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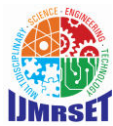
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ijmrset@gmail.com



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STUDY OF HUMAN BEHAVIOUR UNDER STRESS

RAJEEV LOCHAN TRIPATHI

DEPT. OF PHILOSOPHY, BANARAS HINDU UNIVERSITY, VARANASI, UTTAR PRADESH, INDIA

ABSTRACT: In psychology, stress is a feeling of emotional strain and pressure.^[1] Stress is a type of psychological pain. Small amounts of stress may be beneficial, as it can improve athletic performance, motivation and reaction to the environment. Excessive amounts of stress, however, can increase the risk of strokes, heart attacks, ulcers, and mental illnesses such as depression^[2] and also aggravation of a pre-existing condition.

Psychological stress can be external and related to the environment,^[3] but may also be caused by internal perceptions that cause an individual to experience anxiety or other negative emotions surrounding a situation, such as pressure, discomfort, etc., which they then deem stressful.

KEYWORDS-stress, human behavior, emotion, environment, anxiety, pressure

I. INTRODUCTION

Causes

Neutrality of Stressors

Stress is a non-specific response.^[5] It is neutral, and what varies is the degree of response. It is all about the context of the individual and how they perceive the situation. Hans Selye defined stress as “the nonspecific (that is, common) result of any demand upon the body, be the effect mental or somatic.”^[5] This includes the medical definition of stress as a physical demand and the colloquial definition of stress as a psychological demand. A stressor is inherently neutral meaning that the same stressor can cause either distress or eustress. It is individual differences and responses that induce either distress or eustress.^[8]

Types of stressors

A stressor is any event, experience, or environmental stimulus that causes stress in an individual.^[9] These events or experiences are perceived as threats or challenges to the individual and can be either physical or psychological. Researchers have found that stressors can make individuals more prone to both physical and psychological problems, including heart disease and anxiety.^[10]

Stressors are more likely to affect the health of an individual when they are "chronic, highly disruptive, or perceived as uncontrollable".^[10] In psychology, researchers generally classify the different types of stressors into four categories: 1) crises/catastrophes, 2) major life events, 3) daily hassles/microstressors, and 4) ambient stressors. According to Ursin (1988), the common factor between these categories is an inconsistency between expected events ("set value") and perceived events ("actual value") that cannot be resolved satisfactorily,^[11] which puts stress into the broader context of cognitive-consistency theory.^[12]

Crises/catastrophes

This type of stressor is unforeseen and unpredictable and, as such, is completely out of the control of the individual.^[10] Examples of crises and catastrophes include: devastating natural disasters, such as major floods or earthquakes, wars, pandemics, etc. Though rare in occurrence, this type of stressor typically causes a great deal of stress in a person's life. A study conducted by Stanford University found that after natural disasters, those affected experienced a significant increase in stress level.^[10] Combat stress is a widespread acute and chronic problem. With the rapid pace and the urgency of firing first, accidental killings of friendly forces (or fratricide) may occur. Prevention requires stress reduction, emphasis on vehicle and other identification training, awareness of the tactical situation, and continual risk analysis by leaders at all levels.^[13]



Major life events

Common examples of major life events include: marriage, going to college, death of a loved one, birth of a child, divorce, moving houses, etc. These events, either positive or negative, can create a sense of uncertainty and fear, which will ultimately lead to stress. For instance, research has found the elevation of stress during the transition from high school to university, with college freshmen being about two times more likely to be stressed than final year students.^[14] Research has found that major life events are somewhat less likely to be major causes of stress, due to their rare occurrences.^[10]

The length of time since occurrence and whether or not it is a positive or negative event are factors in whether or not it causes stress and how much stress it causes. Researchers have found that events that have occurred within the past month generally are not linked to stress or illness, while chronic events that occurred more than several months ago are linked to stress and illness^[15] and personality change.^[16] Additionally, positive life events are typically not linked to stress – and if so, generally only trivial stress – while negative life events can be linked to stress and the health problems that accompany it.^[10] However, positive experiences and positive life changes can predict decreases in neuroticism.^{[16][17]}

Daily hassles/microstressors

This category includes daily annoyances and minor hassles.^[10] Examples include: making decisions, meeting deadlines at work or school, traffic jams, encounters with irritating personalities, etc. Often, this type of stressor includes conflicts with other people. Daily stressors, however, are different for each individual, as not everyone perceives a certain event as stressful. For example, most people find public speaking to be stressful, but someone who has experience with it will not.

Daily hassles are the most frequently occurring type of stressor in most adults. The high frequency of hassles causes this stressor to have the most physiological effect on an individual. Carolyn Aldwin, Ph.D., conducted a study at the Oregon State University that examined the perceived intensity of daily hassles on an individual's mortality. Aldwin's study concluded that there is a strong correlation between individuals who rate their hassles as very intense and a high level of mortality. One's perception of their daily stressors can have a modulating effect on the physiological impact of daily stressors.^[18]

There are three major psychological types of conflicts that can cause stress.

- The approach-approach conflict, occurs when a person is choosing between two equally attractive options, i.e. whether to go see a movie or to go see a concert.^[10]
- The avoidance-avoidance conflict, occurs where a person has to choose between two equally unattractive options, for example, to take out a second loan with unappealing terms to pay off the mortgage or to face foreclosure on one's house.^[10]
- The approach-avoidance conflict,^[10] occurs when a person is forced to choose whether or not to partake in something that has both attractive and unattractive traits – such as whether or not to attend an expensive college (meaning taking out loans now, but also meaning a quality education and employment after graduation).

Travel-related stress results from three main categories: lost time, surprises (an unforeseen event such as lost or delayed baggage) and routine breakers (inability to maintain daily habits).^[19]

Ambient stressors

As the name implies, these are global (as opposed to individual) low-grade stressors that are a part of the background environment. They are defined as stressors that are "chronic, negatively valued, non-urgent, physically perceptible, and intractable to the efforts of individuals to change them".^[20] Typical examples of ambient stressors are pollution, noise, crowding, and traffic. Unlike the other three types of stressor, ambient stressors can (but do not necessarily have to) negatively impact stress without conscious awareness.^[20]



Organisational stressors

Studies conducted in military and combat fields show that some of the most potent stressors can be due to personal organisational problems in the unit or on the home front.^[21] Stress due to bad organisational practices is often connected to "toxic leadership", both in companies and in governmental organisations.^[22]

Stressor impact

Life events scales can be used to assess stressful things that people experience in their lives. One such scale is the Holmes and Rahe Stress Scale, also known as the Social Readjustment Rating Scale, or SRRS.^[23] Developed by psychiatrists Thomas Holmes and Richard Rahe in 1967, the scale lists 43 stressful events.

To calculate one's score, add up the number of "life change units" if an event occurred in the past year. A score of more than 300 means that individual is at risk for illness, a score between 150 and 299 means risk of illness is moderate, and a score under 150 means that individual only has a slight risk of illness.^{[10][23]}

Life Event	Life Change Units
Death of a spouse	100
Divorce	73
Marital separation	65
Imprisonment	63
Death of a close family member	63
Personal injury or illness	53
Marriage	50
Dismissal from work	47
Marital reconciliation	45
Retirement	45
Change in health of family member	44
Pregnancy	40
Sexual difficulties	39
Gain a new family member	39
Business readjustment	39
Change in financial state	38
Death of a close friend	37
Change to different line of work	36
Change in frequency of arguments	35
Major mortgage	32
Foreclosure of mortgage or loan	30
Change in responsibilities at work	29
Child leaving home	29
Trouble with in-laws	29
Outstanding personal achievement	28
Spouse starts or stops work	26
Begin or end school	26



Life Event	Life Change Units
Change in living conditions	25
Revision of personal habits	24
Trouble with boss	23
Change in working hours or conditions	20
Change in residence	20
Change in schools	20
Change in recreation	19
Change in church activities	19
Change in social activities	18
Minor mortgage or loan	17
Change in sleeping habits	16
Change in number of family reunions	15
Change in eating habits	14
Vacation	13
Minor violation of law	10

A modified version was made for non-adults. The scale is below.^[10]

Life Event	Life Change Units
Unwed pregnancy	100
Death of parent	100
Getting married	95
Divorce of parents	90
Acquiring a visible deformity	80
Fathering an unwed pregnancy	70
Jail sentence of parent for over one year	70
Marital separation of parents	69
Death of a sibling	68
Change in acceptance by peers	67
Pregnancy of unprepared for sibling	64
Discovery of being an adopted child	63
Marriage of parent to stepparent	63
Death of a close friend	63
Having a visible congenital deformity	62
Serious illness requiring hospitalization	58
Failure of a grade in school	56
Not making an extracurricular activity	55
Hospitalization of a parent	55



Life Event	Life Change Units
Jail sentence of parent for over 30 days	53
Breaking up with partner	53
Beginning to date	51
Suspension from school	50
Becoming involved with drugs or alcohol	50
Birth of a sibling	50
Increase in arguments between parents	47
Loss of job by parent	46
Outstanding personal achievement	46
Change in parent's financial status	45
Accepted at college of choice	43
Being a senior in high school	42
Hospitalization of a sibling	41
Increased absence of parent from home	38
Sibling leaving home	37
Addition of third adult to family	34
Becoming a full-fledged member of a church	31
Decrease in arguments between parents	27
Decrease in arguments with parents	26
Parent beginning work	26

