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SCIENCE OF STRESS AND ITS COPING MECHANISMS

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Abstract

Stress has been explained, defined, characterized and conceptualized from biological, psychological, biochemical, physiological and medical perspectives. Stress is thus a composite and multi-dimensional condition impacting with profound consequences on man. It has been described as a force, which affects human beings physically, mentally, emotionally, socially, and spiritually. At time, it is described as the body's response to any undesirable mental demands. Stress at times is described as the wear and tear that stressors inflict on the human body and mental plus behavioural characteristics describing how people react to the demand placed upon them, causing them to worry and compromising ability to cope. Some stress is expected and can be positive force in our life which is called Eutress. It is often what provides us with the energy and motivation to meet our daily challenges both at home and at the workplace. This type of stress response is what helps us rise to a challenge and meet our goals in the workplace such as deadline and targets. Some people will not consider this challenge as a type of stress because having meet the challenges, we are satisfied and happy. Stress may also be described as an umbrella term which encompasses physical trauma, strenuous exercise, metabolic disturbances and anxiety which challenges the body's wellbeing. Thus, it is a natural response that prompts us to address challenges and threat in our lives. And so, a little bit of stress is good and can help us perform daily activities efficiently.

Keywords: Science, Stress, Coping Mechanism

Introduction

At the beginning of each academic session, tens of thousands of students, both traditional age (16 to 25 years of age) and non-traditional age (26 years and above), begin a new academic year that is certain to confront them with change. New course modules, classmates, child care providers, living arrangements, practice schedules, and employment responsibilities arises within hours of arriving on campus and continue in various ways throughout the course of the semester. Whether these episodes of change serve as stressors and elicit the emotional and physiological change that we can call stress depends largely on the interpretation made by the students. For those who become distressed by the types of changes just described, the discomfort may relate closely to their fears of the unknown, failure, commitment, disapproval, and even success. In comparison, those students who thrive in the face of change do so largely because of differences in their interpretation regarding the unpleasantness of changing the insight they gained from pass experiences dealing with change, and the array of effective coping skills they have developed by trial and error and by the careful observation of those who handle change well.

Although people often use the words stressor and stress interchangeably, they represent different concepts. Hans Selye, (1956) the father of the current stress theory, described stress as the nonspecific response of the body to any demand made on it. Stress can be viewed as a physiological and psychological response to exposure to some factor, agent, or event that forces one to change or adapt (Akorede et al., 2021). Some experts categorise stressors as acute when caused by a single episode of stress, episodic when stress relates to a pattern of challenge [for example, the examinations given by a particular professor (Hassan et al., 2024; Avdimiotis et al., 2024)], and chronic when feelings of distress are ever present [for example, a work environment characterised by routine harassment by a supervisor or co-worker (Njoku 2025)]. Regardless of their rate of occurrence, however, stressors are the cause; stress is the effect. The absence of change can also serve as a stressor such as when a relationship is not maturing despite the effort one puts into it.

The Origins of the Term Stress

Physician Hans Selye first introduced the term stress to the biologic science community in 1936. That does not mean that stress did not exist until then; it certainly did. Early humans probably struggled to find food and protect their young. Depression-era, families certainly struggled to survive. Even so, recent research indicates that stress may be at an all-time high. Consider the following statistics according to the American Psychological Association (2009):

i. More than 70% of Americans experience regular physical and psychological stress symptoms; over half rate their stress levels as moderate to high and a third of those reports living with extreme stress. The American Academy of Family Physicians estimates that two-thirds of all office visits to family physicians are because of stress-related symptoms.
ii. At work, eight in ten employees report job-related stress and nearly half say they need help managing stress. The cost of job stress is estimated at more than $300 billion annually in the United States.
iii. Chronic stress is associated with a greater risk for many illnesses such as depression, cardiovascular disease, diabetes, autoimmune diseases, upper respiratory infections, and poorer wound healing.
iv. Mental health and emotional well-being depends on our ability to deal with stress and maintain control of our emotions and behavior. The first step is to understand how the body handles stress.

