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PERSONALITY IN PATIENTS WITH TAKOTSUBO CARDIOMYOPATHY

The last few years have seen an increase in the awareness of a specific heart disease referred to as takotsubo cardiomyopathy. The evidence from the literature demonstrates that psychological variables (especially personality traits) can have a significant impact on the manifestations of different heart diseases. Little is known, however, about the psychological characteristics of takotsubo patients. The primary purpose of this research was to extract the specific personality traits of patients with takotsubo syndrome. Our research covered 76 participants divided into three groups: the clinical group—patients with takotsubo cardiomyopathy ($n = 30$); Comparison Group 1—individuals with acute myocardial infarction group ($n = 21$); and Comparison Group 2—heart-healthy persons ($n = 25$). The study included psychological tests and an MRI examination. The psychological methods used in the research were the NEO Personality Inventory, the Type D Scale, and the assessment of the occurrence of stressful life events. Most takotsubo patients reported stressful life events before the occurrence of takotsubo symptoms. In our studies, it was not typical for takotsubo to be associated type D personality. Takotsubo patients have experienced negative emotions but do not suppress their emotions and participate socially without emotional inhibitions. Moreover, patients are open to experience, have average self-control, and tend to be dutiful and dependable. It is possible that these personality traits could facilitate the healing process.

Keywords: takotsubo cardiomyopathy; personality traits; type D personality; stress; heart disease.

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Takotsubo cardiomyopathy (TC) is a recently defined clinical entity. First described by Japanese researchers in 1990 (Sato et al., 1990), it is diagnosed today in 1–2% of patients presenting with acute coronary syndrome (ACS) (Koulouris et al., 2010). Takotsubo is a type of non-ischemic cardiomyopathy characterized by a sudden, acute, temporary left ventricular dysfunction. An important criterion is the absence of lumen strictures in the coronary arteries (Movahed & Donohue, 2007). Dyspnea and chest pain associated with ECG changes suggestive of anterior wall myocardial infarction (MI) are the typical symptoms. Myocardium stunning is always transient and usually systolic. Ventricular function, as evidenced by ECG, usually improves during the first few days and normalizes in the following few months. As opposed to myocardial infarction, long-term prognosis is better in takotsubo cardiomyopathy. Supportive therapy leads to a complete recovery in most patients—only a fifth of them manifest serious complications, particularly younger ones with physical triggers and psychiatric or neurologic diseases (Templin et al., 2015). Takotsubo cardiomyopathy largely occurs in postmenopausal women, with a mean age of 60–70 and an absence of prior history of heart disease. Besides, studies show that patients with takotsubo have a higher prevalence of psychiatric or neurologic disorders than those with ACS (Templin et al., 2015).

The pathophysiology of takotsubo cardiomyopathy remains poorly understood. Currently, the most likely explanation of TC is offered by theory of catecholamine-mediated myocardial stunning. High plasma catecholamine levels have been reported in several cases (Christoph et al., 2010; Koulouris et al., 2010). Generally speaking, excessive sympathetic stimulation may play a key role in TC above and beyond the burden of conventional cardiovascular risk factors.

A large body of research confirms the link between psychological factors and health condition. Fava and Sonino (2000) emphasize that psychological, social, and biological factors contribute towards a patient's susceptibility to the incidence, progress, and course of a disease. Researchers have enumerated 12 psychosomatic syndromes, eight syndromes concern the main manifestations of abnormal illness behavior: somatization, hypochondriacal fears and beliefs, and illness denial. The other four syndromes (alexithymia, type A behavior, demoralization and irritable mood) refer to the domain of psychological factors affecting medical conditions (Fava et al., 1995; Fava & Sonino, 2000). The role of psychological factors was also demonstrated in takotsubo cardiomyopathy. The symptoms of TC are often preceded by an emotional or physical trigger (Dote et al., 1991; Koulouris et al., 2010; Sabisz et al., 2016; Smeijers et al., 2016), while

no stressful trigger is observed in approximately one-third of patients (Sharkey et al., 2010; Templin et al., 2015). However, most people are exposed to repeated, acute stressors throughout their lifetime, but only a relatively small number develop takotsubo cardiomyopathy. Furthermore, the recurrence rate is low in takotsubo patients despite stressful events over a lifetime. Patients with TC seem to have difficulties in de-emphasizing a stressful event. Generally speaking, their ability to control a stressful situation and their reactions is impaired. Hypothetical risk factors may influence a person's response to stress. Pathophysiological processes involved in takotsubo cardiomyopathy are associated with exaggerated neurohormonal and cardiovascular response patterns. Personality traits may play a role in stress-related autonomic reactions, as they are associated with variations in hypothalamic-pituitary-adrenocortical (HPA) and regulate the HPA response to stressors (psychological and physiological) (Uhart et al., 2004; Pedersen & Denollet, 2006).

It is worth mentioning that numerous studies show the important role of personality in pathogenesis of coronary heart disease (CHD). It is assumed that raised levels of neuroticism occur in patients with cardiovascular disease and autonomic reactivity. High neuroticism aggravates the risk of heart disease associated with depression, reduced heart rate variability equally under rest and stress, and increased cardiovascular mortality (Shipley et al., 2007; Jokela et al., 2014; Čukić & Bates, 2015). Consistent correlations with cardiovascular outcomes have been found also for low agreeableness (Chida & Steptoe, 2009) and low conscientiousness (Martin et al., 2007).

