

Psychosocial Stress and its Correlation With Coronary Heart Diseases

By Stephanie Zhao

Author Bio

Stephanie Zhao is a senior at Magee Secondary School in Vancouver, Canada. She is very passionate about psychology and interested in biology and hopes to pursue both in the future. In the summer, she was able to take a psychology course at Columbia, which further consolidated her interest in the field of psychology. Aside from being a student, Stephanie is also an athlete. She grew up participating in multiple sports (competitive swimming, traditional Chinese dance, tennis, badminton, figure skating, etc.) and is now playing squash competitively during the school year. Outside of academics and sports, you can find her reading, rewatching Brooklyn 99 for the 10th time, and crying to love songs.

Abstract

Times are becoming increasingly stressful, and cardiovascular diseases (CVDs) are the leading cause of death globally. This article examines the relationship between stress and cardiovascular diseases. We will look into the different theories of stress, including the Life-Events Theory, the Hardiness Theory, and the Social-Support theory. There are also a handful of different types of stressors and how these stressors might have direct and indirect effects on cardiac health. Hypertension, hypercholesterolemia (high cholesterol), and smoking all seem to play the most crucial role when it comes to coronary heart disease (CHD). Although seen as the villain, stress is not all harmful. “Eustress” is a term coined for stress that is actually beneficial to the human body. Regardless, stress is a major issue derived from work, school, and a fast-paced society, leading management methods to be more crucial than ever. One can choose from a plethora of coping mechanisms including exercise, yoga, dietary changes, medications, and relaxation techniques.

Keywords: Cardiovascular disease; stress; coronary heart disease; atherosclerosis; hyperhomocysteinemia; hypertension; life-events theory; hardiness theory; social support theory; psychological stressor; physiological stressor; social stressors

Introduction

Cardiovascular diseases (CVDs) are the leading cause of death globally. Cardiovascular disease is defined by various disorders: cardiac muscle and vascular system diseases controlling the heart, brain, and other vital organs (Koolhaas, 2011). Approximately 17.9 million people die from CVDs each year, contributing to 32% of yearly deaths (Steptoe et al, 20122). To put this number in perspective, this is about the same number of people as Ecuador or Guatemala's current population. This has been the case for quite some time. In 2006, cardiovascular disease accounted for the deaths of close to a million people, around 39% of the total deaths in the United States (Gaziano et al, 2006 3). A paper in 2017 by Kivimäki and Steptoe showed that there was a 14.5% increase in deaths from cardiovascular disease from the year 2006 to 2016 (Naghavi et al, 20174). It is not difficult to extrapolate that the number of CVDs will continue to increase, particularly in today's stressful social environment. Numerous works analyzed throughout this paper suggest that there is a correlation between stress and CVDs.

Although a well-known term, recent publications of stress research showed that "stress" as a concept has been broadened to encompass a range of behaviors: everything ranging from a mild response to a small-scale stressor to a severe reaction to a life-altering event. For the purpose of this paper, "stress" strictly refers to the unpredictable and uncontrollable psychological and physiological response where an organism experiences an exceeding amount of environmental demand (Kivimäki et al, 20185).

Like most high school and university students worldwide, stress has become a regular part of life. An increasing amount of fixation on reaching perfection in school, sports, and extracurriculars place most students in pressured environments. Not just students but everyone in society today is significantly impacted by stress. A study conducted by Penn State researchers (Almeida et al, 20206) published in 2020 clearly demonstrated that there is an increase in stress levels when comparing stress levels of adults from the 1990s and the 2010s. In the study, the data was collected by interviewing two groups of participants, one in 1995 and the other in 2012. At the time of the interviews, the

participants were the same age. They were interviewed at the end of the day for eight consecutive days. Psychologists then recorded the stressful events and stress levels of each participant in the past 24 hours. The results showed that overall, adults in the 2010s presented a higher amount of stress than did the adults in the 1990s.

Although existing stressors like finances and diseases seem to be shared across all generations, new stressors are constantly emerging. The advancement of technology, social media, increasing work-life imbalance, and more rigorous academic demands profoundly affect how stress is perceived and experienced. For example, after the invention of the internet, new problems like cyberbullying and identity theft arose. More recently, our planet was struck by a worldwide pandemic, which became a common origin of stress.