The SRRS is used in psychiatry to weight the impact of life events.^[24]

Measurement

Modern people may attempt to self-assess their own "stress-level"; third parties (sometimes clinicians) may also provide qualitative evaluations. Quantitative approaches such as Galvanic Skin Response^[25] or other measurements giving results which may correlate with perceived psychological stress include testing for one or more of the several stress hormones,^[26] for cardiovascular responses,^[27] or for immune response.^[28] There are some valid questionnaires to assess stress level such as, Higher Education Stress Inventory (HESI) is a valid questionnaire used in many communities for assessment the stress level of college students.^{[29][30]} There are many (psycho-)physiological measurement methods that correlate more or less well with psychological stress (mental or emotional) and are thus used as a possible indicator.^{[31][32][33][34][35][36][37][38][39]}

In the physiological domain of oculomotor function alone, several physiological responses are suspected to detect different stress situations in a person-specific and objective manner (not by means of a survey). For example, via eye movement and gaze behavior,^{[40][41][42]} via pupil behavior^{[43][44][45][46]} and via eyelid blink behavior (Blinking).^{[47][48][49][50]}

Physical effects

To measure the body's response to stress, psychologists tend to use Hans Selye's general adaptation syndrome. This biological model, often referred to as the "classic stress response", revolves around the concept of homeostasis. General adaptive syndrome, according to this system, occurs in three stages:



1. The alarm reaction. This stage occurs when the stressor is first presented. The body begins to gather resources to deal with the stressor. The hypothalamic-pituitary-adrenal axis and sympathetic nervous system are activated, resulting in the release of hormones from the adrenal gland such as cortisol, adrenaline (epinephrine), and norepinephrine into the bloodstream to adjust bodily processes. These hormonal adjustments increase energy-levels, increase muscle tension, reduce sensitivity to pain, slow down the digestive system, and cause a rise in blood pressure.^{[51][52]} In addition, the locus coeruleus, a collection of norepinephrine-containing neurons in the pons of the brainstem whose axons project to various regions of the brain, is involved in releasing norepinephrine directly onto neurons. High levels of norepinephrine acting as a neurotransmitter on its receptors expressed on neurons in brain regions, such as the prefrontal cortex, are thought^[by whom?] to be involved in the effects of stress on executive functions, such as impaired working memory.
2. The stage of resistance. The body continues building up resistance throughout the stage of resistance, either until the body's resources are depleted, leading to the exhaustion phase, or until the stressful stimulus is removed. As the body uses up more and more of its resources, it becomes increasingly tired and susceptible to illness. At this stage psychosomatic disorders first begin to appear.^[52]
3. The stage of exhaustion. The body is completely drained of the hormones and resources it was depending on to manage the stressor. The person now begins to exhibit behaviors such as anxiety, irritability, avoidance of responsibilities and relationships, self-destructive behavior, and poor judgment. Someone experiencing these symptoms has a much greater chance of lashing out, damaging relationships, or avoiding social interaction at all.^[52]

This physiological stress response involves high levels of sympathetic nervous system activation, often referred to as the "fight or flight" response. The response Archived 2012-10-10 at the Wayback Machine involves pupil dilation, release of endorphins, increased heart and respiration rates, cessation of digestive processes, secretion of adrenaline, arteriole dilation, and constriction of veins.^[53]

Cancer

Psychological stress does not appear to be a risk factor for the onset of cancer,^{[54][55]} though it may worsen outcomes in those who already have cancer.^[54] Research has found that personal belief in stress as a risk factor for cancer was common in England, though awareness of risk factors overall was found to be low.^[56]

Other effects

There is likely a connection between stress and illness.^[57] Theories of a proposed stress-illness link suggest that both acute and chronic stress can cause illness, and studies have found such a link.^[58] According to these theories, both kinds of stress can lead to changes in behavior and in physiology. Behavioral changes can involve smoking- and eating-habits and physical activity. Physiological changes can be changes in sympathetic activation or hypothalamic pituitary adrenocorticoid activation, and immunological function.^[59] However, there is much variability in the link between stress and illness.^[60]

There is some evidence that stress can make the individual more susceptible to physical illnesses like the common cold. "Although chronic (but not acute) stressful events are associated with greater susceptibility, the association between social diversity and colds is not altered after controlling for life events."^[61] Stressful events, such as job changes, correlate with insomnia, impaired sleeping, and health complaints.^[62] Research indicates the type of stressor (whether it is acute or chronic) and individual characteristics such as age and physical well-being before the onset of the stressor can combine to determine the effect of stress on an individual.^[63] An individual's personality characteristics (such as level of neuroticism),^[16] genetics, and childhood experiences with major stressors and traumas^[17] may also dictate their response to stressors.^[63] Stress may also cause headaches.^[64]

Chronic stress and a lack of coping resources available or used by an individual can often lead to the development of psychological issues such as depression and anxiety (see below for further information).^[65] This is particularly true regarding chronic stressors. These are stressors that may not be as intense as an acute stressor like a natural disaster or a major accident, but they persist over longer periods of time. These types of stressors tend to have a more negative impact on health because they are sustained and thus require the body's physiological response to occur daily. This depletes the body's energy more quickly and usually occurs over long periods of time, especially when such microstressors cannot be avoided (for example: stress related to living in a dangerous neighborhood). See allostatic



load for further discussion of the biological process by which chronic stress may affect the body. For example, studies have found that caregivers, particularly those of dementia patients, have higher levels of depression and slightly worse physical health than non-caregivers.^[66]

Studies have also shown that perceived chronic stress and the hostility associated with Type A personalities are often correlated with much higher risks of cardiovascular disease.^[67] This occurs because of the compromised immune system as well as the high levels of arousal in the sympathetic nervous system that occur as part of the body's physiological response to stressful events.^[68] However, it is possible for individuals to exhibit hardiness – a term referring to the ability to be both chronically stressed and healthy.^[69] Chronic stress can correlate with psychological disorders such as delusions.^[70] Pathological anxiety and chronic stress lead to structural degeneration and impaired functioning of the hippocampus.^[71]

It has long been believed that negative affective states, such as feelings of anxiety and depression, could influence the pathogenesis of physical disease, which in turn, have direct effects on biological process that could result in increased risk of disease in the end. However, studies done by the University of Wisconsin-Madison and other places have shown this to be partly untrue; although perceived stress seems to increase the risk of reported poor health, the additional perception of stress as something harmful increases the risk even further.^{[72][73]} For example, when humans are under chronic stress, permanent changes in their physiological, emotional, and behavioral responses are most likely to occur.^{[16][74]} Such changes could lead to disease. Chronic stress results from stressful events that persist over a relatively long period of time, such as caring for a spouse with dementia, or results from brief focal events that continue to be experienced as overwhelming even long after they are over, such as experiencing a sexual assault.

Experiments show that when healthy human individuals are exposed to acute laboratory stressors, they show an adaptive enhancement of some markers of natural immunity but a general suppression of functions of specific immunity. By comparison, when healthy human individuals are exposed to real-life chronic stress, this stress is associated with a biphasic immune response where partial suppression of cellular and humoral function coincides with low-grade, nonspecific inflammation.^[75]

Even though psychological stress is often connected with illness or disease, most healthy individuals can still remain disease-free after confronting chronic stressful events. Also, people who do not believe that stress will affect their health do not have an increased risk of illness, disease, or death.^[73] This suggests that there are individual differences in vulnerability to the potential pathogenic effects of stress; individual differences in vulnerability arise due to both genetic and psychological factors. In addition, the age at which the stress is experienced can dictate its effect on health. Research suggests chronic stress at a young age can have lifelong impacts on the biological, psychological, and behavioral responses to stress later in life.^[76]

Social impact[edit]

Communication

When someone is stressed, many challenges can arise; a recognised challenge being communication difficulties. Here are some examples of how stress can hinder communication.

The cultures of the world generally fall into two categories; individualistic and collectivistic.^[77]

- An individualistic culture, like that of the United States, where everyone is an independent entity defined by their accomplishments and goals.
- A collectivistic culture, like that of many Asian countries, prefers to see individuals as interdependent on each other. They value modesty and family.

These cultural differences can affect how people communicate when they are stressed. For example, a member of an individualistic culture would be hesitant to ask for pain medication for fear of being perceived as weak. A member of a collectivistic culture would not hesitate. They have been brought up in a culture where everyone helps each other and is one functional unit whereas the member of the individualistic culture is not as comfortable asking others for aid.^[77]



Language barriers

Language barriers can cause stress, and sometimes this stress adds to language barriers. People may feel uncomfortable with the difficulties caused by differences in syntax, vocabulary, ways of showing respect, and use of body language. Along with a desire for successful social interactions, being uncomfortable with the communication around a person can discourage them from communicating at all, thus adding to the language barrier.