Therefore, negative emotions, antagonism, and a lack of self-discipline seem to be the main personality components of cardiac risk. Also type D personality has been established as an independent predictor of acute adverse cardiac events (Denollet et al., 2000; Denollet et al., 2006). Cross-cultural analyses have shown that the prevalence of type D personality ranges between 24 and 37% of CHD patients (Kupper et al., 2013). Moreover, recent studies prove that type D personality is linked with a heightened risk of morbidity and mortality in patients with heart disease (Denollet et al., 2000), with modified cardiovascular responses to psychological stress (Williams et al., 2009), with dysfunctional cardiac output (Howard & Hughes, 2012), with cortisol reactivity to stress, and higher cortisol levels (Habra et al., 2003). Type D personality is also linked to clinical depression, which is frequently present in TC patients (Starrenburg et al., 2013). Consequently, one might expect that type D personality makes some individuals more susceptible to stress cardiomyopathy reactions resulting from acute psychological stressors.

After over 25 years of research toward a better understanding of takotsubo cardiomyopathy current knowledge remains limited. Many earlier studies show the important role of personality in pathogenesis coronary heart disease and personality traits have also been revealed to have significant relevance for patients with takotsubo syndrome (see Compare et al., 2013; Lacey et al., 2014; Scantlebury et al., 2016; Smeijers et al., 2016). However, psychological research into TC reveals inconsistent results. Thus, our decision was to focus specifically on personality traits. Furthermore, the knowledge of this disorder is based on medical case studies. While there have been many studies from a cardiological perspective, the psychological factors underlying TC have rarely been examined. The most significant task for psychologists is to try to answer the question: how can patients at risk from takotsubo be identified and what may be done to protect them?

The generally defined primary purpose of this research was a systemically profiled diagnosis of a TC patient personality. To the best of our knowledge, this is the first study investigating personality assessment, along with MRI in patients with takotsubo cardiomyopathy in Poland.

The following specific goals have been identified:

- identify the characteristic personality traits of TC patients,
- identify the inter- and intrapersonal personality profiles of TC patients,
- identify hypothetical psychosocial problems experienced by TC patients.

Thus, our hypothesis was that patients with takotsubo would manifest a personality profile characterised by high neuroticism, compared with that of the general population and acute myocardial infarction patients. We hypothesized that type D would be more common in TC patients than in the other two groups. We also hypothesized that TC patients are more often exposed to stressful life events than the other two groups.

METHOD

Participants

The research was conducted at the Clinic of Adult Neurology of the University Clinical Centre in Gdańsk. The participants were recruited from among the patients of the Clinical Centre of Cardiology of the University Clinical Centre in Gdańsk by a qualified team of cardiologists, a neurologist, a radiologist, and a psychologist.

The research involved 76 people divided into three groups. The clinical group included patients with takotsubo cardiomyopathy (TC), the first comparison group covered acute myocardial infarction patients (AMI) (C1), and the second comparison group included heart-healthy individuals (C2). All the participants were women. The clinical group included 30 subjects ($M = 65.54$; $SD = 7.8$), examined at least 12 months after an acute episode of takotsubo cardiomyopathy. The patients with takotsubo cardiomyopathy were diagnosed according to Mayo Clinic criteria (Madhavan & Prasad, 2010) and deemed fully recovered, with no ECG and left ventricle wall motion abnormalities. Group C2 consisted of 21 participants ($M = 65.90$; $SD = 7.8$), with acute myocardial infarction. Group C2 included 25 participants ($M = 62.90$; $SD = 4.5$), presenting no signs or symptoms of any cardiovascular diseases (heart-healthy). None of the individuals had any recognized neurological or psychiatric disorders.

There were no significant differences in age ($F(2, 73) = 1.42, p = .25$), years of education ($F(2, 73) = 2.74; p = .07$), marital status ($\chi^2(8, N = 76) = 9.9, p = .26$) and work activity ($\chi^2(6, N = 76) = 3.8, p = .71$) within the three groups. Most of the research subjects (52%) were retired: 53% of TC patients, 52% patients with acute myocardial infarction, and 52% of heart-healthy participants were old-age pensioners. Most of the research subjects (72%) were married: 77% TC patients, 67% patients with acute myocardial infarction, and 72% of heart-healthy participants were married.

Moreover, most takotsubo patients (77%) reported extra-cardiac diseases (e.g., chronic pulmonary disease, thyroid problems, cancer, degeneration of the spine, rheumatoid arthritis, sleep apnea). For comparison, 38% of patients with acute myocardial infarction and 28% of participants without any signs or symptoms of any cardiovascular diseases reported extra-cardiac diseases.

Measures

The study was preceded by a clinical interview with psychologists, which facilitated communication with the subjects, gathering demographic data and information on their psychosocial functioning, as well as the assessment of trigger events that occurred before the onset of the symptoms of the disease.

MRI acquisition. MRI was performed on a 3.0T Achieva TX scanner (Philips, Best, Netherlands) using a 32-channel head coil. The sequence included brain anatomical imaging sequences: T2-weighted TSE in sagittal and coronal (with fat saturation) plane; T1-weighted TFE and FLAIR in axial plane, DWI with three b-values (0, 500, 1000 s/mm²) in axial plane. A trained radiologist

checked the results of this examination. The research excluded all those whose MRI scans have been found inappropriate for their age or indicative of morphological change in the brain.

