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Type D Personality and the Risk of Coronary Heart Disease in Obese Patients

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ABSTRACT

The aim of the paper is to analyze the association between heart function among obese patients and Type D personality to predict the potential risk for coronary heart disease (CHD). Overall, 30 obese patients were evaluated for the DS14 score. Body mass with body mass index (BMI), systolic and diastolic blood pressure, heart rate (HR), and heart rate variability (HRV) were measured before and after a 3-month period. Half of the subjects had been instructed to exercise 4-times weekly (walking 5 km/h) for an hour, the other half did not exercise. Additionally, STAX-1, SWLS, and QOLLTI-P questionnaires had been used. All participants had a normal CRP and sedimentation rate at the enrolment and after 3-month follow up. None of the psychological tests (STAX-1, SWLS and QLLTI-P) showed statistical difference in results between June and October. Participants who exercised showed lower HR compared to participants who did not exercise. Obese patients with high DS14 score showed reduced HRV as an additional risk factor for the future cardiovascular and other stress-related diseases. Type D personality was associated with an increased risk of CHD proved by the HRV measures when the individual was not exercising. Thus, individual personality in fact correlates to autonomic regulation of the heart.

Key words: *exercise, obesity, type D personality, coronary disease, medical anthropology*

Introduction

Psychological stress has been identified as one of the risk factors correlated with coronary heart disease (CHD) and hypertension[1]. Moreover, personality is a major determinant of chronic stress[2]. Hostility has been associated with sympathetic nervous system activation[3], hypertension[4], and recurrent cardiovascular events among cardiac patients[5]. Anger has also been associated with an increased risk of CHD[6], whereas anger inhibition has been shown to predict high blood pressure[7] and increased risk of cardiovascular mortality[8,9]. In addition to hostility and anger, negative affectivity (NA) and social inhibition (SI) are also two global traits connected with CHD[10]. NA refers to the tendency to experience negative emotions[11]. High-NA individuals experience more feelings of dysphoria, anxiety, and irritability; have a negative view of self; and scan the world for signs of impending trouble[12,13]. SI refers to the tendency to inhibit the expression of emotions in social interactions to avoid disapproval by others[13]. High-SI individuals tend to feel inhibited, tense, and insecure when with others[13–15]. Individuals who experience both high NA and SI have a distressed or Type D personality, and are vulnerable to chronic distress[14,15]. Thus, Type D patients are at an increased risk for posttraumatic stress[16,17] and vital exhaustion[18]. Type D may also be associated with early onset of CHD[19], and in the combination of younger age with a poor prognosis in CHD[20].

Thayer and Lane[21] reviewed neuroanatomical studies that implicate inhibitory pathways between the amygdala and the sympathetic and parasympathetic medullary output neurons that modulate heart rate and heart rate variability (HRV). They reviewed the evidence on the role of vagally mediated heart rate variability (HRV) in the regulation of physiological, affective, and cognitive processes. HRV is a measure of autonomic nervous system activity of the heart, and low HRV was established as a risk factor for pathophysiology and psychopathology. Therefore, the

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purpose of our study was to analyse the correlation between autonomic regulation of heart function (HRV) among obese patients and Type D personality to predict the potential risk for CHD.

Materials and Methods

Participants

Participants selected for the study were obese but without any detectable complications of CHD while admitted. Participants were volunteers, gathered from family practitioner office. Obesity has been evaluated as body mass index (BMI) more than 30. Obese patients with angina pectoris, myocardial infarction, valvular heart disease and congestive heart disease had been excluded from the research. The participants were followed for 3 months from June till October 2019 and evaluated at inclusion and 3 months later. This interventional study was conducted according to the Declaration of Helsinki and approved by the institutional ethical committee. Informed consent from all participants was obtained.

Detailed medical anamnesis was collected. Physical status, blood pressure, height and weight were measured. Type D personality was identified with the questionnaires and participants were divided into two groups: Type D positive (DS14+) and Type D negative (DS14–). Half of the participants in each group had been additionally instructed to exercise 4-times weekly for an hour by walking 5 km/h in the following period of 3 months. Exercise report and compliance had been collected by mobile app 24@life, which monitored and registered every exercise session. The effects of 3-month physical exercise on HRV parameters were evaluated after 3 months with Queen college test (stressor situation) between DS14+ and DS14- personalities.

Cortisol levels

Fasting venous blood (10 mL) was withdrawn with a lithium heparin vacuum tube between 8:00 and 9:00 in the morning to measure levels of cortisol.