Though, not all stress is harmful to the human body. The nerves that kick in before public speaking or a test are called "eustress," a term coined by Hans Selye that describes a moderate level of beneficial psychological stress (Marin et al, 20117). Conversely, chronic stress is harmful to the body; it elevates the susceptibility to mental illness and other health issues, and affects cognition (Nabel, 20038) and increases the prevalence of cardiovascular diseases. Cardiovascular disease continues to be the leading cause of death globally; there were approximately 523.2 million cases of cardiovascular disease in 2019, and the numbers are only seeing an upwards trend (Selye, 19579). This paper will look more closely at human coronary heart disease and its relation to stress.

Stress Theories

The Life-Events Theory on stress developed by Holmes and Rahe (Holmes & Rahe, 196710) advances that stress is caused by situations that require more resources than are available. As an example, an individual may experience stress if they walk into a test that they did not study for. Holmes and Rahe designed a stress scale called the Social Readjustment Rating Scale (SRRS) (McEwen & Stellar, 199311) that measures the impact of different life events on a person's stress level. There are a total of 43 accumulated stress events, some of which include the death of a spouse, divorce, marital separation, injury or illness, and retirement.

Another theory revolving around life events is allostasis: a body state that is readjusting to external forces (McEwen & Stellar, 199311). A state of allostasis is described by allostatic load and allostatic overload. Chronic exposure to environmental challenges that cause an individual to react in a particularly stressful way results in chronic allostatic load. Allostatic load increases vulnerability to mental illnesses. According to the theory, stress response mediators, such as glucocorticoids, catecholamines, and proinflammatory cytokines, manifest imbalances as these systems become overtaxed and dysregulated. In addition to causing damage to tissues and major organ systems, chronic dysregulation poses a cumulative physiological risk for disease and disability (Nielsen & Seeman, 200712).

Then there is the Hardiness Theory. According to Maddi and Kobasa (Kobassa et al, 1982; Kobasa et al, 198213-14), hardiness - commitment, control, and endurability - can decrease illnesses that are initiated by stressful life events. Instead of seeing a stressful event as a threat, seeing it as a challenge can decrease the negative impacts such events can have on a person's overall well-being.

Lastly, there is the Social Support Theory. The term "social support" is defined as "an exchange of resources between two individuals perceived by the provider or the recipient to be intended to enhance the well-being of the recipient" (Shumaker & Brownell, 198415). Social supports include but are not limited to emotional support, financial aid, and acts of service. Regardless, social support can help to cope with the event and therefore decrease stress level.

Stressors

There are three environments that can play a role in terms of stressors in life: social, psychological, and physiological environments (Lin & Ensel, 1989 16).

1. Social stressors

Social stressors are defined by Ilfeld, Jr. (Ilfeld, 197617) as life events resulting in situations that are generally perceived as problematic or undesirable. In his article, he discussed how each individual has their own varying responses to stimuli; it is then hard to measure the response rather than the stimulus itself. Similar to Ilfeld's view on the accuracy of measuring stress, Hans Selye (Selye, 195618)

believes that diverse external stimuli may induce different physiological and mental responses from different people. This idea initiated the discussion amongst psychologists, therefore leading to studies done in social epidemiology (e.g., Holmes and Rahe 1967; Dohrenwend & Dohrenwend, 1981; Myers, Lindenthal, Pepper, and Ostrander 1972). Researchers have collectively found that stress from social environments influences mental and physical well-being in a significant manner.

It is well known that work causes stress and therefore makes someone increasingly vulnerable to coronary heart disease (CHD) (Brunner et al., 199919). The chances of getting CHD can be elevated through direct causes such as biological responses and indirect causes like lack of exercise (Møller, Peter, Håkan Wallin, and Lisbeth E. Knudsen. 199620). One of the primary stress responses of the body is the activation of the autonomic nervous system (ANS), which contributes to what is known as the "fight or flight" response. When the ANS is activated repeatedly, heart rate variability is lowered, which is a marker for cardiovascular diseases. Some work-related social stress examples include, but are not limited to: excess amount of work, long working hours, experiencing workplace discrimination or harassment, giving speeches or presentations in front of coworkers or superiors, and constant fear of being laid off.