Global cognitive assessment. As most of the examined participants were elderly before the start of the study, screening with the Mini-Mental Status Examination (MMSE) was performed. This tool offers a simple way to quantify cognitive function and screen for cognitive loss (Stańczak, 2010).

Personality traits assessment. To describe the patients' personality we chose the Big Five personality traits, which were measured with the NEO Personality Inventory (Costa & McCrae, 1985). This questionnaire analyzes the following five factors: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. The reliability factors obtained for the Polish adaptation of the NEO Personality Inventory are satisfactory—Cronbach's alpha from .68 to .82 (Zawadzki et al., 1998). The reliability factors obtained for our research of the NEO Personality Inventory are also satisfactory—Cronbach's alpha from .62 to .74.

Type D personality was measured with Denollet's questionnaire the Type D Scale (DS14) (Denollet, 2005). This tool analyzes type D personality in terms of two independent dimensions: negative affectivity (NA) and social inhibition (SI). Individuals assess their personality on a 5-point Likert scale ranging from 0 (false) to 4 (true). The negative affectivity and social inhibition scales can be scored as continuous variables (ranging 0–28). Type D personality was also analyzed as a categorical construct, with NA and SI components being dichotomized on the basis of ≥ 10 scores on both subscales. The Cronbach's alpha factor of the Type D Scale was high for negative affectivity ($\alpha = .86$) and social inhibition ($\alpha = .84$) (Ogińska-Bulik et al., 2009). The type D construct is applicable in Polish patients with coronary artery disease. The psychometric features of DS14 for the group of patients after myocardial infarction are satisfactory. The inventory's Polish version was shown to have high reliability in negative affectivity ($\alpha = .83$) and in social inhibition ($\alpha = .63$) (Moryś et al., 2006). The reliability factors obtained for our research of the Type D Scale are also satisfactory: Cronbach's alpha of .85 for negative affectivity and .78 for social inhibition.

Procedure

The study included both psychological tests and an MRI examination. MRI was performed on patients with takotsubo and those with acute myocardial

infarction. The images of routine brain examination of all the patients were reviewed by a trained radiologist, who did not recognize any brain abnormalities.

Participants from all the groups were examined individually. Clinical interview and psychological tests were carried out by a psychologist. The sessions lasted about 60 minutes each. Before admission, all the participants were assessed with the MMSE. All the patients who scored less than 20 were excluded from the research.

Prior to the study, written informed consent was obtained from all the participants. Our study was approved by the local ethics committee. After completing the research, the participants were told about the aim of the study and fully debriefed.

RESULTS

In the clinical interview, 29 patients reported experiencing a stressful event immediately preceding the onset of TC. Stressful life events, for example, unexpected death of a relative, passing away of a family member, catastrophic medical diagnoses, operations or unexpected hospitalization (the patient himself or someone close), work problems, heated arguments with friends, relatives or neighbors, financial problems, family problems (e.g., divorce, arguments, separation from someone close), involvement in a road accident—all occurred more often in takotsubo patients (96.6%) than in those with acute myocardial infarction (57%) or participants without signs or symptoms of any cardiovascular diseases (16%).

The first stage of statistical analysis focused on inter-group differences in the personality. The analyses utilized a one-way between groups ANOVA and a post-hoc Tukey test for comparison purposes. The dependent variables were each time expressed as averaged scores on the individual scales in the NEO Personality Inventory and the Type D Scale. Independent variables were defined as group membership (TC \times C1 \times C2). The mean scores with F statistic $F(F\text{-test})$ are presented in Table 1.

The statistical analysis of the two components of Type D showed that the differences between the three groups were significant for social inhibition ($F(2, 73) = 3.24, p < .05$), and insignificant for negative affectivity ($F(2, 73) = 1.04, p = .36$). Post-hoc analyses using Tukey's range test revealed that the results of the TC patients were significantly lower than those of the AMI patients in terms of social inhibition. The findings also indicated that there was no rela-

tionship between type D personality (as a categorical construct) and TC. About 30% of the takotsubo patients were categorized as type D compared with 50% AMI patients.

Table 1. *Inter-Group Differences in Type D Personality and Personality Traits Measured With NEO Personality Inventory*

Variable	Clinical Group		Comparison Group 1		Comparison Group 2		ANOVA	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i> (2,73)	<i>p</i>
Social Inhibition	7.82 _a	5.60	11.70 _a	4.24	9.25	5.44	3.24	.045
Negative Affectivity	10.54	6.12	12.85	7.25	12.75	6.21	1.04	.358
Extraversion	26.57	6.04	25.50	5.16	28.29	5.45	1.40	.253
Neuroticism	21.92	5.46	22.30	6.84	23.46	7.31	0.69	.502
Openness to Experience	26.89 _a	6.01	23.30 _{ab}	5.14	27.88 _b	5.62	3.89	.025
Conscientiousness	35.43	3.97	34.25	3.83	34.63	3.77	0.59	.555
Agreeableness	33.18	3.52	30.80	3.22	31.63	5.21	2.11	.128

Note. Means in a row with the same subscript (a, b) have been found to be statistically different at the level 0.05 (post-hoc Tukey test).

