Proceedings of the 2nd International Conference on Global Politics and Socio-Humanities
DOI: 10.54254/2753-7048/63/20240940

Impact of Psychological Stress on Cardiovascular Health and Strategies for Management

Yancheng Li[1,a,*]

[1]*Hangzhou New Channel School, Hangzhou, 310042, China*
a. gz85825173jl@163.com
**corresponding author*

Abstract: Psychological stress has been demonstrated to precipitate physiological disorders via the hypothalamic-pituitary nerves. Consequently, this phenomenon has been the subject of growing interest in recent years, particularly in the context of cardiovascular disease. In the modern era, there has been a notable rise in the prevalence of psychological stress among the general population. A great number of factors can contribute to the development of psychological stress, including demanding occupational roles and familial relationships. Prior research has demonstrated that elevated psychological stress levels are associated with an increased risk of arrhythmia, elevated blood pressure, and other adverse outcomes. The incidence of cardiovascular disease is higher in individuals who experience elevated levels of psychological stress. And the preventative measures are regular exercise and meditation, which have been demonstrated to reduce psychological stress in individuals. Therefore, the paper presents a review of the causes of psychological stress, methods of assessment, and the mechanisms affecting cardiovascular diseases such as hypertension, arrhythmia, and coronary heart disease, and also discusses non-pharmacological interventions. The results indicate that the application of the scientific method allows individuals to more effectively regulate stress, maintain cardiovascular health, and ultimately achieve a higher sense of overall health and well-being.

Keywords: Psychological Stress, Cardiovascular Disease, Coping Strategies, Interventions.

1. Introduction

Psychological stress can be defined as a state of mental and emotional distress that occurs when an individual perceives the demands of the environment to be burdensome or beyond their capacity to adapt [1]. This concept was first introduced by the physiologist Walter Cannon in his early studies of the American "Fight-Flight" response in the early 1900s. Subsequently, it has been demonstrated that psychological stress can have a significant impact on an individual's psychological well-being and is strongly associated with a range of physiological disorders, particularly cardiovascular disease [2]. Relevant studies have shown that the sympathetic-adrenal-medullary (SAM) system is activated when an individual's control over the environment is challenged. Psychological stress stimulates the adrenal medulla to secrete two catecholamines, epinephrine and norepinephrine, into the bloodstream through the hypothalamus and sympathetic nervous system [3]. Therefore, the mechanisms of psychological stress generation, its measurement, and its specific effects on cardiovascular disease need to be further explored. This paper aims to systematically analyze the generation and

DOI: 10.54254/2753-7048/63/20240940

measurement of psychological stress by reviewing the relevant literature, and to propose intervention recommendations accordingly to provide reference for related studies in order to promote the integrated management and improvement of mental health and cardiovascular health.

2. Psychological Stress Generation and Measurement

Psychological stress arises through a variety of mechanisms, involving physiological, psychological and social dimensions. The accurate measurement of psychological stress is a prerequisite for the study of its impact on health and provides a basis for the design of effective intervention strategies.

2.1. Generation of Psychological Stress

Previously, a self-report questionnaire utilizing the Internet, with 21,369 completed questionnaires, showed that between two-thirds and three-quarters of respondents were experiencing at least mild stress in the areas of loved ones (74.8%), finances (68.6%), love life (66.8%), and health (64.3%). About half of the respondents felt at least mild stress in their relationships with family (56.7%) and with school/staff (52.9%) [4]. Therefore, it is evident that there are various sources of stress, with the workplace being a significant source of stress that cannot be ignored in contemporary society.

The work-related stress has been defined as "a harmful reaction of people to whether or not their work is subject to excessive pressure and demands." Workplace factors associated with stress and health risks can be categorized as follows, including overtime, excessive workload, time pressure, difficulties in completing tasks, lack of rest, lack of variety, and poor physical working conditions (such as space, temperature, and light). Furthermore, a number of additional factors can contribute to the experience of psychological stress, which include social isolation and marital status, for example. A lack of supportive social relationships not only results in the loss of these resources but also leads to an increase in stress levels, which has been linked to an elevated risk of high blood pressure [5].