The System 1 – System 2 model of Daniel Kahneman's Thinking, Fast and Slow and others^[who?] distinguishes between automatic responses, such as those one's native language provides, and a foreign language that requires System 2 work to translate. System 2 can become "depleted" by conscious mental effort, making it more difficult and stressful.^[78]

Changes in the home

Divorce, death, and remarriage are all disruptive events in a household.^[77] Although everyone involved is affected by events such as these, it can be most drastically seen in children. Due to their age, children have relatively undeveloped coping skills.^[79] For this reason a stressful event may cause some changes in their behavior. Falling in with a new crowd, developing some new and sometimes undesirable habits are just some of the changes stress may trigger in their lives.^[77]

A particularly interesting response to stress is talking to an imaginary friend. A child may feel angry with a parent or their peers who they feel brought this change on them. They need someone to talk to but it definitely would not be the person with whom they are angry. That is when the imaginary friend comes in. They "talk" to this imaginary friend but in doing so they cut off communication with the real people around them.^[77]

Social support and health

Researchers have long been interested in how an individual's level and types of social support impact the effect of stress on their health. Studies consistently show that social support can protect against physical and mental consequences of stress.^{[80][81]} This can occur through a variety of mechanisms. One model, known as the "direct effects" model, holds that social support has a direct, positive impact on health by increasing positive affect, promoting adaptive health behaviors, predictability and stability in life, and safeguarding against social, legal, and economic concerns that could negatively impact health. Another model, the "buffering effect", says that social support exerts greatest influence on health in times of stress, either by helping individuals appraise situations in less threatening manners or coping with the actual stress. Researchers have found evidence to support both these pathways.^[82]

Social support is defined more specifically as psychological and material resources provided by a social network that are aimed at helping an individual cope with stress.^[83] Researchers generally distinguish among several types of social support: instrumental support – which refers to material aid (e.g., financial support or assistance in transportation to a physician's appointment), informational support (e.g., knowledge, education or advice in problem-solving), and emotional support (e.g., empathy, reassurance, etc.).^[83] Social support can reduce the rate of stress during pregnancy. Studies have found that those who had a large change in their life with a small amount of social support has a higher chance of complications. Whereas those with a larger support system would have a chance for less complications.^[84]

Management

Stress management refers to a wide spectrum of techniques and psychotherapies aimed at controlling a person's levels of stress, especially chronic stress, usually for the purpose of improving everyday functioning. It involves controlling and reducing the tension that occurs in stressful situations by making emotional and physical changes.

Prevention and resilience building

Decreasing stressful behaviors is a part of prevention. Some of the common strategies and techniques are: self-monitoring, tailoring, material reinforcement, social reinforcement, social support, self-contracting, contracting with significant other, shaping, reminders, self-help groups, and professional help.^[85]

Although many techniques have traditionally been developed to deal with the consequences of stress, considerable research has also been conducted on the prevention of stress, a subject closely related to psychological resilience-



building. A number of self-help approaches to stress-prevention and resilience-building have been developed, drawing mainly on the theory and practice of cognitive-behavioral therapy.^[86]

Biofeedback may also play a role in stress management. A randomized study by Sutarto et al. assessed the effect of resonant breathing biofeedback (recognize and control involuntary heart rate variability) among manufacturing operators; depression, anxiety and stress significantly decreased.^[87]

Exercising to reduce stress

Studies have shown that exercise reduces stress.^{[88][25]} Exercise effectively reduces fatigue, improves sleep, enhances overall cognitive function such as alertness and concentration, decreases overall levels of tension, and improves self-esteem.^[88] Because many of these are depleted when an individual experiences chronic stress, exercise provides an ideal coping mechanism. Despite popular belief, it is not necessary for exercise to be routine or intense in order to reduce stress; as little as five minutes of aerobic exercise can begin to stimulate anti-anxiety effects.^[88] Further, a 10-minute walk may have the same psychological benefits as a 45-minute workout, reinforcing the assertion that exercise in any amount or intensity will reduce stress.^[88] Cycling and walking activities have lower stress scores when compared to other modes of transport or commuting.^[25]

Theoretical explanations

A multitude of theories have been presented in attempts to explain why exercise effectively reduces stress. One theory, known as the time-out hypothesis, claims that exercise provides distraction from the stressor. The time out hypothesis claims that exercise effectively reduces stress because it gives individuals a break from their stressors. This was tested in a recent study of college women who had identified studying as their primary stressor.^[89] The women were then placed under four conditions at varying times: "rest," "studying," "exercising," and "studying while exercising." The stress levels of the participants were measured through self-assessments of stress and anxiety symptoms after each condition. The results demonstrated that the "exercise" condition had the most significant reduction in stress and anxiety symptoms.^[89] These results demonstrate the validity of the time-out hypothesis.^[89] It is also important to note that exercise provided greater stress reduction than rest.

Coping mechanisms

The Lazarus and Folkman model suggests that external events create a form of pressure to achieve, engage in, or experience a stressful situation. Stress is not the external event itself, but rather an interpretation and response to the potential threat; this is when the coping process begins.^[90]

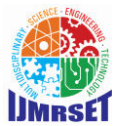
There are various ways individuals deal with perceived threats that may be stressful. However, people have a tendency to respond to threats with a predominant coping style, in which they dismiss feelings, or manipulate the stressful situation.^[90]

There are different classifications for coping, or defense mechanisms, however they all are variations on the same general idea: There are good/productive and negative/counterproductive ways to handle stress. Because stress is perceived, the following mechanisms do not necessarily deal with the actual situation that is causing an individual stress. However, they may be considered coping mechanisms if they allow the individual to cope better with the negative feelings/anxiety that they are experiencing due to the perceived stressful situation, as opposed to actually fixing the concrete obstacle causing the stress. The following mechanisms are adapted from the DSM-IV Adaptive Functioning Scale, APA, 1994.

Another way individuals can cope with stress is by the way one perceives stress. Perceptions of stress are critical for making decisions and living everyday life. The outlook or the way an individual perceives the given situation can affect the manner to which the individual handles stress, whether it be positive or negative. Too much stress can be detrimental to the individual and can cause negative psychological and physical health effects.^[91]

Highly adaptive/active/problem-focused mechanisms

These skills are what one could call as "facing the problem head on", or at least dealing with the negative emotions experienced by stress in a constructive manner. (generally adaptive)



- Affiliation ("tend and befriend") – involves dealing with stress by turning to a social network for support, but an individual does not share with others in order to diffuse or avoid the responsibility.^{[92][93]}
- Humour – the individual steps outside of a situation in order to gain greater perspective, and also to highlight any comic aspect to be found in their stressful circumstances.^[92]

“The Association for Applied and Therapeutic Humour defines therapeutic humour as ‘any intervention that promotes health and wellness by stimulating a playful discovery, expression or appreciation of the absurdity of or incongruity of life’s situations. This intervention may enhance health or be used as a complementary treatment of illness to facilitate healing or coping whether physical, emotional, cognitive, or spiritual’.”^[94]

Sigmund Freud, a well known neurologist, suggests the humour was an excellent defensive strategy in emotional situations.^[90] When one laughs during a tough situation they feel absent from their worries, and this allows them to think differently.^[94] When one experiences a different mind set, they feel more in control of their response, and how they would go about dealing with the event that caused stress.

Lefcourt (2001) suggests that this perspective-taking humour is the most effective due to its ability to distance oneself from the situation of great stress.^[95] Studies show that the use of laughter and humour creates a sense of relief of stress that can last up to 45 minutes post-laughter.^[94]

Also, most hospitalized children have been seen to use laughter and play to relieve their fear, pain and stress. It has been discovered that there is a great importance in the use of laughter and humour in stress coping.^[94] Humans should use humour as a means to transcend their original understanding of an external event, take a different perspective, in which their anxiety may be minimized by.

- Sublimation – allows an "indirect resolution of conflict with neither adverse consequences nor consequences marked by loss of pleasure."^[96] Essentially, this mechanism allows channeling of troubling emotions or impulses into an outlet that is socially acceptable.
- Positive reappraisal – redirects thoughts (cognitive energy) to good things that are either occurring or have not occurred. This can lead to personal growth, self-reflection, and awareness of the power/benefits of one's efforts.^[97] For example, studies on veterans of war or peacekeeping operations indicate that persons who construe a positive meaning from their combat or threat experiences tend to adjust better than those who do not.^[98]

The final path model fitted well (CFI = 1, RMSEA = 0.00) and showed that direct quality of life paths with $\beta = -0.2$, and indirect social support with $\beta = -0.088$ had the most effects on reduction of stress during pregnancy. Other adaptive coping mechanisms include anticipation, altruism, and self-observation.

Mental inhibition/disavowal mechanisms

These mechanisms cause the individual to have a diminished (or in some cases non-existent) awareness about their anxiety, threatening ideas, fears, etc., that come from being conscious of the perceived threat.

- Displacement – This is when an individual redirects their emotional feelings about one situation to another, less threatening one.^[99]
- Repression – Repression occurs when an individual attempts to remove all their thoughts, feelings, and anything related to the upsetting/stressful (perceived) threat out of their awareness in order to be disconnected from the entire situation. When done long enough in a successful way, this is more than just denial.
- Reaction formation – An attempt to remove any “unacceptable thoughts” from one's consciousness by replacing them with the exact opposite.^[100]

Other inhibition coping mechanisms include undoing, dissociation, denial, projection, and rationalization. Although some people claim that inhibition coping mechanisms may eventually increase the stress level because the problem is not solved, detaching from the stressor can sometimes help people to temporarily release the stress and become more prepared to deal with problems later on.

Active mechanisms

These methods deal with stress by an individual literally taking action, or withdrawing.



- Acting out – Often viewed as counter-normative, or problematic behavior. Instead of reflecting or problem-solving, an individual takes maladaptive action.^[93]
- Passive aggression – When an individual indirectly deals with their anxiety and negative thoughts/feelings stemming from their stress by acting in a hostile or resentful manner towards others. Help-Rejecting Complaining can also be included in this category.

Health promotion

There is an alternative method to coping with stress, in which one works to minimize their anxiety and stress in a preventative manner.

