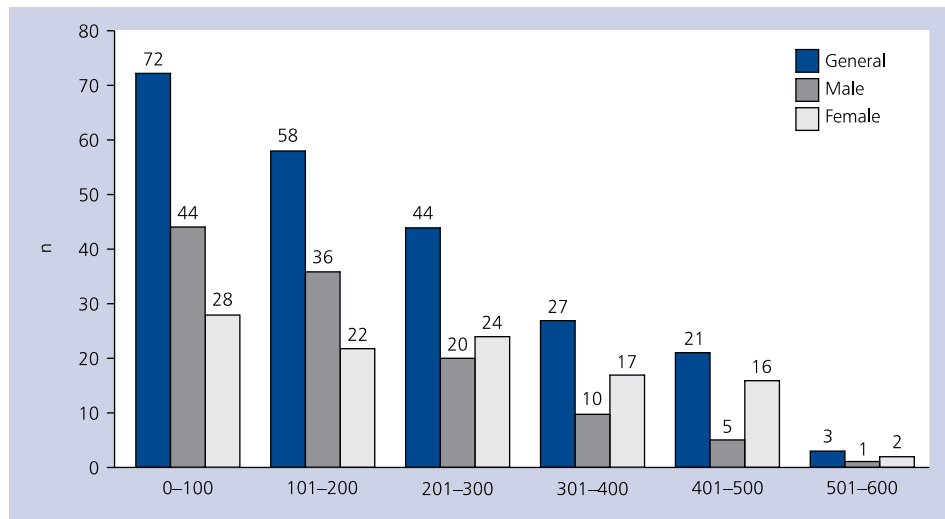
Figure 1. Distribution of the Nottingham Health Profile scores by sex

the findings in our study shed further light on the HRQoL among patients with CAD.

It has long been hypothesised that psychosocial factors such as depression, perceived stress, anger, and anxiety play a role in the development of CV disease. In Western populations, a number of prospective studies have found that these psychosocial characteristics are associated with an increased risk of CV morbidity and mortality [16]. In outpatients with CAD, a robust association between anxiety and CV events was found that could not be explained by disease severity, health behaviours, or biological mediators [17]. It has been reported that chronic anxiety is associated with an increased risk of CAD. The postulated mechanisms through which anxiety may increase the risk of fatal CAD include hyperventilation during an acute attack, which could in turn induce coronary spasm, or an acute attack of anxiety triggering an episode of fatal ventricular arrhythmias [18]. Likewise, in our study, patients with anxiety had more severe CAD.

Depression prevalence in the general population ranges from 4.4% to 20%, but the prevalence in patients with CAD is two-fold higher [19]. About 20% of patients with CAD suffer from major depression within one year following an acute myocardial infarction, while another 27% do not meet the diagnostic criteria but show depressive symptoms or suffer from minor depression. In those with CAD, depressive comorbidity is associated with an increased risk of mortality and morbidity independent of traditional CV risk factors [19]. In CAD patients who have depression, hyperactivity of the noradrenergic system is one important possible mechanism that may explain the association between depression and CAD [20]. In the same way, there was a positive statistically significant correlation between Gensini scores and HADS depression scores in our study, and those with more severe CAD had higher depression scores.

It has been reported that psychiatric disorders such as depression and anxiety impair HRQoL [21]. Likewise, we determined a positive correlation between HADS and NHP in our study. Therefore, anxiety and depression with poor HRQoL may synergistically affect the severity of the CAD.

The present study also examined the association between CV disease risk (which was assessed by FRS) and NHP. There was a statistically significant positive correlation between FRS and NHP and its subdivisions (except NHP-ER) in our study. The data in this study supports the hypothesis that an individual with a high risk of CV disease at ten-year prediction will experience a lowered HRQoL.

It has been reported that high serum lipid concentrations are closely associated with stress and anxiety [22]. Sympathetic activation in generalised anxiety disorders causes an increase in the activity of lipoprotein-lipase through the release of epinephrine and corticosteroids [23]. This hyperactivity in lipoprotein-lipase results in an increase in free fatty acids, which may be converted to cholesterol and triglycerides. Moreover, an association between low cholesterol levels and major depressive disorders has been reported in the literature [24]. In accordance with this, there was a positive correlation between anxiety and serum triglyceride levels in our study, but no correlation was seen between lipid profiles and depression scores.

Additionally, similar to previous findings, women reported both higher anxiety–depression scores and poorer HRQoL compared to men in our study [25, 26].

Limitations of the study

Our study had some limitations. First, the study population was relatively small. A larger study population would provide a higher statistical power. While the relation between severity of CAD and emotional status was investigated via a questionnaire, a psychiatrist should also be in the treatment team.

CONCLUSIONS

Our study demonstrates that HRQoL and the symptoms of anxiety and depression in CAD patients are related to the severity of CAD. Further cross-sectional and longitudinal epidemiological studies are needed to elucidate the importance of treatment of HRQoL, anxiety, and depression during the medical treatment of CAD.

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Wpływ stanu emocjonalnego i jakości życia uwarunkowanej stanem zdrowia na nasilenie choroby wieńcowej

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Streszczenie

Wstęp: Choroba wieńcowa (CAD) jest najczęstszą postacią choroby serca i główną przyczyną zgonów na świecie. Dzięki licznym badaniom klinicznym i analizom statystycznym zidentyfikowano kilka czynników zwiększających ryzyko CAD i zawału serca.

Cel: Celem badania była ocena zależności między nasileniem CAD a lękiem, depresją i jakością życia uwarunkowaną stanem zdrowia (HRQoL).

Metody: Do badania włączono 225 chorych (116 mężczyzn, 109 kobiet), u których wykonano koronarografię w trybie planowym. Wszystkich pacjentów zbadano pod kątem obecności czynników ryzyka sercowo-naczyniowego. Oceniono również przyjmowane przez nich leki. Przed zabiegiem u wszystkich chorych wykonano badania biochemiczne. Uczestników badania (n = 225) podzielono na 3 grupy (grupa kontrolna, grupa CAD z minimalnymi zmianami i grupa z istotną CAD) w zależności od punktacji w skali Gensiniego służącej do oceny zaawansowania CAD. Do pomiaru HRQoL zastosowano kwestionariusz *Nottingham Health Profile* (NHP). Lęk i depresję oceniano, używając skali *Hospital Anxiety and Depression Scale* (HADS).

Wyniki: Stwierdzono istotną dodatnią korelację między wynikami uzyskanymi za pomocą kwestionariusza HADS i skali Gensiniego (HADS-lęk: r = 0,139; p = 0,038; HADS-depresja: r = 0,156; p = 0,019). Wykazano również istnienie dodatniej korelacji miedzy całkowitą punktacją w kwestionariuszu NHP i w skali Gensiniego (r = 0,145; p = 0,029). Zgodnie z wynikami uzyskanymi w kwestionariuszu NHP osoby z grupy kontrolnej miały więcej energii (p = 0,048) i cechowały się większą sprawnością fizyczną (p = 0,021) niż osoby z CAD.

Wnioski: W badaniu wykazano, że lęk, depresja i HRQoL wiążą się z nasileniem CAD. Dlatego w przypadku pacjentów z CAD należy uwzględnić ocenę stanu emocjonalnego oraz HRQoL w rutynowym postępowaniu klinicznym.

Słowa kluczowe: choroba wieńcowa, jakość życia uwarunkowana stanem zdrowia, lęk, depresja

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