



Some factors of chronic social stress accompanying the development of cardiovascular diseases

Akimov A.M., Novosyolov A.V., Lebedev E.V., Kayumova M.M.

Tyumen Cardiology Research Center – a branch of Tomsk National Research Medical Center of the Russian Academy of Sciences, Tomsk, Russia.

AUTHORS

Alexander M. Akimov*, PhD of Social Sciences, Senior Researcher of the Laboratory of Epidemiology and Prevention of Cardiovascular Diseases of the Tyumen Cardiology Research Center — a branch of Tomsk National Research Medical Center of the Russian Academy of Sciences, Tomsk, Russia.

Anton V. Novosyolov, junior researcher of the Laboratory of Epidemiology and Prevention of Cardiovascular Diseases, Tyumen Cardiology Research Center — a branch of Tomsk National Research Medical Center of the Russian Academy of Sciences, Tomsk, Russia.

Egor V. Lebedev, junior researcher of the Laboratory of Epidemiology and Prevention of Cardiovascular Diseases, Tyumen Cardiology Research Center — a branch of Tomsk National Research Medical Center of the Russian Academy of Sciences, Tomsk, Russia.

Marina M. Kayumova, M.D., PhD, senior researcher of the Laboratory of Epidemiology and Prevention of Cardiovascular Diseases, Tyumen Cardiology Research Center — a branch of Tomsk National Research Medical Center of the Russian Academy of Sciences, Tomsk, Russia.

Abstract

Chronic stress factors include family stress, work stress, dissatisfaction with social status, social isolation, and domestic factors. The literature analysis has shown that chronic stress factors are associated with cardiovascular diseases (CVDs) through chronic physiological events. Chronic stress refers to a nonspecific systemic response that occurs when the body is stimulated by various internal and external negative factors over a long period. The physiological response to chronic stress serves as a pow-

erful modulator of atherosclerosis onset. Thus, the scientific studies carried out over the last three decades have formed the evidence base about the key role of psychosocial factors in the development of cardiovascular pathology. Moreover, more than half of the cardiovascular disease cases could be affected by non-conventional risk factors

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* Corresponding author. Tel. +7 (982) 910-1778. E-mail: akimovam@infarkta.net

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Introduction

According to modern concepts, stress reactivity may underline mechanism of psychological stress influence on cardiovascular diseases (CVD). A number of studies have investigated physiological parameters associated with the psychological stress – the predictors of the cardiovascular outcomes [1]. A meta-analysis by Chida Y. et al. demonstrated the relationship of increased reactivity and decreased recovery time after stress with negative cardiovascular outcomes. Researchers have found its strong correlation with the development of arterial hypertension (AH) and the increase of intima-media thickness [2]. Gabbay F.H. et al. showed that the stress is a predictor of myocardial ischemia in circulatory insufficiency. In addition, Gullette E.C. et al. found the twofold increase of ischemia relative risk (RR) among patients with CVD, during the periods of psycho-emotional stress. Moreover, researchers proved the increase of irregular heart rate in connection with stressful events in patients after myocardial infarction (MI) [3].

The risk of cardiovascular diseases development depending on the chronic social stress factors

Association between psychosocial stress and cardiovascular risk was studied in two clusters due to their different influence on cardiovascular events (CVE): chronic stressors and triggers (acute stressors) [4]. Triggers include: disasters, large-scale sport events, as well as excessive sexual activity [5]. Acute psychological stress influence on the development of cardiovascular diseases and contribute to the growth of MI rate, myocardial ischemia, stroke and arrhythmias [6-8]. Chronic stress factors include: family and work stresses, dissatisfaction with social status, social isolation, household factors [9-15]. Social integration can be particularly important as a predictor of CVD risk in women: on the one hand, it can be disruptive and, at the same time, be protective to the extent that it enhances both biological and behavioral pathways

of stress resistance [16]. Chronic stress factors interconnect with CVD through chronic physiological states [8]. Chronic stress refers to a nonspecific systemic response that occurs when the body is stimulated by various internal and external negative factors over a long period of time. The physiological response to chronic stress has long been recognized as a powerful modulator of the atherosclerosis development.

Several clinical and epidemiological studies have shown that chronic stress is an independent risk factor (RF) of CVD and increased morbidity and mortality in patients with existing coronary heart disease (CHD) [17-21]. One of the possible mechanisms of this process is that chronic stress causes endothelial damage by directly activating macrophages, promoting the formation of foam cells and causing the formation of atherosclerotic plaques. This mechanism involves many variables, including inflammation, signaling pathways, lipid metabolism, and endothelial function [22]. Thus, the scientific studies carried out over the last three decades have formed the evidence base about the key role of psychosocial factors in the occurrence and development of cardiovascular pathology and have shown the possibility that non-conventional RFs can contribute to more than half of the CVD cases.