Another rising social stress factor in today's society is school. With the growing obsession with getting into "prestigious" schools, students today deal with more stress than ever. The time that used to be spent on hanging out with friends and doing leisurely activities is now spent on studying and homework. Academic success is actively threatened by challenges, demands, and expectations. For example, a study (Natvig et al, 199921) showed that there is a correlation between psychosomatic symptoms (some include excessive thoughts, digestive issues, headaches, elevated blood pressure, and dizziness) and school-induced stress in 862 Norwegian adolescents (ages 13-15).

2. Psychological stressors

A person's sense of mastery, feelings of competence, self-esteem, and locus of control have been recognized as personality factors that affect their reactions to stressful situations. Psychological stress can increase health problems. In a paper by Mellinger et al.

(Mellinger et al, 197822), psychological stress or “psychological vulnerability” could result in physical illness. In this study, Mellinger et al. conducted a nationwide cross-section survey of U.S. adults. Data was collected on the relationship between psychic distress and life crisis among all ages, races, and demographics. This study used a shortened version of the Holmes-Rahe Social Adjustment Rating Scale, as mentioned above.

3. Physiological stressors

The term physiological stress refers to any condition that changes a cell’s or organism’s homeostasis. Examples of physiological stressors can include fluctuations in oxygen levels, temperature, and traumatic events. Aside from external stressors, physiological stressors can occur internally as well. For example, organisms can experience physical stress from inner chemistry changes during development (most common amongst adolescents). On top of that, aging is also a common physiological stressor experienced amongst humans. With aging comes molecular damage, which can lead to other health problems, such as decreased effectiveness of the nervous system and immune system.

Stress and its relationship to cardiology health

It is not surprising to learn that stress can cause physical damage to the body, such as heart attacks and strokes (Ueyama et al, 200323). When stressed, people experience increased heart rate variability (Kim, Hye-Geum, et al., 201824), elevated blood pressure, higher cholesterol level, and increased blood volume . These contribute significantly to CHD. Batteries of studies have concluded that three factors - hypercholesterolemia (high cholesterol), hypertension, and smoking - play the most critical role in CHD (Greenberg, 200225). Specifically, hypercholesterolemia and hypertension can easily be influenced by chronic stress.

Although hypercholesterolemia, hypertension, and smoking are the conventional vital factors that may lead to CHD, researchers (Linden et al., 200733) found that half of the patients with CHD do not present any of the above clinical symptoms. In fact, 91% of heart attacks were caused by work-related stress. Therefore, work stress is believed to be a more significant cause

of CHD than the conventional risk factors we hear about (Russek & Russek, 197626).

Table 1 shows that 91% of the 100 patients in the “coronary group” have struggled with their jobs, either from long working hours or emotional instability. This is a significant difference compared to the 20% of the control group who had heart attacks due to work-related stress.

Table 1: Incident of various factors in patients who had coronary attacks and in control groups (Russek & Russek, 197626)

	No.	Heredity (Positive)	High-fat Diet	Stress and Strain (Occupational)	Obesity	Tobacco (30 Cigarettes, Plus)	Exercise
Coronary group	100	67%	53%	91%	26%	70%	58%
Control group	100	40%	20%	20%	20%	35%	60%
Ratio		1.7:1	2.7:1	4.6:1	1.3:1	2:1	1:1

In the study done by Henry I. Russek and Linda G. Russek (Russek & Russek, 197626), they concluded that emotional stress is a significant factor in CHD. Interestingly, they talked about the evolution of Homo sapiens and the role natural selection plays in humans’ adaptation to new environments. From living in forests to farms to factories, getting used to new environments and lifestyles inevitably takes thousands of years. The Russeks made the connection that CHD might be one mechanism that nature poses as a means of eliminating those who fail to withstand the stress from the new world that we live in. Like learning how to hunt and staying away from vicious animals are skills humans had to learn centuries ago, coping with stress is also a symbolic challenge we would have to learn how to overcome. They also mentioned that even before the turn of the century, scientists have described men with coronary diseases as “ambitious” and “competitive” with “intense emotional drives.” Coincidentally, the adjectives that the scientists used tie in with another concept: a correlation was found between CHD and stress and Type A personality. Type A personality is defined as being driven, persistent, involved in work, competitive, aggressive, and time-urgent. This type of behavior suggests that there is a relationship between CHD and stress (Sparacino, 197927).