2.2. Measurement of Psychological Stress

Prior to measurement, it is important to first identify the specific stressor to be studied and then determine what types of stress responses (e.g., psychological, behavioral, cognitive, physiological) can be assessed in the research design. The selection of a specific population and the identification of a suitable scale are dependent on the stage and characteristics of the stressor in question [6]. The level of stress is typically gauged through self-report, and the impact of different stressors can vary considerably. Smartphones can measure human salivary cortisol to assess psychological stress. Saliva is mixed with a specific solution and two to three drops of a buffer solution are placed on a cortisol strip. They were tested using specific modes of the particular phone. The results showed that salivary cortisol concentration is a biomarker of psychological stress because physiologic cortisol is secreted in a circadian rhythm and cortisol concentration varies. Therefore, measuring color intensity of cortisol correlates well with cortisol concentrations in the range of 1-100 ng/mL [7]. In the future, it may be more straightforward to quantify pressure. Previously, a study proposed a new method for detecting stress utilizing hyperspectral imaging (HSI) technology to extract tissue oxygen saturation (StO_2) values as a physiological signature for stress detection. The results showed that the new feature may not be influenced by sweat and ambient temperature, and that StO_2 levels can be used as a new modality to recognize stress at a distance [8]. Nowadays, there are numerous methodologies for assessing psychological stress, which streamlines the experimental process and fosters a more nuanced comprehension of an individual's psychological state.

DOI: 10.54254/2753-7048/63/20240940

3. Relationship Between Psychological Stress and Cardiovascular Disease

There is a robust correlation between psychological stress and the development of cardiovascular disease. Numerous studies have demonstrated that persistent psychological stress can affect the cardiovascular system through a variety of physiological and psychological mechanisms, thereby increasing the risk of cardiovascular diseases such as coronary heart disease, hypertension and arrhythmias. Understanding how psychological stress affects cardiovascular health is important for the prevention and treatment of these diseases.

3.1. Coronary Heart Disease and Psychological Stress

Coronary Heart Disease (CHD) is one of the most common forms of cardiovascular disease, which is characterized by myocardial ischemia or hypoxia due to coronary atherosclerosis. In recent years, researchers have found that psychological stress is one of the important risk factors for CHD, and that psychological stress affects the occurrence and development of CHD through a variety of mechanisms. Psychological stress causes activation of the sympathetic and endocrine systems, leading to increased heart rate, elevated blood pressure and vasoconstriction. This physiological response increases the workload of the heart and reduces the supply of oxygen to the heart muscle. Furthermore, chronic psychological stress has been linked to the development of atherosclerosis, which increases the likelihood of blockage in the coronary arteries. Studies have shown that chronic stress increases the risk of coronary heart disease and adverse cardiovascular outcomes, acute emotional stress can trigger acute coronary heart disease events in susceptible patients, and there is an association between chronic stress and increased inflammation. Stress-induced overactivation or delay of the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system (SNS) may increase the risk of coronary heart disease. However, individuals tend to exhibit strong or exaggerated physiological responses to acute stressors [9]. Exaggerated cardiovascular reactivity and delayed recovery from acute laboratory challenges predict adverse cardiovascular outcomes, including coronary heart disease severity, coronary heart disease events, or mortality [10].

3.2. Hypertension and Psychological Stress

Hypertension, one of the most common cardiovascular diseases worldwide, has been known as the “silent killer” in that it often has no obvious symptoms but can lead to serious cardiovascular complications in the long term. In recent years, psychological stress has been recognized as one of the important risk factors for hypertension, and studies have shown that psychological stress has a significant effect on the regulation of blood pressure. Psychological stress activates the sympathetic nervous system, leading to increased heart rate, vasoconstriction and elevated blood pressure. This activation of the sympathetic nervous system can become chronic when individuals are exposed to persistent or frequent stressors, leading to a state of persistent hypertension. Besides, psychological stress increases the production of stress hormones such as adrenaline and norepinephrine, which directly contribute to vasoconstriction and elevated blood pressure. For example, previous research evaluating the effects of a psychological stress task on elevated blood pressure in adults aged 18 to 64 years suggests that when stress is elevated, blood pressure is also elevated [11]. Blood pressure reactivity may serve as a measure of endothelial dysfunction or the inability of the endothelium to adequately counteract vasoconstrictive force caused by sympathetic stimulation. In addition, blood pressure reactivity reflects a more general hyperadrenergic state, with elevated neurohormones leading to an increased risk of hypertension [12].