The Fight-or-Flight Response

'Fight or flight' was a phrase first introduced to the literature by Walter Cannon in 1914 cited in Loy (2014). Cannon, a Harvard physiologist, used the term to describe our body's physiologic response that produces the energy to either 'fight' or 'flee' when we are confronted with a stressor. The fight-or-flight response, also known as the stress response, begins with the interpretation of an event (conscious or unconscious). Once recognized as a threat, a physiologic reaction occurs activating the nervous and endocrine systems, leading to the arousal of protective bodily functions. When the stressor is gone, the body returns to homeostasis (the tendency towards a relatively stable equilibrium between interdependent elements, especially as maintained by physiological processes). The fight-or-flight response is often characterized by describing the two options cavemen had when confronted by a lion and the instinctive response to stay and fight the animal or to run away from it. Fight or flight is easily recognized when the stressor is physical in nature; however, the urge to fight or flee is also a reaction brought on by nonphysical stressors, such as pressure of an upcoming exam or a big project at work or a verbal encounter with someone. In some cases, even our imagination can elicit the stress response; consider the effects of a scary dream or the thought that a loved one who has not returned home on time may be lost.

Science of Stress

Cannon identified physiologic reactions that occur to prepare for fighting or fleeing that have clear protective functions. For example, when under stress our heart rate increases carrying more oxygen to our muscles, arteries dilate in order to redirect blood flow to muscles and organs that need it, and we perspire more, using our body's innate cooling system. Taylor et al (2000) coined the term 'tend and befriend' to describe a behavioural response most often found in women, which is less confrontational and more nurturing. According to their research, the authors found that although men and women experience similar physiologic responses to a threat, women typically respond with an impulse to nurture and to befriend others. They theorized that the tend-and-befriend behaviour is the result of a combination of brain chemistry and gender-specific hormones released during the stress response, and there is no doubt that social mores also influence this gender-specific response.

The autonomic nervous system, endocrine system, and immune system are three physiologic pathways involved in the stress response and the stress illness relationship. The autonomic nervous system (ANS) is the part of the peripheral nervous system (brain, spinal cord, and nerves) that regulates involuntary body functions. Autonomic functions are automatic or reflexive, regulating many of our vital body functions, such as heart rate and respiration. This system has two parts: (1) the sympathetic nervous system, recognized as the stress system because it excites and speeds you up, and (2) the parasympathetic system, known for stimulating the relaxation response and helping the body return to a relaxed, normal state. Inciting the sympathetic system releases chemicals and hormones that initiate the stress response, increasing capabilities of essential organs of the body and constraining organs that are not essential (Torubeli, 2022).

The endocrine system is made up of glands that secrete hormones into the bloodstream. Three major glands involved in the stress response are the pituitary, the thyroid, and the adrenal glands. The pituitary, a pea-sized gland located at the base of the skull, is often called the master gland because it controls all other glands. Pituitary hormones trigger hormone release in other organs. The thyroid gland, located in the front of the neck below the larynx, regulates metabolism, and in reaction to stress its hormones increase the rate with which the body can use energy. Adrenal glands, located on the top of each kidney, have two distinct parts: an outer part called the cortex, which produces steroid hormones such as cortisol, aldosterone, and testosterone, and an inner part called the medulla, which produces adrenaline and noradrenaline. The adrenal cortex produces a glucocorticoid called cortisol, which increases blood sugar and assists in metabolizing fat, protein, and carbohydrates. In recent years, there has been growing interest in using cortisol as an objective marker of stress because it is easy to trace in urine, saliva, and plasma. Cortisol has also been shown to affect immune function.

Chronic stress suppresses the immune system by raising cortisol levels, leading to increased inflammation and susceptibility to infections (Alotiby, 2024). Short-term (acute) stress can temporarily boost immunity, but prolonged stress reduces immune cells and causes chronic inflammation. Effective management includes regular sleep, exercise, and mindfulness (Ibangha, 2022).

Anxiety, irritation, nervousness, anger, eye bags, fine lines or wrinkles are all brought by stress. Whether it is cramming for an exam, juggling multiple activities or applying for jobs/grad school, we have all experienced stress in one form or the other. The good news is that not all stress is bad for you. Acute stress experienced for short periods, especially when it promotes a sense of motivation can be good for you. Stress experienced while taking tests, working on a difficult assignment, or planning a big event are all examples of acute stress. On the other hand, chronic stress that persists long-term can have a negative impact on your health and overall wellbeing. This type of on-going stress can result in long-term physical health problems such as hypertension, depression, anxiety, addictive behaviours, and immune disorders (Maruva, 2025).