Of the personality traits measured by NEO Personality Inventory only openness to experience differentiated the groups ($F(2, 73) = 3.89, p < .05$). Our post-hoc analyses with Tukey's range test revealed that the results of the AMI patients were significantly lower than those of the TC patients or those of the participants without cardiovascular diseases. The differences between the three groups were not significant for extraversion ($F(2, 73) = 1.40, p = .25$), neuroticism ($F(2, 73) = .69, p = .50$), conscientiousness ($F(2, 73) = .59, p = .55$), and agreeableness ($F(2, 73) = 2.11, p = .13$).

The next step was a qualitative analysis. Initially, the full scale of the measurement was unified by transforming the raw results into calculated data, which was then placed on the standardized scale (z-scores). The transformation was made based on the average and standard deviation of the heart-healthy group.

The ipsatization allowed us to observe possible intraindividual variability. The tests were carried out according to the following criteria:

- results within the norm ($-1 \leq z \leq 1$)
- results beyond the norm* ($-2 \leq z < -1$)
- results significantly beyond the norm* ($z < -2$).

(*excessive intensity of the psychological trait or slight intensity of the psychological trait).

The test results were then dichotomized by merging the “results beyond the norm” with “results significantly beyond the norm.” Personality profiles of the patients with takotsubo cardiomyopathy are presented in Table 2.

Table 2. *Personality Differentiation of Patients With Takotsubo Cardiomyopathy*

Personality profiles of takotsubo patients																		
Personality Traits	A <i>n</i> = 3	B <i>n</i> = 2	C <i>n</i> = 1	D <i>n</i> = 2	E <i>n</i> = 1	F <i>n</i> = 2	G <i>n</i> = 2	H <i>n</i> = 2	I <i>n</i> = 1	J <i>n</i> = 1	K <i>n</i> = 2	L <i>n</i> = 2	M <i>n</i> = 2	N <i>n</i> = 2	O <i>n</i> = 2	P <i>n</i> = 1	Q <i>n</i> = 1	R <i>n</i> = 1
Extraversion	–	–	–	–	–	–	–	–	↓	↓	–	↑	↑	–	–	↓	↓	↓
Neuroticism	–	–	–	–	–	–	–	–	–	–	–	–	↓	↓	↓	–	↑	–
Openness to Experience	–	–	–	–	–	–	↓	↑	–	–	↓	↑	–	↑	↑	–	–	↓
Conscientiousness	–	↑	↓	–	–	–	↑	–	↑	↑	–	↑	–	–	↑	–	↓	↓
Agreeableness	–	–	–	↑	–	–	–	–	–	–	–	↑	↑	–	–	↓	–	–
Negative Affectivity	–	–	–	–	↓	–	–	–	–	–	↓	–	–	↓	↓	↑	↑	↑
Social Inhibition	–	–	–	–	–	↓	–	↓	↓	↑	↓	–	↓	↓	–	↑	↑	↑

Note. – = average intensity of the trait; ↓ = low intensity of the trait; ↑ = high intensity of the trait.

The personality of tokotsubo patients seemed to be heterogeneous in the light of the inter- and intrapersonal comparisons. The analysis extracted many personality profiles. Profile analyses exposed some interesting trends. It is also noteworthy that about a third of takotsubo patients are characterized by a high level of conscientiousness. However, this trend was not confirmed statistically. A similar trend was observed in our earlier preliminary study (Sabisz et al., 2016).

DISCUSSION

Since its original description in Japan in the 1990s, takotsubo cardiomyopathy has been reported with increasing frequency in recent years. The onset of TC can be triggered by an acute, intense stress, but the exact pathogenic mechanisms remain unknown at present. Conceivably, some people may be predisposed to suffer from takotsubo cardiomyopathy. The evidence from the literature demonstrates that psychological variables may have a significant impact on the manifestations of different heart diseases—including takotsubo cardiomyopathy (see Compare et al., 2013; Kastaun et al., 2014; Lacey et al., 2014; Sabisz et al., 2016; Scantlebury et al., 2016; Smeijers et al., 2016). Undoubtedly, personality traits may play a role in response to stressors (psychological and physiological).

Stressful life events occurred in the majority of takotsubo patients. Generally, cumulative stress exposure across the lifespan, reinforced by personality traits, such as high neuroticism, negative affectivity, social inhibition, contribute to increasing the risk of heart disease. In the context of the present study this mechanism does not work. We did not observe high neuroticism in TC patients but the results reported in the literature are contradictory. The results reported by Scantlebury et al. (2016) showed that patients with TC do not demonstrate higher levels of neuroticism compared with the general population. According to Lacey et al. (2014) only “neuroticism” significantly differed between participants with takotsubo patients and healthy volunteers. Healthy controls had lower levels of neuroticism compared to TC group; in this study, however, the groups were differentiated by age.