Stress could induce biological and physiological changes in the body, which can cause additional health issues. For example,

hypercholesterolemia - increased serum cholesterol - is known to clog the arteries (atherosclerosis) and decrease the elasticity of arteries (arteriosclerosis). Cholesterol is a fatty and waxy substance that is a component of all the cells in the body; it is vital for making cell membranes and many hormones. Cholesterol can come from both the liver and the foods we eat. The clogs caused by high cholesterol can later lead to a heart attack or a stroke. Both atherosclerosis and arteriosclerosis overwork the heart muscle, pumping oxygen extra hard to other places and leaving less oxygen for itself. Similarly, increased blood pressure, blood volume, and accelerated heart rate can all lead to an excessive workload on the heart (Félix-Redondo, Francisco J., Maria Grau, and Daniel Fernández-Bergés 201328).

In addition, homocysteine is another biological molecule that stress could affect and influence. Stoney (Stoney, 199929) found a positive relationship found between anger and hostility and homocysteine levels. The production of plasma homocysteine is closely related to CHD. Researchers H. Refsum and P. M. Ueland found that “An elevated level of total homocysteine (tHcy) in blood, denoted hyperhomocysteinemia, is emerging as a prevalent and strong risk factor for atherosclerotic vascular disease in the coronary, cerebral, and peripheral vessels, and for arterial and venous thromboembolism” (Refsum et al, 199830). The amino acid homocysteine is formed by the metabolism of plasma methionine. Hyperhomocysteinemia (unusually high levels of homocysteine) can lead to ischemic injury (caused by blood supply unable to reach muscles, tissues, or organs of the body) and, therefore, CHD. Blood clots, heart attacks, and strokes are also associated with hyperhomocysteinemia.

Stress can affect the heart in indirect ways as well. Someone might have a habit of smoking after a stressful day or skip exercising because of experiencing too much stress. As a result, stress often exacerbates heart diseases by introducing other heart-damaging behaviors into the mix.

Stress management

People often make the mistake of coping with stress by suppressing negative emotions, which is proven to be counterproductive as it increases vulnerability to developing CVDs (Leineweber et

al, 201131). Stress levels can be managed by using different strategies. Although no primary coping strategy was established to prevent CVDs, there are some secondary preventive methods proven to be efficacious in patients with congenital heart defects (CHD). Some of these secondary methods are even shown to be effective in reducing myocardial infarction levels (O'Donnell et al, 2008; Linden et al, 200722-33). These techniques include relaxation procedures and cognitive behavioral methods (Whalley et al, 2011; Dixhoorn & White, 200534-35), such as exercise, yoga breathing techniques, changing diets, progressive relaxation, imagery, behavior and anxiety management techniques, or medications (Holmes and Rahe, n.d.36).

Conclusion

Coronary heart disease will continue to be an issue globally, and stress will continue to be present. This study looked into the correlation between stress and CHD. We analyzed the difference between “good” stress and “bad” stress, the different stress theories that other scientists had developed to explain stress, the main types of stressors, and stress' relation to cardiovascular health. We also discussed specific stress management methods that could diminish, not wholly, the amount of stress and its adverse effects on the body.

Through the articles this paper has covered, it is clear that there is a correlation between stress and cardiovascular diseases. Bodily functions such as heart rate and blood pressure can be affected by the amount of stress someone goes through. Furthermore, high cholesterol levels and increased blood volume - which are known to have negative impacts on the heart - can be caused by an increased level of chronic stress. Even though some evidence is not as direct as others, there is still a link between heart health and stress.

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