Psychological assessment

All participants completed psychological questionnaires, DS14, STAX-1, SWLS and QLLTI-P, at admission and after 3 months. The DS14 was used to assess negative affectivity (NA), social inhibition (SI) and Type D personality. Subjects rated their personality on a 5-point Likert scale ranging from 0-false to 4-true. The NA and SI scales can be scored as continuous variables (range, 0–28). A cut-off of 10 on both scales is used to classify subjects as Type D (i.e., NA 10 and SI 10)[22].

State-Trait Anxiety Inventory (STAI–X) measured anxiety as a stable personality trait, a persons' disposition to be nervous, instead of the more prominent use of the term assessing an emotional state characterized by subjective feelings of tension, apprehension, nervousness and worry, and by activation or arousal of the autonomic nervous system. The state anxiety items are each rated on a 4-point intensity scale, from 1 for "not at all" to 4 for "very much so." Score range is 20–80 and higher scores indicate greater levels of anxiety.

Satisfaction with Life Scale (SWLS) was obtained by accessing global cognitive judgment of participants' view of their life on a 5-item scale. There is a 7-point scale from "strongly disagree" to "strongly agree" with a score range of 5–35. A score of 20 represents the neutral point on the scale. Scores between 31 and 35 indicate extremely satisfied, 26–30 indicate satisfied, 21–25 slightly satisfied, 15–19 slightly dissatisfied, 10–14 dissatisfied, and 5–9 score indicate extremely dissatisfied.

Quality of Life in Life-Threatening Illness-Patient (QOLLTI-P) questionnaire is a self-administered questionnaire based on the McGill Quality of Life questionnaire (MQOL) with domains added to enhance content validity.

Vegetative assesment – heart rate variability (HRV)

HRV was measured for 24 hours by a holter device. Participants were instructed to withstand using or consuming stimulants (for instance consumption of more than 3 cups of coffee). Power spectral density of heart rate (HR) was analysed using Holter Medilog® AR12 plus (Schiller, Switzerland) with a program "Fire of Life" to analyze HRV. A short-term 5-minute recordings and nominal 20-hour long-term recordings were detected. The combination of Time domain methods and Frequency domain methods to compare variability among groups in physical exercise were chosen.

Measurements assessed with Time domain parameters were:

- HR (within 5-minute intervals)
- Standard deviation of the N-N intervals (SDNN), the square root of variance. Since variance is mathematically equal to total power of spectral analysis, SDNN reflects all the cyclic components responsible for variability in the period of recording. In many studies SDNN is calculated over a 24-hour period and thus encompasses short-term HF variations as well as the lowest-frequency components seen in a 24-hour period. In this case SDNN can be considered as a marker of good health. R-MSSD is square root of the mean squared differences of successive N-N intervals (ms) and is a measure of HRV, which reflects the integrity of vagus nerve-mediated autonomic control of the heart.

Measurements assessed with Frequency domain parameters were:

- Total Power: a short-term estimate of the total power of spectral density in the range of frequencies between 0 and 0.4 Hz (ms^2) representing the overall activity of the autonomic nervous system where sympathetic activity (Fight-Flight) is principal.

– Low Frequency (LF): frequencies between 0.04 and 0.15 Hz reflecting mixed sympathetic and parasympathetic activity, the last one being prevalent when breathing slowly (ms^2).
– High Frequency (HF): frequencies between 0.15 and 0.4 Hz reflect parasympathetic activity and corresponds to N-N variations (time between two heartbeats) caused by respiration: the respiratory sinus arrhythmia. Deep, even breathing activates the parasympathetic and raises the amplitude of HF (ms^2). Stress decreases HF activity.
– LF/HF ratio: high numbers mean dominance of sympathetic activity while low numbers mean dominance of the para-sympathetic activity. After deep and even breathing an increase reflects changes in the parasympathetic regulation.

Statistical analysis

Data analyses were performed using SPSS 21. The comparison of the mean values of HRV parameters that showed normal distributions among groups were analysed using the Student's T-test. The comparison of the parameters with normal distribution in the patients on admission and after three months period, were analysed using the T-test of equal variance. Further, T-tests for independent samples were used to check the differences between high versus low DS14 scores group. In case of abnormally distributed variables a Kruskal-Wallis test was performed. The level of significance was set to $p< 0.05$ for all the tests.