Eustress and Distress

Not all stress is bad. The frequency, duration, and intensity each play a role in whether stress is good (eustress) or bad (distress). Endocrinologist Hans Selye (1956) noted and recognized stress as not only a demand but also commonly quite helpful. In the preface to his book he wrote:

> ‘No one can live without experiencing some degree of stress all the time. You may think that only serious disease or intensive physical or mental injury can cause stress. This is false. Crossing a busy intersection, exposure to a draft, or even sheer joy are enough to activate the body’s stress-mechanism to some extent. Stress is not even necessarily bad for you; it is also the spice of life, for any emotion, any activity causes stress.’

It is important to remember that stress is most often good; after all, our body’s physiologic response to a stressor is designed to help us achieve success and protect us from physical and psychological demands. Indeed, humans need stress to be healthy, happy, and productive. The Yerkes-Dodson law (Yerkes & Dodson, 1908) was conceptualized by two psychologists to show the interaction between arousal and performance. Applied more broadly, it demonstrates that having either too little or too much stress can create distress and harmful effects. People perform at peak levels when they are in the zone of optimal stress. Hans Selye’s research demonstrated that our bodies respond to stress in remarkably similar ways and that the physical response to a stressor goes through three predictable stages known as the general adaptation syndrome (GAS) - alarm, resistance, and exhaustion.

The alarm stage, previously described as the fight-or-flight response, prepares our body for action. During the resistance stage, our body reduces arousal levels to more appropriate and manageable levels, which are necessary to continue to protect us for a longer duration. Our body’s defences against stress cannot go on forever, and once our protective resources are depleted we reach a state of exhaustion in which our body can no longer meet the demands placed on it and it fails to function properly. This is when chronic and serious illness can develop. Even if our stress is not particularly intense, if prolonged, it has been shown to lead to poor performance outcomes or poor mental health such as depression and illness (Cohen, Janicki-Deverts, & Miller, 2007). Two early researchers, Thomas Holmes and Richard Rahe (Holmes & Rahe, 1967), studied the link between stress and

illness. Holmes and Rahe found significant correlations between the severity of the life events (positive and negative) and medical histories of their study participants. Based on what they learned, they designed a Social Readjustment Rating Scale. Their scale assigned 'life change units' (LCUs) to each of forty-three stressful, yet common life events. According to Holmes and Rahe, a score of 150 LCUs or above indicated the potential for major health-related problems.

Coping Mechanisms: Stress Management Techniques

Effective stress management involves using active, healthy coping mechanisms to manage, reduce, or reframe stressful situations. Key strategies include physical exercise, mindfulness (meditation, deep breathing), social support, and time management. Developing adaptive habits like regular sleep, healthy eating, and setting boundaries would prevents long-term burnout (Tompa, 2026). Stress management involves using various techniques and coping strategies to manage one's overall stress levels, improve how one react to stressful things in one's life, and build resilience. It may seem like there's nothing one can do about stress (no way to avoid it and no way to de-stress completely when it hits). The bills won't stop coming, there will never be more hours in the day and one's work and family responsibilities will always be demanding. But the truth is one have a lot more control over stress than one may think. In fact, the simple realization that one is in control of one's life is the foundation of stress management (Robinson & Smith, 2026).

Managing stress is all about taking charge: of one's thoughts, emotions, schedule, environment, and the way one deal with problems. The ultimate goal is a balanced life, with time for work, relationships, relaxation, and fun; plus the ability to hold up under pressure and meet challenges head on. But there is no one-size-fits-all solution to stress management. That is why it is important to experiment and find out what works best for you. Whether one is looking to reduce one's overall stress levels, avoid unnecessary stressors in one's life, or deal with stress in the moment, the following stress management techniques and strategies can help.

Four Coping Opportunities

One important moment in dealing with stress is at the very moment we encounter, perceive, and interpret a stressor; however, this is not the only moment that matters. Intervention in the stress-distress cycle is possible at any time and in many ways (Loy, 2014). The sections below describe four opportunities.

Opportunity 1

One of the first opportunities occurs at that very moment we encounter a stressor. This moment is key because shortly thereafter we interpret and act on what we perceive as a threat. This interpretation is what sets the physiologic stress response in motion. If we view a threat as being more or less than it really is, we risk being ineffective at dealing with it, and we will be harmed either by the stressor itself or by the stress hormones being produced (Abaribe et al., 2025). A few other stress management approaches that can help manage perceptions are mindfulness, spirituality, finding purpose and meaning, visualization and self-talk, gratitude, and managing our environment. Let's consider mindfulness as an example.