Stress in the family and at work according to the epidemiological studies. The gender aspect

Epidemiological studies review two kinds of families. These are the nuclear family, which is a married couple or a couple with children, and the extended family, which includes other relatives. Research has shown that the extended family can serve as protective factor for IM. The family provides a sense of security and safety, as well as economic, emotional, social, and other forms of support [12]. Social support can play a protective role, being the barrier in difficult life situations. The scientific literature shows different forms of social support, including, among others, an index



of close contacts. There are accumulated data on the dependence of CVDs and their complications on the levels of social support. Among a number of investigated physiological mechanisms, the neuroendocrine and immunological models are the most demanded [23-25]. Lett H.S. et al. in one of the most extensive reviews, considering social support in relation to cardiovascular pathology, showed that the risk of CVD development at low levels of social support was 1.5-2 times higher both in patients with CVD and in the general population. Moreover, of all forms of social support, the most significant predictor of CVDs and their complications was material (functional) support. The Finnish study, on the contrary, demonstrated a high demand for emotional support for women. In elderly and middle-aged patients with CHD, it was shown that in the cluster with low resilience, introversion, and high neuroticism, women were more often lonely, had fewer personalized connections, and spent more time at work. At the same time, despite attempts to cope with stress in different ways, high levels of depression and anxiety were found in the high-distress group after six months [26]. The Stockholm Prospective Study of Women's Coronary Risk showed that stress in interpersonal relationships increases the risk of CHD among married women. Women with CHD have an almost threefold increased risk of recurrent CHD with high levels of family stress. Since women in general are more susceptible to stress, it allows them to use and develop necessary compensatory mechanisms when faced with prolonged stress and seek social and emotional support. Women are better adapted to severe and prolonged stresses, which has been shown to correlate with a less significant deterioration in their health status, including the incidence of CVDs.

Considering the role of the family, it should be noted that the death of a spouse can be the most serious stressful event that one has to face in family life. At the same time, scientific research has shown that widowhood is less traumatic for women than for men in the gender aspect. Other things being equal, widowers had a 10% higher mortality rate, while no such correlation among widows - the overall mortality rate among widows was insignificantly higher compared to married women. The primary source of stress in response to the loss of a spouse is closely related to the fact that the roles of men and women in the family are different. Marital life is less favorable for women, which also makes women less vulnerable to the loss

of a spouse. In addition, widowed women spent less time on household chores. Another study analyzed the quality of social roles in both sexes as a predictor of morbidity and overall mortality. The women who were well off in the family and at work had lower morbidity and mortality. For married women, companionship with a partner and equality in decision-making were the predictors of overall mortality. No significant effect of the parental role in women was found in this study [27]. The Luecken L.J. et al. study examined the effects of family and parental status on daily urinary catecholamine and cortisol excretion in a sample of 109 working women to assess the biological and psychological effects of role overload. Other parameters included work and home stress and social support. Results showed that working women with children at home, regardless of marital status or social support, excreted more cortisol and experienced higher levels of home stress [28]. The Russian study showed that women's stress related to childcare and other family responsibilities affects mental and physical well-being significantly more than stress at work [29].

There is an evidence that in women, chronic family stress associated with caring for a seriously ill spouse also increases the risk of CHD [30]. There is a proven hypothesis that one of the main sources of distress in working women with family is a role conflict [31]. It has been shown that women negate the stress received at work by acting both as mothers and as sexual partners. At the same time, women become mentally and physically healthier, when performing more social roles compared to those who have a smaller role set. When both spouses work full-time in the family, no sex differences emerge in the structure of their psychological distress from the roles of parent, employee, and sexual partner, and then the distress of one spouse induces the distress of the other. Therefore, it is assumed that for the married women, the husband's job may be a stressor, inducing stress in women in the family [32]. In Lebanon, a weak association between cardiovascular mortality and social status was found in never-married women. In contrast to the male cohort, widowhood in women was not associated with overall mortality. The authors attributed the resulting patterns to women frequently living with children and grandchildren. At the same time, the risk of cardiovascular events significantly increased in both sex groups when there was an adult married/married child in the family [33]. In a five-

year prospective observational study in the MONICA trial, the relative cardiovascular risk in single women was statistically insignificant [34]. In a Japanese study, single women aged 40-79 years had a higher overall mortality rate compared to the control group of married women [35]. At the same time, unmarried women did not show a tendency to an increased cardiovascular risk compared with married women. To date, there is a viewpoint, according to which family stress in women is considered to be a more unfavorable prognostic factor of CVD development compared to men [36].