Results

Overall, 30 participants, 14 men of average age 56.3±15.5 years, and 16 women of average age of 53.5±4.2 years, were included into the analysis. All participants had a normal CRP and sedimentation rate at the enrolment and after 3 month of follow-up.

Test results demonstrated normal levels of serum free cortisol in all groups. The average cortisol level in June was 329.88 nmol/L and the average level in October was 386.53 nmol/L (p=0.243). Moreover, none of the psychological tests (STAX-1, SWLS and QLLTI-P) showed statistical difference among results between June and October (data not shown). However, there were statistically significant differences between June and October measurements for average blood pressure values (Table 1).

Exercising had shown impact on heart rate frequencies but did not significantly impact the HRV parameters. Participants who exercised showed lower heart rates compared to participants who did not exercise during the 3-month follow-up period (Table 2). However, in females some differences in heart variability were observed, namely in HF (p=0.031) and LF/HF ratio (p=0.022). In males approximately equal average variabilities were observed (Table 2).

Type D personality showed no impact or differences in heart functions between the group of participants who exercised (Table 3). There was no statistical significance between DS14+ and DS14– participants. However, when comparing participants with DS14+ personality, statistically significant differences in logLF/HF, LF, heart rates, QRS and LF/HF ratio were found between the participants who exercised and those who did not (Table 3). On the contrary, within DS14– participants no differences were observed among heart variability functions (Table 3).

Discussion

Studies proved that average heart frequency is higher in individuals with hypertension [23]. Moreover, emotional state and neurogenic factors might also affect many functions of cardiovascular system [24]. In the current

TABLE 1

COMPARISONS OF AVERAGE SYSTOLIC, DIASTOLIC BLOOD PRESSURE AND HEART RATE AT THE BEGINNING AND AT THE END OF THE STUDY

	June	October	p-value
	Before taking Queen College Test		
Average systolic BP [mmHg]	115.8	113.5	0.046
Average diastolic BP [mmHg]	70.3	69.3	0.050
	During Queen College Test		
Average systolic BP [mmHg]	111.1	110.5	0.530
Average diastolic BP [mmHg]	72.9	72.3	<0.001
	After Queen College Test		
Average systolic BP [mmHg]	132.1	138.3	<0.001
Average diastolic BP [mmHg]	76.4	78.6	0.084

*BP – blood pressure

TABLE 2

AVERAGE VALUES OF HEART FUNCTION PARAMETERS DURING QUEEN COLLEGE TEST

	Exercise	No exercise	p-value	Male exercise	Male no exercise	p-value	Female exercise	Female no exercise	p-value
LF	270.213	199.686	0.368	292.858	253.789	0.880	260.148	184.930	0.313
HF	132.454	67.252	0.051	110.933	62.411	0.635	142.019	68.573	**0.031**
Total	3118.795	2034.938	0.136	2492.792	1577.289	0.547	3397.019	2159.752	0.159
log LF/HF	0.358	0.569	0.055	0.497	0.776	0.114	0.297	0.513	0.101
ULF%	0.307	0.236	0.159	0.358	0.162	0.225	0.285	0.256	0.549
VLF%	0.521	0.564	0.285	0.485	0.537	0.649	0.537	0.571	0.415
LF%	0.111	0.151	0.195	0.109	0.218	0.098	0.112	0.133	0.559
HF%	0.061	0.043	0.214	0.049	0.049	0.997	0.066	0.041	0.121
Min HR [BpM]	67.992	80.674	**0.002**	69.368	78.506	**0.041**	67.381	81.265	**0.013**
Mean HR [BpM]	87.227	101.442	**<0.001**	84.199	96.053	**0.018**	88.572	102.912	**0.010**
Max HR [BpM]	102.135	116.935	**0.010**	94.182	109.392	0.053	105.670	118.992	0.058
SDNN [ms]	53.749	40.800	0.064	47.017	39.400	0.674	56.741	41.182	**0.048**
r-MSSD [ms]	16.690	13.421	0.134	14.850	17.989	0.632	17.507	12.176	**0.012**
pNN50 [%]	1.263	0.804	0.211	0.782	0.940	0.852	1.477	0.767	0.097
LF/HF	2.365	4.911	**0.011**	3.550	5.628	0.339	1.970	4.672	**0.022**

TABLE 3

DIFFERENCES IN AVERAGE VALUES OF HEART FUNCTION PARAMETERS DURING QUEEN COLLEGE TEST FOR DS14 POSITIVE AND NEGATIVE PERSONALITIES