DOI: 10.54254/2753-7048/63/20240940

3.3. Arrhythmia and Psychological Stress

Arrhythmias are abnormalities in the frequency or rhythm of the heartbeat, including tachycardia, bradycardia and irregular heartbeats. In recent years, an increasing number of studies have shown a significant correlation between psychological stress and the onset and progression of arrhythmias. Psychological stress results in an elevation of the heart rate and cardiac contractility due to the activation of the sympathetic nervous system. Excessive activation of the sympathetic nervous system can result in abnormal electrical activity within the heart, which in turn can lead to the onset of arrhythmias. Individuals who experience psychological stress demonstrate a notable increase in sympathetic activity and a reduction in cardiac electrical stability, making them more susceptible to arrhythmias. It can be argued that stress is a major contributor to cardiac arrhythmias and has a profound effect on the electrophysiology of cardiomyocytes and on cardiac rhythms [13]. Psychological and physiological stress affects the cardiovascular system via the autonomic nervous system (ANS). Studies have shown that vagus and sympathetic nerve stimulation may trigger the occurrence of atrial fibrillation through autonomic effects on atrial electrophysiology. 2%-30% of atrial fibrillation episodes occur during periods of "emotional or physical exhaustion," and 1%-30% occur after coughing, vomiting, eating, or sleeping [14]. Behavioral stress, whether generated by aversive conditioning or more natural conflict, significantly reduces the electrical stability of the heart. For example, irritation-like stimuli are particularly likely to cause arrhythmias [15].

4. Coping Strategies for Psychological Stress

Given that stress can precipitate not only cardiovascular disease but also an elevated risk of other ailments such as hypertension and obesity, it is imperative that efficacious behavioral interventions be implemented to mitigate perceived stress, thus promoting optimal physical and mental health.

4.1. Psychological Interventions

Psychological interventions are crucial for managing stress, aiming to alleviate pressure and improve mental health by altering an individual's cognitive and behavioral patterns. Firstly, Cognitive Behavioral Therapy (CBT) effectively reduces stress and negative emotions by helping individuals identify and challenge negative thoughts and implement positive behavioral changes. In addition, mindfulness therapy, through practices such as mindfulness meditation and integrating mindfulness into daily life, fosters a deep awareness and acceptance of the present moment, significantly reducing anxiety and depression symptoms. Besides, stress management techniques, such as time management and relaxation training, help alleviate time pressure and physical tension by organizing tasks more efficiently and lowering physiological arousal levels, thereby mitigating the negative impact of stress. Psychological counseling provides emotional support and guidance, aiding individuals in identifying and resolving stressors while enhancing self-efficacy and resilience. Therefore, the comprehensive application of these psychological interventions not only alleviates stress but also significantly improves overall quality of life and well-being. By thoughtfully selecting and combining these methods, individuals can better manage everyday stressors, maintaining both mental and physical health.

4.2. Physiological Interventions

Physical activity has a positive impact on health [16]. Regular exercise has been demonstrated to reduce the risk of developing cardiovascular disease and obesity [17]. Moreover, individuals who exercise regularly are less likely to experiencing anxiety, which confers psychological benefits [18]. First, physical activity, including aerobic exercises like running and swimming, and resistance

DOI: 10.54254/2753-7048/63/20240940

training, helps alleviate stress by releasing endorphins and improving cardiovascular health. Additionally, dietary adjustments that include consuming vegetables, fruits, whole grains, high-quality proteins, and healthy fats, can enhance stress resilience by providing essential nutrients that regulate mood and reduce anxiety. Moreover, adequate sleep is vital for stress management, as it restores the body and improves emotional stability; establishing a regular sleep schedule and creating a restful environment can significantly enhance sleep quality. Furthermore, relaxation techniques such as progressive muscle relaxation, deep breathing, and guided imagery help lower physiological arousal and reduce tension. Biofeedback, which involves monitoring and adjusting physiological signals, enables individuals to manage stress responses by promoting self-regulation. Finally, conventional techniques such as acupuncture and moxibustion can harmonize the body's energy dynamics, mitigating stress and enhancing overall well-being. Therefore, the incorporation of these physiological interventions is an efficacious method for not only the alleviation of stress but also the promotion of overall health and an enhanced quality of life.

5. Conclusion

The paper has explored the relationship between psychological stress and cardiovascular diseases, highlighting the impact of stress on conditions such as coronary artery disease, hypertension, and arrhythmias. It emphasizes the importance of both psychological and physiological interventions in managing stress effectively. Psychological interventions, including CBT, mindfulness therapy, stress management techniques, and psychological counseling, are crucial for reducing stress levels and negative emotions by altering cognitive and behavioral patterns. Furthermore, physiological interventions, such as physical activity, dietary adjustments, adequate sleep, relaxation techniques, and biofeedback, improve bodily functions and enhance stress resilience. The integration of these intervention strategies has been demonstrated to significantly alleviate stress, improve overall health, and enhance quality of life. Further research should concentrate on the long-term consequences of these interventions and the optimization of their implementation with the objective of achieving superior psychological and physiological health management. The implementation of scientific and holistic approaches enables individuals to more effectively regulate stress, sustain cardiovascular well-being, and ultimately attain enhanced overall well-being and happiness.