A considerable amount of data have been accumulated on cardiovascular risks and negative prognosis in women because of workplace stress [27, 37-39]. Several significant stressors at work are discussed in the scientific literature as possible triggers. These are the feeling of deprivation, unfairness due to relatively low social status, personnel changes, and impossibility to influence administrative decisions. In addition, it is high competition in the work team, as well as the excess of costs over the income of working people. Workplace hypertension has been described, which appears to be a variant of stress-induced AH. Women were found to be less prone to such hyperreactivity than men were. These differences were exacerbated when estrogen levels increased in women (e.g., when they were in the menstrual phase) because of the specific stress-protective effects of estrogen [39-41]. Regarding women, associations of work stress with low health self-esteem and mental disorders have been established [42, 43]. A Finnish study of working women in Helsinki showed an association between psychosocial working conditions and angina symptoms in women - work fatigue was strongly associated with angina symptoms. A meta-analysis by Eller N.H. et al. found a quantitative interdependence between the development of CHD and work-associated psychosocial factors. The authors concluded that the risk of developing CHD increased with high psychological demands at work and low social support. Other studies related to workplace stress also predicted high cardiovascular risk [11, 44].

The wide variety of methods for measuring stress and workload in the scientific literature has made it objectively difficult to compare the impact of work stress on cardiovascular risks. Therefore, regarding studies of work stress and its influence on the risk of cardiovascular death, researchers focused

on two specific models, for which there is no doubt about the relationship with the development of CVD. In the 1980s, the Karasek/Theorell "Job strain model" was demonstrated, which represented a cluster of high psycho-emotional stress at work with an inability of independent decision-making opportunities. According to the model, the workers who were most at risk were those who were subjected to high demands without decision-making power. As a result, the "risky" groups were predominantly consisting of women. Nurses, waiters, and middle managers belonged to this vulnerable group, which experienced the influence of control from both subordinates and managers [22]. Later it has been proven that job strain model predicts recurrent cardiovascular events in persons who suffered acute MI and returned to work. Marmot M.G. et al. showed that first-onset CHD is more often found in persons with minimal control capacity at work, and female low-level employees had 1.5 times higher risk of CHD than female supervisors. The analysis of cross-sectional studies showed that those examined in the Job strain model more often revealed conventional CVD RFs [45].

A prospective cohort study examined the association between working during pregnancy and pregnancy-induced hypertension. The connection was not explained by other RFs such as physical activity, work hours, housework, and child care. Gestational hypertension was associated with low decision-making ability and low job complexity among women in low-status positions. The urge to move from low to higher social status also tends to cause chronic social stress [46]. According to Dressler W.W., the risk of developing AH was higher when there was high psycho-emotional stress associated with ambition for promotion. According to another study, career success in working women was a predictor for lower risks of overall mortality [27]. Significantly less research on female populations has been conducted in Siegrist J. "effort-mismatch - reward" theoretical model but it is the one that has identified higher risks of CHD in women. The model demonstrates an increase in cardiovascular risk when combining high workload with low wages [47]. In the following decades, the model has been repeatedly tested through analysis of both single and cohort cross-sectional studies. Siegrist J. suggests testing the model by external and internal cluster measurements. The external cluster is measured by the growth in work-

place demands and material compensation. On the other hand, a workplace stress coping is measured in the internal cluster as it consists of the ways to adapt to stress, including a component of job satisfaction opportunities. For women, the situational (external) cluster, determined by hierarchical advancement and power, plays a much smaller role. At the same time, it turned out that psychological adaptation (internal cluster) for women plays a significant role in determining the cardiovascular risks [48]. In a study conducted in Finland, employees (including more than 200 women) without a history of CVD were examined. They studied the influence of imbalance between labor input and payment, which predicted a high risk of cardiovascular death at duration of follow-up more than 25 years. The researchers found a connection between unidirectional increases in workload and total plasma cholesterol over a five-year follow-up period [49]. There are also studies that combine the independent effects on cardiovascular risks of both models [50]. These include prospective studies on a population of British employees, concerning a four-fold excess of the risk of cardiovascular death at low levels of social support and job rank. Meanwhile, the patterns were found only for the male cohort.

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