Suggested strategies to improve stress management include:^[101]

1. Regular exercise – set up a fitness program, 3–4 times a week
2. Support systems – to listen, offer advice, and support each other
3. Time management – develop an organizational system
4. Guided imagery and visualization – create a relaxing state of mind
5. Progressive muscle relaxation – loosen tense muscle groups
6. Assertiveness training – work on effective communication
7. Journal writing – express true emotion, self-reflection
8. Stress management in the workplace – organize a new system, switch tasks to reduce own stress.

Depending on the situation, all of these coping mechanisms may be adaptive, or maladaptive.

History

Prior to the introduction of the concept "stress" in the psychological sense c. 1955,^{[102][103]} people already identified a range of more nuanced ideas to describe and confront such emotions as worry, grief, concern,^[104] obsession, fear, annoyance, anxiety, distress, suffering and passion.^[105] By the 19th century, the popularisation of the nascent science of neurology made it possible to group some undifferentiated combination of one or more of these with an informal diagnosis such as "nerve strain".^[106]

"Stress" has subsequently become a mainstay of pop psychology.^{[107][108]} Though stress is discussed throughout history from many distinct topics and cultures, there is no universal consensus over describing stress.^{[109][need quotation to verify]} This has led to multiple kinds of research, looking at the different aspects of psychological stress and how it changes over a lifespan.^[109]

II. DISCUSSION

Stress, whether physiological, biological or psychological, is an organism's response to a stressor such as an environmental condition.^[1] Stress is the body's method of reacting to a condition such as a threat, challenge or physical and psychological barrier. There are two hormones that an individual produces during a stressful situation, well known as adrenaline and cortisol.^[2] There are two kinds of stress hormone levels. Resting (basal) cortisol levels are normal everyday quantities that are essential for standard functioning. Reactive cortisol levels are increases in cortisol in response to stressors. Stimuli that alter an organism's environment are responded to by multiple systems in the body.^[3] In humans and most mammals, the autonomic nervous system and hypothalamic-pituitary-adrenal (HPA) axis are the two major systems that respond to stress.^[4]

The sympathoadrenal medullary (SAM) axis may activate the fight-or-flight response through the sympathetic nervous system, which dedicates energy to more relevant bodily systems to acute adaptation to stress, while the parasympathetic nervous system returns the body to homeostasis.

The second major physiological stress-response center, the HPA axis, regulates the release of cortisol, which influences many bodily functions such as metabolic, psychological and immunological functions. The SAM and HPA axes are regulated by several brain regions, including the limbic system, prefrontal cortex, amygdala, hypothalamus, and stria terminalis.^[4] Through these mechanisms, stress can alter memory functions, reward, immune function, metabolism and susceptibility to diseases.^[5]



Disease risk is particularly pertinent to mental illnesses, whereby chronic or severe stress remains a common risk factor for several mental illnesses.^{[6][7]}

Psychology

Acute stressful situations where the stress experienced is severe is a cause of change psychologically to the detriment of the well-being of the individual, such that symptomatic derealization and depersonalization, and anxiety and hyperarousal, are experienced.^[8] The International Classification of Diseases includes a group of mental and behavioral disorders which have their aetiology in reaction to severe stress and the consequent adaptive response.^{[9][10]} Chronic stress, and a lack of coping resources available, or used by an individual, can often lead to the development of psychological issues such as delusions,^[11] depression and anxiety (see below for further information).^[12] Chronic stress also causes brain atrophy, which is the loss of neurons and the connections between them. It affects the part of the brain that is important for learning, responding to the stressors and cognitive flexibility.^[13]

Chronic stressors may not be as intense as acute stressors such as natural disaster or a major accident, but persist over longer periods of time and tend to have a more negative effect on health because they are sustained and thus require the body's physiological response to occur daily.^[14] This depletes the body's energy more quickly and usually occurs over long periods of time, especially when these microstressors cannot be avoided (i.e. stress of living in a dangerous neighborhood). See allostatic load for further discussion of the biological process by which chronic stress may affect the body. For example, studies have found that caregivers, particularly those of dementia patients, have higher levels of depression and slightly worse physical health than non-caregivers.^[14]

When humans are under chronic stress, permanent changes in their physiological, emotional, and behavioral responses may occur.^[15] Chronic stress can include events such as caring for a spouse with dementia, or may result from brief focal events that have long term effects, such as experiencing a sexual assault. Studies have also shown that psychological stress may directly contribute to the disproportionately high rates of coronary heart disease morbidity and mortality and its etiologic risk factors. Specifically, acute and chronic stress have been shown to raise serum lipids and are associated with clinical coronary events.^[16]

However, it is possible for individuals to exhibit hardiness—a term referring to the ability to be both chronically stressed and healthy.^[17] Even though psychological stress is often connected with illness or disease, most healthy individuals can still remain disease-free after being confronted with chronic stressful events. This suggests that there are individual differences in vulnerability to the potential pathogenic effects of stress; individual differences in vulnerability arise due to both genetic and psychological factors. In addition, the age at which the stress is experienced can dictate its effect on health. Research suggests chronic stress at a young age can have lifelong effects on the biological, psychological, and behavioral responses to stress later in life.^[18]

Etymology and historical usage

The term "stress" had none of its contemporary connotations before the 1920s. It is a form of the Middle English *destresse*, derived via Old French from the Latin *stringere*, "to draw tight".^[19] The word had long been in use in physics to refer to the internal distribution of a force exerted on a material body, resulting in strain. In the 1920s and '30s, biological and psychological circles occasionally used the term to refer to a mental strain or to a harmful environmental agent that could cause illness.^{[20][21]}

Walter Cannon used it in 1926 to refer to external factors that disrupted what he called homeostasis.^[22] But "...stress as an explanation of lived experience is absent from both lay and expert life narratives before the 1930s".^[23] Physiological stress represents a wide range of physical responses that occur as a direct effect of a stressor causing an upset in the homeostasis of the body. Upon immediate disruption of either psychological or physical equilibrium the body responds by stimulating the nervous, endocrine, and immune systems. The reaction of these systems causes a number of physical changes that have both short- and long-term effects on the body.^[24]

The Holmes and Rahe stress scale was developed as a method of assessing the risk of disease from life changes.^[25] The scale lists both positive and negative changes that elicit stress. These include things such as a major holiday or marriage, or death of a spouse and firing from a job.



Biological need for equilibrium

Homeostasis is a concept central to the idea of stress.^[26] In biology, most biochemical processes strive to maintain equilibrium (homeostasis), a steady state that exists more as an ideal and less as an achievable condition. Environmental factors, internal or external stimuli, continually disrupt homeostasis; an organism's present condition is a state of constant flux moving about a homeostatic point that is that organism's optimal condition for living.^[27] Factors causing an organism's condition to diverge too far from homeostasis can be experienced as stress. A life-threatening situation such as a major physical trauma or prolonged starvation can greatly disrupt homeostasis. On the other hand, an organism's attempt at restoring conditions back to or near homeostasis, often consuming energy and natural resources, can also be interpreted as stress.^[28] The brain cannot sustain an equilibrium under chronic stress; the accumulation of such an ever-deepening deficit is called chronic stress.^[13]

The ambiguity in defining this phenomenon was first recognized by Hans Selye (1907–1982) in 1926. In 1951 a commentator loosely summarized Selye's view of stress as something that "...in addition to being itself, was also the cause of itself, and the result of itself".^{[29][30]}

First to use the term in a biological context, Selye continued to define stress as "the non-specific response of the body to any demand placed upon it". Neuroscientists such as Bruce McEwen and Jaap Koolhaas believe that stress, based on years of empirical research, "should be restricted to conditions where an environmental demand exceeds the natural regulatory capacity of an organism".^[31] The brain cannot live in an harsh family environment, it needs some sort of stability between another brain. People who have reported being raised in harsh environments such as verbal and physical aggression have showed a more immune dysfunction and more metabolic dysfunction.^[13] Indeed, in 1995 Toates already defined stress as a "chronic state that arises only when defense mechanisms are either being chronically stretched or are actually failing,"^[32] while according to Ursin (1988) stress results from an inconsistency between expected events ("set value") and perceived events ("actual value") that cannot be resolved satisfactorily,^[33] which also puts stress into the broader context of cognitive-consistency theory.^[34]

Biological background

Stress can have many profound effects on the human biological systems.^[35] Biology primarily attempts to explain major concepts of stress using a stimulus-response paradigm, broadly comparable to how a psychobiological sensory system operates. The central nervous system (brain and spinal cord) plays a crucial role in the body's stress-related mechanisms. Whether one should interpret these mechanisms as the body's response to a stressor or embody the act of stress itself is part of the ambiguity in defining what exactly stress is.