References

[1] *Cohen, S., Kessler, R. C., & Gordon, L. U. (1995). Strategies for measuring stress in studies of psychiatric and physical disorders. Measuring Stress: A Guide for Health and Social Scientists, 28, 3–26.*

[2] *Steptoe, A., & Kivimäki, M. (2012). Stress and cardiovascular disease. Nature Reviews Cardiology, 9(6), 360–370.*

[3] *Lundberg, U. (1999). Coping with stress: Neuroendocrine reactions and implications for health. Noise and Health, 1(4), 67.*

[4] *Michie, S. (2002). CAUSES AND MANAGEMENT OF STRESS AT WORK. Occupational and Environmental Medicine, 59(1), 67–72. https://doi.org/10.1136/oem.59.1.67*

[5] *Spruill, T. M. (2010). Chronic Psychosocial Stress and Hypertension. Current Hypertension Reports, 12(1), 10–16. https://doi.org/10.1007/s11906-009-0084-8*

[6] *Crosswell, A. D., & Lockwood, K. G. (2020). Best practices for stress measurement: How to measure psychological stress in health research. Health Psychology Open. https://doi.org/10.1177/2055102920933072*

[7] *Choi, S., Kim, S., Yang, J.-S., Lee, J.-H., Joo, C., & Jung, H.-I. (2014). Real-time measurement of human salivary cortisol for the assessment of psychological stress using a smartphone. Sensing and Bio-Sensing Research, 2, 8–11.*

[8] *Chen, T., Yuen, P., Richardson, M., Liu, G., & She, Z. (2014). Detection of Psychological Stress Using a Hyperspectral Imaging Technique. IEEE Transactions on Affective Computing, 5(4), 391–405. IEEE Transactions on Affective Computing. https://doi.org/10.1109/TAFFC.2014.2362513*

[9] *Wirtz, P. H., & Von Känel, R. (2017). Psychological Stress, Inflammation, and Coronary Heart Disease. Current Cardiology Reports, 19(11), 111. https://doi.org/10.1007/s11886-017-0919-x*

[10] *Panaite, V., Salomon, K., Jin, A., & Rottenberg, J. (2015). Cardiovascular recovery from psychological and physiological challenge and risk for adverse cardiovascular outcomes and all-cause mortality. Psychosomatic Medicine, 77(3), 215–226. https://doi.org/10.1097/PSY.0000000000000171*

[11] *Gasperin, D., Netuveli, G., Dias-da-Costa, J. S., & Pattussi, M. P. (2009). Effect of psychological stress on blood pressure increase: A meta-analysis of cohort studies. Cadernos de Saúde Pública, 25(4), 715–726. https://doi.org/10.1590/S0102-311X2009000400002*

[12] *Matthews, K. A., Katholi, C. R., McCreath, H., Whooley, M. A., Williams, D. R., Zhu, S., & Markovitz, J. H. (2004). Blood Pressure Reactivity to Psychological Stress Predicts Hypertension in the CARDIA Study. Circulation, 110(1), 74–78. https://doi.org/10.1161/01.CIR.0000133415.37578.E4*

[13] *Lampert, R. (2010). Anger and ventricular arrhythmias. Current Opinion in Cardiology, 25(1), 46–52.*

[14] *Shusterman, V., & Lampert, R. (2013). Role of Stress in Cardiac Arrhythmias. Journal of Atrial Fibrillation, 5(6), 834. https://doi.org/10.4022/jafib.834*

[15] *Rozanski, A., Blumenthal, J. A., & Kaplan, J. (1999). Impact of Psychological Factors on the Pathogenesis of Cardiovascular Disease and Implications for Therapy. Circulation. https://doi.org/10.1161/01.CIR.99.16.2192*

[16] *Wei, M., Gibbons, L. W., Kampert, J. B., Nichaman, M. Z., & Blair, S. N. (2000). Low Cardiorespiratory Fitness and Physical Inactivity as Predictors of Mortality in Men with Type 2 Diabetes. Annals of Internal Medicine, 132(8), 605. https://doi.org/10.7326/0003-4819-132-8-200004180-00002*

[17] *Stampfer, M. J., Hu, F. B., Manson, J. E., Rimm, E. B., & Willett, W. C. (2000, July 6). Primary Prevention of Coronary Heart Disease in Women through Diet and Lifestyle (world) [Research-article]. The New England Journal of Medicine; Massachusetts Medical Society. https://doi.org/10.1056/NEJM200007063430103*

[18] *Wipfli, B. M., Rethorst, C. D., & Landers, D. M. (2008). The anxiolytic effects of exercise: A meta-analysis of randomized trials and dose-response analysis. In Database of Abstracts of Reviews of Effects (DARE): Quality-assessed Reviews [Internet]. Centre for Reviews and Dissemination (UK).*