Also, our takotsubo patients did not tend to suppress their emotions or inhibit their self-expression in social interactions. However, the TC subjects experienced negative emotions (so did AMI patients), but without a tendency to feel inhibited, tense, and insecure when with others. It is worth adding that in our earlier preliminary study we observed that the majority of the TC patients were more likely to worry and experience an elevated level of negative emotions at various times and situations. At the same time, most of the takotsubo patients reported that they did not suppress their emotions and participated socially without any emotional inhibitions (Sabisz et al., 2016). Our study supports the hypothesis that takotsubo patients could have problems with emotional control. This tendency to experience negative affectivity, without a trend towards the inability to express these negative emotions may suggest a greater focus on self in the TC group. These results may also correspond to our earlier preliminary study, in which RS-fMRI tests found an increase in the number of active areas in the precuneus. The

patients' psychological sense of self may contribute to the increased connectivity in the precuneus area. This may suggest a greater focus on self in the TC group, including their negative emotions (Sabisz et al., 2016). The patients feel more nervous during stress and while experiencing negative emotions and are therefore tense. A greater focus on self in the TC group trend was observed in case report (Jenab et al., 2017). The main common elevated scale was hypochondriasis. Individuals with high scores on this scale are obsessed with themselves, and often use their disease symptoms in order to manipulate others. They are mainly passive aggressive, critical, and demanding (Jenab et al., 2017).

However, our findings contrast with those obtained by Compare et al. (2013). The results of Compare et al. (2013) study documented a higher prevalence of type D personality in TC patients, both with and without emotional triggers, compared with acute myocardial infarction patients. Furthermore, the prevalence of type D in TC individuals (59.5%) was higher than the levels observed in other studies of AMI patients (see Pedersen & Denollet, 2006; Kupper et al., 2013) and in general populations (see Denollet, 2005). In our study no association between type D and TC was found (similar results were obtained by Smeijers et al., 2016). The prevalence of type D in the TC patients was about 30% (a greatly elevated level), which is consistent with the corresponding figure for the general population in Poland. Research on the prevalence of type D personality in the Polish population showed that 34.8% in the general population (Ogińska-Bulik & Juczyński, 2009) present type D personality, while the percentage of cardiac patients ranged from 52% (Moryś et al., 2015) to 72.1% (Ogińska-Bulik & Juczyński, 2009). Additionally, the study of Compare et al. (2013) suggests a potential key role for social inhibition in increased cardiovascular reactivity to acute emotional distress in takotsubo patients. Our study does not corroborate the operation of this mechanism.

Also, our study did not confirm the occurrence of a specific personality profile in patients with takotsubo cardiomyopathy. Takotsubo patients were internally heterogeneous. The analyses failed to identify regular patterns. Our results are consistent with those presented by Kastaun et al. (2014) and Smeijers et al. (2016)—their findings do not lend support for personality characteristics of TC, either.

On the other hand, it is important to remember that personality may improve health and have an influence on people's emotional and social life (Deary et al., 2010). Stable personality factors may contribute to individual differences in emotional well-being, responses to distressing factors and cardiovascular reactivity to emotional stress. For example, a person with high conscientiousness is

more likely to apply optimal health behaviors (Lodi-Smith et al., 2010). High extraversion, low neuroticism and average agreeableness help to curb negative emotions, while also encouraging the seeking of social support in difficult situations and risk-taking (Chida & Steptoe, 2008; Boehm & Kubzansky, 2012). It is not inconceivable that personality is a hypothetical factor protecting against significant heart incidents.

Even though takotsubo patients had experienced negative emotions, they were not characterized by strong sensitivity to negative affectivity, social inhibition, interpersonal hostility, or antagonism. They were open to a variety of experiences in different domains of life, open-minded and possessed of average self-control, they also had a tendency to plan ahead, to be task-oriented, self-disciplined, dutiful, and dependable. Consequently, one might expect that TC patients would be willing to search for and adhere to relevant health information, search for and use social support in difficult situations, not to avoid expressing emotions in social situations or avoid people. However, our findings contrast with those obtained by Smeijers et al. (2016). They found that TC patients reported lower levels of openness to experience compared with healthy individuals; in our study, in contrast, the groups were differentiated on the basis of age and years of education. It is worth adding that many of the TC patients showed an elevated level of conscientiousness (but it was only a statistically unconfirmed trend). We observed a similar trend in the earlier preliminary study (Sabisz et al., 2016). Perhaps these cognitive-behavioral styles are likely to contribute to the serious consequences of heart incidents (like acute myocardial infarction). However, this is only a hypothesis which requires empirical confirmation. Further psychological research is needed. It may prove significant to determine the psychosocial variables which could lead to the development of takotsubo cardiomyopathy. Clarifying the role of psychological factors in TC may provide these patients with more intervention possibilities.

CONCLUSIONS

In our study, a high incidence of stressful life events may be observed in TC patients. The personality of the takotsubo patients was internally heterogeneous. It was not typical for them to have type D personality, but they are likely to experience negative emotions. Our study supports the hypothesis that takotsubo patients could have problems with emotional control. Takotsubo patients also have personal traits that can help them cope with illness.

This study suggests the need for cooperation among multiple specialists. Psychological assessment can be helpful in developing health care plans for TC patients. Interpersonal psychotherapy, social skills training, emotional support, and other stress-reducing techniques are needed so that takotsubo patients may improve their quality of life. The problem of TC patients' psychological functioning requires further research. The results of such research will be important for theoretical (determining traits specific to such patients) and practical (establishing a complete model for the functioning of the TC sufferer). A detailed and person-oriented exploration of the situation of sufferers will provide an opportunity to offer better assistance while also mitigating the consequences of the illness.

LIMITATIONS

The main limitation of our study is the relatively small size of the examined group. Also, the number of people in the groups was not equal. The disparity in numbers between the groups stems from restrictive criteria for sample representativeness, with a large number of variables controlled for, such as age, education, or the length of married life.