The central nervous system works closely with the body's endocrine system to regulate these mechanisms. The sympathetic nervous system becomes primarily active during a stress response, regulating many of the body's physiological functions in ways that ought to make an organism more adaptive to its environment. Below there follows a brief biological background of neuroanatomy and neurochemistry and how they relate to stress.^[36]

Stress, either severe, acute stress or chronic low-grade stress may induce abnormalities in three principal regulatory systems in the body: serotonin systems, catecholamine systems, and the hypothalamic-pituitary-adrenocortical axis. Aggressive behavior has also been associated with abnormalities in these systems.^[37]

Biology of stress

The brain endocrine interactions are relevant in the translation of stress into physiological and psychological changes. The autonomic nervous system (ANS), as mentioned above, plays an important role in translating stress into a response. The ANS responds reflexively to both physical stressors (for example baroreception), and to higher level inputs from the brain.^[38]

The ANS is composed of the parasympathetic nervous system and sympathetic nervous system, two branches that are both tonically active with opposing activities. The ANS directly innervates tissue through the postganglionic nerves, which is controlled by preganglionic neurons originating in the intermediolateral cell column. The ANS receives inputs from the medulla, hypothalamus, limbic system, prefrontal cortex, midbrain and monoamine nuclei.^[39]



The activity of the sympathetic nervous system drives what is called the "fight or flight" response. The fight or flight response to emergency or stress involves mydriasis, increased heart rate and force contraction, vasoconstriction, bronchodilation, glycogenolysis, gluconeogenesis, lipolysis, sweating, decreased motility of the digestive system, secretion of the epinephrine and cortisol from the adrenal medulla, and relaxation of the bladder wall. The parasympathetic nervous response, "rest and digest", involves return to maintaining homeostasis, and involves miosis, bronchoconstriction, increased activity of the digestive system, and contraction of the bladder walls.^[38] Complex relationships between protective and vulnerability factors on the effect of childhood home stress on psychological illness, cardiovascular illness and adaption have been observed.^[40] ANS related mechanisms are thought to contribute to increased risk of cardiovascular disease after major stressful events.^[41]

The HPA axis is a neuroendocrine system that mediates a stress response. Neurons in the hypothalamus, particularly the paraventricular nucleus, release vasopressin and corticotropin releasing hormone, which travel through the hypophysial portal vessel where they travel to and bind to the corticotropin-releasing hormone receptor on the anterior pituitary gland. Multiple CRH peptides have been identified, and receptors have been identified on multiple areas of the brain, including the amygdala. CRH is the main regulatory molecule of the release of ACTH.^[42]

The secretion of ACTH into systemic circulation allows it to bind to and activate Melanocortin receptor, where it stimulates the release of steroid hormones. Steroid hormones bind to glucocorticoid receptors in the brain, providing negative feedback by reducing ACTH release. Some evidence supports a second long term feedback that is non-sensitive to cortisol secretion. The PVN of the hypothalamus receives inputs from the nucleus of the solitary tract, and lamina terminalis. Through these inputs, it receives and can respond to changes in blood.^[42]

The PVN innervation from the brain stem nuclei, particularly the noradrenergic nuclei stimulate CRH release. Other regions of the hypothalamus both directly and indirectly inhibit HPA axis activity. Hypothalamic neurons involved in regulating energy balance also influence HPA axis activity through the release of neurotransmitters such as neuropeptide Y, which stimulates HPA axis activity. Generally, the amygdala stimulates, and the prefrontal cortex and hippocampus attenuate, HPA axis activity; however, complex relationships do exist between the regions.^[42]

The immune system may be heavily influenced by stress. The sympathetic nervous system innervates various immunological structures, such as bone marrow and the spleen, allowing for it to regulate immune function. The adrenergic substances released by the sympathetic nervous system can also bind to and influence various immunological cells, further providing a connection between the systems. The HPA axis ultimately results in the release of cortisol, which generally has immunosuppressive effects. However, the effect of stress on the immune system is disputed, and various models have been proposed in an attempt to account for both the supposedly "immunodeficiency" linked diseases and diseases involving hyper activation of the immune system. One model proposed to account for this suggests a push towards an imbalance of cellular immunity(Th1) and humoral immunity(Th2). The proposed imbalance involved hyperactivity of the Th2 system leading to some forms of immune hypersensitivity, while also increasing risk of some illnesses associated with decreased immune system function, such as infection and cancer.^[7]

Effects of chronic stress

Chronic stress is a term sometimes used to differentiate it from acute stress. Definitions differ, and may be along the lines of continual activation of the stress response,^[43] stress that causes an allostatic shift in bodily functions,^[5] or just as "prolonged stress".^[44] For example, results of one study demonstrated that individuals who reported relationship conflict lasting one month or longer have a greater risk of developing illness and show slower wound healing. It can also reduce the benefits of receiving common vaccines.^[13] Similarly, the effects that acute stressors have on the immune system may be increased when there is perceived stress and/or anxiety due to other events. For example, students who are taking exams show weaker immune responses if they also report stress due to daily hassles.^[45] While responses to acute stressors typically do not impose a health burden on young, healthy individuals, chronic stress in older or unhealthy individuals may have long-term effects that are detrimental to health.^[46]

Immunological

Acute time-limited stressors, or stressors that lasted less than two hours, results in an up regulation of natural immunity and down regulation of specific immunity. This type of stress saw in increase in granulocytes, natural killer cells, IgA, Interleukin 6, and an increase in cell cytotoxicity. Brief naturalistic stressors elicit a shift from Th1 (cellular)



to Th2 (humoral) immunity, while decreased T-cell proliferation, and natural killer cell cytotoxicity. Stressful event sequences did not elicit a consistent immune response; however, some observations such as decreased T-Cell proliferation and cytotoxicity, increase or decrease in natural killer cell cytotoxicity, and an increase in mitogen PHA. Chronic stress elicited a shift toward Th2 immunity, as well as decreased interleukin 2, T cell proliferation, and antibody response to the influenza vaccine. Distant stressors did not consistently elicit a change in immune function.^[7] Another response to high impacts of chronic stress that lasts for a long period of time, is more immune dysfunction and more metabolic dysfunction. It is proven in studies that when continuously being in stressful situations, it is more likely to get sick. Also, when being exposed to stress, some claim that the body metabolizes the food in a certain way that adds extra calories to the meal, regardless of the nutritional values of the food.^[13]

Infectious

Some studies have observed increased risk of upper respiratory tract infection during chronic life stress. In patients with HIV, increased life stress and cortisol was associated with poorer progression of HIV.^[43] Also with an increased level of stress, studies have proven evidence that it can reactivate latent herpes viruses.^[47]

Chronic disease

A link has been suggested between chronic stress and cardiovascular disease.^[43] Stress appears to play a role in hypertension, and may further predispose people to other conditions associated with hypertension.^[48] Stress may precipitate abuse of drugs and/or alcohol.^[5] Stress may also contribute to aging and chronic diseases in aging, such as depression and metabolic disorders.^[49]

The immune system also plays a role in stress and the early stages of wound healing. It is responsible for preparing the tissue for repair and promoting recruitment of certain cells to the wound area.^[45] Consistent with the fact that stress alters the production of cytokines, Graham et al. found that chronic stress associated with care giving for a person with Alzheimer's disease leads to delayed wound healing. Results indicated that biopsy wounds healed 25% more slowly in the chronically stressed group, or those caring for a person with Alzheimer's disease.^[50]

Development

Chronic stress has also been shown to impair developmental growth in children by lowering the pituitary gland's production of growth hormone, as in children associated with a home environment involving serious marital discord, alcoholism, or child abuse.^[51] Chronic stress also has a lot of illnesses and health care problems other than mental that comes with it. Severe chronic stress for long periods of time can lead to an increased chance of catching illnesses such as diabetes, cancer, depression, heart disease and Alzheimer's disease.^[13] More generally, prenatal life, infancy, childhood, and adolescence are critical periods in which the vulnerability to stressors is particularly high.^{[52][53]} This can lead to psychiatric and physical diseases which have long term impacts on an individual.^[13]

Psychopathology

Chronic stress is seen to affect the parts of the brain where memories are processed through and stored. When people feel stressed, stress hormones get over-secreted, which affects the brain. This secretion is made up of glucocorticoids, including cortisol, which are steroid hormones that the adrenal gland releases, although this can increase storage of flashbulb memories it decreases long-term potentiation (LTP).^{[54][55]} The hippocampus is important in the brain for storing certain kinds of memories and damage to the hippocampus can cause trouble in storing new memories but old memories, memories stored before the damage, are not lost.^[56] Also high cortisol levels can be tied to the deterioration of the hippocampus and decline of memory that many older adults start to experience with age.^[55] These mechanisms and processes may therefore contribute to age-related disease, or originate risk for earlier-onset disorders. For instance, extreme stress (e.g. trauma) is a requisite factor to produce stress-related disorders such as post-traumatic stress disorder.^[6]

Chronic stress also shifts learning, forming a preference for habit based learning, and decreased task flexibility and spatial working memory, probably through alterations of the dopaminergic systems.^[39] Stress may also increase reward associated with food, leading to weight gain and further changes in eating habits.^[57] Stress may contribute to various disorders, such as fibromyalgia,^[58] chronic fatigue syndrome,^[59] depression,^[60] as well as other mental illnesses^[13] and functional somatic syndromes.^[61]



Psychological concepts

Eustress

Selye published in year 1975 a model dividing stress into eustress and distress.^[62] Where stress enhances function (physical or mental, such as through strength training or challenging work), it may be considered eustress. Persistent stress that is not resolved through coping or adaptation, deemed distress, may lead to anxiety or withdrawal (depression) behavior.

The difference between experiences that result in eustress and those that result in distress is determined by the disparity between an experience (real or imagined) and personal expectations, and resources to cope with the stress. Alarming experiences, either real or imagined, can trigger a stress response.^[63]

Coping

Responses to stress include adaptation, psychological coping such as stress management, anxiety, and depression. Over the long term, distress can lead to diminished health and/or increased propensity to illness; to avoid this, stress must be managed.