Mindfulness, at its core, is a way of paying attention, perceiving things as they truly are, and living in the moment. Being mindful enables us to recognize habitual, often unconscious, emotional and physiological reactions to everyday events. Considering the role of perception on stress, it is easy to see how mindfulness can help accurately interpret and initiate an appropriate stress response. Although mindfulness stems from Buddhist tradition (Huda et al., 2024) it is not a religious concept nor is it affiliated with any religious, cultural, or belief system. It is secular in nature; however, mindfulness practice has been shown to foster a sense of purpose and meaning and feelings of being grounded and connected with one's own spirituality. It is not uncommon for companies, hospitals, and community centres to provide mindfulness instruction to their employees, patients, or residents as a way of helping them succeed, reduce stress, cope with mental illness, or deal with chronic pain (Nwadi et al., 2025).

Mindfulness is a way of thinking and a skill that takes time and practice to learn. It can be practiced in a number of ways but is most often taught through meditation. One of the most frequently cited contemporary authorities on mindfulness is Jon Kabat-Zinn, professor of medicine at the University of Massachusetts Medical School. Kabat-Zinn developed an eight-week meditation-based training called the Mindfulness-Based Stress Reduction (MBSR). MBSR has demonstrated benefits for a wide range of emotional and physical issues, including stress,

anxiety, depression (Goldin & Gross, 2010), and psychological distress in people with chronic somatic diseases (Bohlmeijer et al., 2010). Mindfulness is a useful strategy to help react to stress appropriately, cope for the short and long term, and develop resiliency.

Opportunity 2

Shortly after the stress response occurs, we have a second opportunity to cope. The act of breathing is a simple yet powerful way to bring about a parasympathetic relaxation response that stops the flow of stress hormones, calms us, and returns our body to equilibrium. Deep breathing is a common technique used, but just about any type of breathing will work. All relaxation techniques as well as meditation have breathing as a core component (Labrague, 2024). Imagery, progressive muscle relaxation, meditation, touch and massage, and anchoring are also effective ways to produce calm when under stress. People who first try meditation or other stress management techniques often leave with the attitude that the relaxation exercise was quieting but they have a limited sense of its benefits. That is because starting a formal relaxation routine in many ways is similar to starting a formal exercise routine, and similar to exercise, it takes time for the benefits to become apparent. If you were asked to describe what it felt like after your first day of strength training, you would probably say 'sore'; if asked again after six weeks, you would probably say that your muscles feel tighter and stronger; and if asked after six months, you would probably notice other people admiring your new look and say that strength training is a routine that you can't live without. The same is true with any formal relaxation routine; at first it may seem only vaguely helpful, but as you progress you will begin to experience its benefits and at some point you will begin to rely on them and it will become an activity that you can't live without. There are many relaxation activities to choose from and all include or are enhanced by breathing; however, all relaxation techniques also have characteristics that are unique. Visualization and anchoring are two examples that illustrate how different techniques can be used to manage stress.

Visualization serves three purposes: (1) to bring calm to a stressful situation, (2) to support behaviour change by enabling opportunities to experience the benefits of the desired change through imagining their benefits, and (3) to provide an opportunity to mentally rehearse and prepare for a potentially stressful situation. Visualization has been used extensively among athletes to help them practice desired standards of performance and think through potential stressful situations before they happen. In this way, visualization enables athletes to think through and rehearse their game plan and plan ahead of time for any stressful situation that might occur so they will be able to maintain perspective and keep stress at optimal levels when under the pressure of a big game (Frontier in Digital Health, 2025). Considering its purposes, it is easy to see the many uses of visualization in day-today life.

Anchoring, which is different from visualization, is a tactic that helps prepare in advance for stress. An anchor is a physical or mental cue (e.g., touching our thumb and forefinger together, imagining our favourite beach) that stimulates a desirable conditioned response. For example, if we use a physical cue such as touching our thumb and forefinger whenever we are in a relaxed state, this conditions our body to associate the touching of our finger to our thumb with the state of relaxation. Practice this enough and it becomes a conditioned response that can be used to trigger relaxation whenever a stressful situation arises (Islam & Rabbi, 2024).