It is extremely difficult to test men with takotsubo, as the condition usually affects women who are estimated to account for approximately 90% of all cases (Prasad et al., 2008). Thus, all the participants in our research are women. It is also necessary to consider the need for social approval leading the patients to intentionally or unintentionally provide false information and resulting in less reliability in self-reported data (Zalewska, 2005). Some researchers suggest that this tendency is more pronounced among women (Zawadzki, 1995). Also, studies stress that in women social approval increasingly correlates with age (Ray, 1988; Zalewska, 2005). It is therefore necessary to test a wider sample of patients, including males.

REFERENCES

- Boehm, J. K., & Kubzansky, L. D. (2012). The heart's content: The association between positive psychological well-being and cardiovascular health. *Psychological Bulletin, 138*(4), 655–659. <https://doi.org/10.1037/a0027448>

- Chida, Y., & Steptoe, A. (2008). Positive psychological well-being and mortality: A quantitative review of prospective observational studies. *Psychosomatic Medicine*, *70*(7), 741–756. <https://doi.org/10.1097/PSY.0b013e31818105ba>
- Chida, Y., & Steptoe, A. (2009). The association of anger and hostility with future coronary heart disease. A meta-analytic review of prospective evidence. *Journal of the American College of Cardiology*, *53*(11), 936–946. <https://doi.org/10.1016/j.jacc.2008.11.044>
- Christoph, M., Ebner, B., Stolte, D., Ibrahim, K., Kolschmann, S., Strasser, R. H., & Schön, S. (2010). Broken heart syndrome: Tako Tsubo cardiomyopathy associated with an overdose of the serotonin-norepinephrine reuptake inhibitor Venlafaxine. *European Neuropsychopharmacology*, *20*(8), 594–597. <https://doi.org/10.1016/j.euroneuro.2010.03.009>
- Compare, A., Bigi, R., Orrego, P. S., Proietti, R., Grossi, E., & Steptoe, A. (2013). Type D personality is associated with the development of stress cardiomyopathy following emotional triggers. *Annals of Behavioral Medicine*, *45*(3), 299–307. <https://doi.org/10.1007/s12160-013-9474-x>
- Costa, P. T., & McCrae, R. R. (1985). *The NEO personality inventory Manual*. Psychological Assessment Resources.
- Čukić, I., & Bates, T. C. (2015). The association between neuroticism and heart rate variability is not fully explained by cardiovascular disease and depression. *PLoS ONE*, *10*(5), 1–11. <https://doi.org/10.1371/journal.pone.0125882>
- Deary, I. J., Weiss, A., & Batty, G. D. (2010). Intelligence and personality as predictors of illness and death: How researchers in differential psychology and chronic disease epidemiology are collaborating to understand and address health inequalities. *Psychological Science in the Public Interest, Supplement*, *11*(2), 53–79. <https://doi.org/10.1177/1529100610387081>
- Denollet, J. (2005). DS14: Standard assessment of negative affectivity, social inhibition, and type D personality. *Psychosomatic Medicine*, *67*(1), 89–97. <https://doi.org/10.1097/01.psy.000014-9256.81953.49>
- Denollet, J., Pedersen, S. S., Vrints, C. J., & Conraads, V. M. (2006). Usefulness of type D personality in predicting five-year cardiac events above and beyond concurrent symptoms of stress in patients with coronary heart disease. *American Journal of Cardiology*, *97*(7), 970–973. <https://doi.org/10.1016/j.amjcard.2005.10.035>
- Denollet, J., Vaes, J., & Brutsaert, D. L. (2000). Inadequate response to treatment in coronary heart disease: Adverse effects of type D personality and younger age on 5-year prognosis and quality of life. *Circulation*, *102*(6), 630–635. <https://doi.org/10.1161/01.CIR.102.6.630>
- Dote, K., Sato, H., Tateishi, H., Uchida, T., & Ishihara, M. (1991). Myocardial stunning due to simultaneous multivessel coronary spasms: A review of 5 cases. *Journal of Cardiology*, *21*(2), 203–214.
- Fava, G. A., Freyberger, H. J., Bech, P., Christodoulou, G., Sensky, T., Theorell, T., & Wise, T. N. (1995). Diagnostic criteria for use in psychosomatic research. *Psychotherapy and Psychosomatics*, *63*(1), 1–8. <https://doi.org/10.1159/000288931>
- Fava, G. A., & Sonino, N. (2000). Psychosomatic medicine: Emerging trends and perspectives. *Psychotherapy and Psychosomatics*, *69*(4), 184–197. <https://doi.org/10.1159/000012393>
- Habra, M. E., Linden, W., Anderson, J. C., & Weinberg, J. (2003). Type D personality is related to cardiovascular and neuroendocrine reactivity to acute stress. *Journal of Psychosomatic Research*, *55*(3), 235–245. [https://doi.org/10.1016/s0022-3999\(02\)00553-6](https://doi.org/10.1016/s0022-3999(02)00553-6)