Stress management encompasses techniques intended to equip a person with effective coping mechanisms for dealing with psychological stress, with stress defined as a person's physiological response to an internal or external stimulus that triggers the fight-or-flight response. Stress management is effective when a person uses strategies to cope with or alter stressful situations.

There are several ways of coping with stress,^[64] such as controlling the source of stress or learning to set limits and to say "no" to some of the demands that bosses or family members may make.

A person's capacity to tolerate the source of stress may be increased by thinking about another topic such as a hobby, listening to music, or spending time in a wilderness.

A way to control stress is first dealing with what is causing the stress if it is something the individual has control over. Other methods to control stress and reduce it can be: to not procrastinate and leave tasks for the last minute, do things you like, exercise, do breathing routines, go out with friends, and take a break. Having support from a loved one also helps a lot in reducing stress.^[55]

One study showed that the power of having support from a loved one, or just having social support, lowered stress in individual subjects. Painful shocks were applied to married women's ankles. In some trials women were able to hold their husband's hand, in other trials they held a stranger's hand, and then held no one's hand. When the women were holding their husband's hand, the response was reduced in many brain areas. When holding the stranger's hand the response was reduced a little, but not as much as when they were holding their husband's hand. Social support helps reduce stress and even more so if the support is from a loved one.^[55]

Cognitive appraisal

Lazarus^[65] argued that, in order for a psychosocial situation to be stressful, it must be appraised as such. He argued that cognitive processes of appraisal are central in determining whether a situation is potentially threatening, constitutes a harm/loss or a challenge, or is benign.

Both personal and environmental factors influence this primary appraisal, which then triggers the selection of coping processes. Problem-focused coping is directed at managing the problem, whereas emotion-focused coping processes are directed at managing the negative emotions. Secondary appraisal refers to the evaluation of the resources available to cope with the problem, and may alter the primary appraisal.

In other words, primary appraisal includes the perception of how stressful the problem is and the secondary appraisal of estimating whether one has more than or less than adequate resources to deal with the problem that affects the overall appraisal of stressfulness. Further, coping is flexible in that, in general, the individual examines the effectiveness of the coping on the situation; if it is not having the desired effect, s/he will, in general, try different strategies.^[66]



Assessment

Health risk factors

Both negative and positive stressors can lead to stress. The intensity and duration of stress changes depending on the circumstances and emotional condition of the person with it (Arnold. E and Boggs. K. 2007). Some common categories and examples of stressors include:

- Sensory input such as pain, bright light, noise, temperatures, or environmental issues such as a lack of control over environmental circumstances, such as food, air and/or water quality, housing, health, freedom, or mobility.
- Social issues can also cause stress, such as struggles with conspecific or difficult individuals and social defeat, or relationship conflict, deception, or break ups, and major events such as birth and deaths, marriage, and divorce.
- Life experiences such as poverty, unemployment, clinical depression, obsessive compulsive disorder, heavy drinking,^[67] or insufficient sleep can also cause stress. Students and workers may face performance pressure stress from exams and project deadlines.
- Adverse experiences during development (e.g. prenatal exposure to maternal stress,^{[68][69]} poor attachment histories,^[70] sexual abuse)^[71] are thought to contribute to deficits in the maturity of an individual's stress response systems. One evaluation of the different stresses in people's lives is the Holmes and Rahe stress scale.

General adaptation syndrome

Physiologists define stress as how the body reacts to a stressor - a stimulus, real or imagined. Acute stressors affect an organism in the short term; chronic stressors over the longer term. The general adaptation syndrome (GAS), developed by Hans Selye, is a profile of how organisms respond to stress; GAS is characterized by three phases: a nonspecific mobilization phase, which promotes sympathetic nervous system activity; a resistance phase, during which the organism makes efforts to cope with the threat; and an exhaustion phase, which occurs if the organism fails to overcome the threat and depletes its physiological resources.^[72]

Stage 1

Alarm is the first stage, which is divided into two phases: the shock phase and the antishock phase.^[73]

- Shock phase: During this phase, the body can endure changes such as hypovolemia, hypoosmolarity, hyponatremia, hypochloremia, hypoglycemia—the stressor effect. This phase resembles Addison's disease. The organism's resistance to the stressor drops temporarily below the normal range and some level of shock (e.g. circulatory shock) may be experienced.
- Antishock phase: When the threat or stressor is identified or realized, the body starts to respond and is in a state of alarm. During this stage, the locus coeruleus and sympathetic nervous system activate the production of catecholamines including adrenaline, engaging the popularly-known fight-or-flight response. Adrenaline temporarily provides increased muscular tonus, increased blood pressure due to peripheral vasoconstriction and tachycardia, and increased glucose in blood. There is also some activation of the HPA axis, producing glucocorticoids (cortisol, aka the S-hormone or stress-hormone).

Stage 2

Resistance is the second stage. During this stage, increased secretion of glucocorticoids intensifies the body's systemic response. Glucocorticoids can increase the concentration of glucose, fat, and amino acid in blood. In high doses, one glucocorticoid, cortisol, begins to act similarly to a mineralocorticoid (aldosterone) and brings the body to a state similar to hyperaldosteronism. If the stressor persists, it becomes necessary to attempt some means of coping with the stress. The body attempts to respond to stressful stimuli, but after prolonged activation, the body's chemical resources will be gradually depleted, leading to the final stage.

Stage 3

The third stage could be either exhaustion or recovery:

- Recovery stage follows when the system's compensation mechanisms have successfully overcome the stressor effect (or have completely eliminated the factor which caused the stress). The high glucose, fat and amino acid levels in blood prove useful for anabolic reactions, restoration of homeostasis and regeneration of cells.



- Exhaustion is the alternative third stage in the GAS model. At this point, all of the body's resources are eventually depleted and the body is unable to maintain normal function. The initial autonomic nervous system symptoms may reappear (panic attacks, muscle aches, sore eyes, difficulty breathing, fatigue, heartburn, high blood pressure, and difficult time sleeping, etc.). If stage three is extended, long-term damage may result (prolonged vasoconstriction results in ischemia which in turn leads to cell necrosis), as the body's immune system becomes exhausted, and bodily functions become impaired, resulting in decompensation.

The result can manifest itself in obvious illnesses, such as general trouble with the digestive system (e.g. occult bleeding, melena, constipation/obstipation), diabetes, or even cardiovascular problems (angina pectoris), along with clinical depression and other mental illnesses.

Stress relief

A person can stop stress from being overwhelming by exercising when symptoms of stress become apparent, reflecting on their day (thinking about what they accomplished, not what they have not), and speaking to a therapist about their concerns. The parasympathetic nervous system is responsible for calming down the body's arousal and helping a person relax.

History in research

The current usage of the word stress arose out of Hans Selye's 1930s experiments. He started to use the term to refer not just to the agent but to the state of the organism as it responded and adapted to the environment. His theories of a universal non-specific stress response attracted great interest and contention in academic physiology and he undertook extensive research programs and publication efforts.^[74]

While the work attracted continued support from advocates of psychosomatic medicine, many in experimental physiology concluded that his concepts were too vague and unmeasurable. During the 1950s, Selye turned away from the laboratory to promote his concept through popular books and lecture tours. He wrote for both non-academic physicians and, in an international bestseller entitled *Stress of Life*, for the general public.

A broad biopsychosocial concept of stress and adaptation offered the promise of helping everyone achieve health and happiness by successfully responding to changing global challenges and the problems of modern civilization. Selye coined the term "eustress" for positive stress, by contrast to distress. He argued that all people have a natural urge and need to work for their own benefit, a message that found favor with industrialists and governments.^[74] He also coined the term stressor to refer to the causative event or stimulus, as opposed to the resulting state of stress.

Selye was in contact with the tobacco industry from 1958 and they were undeclared allies in litigation and the promotion of the concept of stress, clouding the link between smoking and cancer, and portraying smoking as a "diversion", or in Selye's concept a "deviation", from environmental stress.^[75]

From the late 1960s, academic psychologists started to adopt Selye's concept; they sought to quantify "life stress" by scoring "significant life events", and a large amount of research was undertaken to examine links between stress and disease of all kinds. By the late 1970s, stress had become the medical area of greatest concern to the general population, and more basic research was called for to better address the issue. There was also renewed laboratory research into the neuroendocrine, molecular, and immunological bases of stress, conceived as a useful heuristic not necessarily tied to Selye's original hypotheses. The US military became a key center of stress research, attempting to understand and reduce combat neurosis and psychiatric casualties.^[74]

The psychiatric diagnosis post-traumatic stress disorder (PTSD) was coined in the mid-1970s, in part through the efforts of anti-Vietnam War activists and the Vietnam Veterans Against the War, and Chaim F. Shatan. The condition was added to the Diagnostic and Statistical Manual of Mental Disorders as posttraumatic stress disorder in 1980.^[76] PTSD was considered a severe and ongoing emotional reaction to an extreme psychological trauma, and as such often associated with soldiers, police officers, and other emergency personnel. The stressor may involve threat to life (or viewing the actual death of someone else), serious physical injury, or threat to physical or psychological integrity. In some cases, it can also be from profound psychological and emotional trauma, apart from any actual physical harm or threat. Often, however, the two are combined.