	DS14+ exercise	DS14- exercise	p-value	DS14+ exercise	DS14+ no exercise	p-value	DS14- exercise	DS14- no exercise	p-value
LF	187.200	367.061	0.163	187.200	192.383	0.808	367.061	197.685	0.210
HF	91.986	179.667	0.115	91.986	29.017	0.183	179.667	78.841	0.060
Total	2872.290	3406.383	0.628	2872.290	1424.942	0.131	3406.383	2448.419	0.378
log LF/HF	0.352	0.366	0.907	0.352	0.818	**0.002**	0.366	0.455	0.589
ULF%	0.372	0.231	0.116	0.372	0.212	0.072	0.231	0.261	0.502
VLF%	0.483	0.566	0.196	0.483	0.554	0.616	0.566	0.586	0.528
LF%	0.091	0.134	0.122	0.091	0.205	**0.010**	0.134	0.110	0.490
HF%	0.054	0.069	0.535	0.054	0.030	0.650	0.069	0.042	0.208
Min HR [BpM]	68.210	67.738	0.872	68.210	82.775	**0.005**	67.738	79.437	0.085
Mean HR [BpM]	84.093	90.882	0.118	84.093	101.904	**0.008**	90.882	101.642	0.085
Max HR [BpM]	101.333	103.070	0.845	101.333	114.732	0.246	103.070	119.073	**0.029**
SDNN [ms]	50.743	57.256	0.545	50.743	35.650	0.141	57.256	44.367	0.188
r-MSSD [ms]	15.405	18.189	0.302	15.405	15.850	0.764	18.189	12.889	0.091
pNN50 [%]	0.985	1.588	0.306	0.985	0.728	0.521	1.588	0.894	0.201
LF/HF	2.394	2.336	0.926	2.394	6.539	**0.013**	2.336	4.378	0.201

research the aim was to identify the correlation between heart function parameters and Type D personality to predict the potential risk patients for CHD.

Exercising by moderate walking during the 3-month follow-up period was included as a stress release factor and participants had to complete the Queen College test after the period of 3 months. There was a significant effect of exercise on the level of blood pressure after 3-month follow-up for all participants ($p<0.05$), referring that exercise helped in lowering average blood pressure. However, it must be mentioned, that we did not obtain any records on the hypertension therapy. Participants could receive the therapy some time during the 3 months and this could potentially lower the average blood pressure, especially in a small sample of only 30 participants. Furthermore, not only blood pressure, but also HRV parameters showed improvements in participants who exercised regularly when compared to participants who did not exercise. The differences were however not statistically significant, but it is well established that reduced HRV and delayed blood pressure recovery are associated with increased cardiovascular risk.

Autonomic imbalance is associated with the stress release in exercise and here we provide evidence that this autonomic imbalance can be indexed by HRV. Next, in using NI and SI as an experiment investigating emotional regulation, we showed that levels of HRV were related to emotion modulated in DS14 scores. Prefrontal cortex modulates responses to threat via a top-down regulation of sympathoexcitatory circuits and affects human cognitive functions expressed in behaviour and decision making process. We also propose that these findings have important implications for the understanding of the two-way communication (hormonal-peptide path and neuro-vegetative path) between the brain and the heart, and indicate a connection between negative emotions and negative health consequences via the common mechanism of autonomic imbalance – low parasympathetic activity. As explained, we used moderate exercise as a stress release effect for our psychoneuroimunological model as exercise has very important but also limited implication of stress release and is conditioned by emotion expression and positioning as reflected in DS14 score. These findings support the notion that each person's individual personality correlates to autonomic regulation of heart (HRV).