- Howard, S., & Hughes, B. M. (2012). Construct, concurrent and discriminant validity of Type D personality in the general population: Associations with anxiety, depression, stress and cardiac output. *Psychology & Health, 27*(2), 242–258. <https://doi.org/10.1080/08870446.2011.603423>
- Jenab, Y., Roghaieh Hashemi, S., Ghaffari-Marandi, N., Zafarghandi, H., & Shahmansouri, N. (2017). Psychological features of Takotsubo cardiomyopathy: Report of four cases. *Journal of Tehran University Heart Center, 12*(2), 95–98.
- Jokela, M., Pulkki-Råback, L., Elovainio, M., & Kivimäki, M. (2014). Personality traits as risk factors for stroke and coronary heart disease mortality: Pooled analysis of three cohort studies. *Journal of Behavioral Medicine, 37*(5), 881–889. <https://doi.org/10.1007/s10865-013-9548-z>
- Kastaun, S., Gerriets, T., Yeniguen, M., Nef, H., Moellmann, H., Sammer, G., & Juenemann, M. (2014). Locus of control and stress management strategies in women with takotsubo cardiomyopathy. *International Journal of Cardiology, 177*(2), 658–660. <https://doi.org/10.1016/j.ijcard.2014.09.173>
- Koulouris, S., Pastromas, S., Sakellariou, D., Kratimenos, T., Piperopoulos, P., & Manolis, A. S. (2010). Takotsubo cardiomyopathy: The “broken heart” syndrome. *Hellenic Journal of Cardiology, 51*(5), 451–457.
- Kupper, N., Pedersen, S. S., Höfer, S., Saner, H., Oldridge, N., & Denollet, J. (2013). Cross-cultural analysis of Type D (distressed) personality in 6222 patients with ischemic heart disease: A study from the International HeartQoL Project. *International Journal of Cardiology, 166*(2), 327–333. <https://doi.org/10.1016/j.ijcard.2011.10.084>
- Lacey, C., Mulder, R., Bridgman, P., Kimber, B., Zarifeh, J., Kennedy, M., & Cameron, V. (2014). Broken heart syndrome—Is it a psychosomatic disorder? *Journal of Psychosomatic Research, 77*(2), 158–160. <https://doi.org/10.1016/j.jpsychores.2014.05.003>
- Lodi-Smith, J., Jackson, J., Bogg, T., Walton, K., Wood, D., Harms, P., & Roberts, B. W. (2010). Mechanisms of health: Education and health-related behaviours partially mediate the relationship between conscientiousness and self-reported physical health. *Psychology and Health, 25*(3), 305–319. <https://doi.org/10.1080/08870440902736964>
- Madhavan, M., & Prasad, A. (2010). Proposed Mayo Clinic criteria for the diagnosis of Tako-Tsubo cardiomyopathy and long-term prognosis. *Herz, 35*(4), 240–243. <https://doi.org/10.1007/s00059-010-3339-x>
- Martin, L. R., Friedman, H. S., & Schwartz, J. E. (2007). Personality and mortality risk across the life span: The importance of conscientiousness as a biopsychosocial attribute. *Health Psychology, 26*(4), 428–436. <https://doi.org/10.1037/0278-6133.26.4.428>
- Moryś, J. M., Bellwon, J., Jezewska, M., Adamczyk, K., & Gruchała, M. (2015). The evaluation of stress coping styles and type D personality in patients with coronary artery disease. *Kardiologia Polska, 73*(7), 557–566. <https://doi.org/10.5603/KP.a2015.0039>
- Moryś, J., Majkiewicz, M., Ogińska-Bulik, N., & Rynkiewicz, A. (2006). Właściwości psychometryczne kwestionariusza do diagnozy osobowości typu D (DS14) szacowane na podstawie badania pacjentów z przebyłym zawałem serca [Psychometrical features of the type D personality questionnaire estimated in the group of patients after myocardial infarction]. *Psychiatria, 3*(2), 62–69.
- Movahed, M. R., & Donohue, D. (2007). Review: Transient left ventricular apical ballooning, broken heart syndrome, ampulla cardiomyopathy, atypical apical ballooning, or Tako-Tsubo cardiomyopathy. *Cardiovascular Revascularization Medicine, 8*(4), 289–292. <https://doi.org/10.1016/j.carrev.2007.02.001>