By the 1990s, "stress" had become an integral part of modern scientific understanding in all areas of physiology and human functioning, and one of the great metaphors of Western life. Focus grew on stress in certain settings, such as workplace stress, and stress management techniques were developed. The term also became a euphemism, a way of referring to problems and eliciting sympathy without being explicitly confessional, just "stressed out". It came to cover a huge range of phenomena from mild irritation to the kind of severe problems that might result in a real breakdown of health. In popular usage, almost any event or situation between these extremes could be described as stressful.

The American Psychological Association's 2015 Stress In America Study^[77] found that nationwide stress is on the rise and that the three leading sources of stress were "money", "family responsibility", and "work".

III. RESULTS

Chronic stress is the physiological or psychological response induced by a long-term internal or external stressor.^[1] The stressor, either physically present or recollected, will produce the same effect and trigger a chronic stress response.^[1] There is a wide range of chronic stressors, but most entail relatively prolonged problems, conflicts and threats that people encounter on a daily basis.^[2] And several chronic stressors, including "neighbourhood environment, financial strain, interpersonal stress, work stress and caregiving.", have been identified as associated with disease and mortality.^[3]

Stress responses, such as the fight or flight response, is fundamental. The complexity of the environment means that it is constantly changing. To navigate the surroundings, we, therefore, need a system that is capable of responding to perceived threatening and harmful situations.^[4] The stress response system thus has its role as an adaptive process to restore homeostasis in the body by actively making changes.^{[4][5]} For instance, the body will involve in an endocrine system response in which corticosteroids are released. This process is known as allostasis, first proposed by Sterling and Eyer (1988).^[6] Research has provided considerable evidence to illustrate the stress response as a short-term adaptive system.^[4] The immediate effects of stress hormones are beneficial in a particular short-term situation. The system is arguably a protective defense against threats^[5] and usually does not pose a health risk.^[7]

However, the problem arises when there is a persistent threat. First-time exposure to a stressor will trigger an acute stress response in the body; however, repeated and continuous exposure causes the stressor to become chronic.^[4] McEwen and Stellar (1993) argued there is a "hidden cost of chronic stress to the body over long time periods".^[8] That is often known as allostatic load. Chronic stress can cause the allostasis system to overstimulate in response to the persistent threat.^[7] And such overstimulation can lead to an adverse impact. To illustrate, the long-term exposure to stress creates a high level of these hormones. This may lead to high blood pressure (and subsequently heart disease), damage to muscle tissue, inhibition of growth,^[9] and damage to mental health. Chronic stress also relates directly to the functionality and structure of the nervous system, thereby influencing affective and physiological responses to stress.^[3] These subsequently can result in damage to the body.

Historical development

Hans Selye (1907–1982), known as the "father of stress",^[10] is credited with first studying and identifying stress. He studied stress effects by subjecting lab mice to various physical, antigenic, and environmental stressors, including excessive exercise, starvation, and extreme temperatures. He determined that regardless of the type of stress, the mice exhibited similar physical effects, including thymus gland deterioration and the development of ulcers.^[10] Selye then developed his theory of general adaptive syndrome (GAS) in 1936, known today as "stress response". He concluded that humans exposed to prolonged stress could also experience hormonal system breakdown and subsequently develop conditions such as heart disease and elevated blood pressure.^[11] Selye considered these conditions to be "diseases of adaptation", or the effects of chronic stress caused by heightened hormonal and chemical levels.^[10] His research on acute and chronic stress responses introduced stress to the medical field.^[10]

Physiology

Animals exposed to distressing events over which they have no control respond by releasing corticosteroids.^[5] The sympathetic branch of the nervous system is activated, also releasing epinephrine and norepinephrine.^[9]

Stress has a role in humans as a method of reacting to difficult and possibly dangerous situations. The "fight or flight" response when one perceives a threat helps the body exert energy to fight or run away to live another day. This



response is noticeable when the adrenal glands release epinephrine, causing the blood vessels to constrict and heart rate to increase. In addition, cortisol is another hormone that is released under stress and its purpose is to raise the glucose level in the blood. Glucose is the main energy source for human cells and its increase during time of stress is for the purpose of having energy readily available for over active cells.^[12]

Chronic stress is also known to be associated with an accelerated loss of telomeres in most but not all studies.^{[13][14]}

Response

Different types of stressors, the timing (duration) of the stressors, and genetic inherited personal characteristics all influence the response of the hypothalamic–pituitary–adrenal axis to stressful situations. The hypothalamic–pituitary–thyroid axis and other endocrine axes are also involved in the stress response. Those with a wealthy background have a stronger response to stress than those in the lower strata.^[15]

Resilience in chronic stress is defined as the ability to deal and cope with stresses in a healthy manner.^[16] There are six categories of resources that affect an individual's coping resources.^[16]

- Personality (Empathy/Sympathy, Commitment, Optimism)
- Ego-related traits (Self-esteem, Self-confidence, Self-control)
- Social Connectivity (Social network, Available support)
- Cultural Views (Religious beliefs, Moral beliefs)
- Behavioral Skills (Social Skills, Response to emotions management)
- Other (Socioeconomic status, General Health)

Symptoms

People may experience anxiety,^[17] depression,^[18] sadness,^[17] anger,^[17] irritability,^[17] social isolation, headache,^[17] menstrual problems,^[19] abdominal pain, back pain and difficulty concentrating.^[20]

Impacts

Chronic stress causes the body to stay in a constant state of alertness, despite being in no danger. Extensive studies have provided evidence of the association between "chronic stressors and physical health outcomes"^[3] Take caregiving as an example. A review of 37 studies has suggested that dementia caregivers subjected to chronic stress are more susceptible to diseases.^[21] Although the connection between stress and health requires continuous research,^[7] the existing findings have suggested the potential link between the two.

Brain

A primary target of stress is the brain. When exposed to stress, it serves as the centre to interpret the stressors and determine the appropriate behavioural and psychological responses.^[7] Therefore, exposure to chronic stress will have a direct impact on brain function.^[7] For instance, chronic stress inhibits neuron growth inside the hippocampus and prefrontal cortex.^[5] The neuronal atrophy in these two structures can lead to hypertrophy in amygdala, responsible for anxiety and stress.^[22] In turn, this will lead to an increase of fear and aggression and impairment in learning ability. Memory and decision-making can also be negatively affected.^[22] Additionally, chronic stress can suppresses neural pathways active in cognition and decision-making, speeding up aging. Also, being chronically stressed worsens the damage caused by a stroke and can lead to sleep disorders due to the overexposure of cortisol.^[23]

Other systems

The alterations in brain function can have a more extensive effect on other body systems. Since chronic stress is due to a wide variety of environmental, nutritional, chemical, pathological, or genetic^[24] factors, a wide range of physiological systems can be damaged.^[25] Prolonged stress can disturb the immune, digestive, cardiovascular, sleep, and reproductive systems.^[17] For example, it was found that:



- Chronic stress reduces resistance of infection and inflammation, and might even cause the immune system to attack itself.^[26]
- Stress responses can cause atrophy of muscles and increases in blood pressure.^[27] When the stress is chronic, it will lead to sustained elevated blood pressure, impairing the heart functions.^[7]

Measurement

The advancement of the scientific study of stress will require better and more accurate measurement of the stress process. However, the complexity of stress has added difficulties to establish consistent and thorough measures.^[3]

Chronic stress measures primarily comprise epidemiological studies that look at current experiences within specific life domains. Despite its significance, cumulative stress exposure from past experiences is often compromised due to practical difficulties such as limitations on time.^[3] Another potential issue with measuring chronic stress is the validity. In particular for retrospective studies, the validity of the measure is strongly dependent on the accuracy of recollection. Biases and memory decay can contribute to underreporting. Similarly for prospective studies, the validity of the measures will depend on the accuracy of report and detection by the respondent and monitoring agencies.^[3]

In regards to measuring stress responses, it is important to note that it can vary from person.^[28] It is suggested that individual and environmental contextual factors, such as genes and culture, will contribute to one's vulnerability and resilience to stress. By contrast, protective factors, such as a supportive environment, can strengthen resilience.^[3] The two factors are important as they influence the brain's judgment of the stressors. In addition, the interactions of different stressors will lead to cumulative stress exposure. These all together contribute to the differential stress responses.^[3] The subjective differences thus may pose challenges for researchers.

Owing to the complexity of measuring stress processes over the lifespan, many researchers decided on measuring more assessable aspects of stress. That includes: "historic exposure, current exposure and responses across different time scale".^[3] In many cases, chronic stress is measured by its duration. Yet, there can be considerable variations in the criteria.^[3] For example, the Life Events and Difficulties Schedule by Brown and Harris (1978)^[29] proposed that chronic difficulty is characterised by a 4-week-cut-off. Alternatively, other researchers may define chronicity with a shorter or longer period. The implication is that studies on chronic stress may not necessarily have a uniform scale for comparison.