Decreased HRV has been associated with increased risk of CHD[25–27]. According to the allostatic load model, healthy individuals can mount an appropriate response to stressors and return to basal state after the stressor has ended. Those, who show continued stress responses after the stressor is over, for example, delayed recovery of blood pressure and HRV, are at increased risk for poor health[28,29]. Previous research suggests that the observed differences between high and low HRV groups may have implications for the future development of cardiovascular disease. In one of the studies, hypertensives showed significantly reduced HRV, while reduced HRV was a predictor for the development of hypertension in a follow-up period of 3 years[30]. Hence, impaired post-stress recovery as well as reduced baseline HRV may indicate disturbances in the regulation of cardiovascular stress responses that contribute to changes in blood pressure. The high HRV individuals showed the expected stress-associated decrease of HRV during the stress tasks and return to baseline levels during recovery[31]. In contrast, the low HRV subjects stayed at significantly lower HRV levels, unaffected by the stage of the task, with no post-stress recovery. Weber et al.[32] suggested that subjects with low HRV do not show context-appropriate responses to environmental challenges. This may predispose them to sustained perturbations of sympathovagal balance with subsequent development of cardiovascular disease. Autonomic imbalance implying decreased vagal tone, and a failure in the adaptation to stressors may precede the development of manifest disease and hence apparently identify healthy subjects at risk[33]. DS14+ personality participants showed the increased risk for CHD in our study. Our data demonstrate that patients with DS14+ who were not exercising had increased heart frequency and reduced HRV frequency. Increased heart frequency and reduced HRV frequency in patients with DS14+ personality can contribute to progression of cardial morbidity and mortality. But exercise can improve the heart variability, as was confirmed also by other studies[34]. Interestingly, by exercising the difference in DS14+ and DS14– was not significant, implying again that exercise lowers the risk for CHD in overall population. A decrease in HRV frequency was significantly reduced, which is already confirmed in some earlier studies[3–7,20]. Negative emotions were shown as predictors for the development and progression of CHD[35]. Type DS14 personality represents the tendency to experience negative emotions and therefore, as shown by our findings, is correlated with increased risk for CHD. Moreover, in a study by Albus et al.[36] the authors recommended the use of the DS14 evaluation in patients with CHD.

Our study obtained significant findings but it had also some limitations. A relatively small sample size of 30 participants was used in the analysis. Moreover, no medication records were obtained among the participants that might bias the result of heart rate frequencies or HRV frequencies. Therefore, the findings need to be interpreted with some caution given the small size of this case-control study. Other limitations include lack of information on smoking, and other behavioral risk factors for cardiovascular morbidity. Despite the mentioned limitations, as findings from previous studies on Type D personality are limited, the results contribute significantly to the understanding of exercise and emotions in patients with the risk of cardiovascular morbidity.

Conclusions

Information on Type D emotional state and its correlation to CHD is lacking. Moreover, little is known about the prevention of cardiac events in DS14+ individuals. Therefore, the current study reports on Type D individuals and HRV frequencies. However, with the DS14, assessed by NA and SI emotions, Type D was associated with increased risk of CHD proved by the HRV measures. Question remains how to address the Type D individuals to lower their risk for cardiovascular events. Our research found that exercise has a significant impact on the individual blood pressure, heart rate and HRV frequency, as participants who exercised regulary in the 3-month period, showed lower risk for cardiovascular events. These findings support the notion that each person's individual personality correlates to autonomic regulation of heart (HRV). However, more research is needed to examine the validity of correlation between Type D, exercising and HRV.

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TIP D LIČNOSTI I RIZIK OD KORONARNE BOLESTI SRCA U PRETILIH PACIJENATA

S A Ž E T A K

Cilj rada je analizirati povezanost između srčane funkcije kod pretilih pacijenata i osobina ličnosti tipa D kako bi se predvidio potencijalni rizik za koronarnu bolest srca (CHD). Tip DS14 je procijenjen u ukupno 30 pretilih pacijenata. Tjelesna masa s indeksom tjelesne mase (BMI), sistolički i dijastolički krvni tlak, broj otkucaja srca (HR) i varijabilnost otkucaja srca (HRV) mjereni su prije i nakon tromjesečnog razdoblja. Polovica ispitanika dobila je upute da vježba 4 puta lakše hodanje (5 km/h) po sat vremena, druga polovica nije vježbala. Dodatno su korišteni STAX-1, SWLS i QOLLTI-P upitnici. Svi su sudionici imali normalan CRP i brzinu sedimentacije na početku studije i nakon 3 mjeseca praćenja. Nijedan psihološki test (STAX-1, SWLS i QLLTI-P) nije pokazao statističku razliku između rezultata u lipnju i listopadu. Ispitanici koji su vježbali imali su niži HR u usporedbi sa sudionicima koji nisu vježbali. Pretili pacijenti s visokim rezultatom DS14 pokazali su smanjen HRV kao dodatni čimbenik rizika za buduće kardiovaskularne i druge bolesti povezane sa stresom. Ličnost tipa D bila je povezana s povećanim rizikom od CHD-a, a to je dokazano mjerenjem HRV-a kada osoba nije vježbala. Rezultati ukazuju da je individualni tip ličnosti zapravo u korelaciji s autonomnom regulacijom srca.