- Ogińska-Bulik, N., & Juczynski, Z. (2009). Type D personality in Poland: Validity and application of the Polish DS14. *Polish Psychological Bulletin*, 40(3), 130–136. <https://doi.org/10.2478/s10059-009-0029-8>
- Ogińska-Bulik, N., Juczynski, Z., & Denollet, J. (2009). DS14 – Skala do Pomiaru Typu D [DS14: Type D measurement scale]. In Z. Juczynski & N. Ogińska-Bulik (Eds.), *Narzędzia Pomiaru Stresu i Radzenia Sobie ze Stresem* [Tools for measuring stress and coping] (pp. 71–85). Pracownia Testów Psychologicznych Polskiego Towarzystwa Psychologicznego.
- Pedersen, S., & Denollet, J. (2006). Is type D personality here to stay? Emerging evidence across cardiovascular disease patient groups. *Current Cardiology Reviews*, 2(3), 205–213. <https://doi.org/10.2174/157340306778019441>
- Prasad, A., Lerman, A., & Rihal, C. S. (2008). Apical ballooning syndrome (Tako-Tsubo or stress cardiomyopathy): A mimic of acute myocardial infarction. *American Heart Journal*, 155(3), 408–417. <https://doi.org/10.1016/j.ahj.2007.11.008>
- Ray, J. J. (1988). Lie scales and the elderly. *Personality and Individual Differences*, 9(2), 417–418. [https://doi.org/10.1016/0191-8869\(88\)90106-7](https://doi.org/10.1016/0191-8869(88)90106-7)
- Sabisz, A., Tredner, N., Fijałkowska, M., Sieminski, M., Fijałkowski, J., Naumczyk, P., Nowak, R., Jaguszewski, M., Cwalina, N., Gruchala, M., Szurowska, & E., Fijałkowski, M. (2016). Brain resting state functional magnetic resonance imaging in patients with takotsubo cardiomyopathy an inseparable pair of brain and heart. *International Journal of Cardiology*, 1(224), 376–381. <https://doi.org/10.1016/j.ijcard.2016.09.067>
- Sato, H. T. H., Uchida, T., Dote, K., & Ishihara, M. (1990). Tako-tsubo-like left ventricular dysfunction due to multivessel coronary spasm. In K. Kodama, K. Haze, & M. Hori (Eds.), *Clinical aspect of myocardial injury: From ischemia to heart failure* (pp. 56–64). Kagakuhyoronsha Publishing.
- Scantlebury, D. C., Rohe, D. E., Best, P. J. M., Lennon, R. J., Lerman, A., & Prasad, A. (2016). Stress-coping skills and neuroticism in apical ballooning syndrome (Takotsubo/stress cardiomyopathy). *Open Heart*, 3(1), 1–6. <https://doi.org/10.1136/openhrt-2015-000312>
- Sharkey, S. W., Windenburg, D. C., Lesser, J. R., Maron, M. S., Hauser, R. G., Lesser, J. N., Haas, T. S., Hodges, B. J., Maron, B. J. (2010). Natural history and expansive clinical profile of stress (Tako-Tsubo) cardiomyopathy. *Journal of the American College of Cardiology*, 55(4), 333–341. <https://doi.org/10.1016/j.jacc.2009.08.057>
- Shipley, B. A., Weiss, A., Der, G., Taylor, M. D., & Deary, I. J. (2007). Neuroticism, extraversion, and mortality in the UK health and lifestyle survey: A 21-year prospective cohort study. *Psychosomatic Medicine*, 69(9), 923–931. <https://doi.org/10.1097/PSY.0b013e31815abf83>
- Smeijers, L., Szabó, B. M., & Kop, W. J. (2016). Psychological distress and personality factors in takotsubo cardiomyopathy. *Netherlands Heart Journal*, 24(9), 530–537. <https://doi.org/10.1007/s12471-016-0861-3>
- Stańczak, J. (2010). *MMSE Polska Normalizacja* [MMSE Polish Standardization]. Pracownia Testów Psychologicznych Polskiego Towarzystwa Psychologicznego
- Starrenburg, A. H., Kraaier, K., Pedersen, S. S., van Hout, M., Scholten, M., & van der Palen, J. (2013). Association of psychiatric history and Type D personality with symptoms of anxiety, depression, and health status prior to ICD implantation. *International Journal of Behavioral Medicine*, 20(3), 425–433.
- Templin, C., Ghadri, J. R., Diekmann, J., Napp, L. C., Bataiosu, D. R., Jaguszewski, M., Cammann, V. L., Sarcon, A., Geyer, V., Neumann, C. A., Seifert, B., Hellermann, J., Schwyzer, M., Eisenhardt, K., Jenewein, J., Franke, J., Katus, H. A., Burgdorf, C., Schunkert, H., ... Lüscher,

- T. F. (2015). Clinical features and outcomes of takotsubo (stress) cardiomyopathy. *New England Journal of Medicine*, 373(10), 929–938. <https://doi.org/10.1056/NEJMoa1406761>
- Uhart, M., McCaul, M. E., Oswald, L. M., Choi, L., & Wand, G. S. (2004). GABRA6 gene polymorphism and an attenuated stress response. *Molecular Psychiatry*, 9(11), 998–1006. <https://doi.org/10.1038/sj.mp.4001535>
- Williams, L., O'Carroll, R. E., & O'Connor, R. C. (2009). Type D personality and cardiac output in response to stress. *Psychology and Health*, 24(5), 489–500. <https://doi.org/10.1080/08870440701885616>
- Zalewska, A. M. (2005). Potrzeba aprobaty społecznej – co oznacza u osób dorosłych w badaniach anonimowych [Social desirability: What it means in adults in anonymous studies]. *Przegląd Psychologiczny*, 48(4), 401–415.
- Zawadzki, B. (1995). Uniwersalność PEN – trzech superczynników osobowości: charakterystyka psychometryczna polskiej adaptacji „Zrewidowanego Inwentarza Osobowości H. J. Eysencka (EPQ-R)” [The universality of PEN—three superfactors of personality: The psychometric profile of the Polish adaptation of the Eysenck Personality Questionnaire–Revised]. *Studia Psychologiczne*, 33(1–2), 147–188.
- Zawadzki, B., Strelau, J., Szczepaniak, P., & Śliwińska, M. (1998). NEO-FFI. *Inwentarz Osobowości Paula T. Costy Jr i Roberta R. McCrae. Adaptacja polska. Podręcznik* [Personality Inventory NEO-FFI by Costa and McCrae]. Pracownia Testów Psychologicznych Polskiego Towarzystwa Psychologicznego.