Opportunity 3

Exercise is one of the most helpful stress management techniques. To understand why, recall the science of stress section. Physical action, such as exercise, is one way of following through on the fight-or-flight response. By using major muscle groups during exercise, our body metabolizes excess blood sugar, fats, and stress hormones (adrenalin and cortisol), and with the hormones gone, our body can return to homeostasis. Not only does exercise help with the stress of the moment, but it is believed that regular exercise over time reduces the amount of adrenalin and cortisol released during other stressful times (Olpin & Hesson, 2010) and may weaken neural mechanisms involved in the stress response resulting in lower sympathetic nervous system activity in response to perceived stress (Kelley, 2009; Chukwuemeka et al., 2023). There is much evidence on the positive and lasting relationship between exercise and emotional health for the mentally healthy as well as psychiatric populations. For example, a number of studies have demonstrated a positive relationship between exercise and mental health in people with emotional and mental health issues that range from hostility and drug and alcohol abuse to clinical depression and schizophrenia (Olubiyi et al., 2019; Daley, 2002).

Exercise has long been known to improve mood and reduce anxiety. It increases daily energy levels, boosts self-confidence, and creates a sense of accomplishment (Anieche & Ottiwu, 2024). Brain chemicals such as endorphins and serotonin are released during exercise and produce a feeling of euphoria sometimes called a 'runners' high'. These uplifting feelings can last for hours after the exercise is completed. All types of exercise can contribute to emotional and mental health, and activities such as yoga, tai chi, and qi gong can bring additional coping benefits, such as breathing work, being grounded, and maintaining perspective.

Opportunity 4

Music, art, and writing are each considered expressive coping strategies that are available to help manage stress and build resilience over time. Other examples of expressive therapies are drama, photography, dance, drumming, and play. These activities cater to a greater variety of communication styles, for example, verbal, visual, tactile, and so on, and provide supportive ways to communicate effectively and authentically. Expressive strategies help individuals quickly communicate relevant issues in ways that talk cannot accomplish. Expressive strategies can be particularly helpful for people with limited language skills, such as children, trauma victims, or older persons who may have suffered a stroke or are dealing with dementia. Each expressive strategy has its own unique properties and can play a variety of roles in sustaining emotional health and building resilience.

Music as a coping strategy can be as simple as a change in your emotional state by listening to uplifting music when feeling depressed. Music is routinely used by companies to achieve desired emotional effects or to sell products. Consider the use of 'elevator music' as a way to calm clients who are waiting to be seen by a physician, rock and roll to excite players and fans at a professional sporting event, or jazz at a night club to portend romance. According to the American Music Therapy Association (2005), music can also effect positive changes in psychological, physical, cognitive, and social functioning, and it has the ability to break down strong emotional defences and enable the expression of feelings. Not only is listening to music helpful, but also creating, singing, and moving to music can be therapeutic.

Art therapy, according to the American Art Therapy Association (2008), is the use of art media, the creative process, and the resulting artwork to help people explore and express feelings, deal with emotions, gain self-awareness, improve self-esteem, and reduce stress, fear, and anxiety. In some cases, such as with children, difficult emotions and information about stressful or traumatic events can be more easily expressed through drawings than through conversation. Art can also inspire a sense of freedom and personal well-being.

Writing is another expressive therapy that helps us understand and communicate perceptions, make reasoned interpretations, and consider appropriate responses. It can take many forms, such as journaling, poetry, letter writing, and blogging. Expressive writing provides opportunities to express and release emotions, make sense of stressful events, and process their meanings. If shared, writing can facilitate social support and enable opportunities to receive feedback and advice.

Only a few of the many available healthy coping strategies have been discussed in this article. Unfortunately, poor coping is all too common in response to stress. Overeating, using tobacco products or consuming alcohol are unhealthy and counterproductive and can lead to a cycle of unresolved stress and a wide range of lifestyle illnesses. Thus, it is important to make healthy lifestyle choices and maintain a variety of healthy coping strategies.

Conclusion

This discourse have emphasised the importance of stress to the human body as well as explain how the human body respond to stress. This is to debunk the myth that 'stress is bad for you' as there are health and psychological benefits as outlined in this article that makes stress beneficial. Indeed, human need stress to be healthy, happy and productive. It is the 'too much' or 'too little' of everything that is 'bad for you'; so also is stress.

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