IV. CONCLUSION

Social stress is stress that stems from one's relationships with others and from the social environment in general. Based on the appraisal theory of emotion, stress arises when a person evaluates a situation as personally relevant and perceives that they do not have the resources to cope or handle the specific situation.^{[1][2]}

The activation of social stress does not necessarily have to occur linked to a specific event, the mere idea that the event may occur could trigger it. This means that any element that takes a subject out of their personal and intimate environment could become a stressful experience. This situation makes them socially incompetent individuals.^[3]

There are three main categories of social stressors.^[4] Life events are defined as abrupt, severe life changes that require an individual to adapt quickly (ex. sexual assault, sudden injury).^[5] Chronic strains are defined as persistent events which require an individual to make adaptations over an extended period of time (ex. divorce, unemployment).^[5] Daily hassles are defined as minor events that occur, which require adaptation throughout the day (ex. bad traffic, disagreements).^[5] When stress becomes chronic, one experiences emotional, behavioral, and physiological changes that can put one under greater risk for developing a mental disorder and physical illness.^[6]

Humans are social beings by nature, as they typically have a fundamental need and desire to maintain positive social relationships.^[7] Thus, they usually find maintaining positive social ties to be beneficial. Social relationships can offer nurturance, foster feelings of social inclusion, and lead to reproductive success.^[8] Anything that disrupts or threatens to disrupt their relationships with others can result in social stress. This can include low social status in society or in particular groups, giving a speech, interviewing with potential employers, caring for a child or spouse with a chronic illness, meeting new people at a party, the threat of or actual death of a loved one, divorce, and discrimination.^{[9][10][11][12]} Social stress can arise from one's micro-environment (e.g., family ties) and macro-



environment (e.g., hierarchical societal structure). Social stress is typically the most frequent type of stressor that people experience in their daily lives and affects people more intensely than other types of stressors.^[13]

Definitions

Researchers define social stress and social stressors in various ways. Wadman, Durkin, and Conti-Ramsden (2011) defined social stress as "the feelings of discomfort or anxiety that individuals may experience in social situations, and the associated tendency to avoid potentially stressful social situations".^[14] Ilfield (1977) defined social stressors as "circumstances of daily social roles that are generally considered problematic or undesirable".^[15] Dormann and Zapf (2004) defined social stressors as "a class of characteristics, situations, episodes, or behaviors that are related to psychological or physical strain and that are somehow social in nature".^[16]

Measurement

Social stress is typically measured through self-report questionnaires. In the laboratory, researchers can induce social stress through various methods and protocols.

Self-reports

There are several questionnaires used to assess environmental and psychosocial stress. Such self-report measures include the Test of Negative Social Exchange,^[17] the Marital Adjustment Test,^[18] the Risky Families Questionnaire,^[19] the Holmes–Rahe Stress Inventory,^[20] the Trier Inventory for the Assessment of Chronic Stress,^[21] the Daily Stress Inventory,^[22] the Job Content Questionnaire,^[23] the Perceived Stress Scale,^[24] and the Stress and Adversity Inventory.^[25]

In addition to self-report questionnaires, researchers can employ structured interview assessments. The Life Events and Difficulties Schedule (LEDS) is one of the most popular instruments used in research.^{[26][27]} The purpose of this type of measure is to probe the participant to elaborate on their stressful life events, rather than answering singular questions.^[26] The UCLA Life Stress Interview (LSI), which is similar to the LEDS, includes questions about romantic partners, closest friendships, other friendships, and family relationships.^[28]

Induction

In rodent models, social disruption and social defeat are two common social stress paradigms. In the social disruption paradigm, an aggressive rodent is introduced into a cage housing male rodents that have already naturally established a social hierarchy. The aggressive "intruder" disrupts the social hierarchy, causing the residents social stress.^[29] In the social defeat paradigm, an aggressive "intruder" and another non-aggressive male rodent fight.^[30]

In human research, the Trier Social Stress Task (TSST) is widely used to induce social stress in the laboratory. In the TSST, participants are told that they have to prepare and give a speech about why they would be a great candidate for their ideal job. The experimenter films the participant while they give the speech and informs the participant that a panel of judges will evaluate that speech. After the public speaking component, the experimenter administers a mathematics task that involves counting backwards by certain increments. If the participant makes a mistake, the experimenter prompts them to start again.^[31] The threat of negative evaluation is the social stressor. Researchers can measure the stress response by comparing pre-stress salivary cortisol levels and post-stress salivary cortisol levels.^[31] Other common stress measures used in the TSST are self-report measures like the State-Trait Anxiety Inventory and physiological measures like heart rate.^[32]

In a laboratory conflict discussion, couples identify several specific areas of conflict in their relationship. The couples then pinpoint a couple topics to discuss later on in the experiment (ex. finances, child-rearing). Couples are told to discuss the conflict(s) for 10 minutes while being videotaped.^[33]

Brouwer and Hogervorst (2014) designed the Sing-a-Song Stress Test (SSST) to induce stress in the laboratory setting. After viewing neutral images with subsequent 1-minute rest periods, the participant is instructed to sing a song after the next 1-minute rest period is complete. Researchers found that skin conductance and heart rate are significantly higher during the post-song message interval than the previous 1-minute intervals. The stress levels are comparable to that induced in the Trier Social Stress Task.^[34] In 2020, a systematic review about the TSST provided several guidelines to standardize the use of the TSST across studies.^[35]



Statistical indicators of stress in large groups

A statistical indicator of stress, simultaneous increase of variance and correlations, was proposed for diagnosis of stress and successfully used in physiology and finance.^{[36][37]} Its applicability for early diagnosis of social stress in large groups was demonstrated by the analysis of crises. It was examined in the prolonged stress period preceding the 2014 Ukrainian economic and political crisis. There was a simultaneous increase in the total correlation between the 19 major public fears in the Ukrainian society (by about 64%) and also in their statistical dispersion (by 29%) during the pre-crisis years.^[38]

Mental health

Research has consistently demonstrated that social stress increases risk for developing negative mental health outcomes.^[39] One prospective study asked over fifteen hundred Finnish employees whether they had "considerable difficulties with [their] coworkers/superiors/inferiors during the last 6 months, 5 years, earlier, or never".^[40] Information on suicides, hospitalizations due to psychosis, suicidal behavior, alcohol intoxication, depressive symptoms, and medication for chronic psychiatric disorders was then gathered from the national registries of mortality and morbidity. Those who had experienced conflict in the workplace with coworkers or supervisors in the last five years were more likely to be diagnosed with a psychiatric condition.^[40]

Research on the LGBT population has suggested that people who identify as LGBT suffer more from mental health disorders, such as substance abuse and mood disorders, compared to those who identify as heterosexual.^[41] Researchers deduce that the LGBT people's higher risk of mental health issues derives from their stressful social environments. Minority groups can face high levels of stigma, prejudice, and discrimination on a regular basis, therefore leading to the development of various mental health disorders.^[41]

Depression

Risk for developing clinical depression significantly increases after experiencing social stress,^[42] depressed individuals often experience interpersonal loss before becoming depressed.^{[43][44]} One study found that depressed individuals who had been rejected by others had developed depression about three times more quickly than those who had experienced stress not involving social rejection.^[45] Several studies have suggested that unemployment roughly doubles the risk of developing depression.^{[46][47][48][49][50]} In non-clinically depressed populations, people with friends and family who make too many demands, criticize, and create tension and conflict tend to have more depressive symptoms.^{[51][52][53]} Conflict between spouses leads to more psychological distress and depressive symptoms, especially for wives.^[54] In particular, unhappy married couples are 10–25 times more at risk for developing clinical depression. Similarly, social stress arising from discrimination is related to greater depressive symptoms.^{[41][57]} In one study, African-Americans and non-Hispanic whites reported on their daily experiences of discrimination and depressive symptoms. Regardless of race, those who perceived more discrimination had higher depressive symptoms.^[57] Posselt and Lipson found, in 2016, that undergraduates had a 37% higher chance of developing depression if they perceived their classroom environments as highly competitive.^[58]

Anxiety

The biological basis for anxiety disorders is rooted in the consistent activation of the stress response.^[59] Fear, which is the defining emotion of an anxiety disorder, occurs when someone perceives a situation (a stressor) as threatening.^[60] This activates the stress response. If a person has difficulty regulating this stress response, it may activate inappropriately. Stress can therefore arise when a real stressor is not present or when something isn't actually threatening. This can lead to the development of an anxiety disorder (panic attacks, social anxiety, OCD, etc.).^{[59][61]} Social anxiety disorder is defined as the fear of being judged or evaluated by others, even if no such threat is actually present.^[62]

Research shows a connection between social stress, such as traumatic life events and chronic strains, and the development of anxiety disorders.^{[63][64]} A study that examined a subpopulation of adults, both young and middle-age, found that those who had diagnosed panic disorder in adulthood also experienced sexual abuse during childhood.^[65] Children who experience social stressors, such as physical and psychological abuse, as well as parental loss, are also more at risk for developing anxiety disorders during adulthood than children who did not experience such stressors.^[64]



In 2016, an analysis of 40,350 undergraduates from 70 institutions by Posselt and Lipson found that they had a 69% higher chance of developing anxiety if they perceived their classroom environments as highly competitive.^[58]

Long-term effects

Social stress occurring early in life can have psychopathological effects that develop or persist in adulthood. One longitudinal study found that children were more likely to have a psychiatric disorder (e.g. anxiety, depressive, disruptive, personality, and substance use disorders) in late adolescence and early adulthood when their parents showed more maladaptive child-rearing behaviors (e.g., loud arguments between parents, verbal abuse, difficulty controlling anger toward the child, lack of parental support or availability, and harsh punishment). Child temperament and parental psychiatric disorders did not explain this association.^[66] Other studies have documented the robust relationships between children's social stress within the family environment and depression, aggression, antisocial behavior, anxiety, suicide, and hostile, oppositional, and delinquent behavior.^[67]

Relapse and recurrence

Social stress can also exacerbate current psychopathological conditions and compromise recovery. For instance, patients recovering from depression or bipolar disorder are two times more likely to relapse if there is familial tension.^[68] People with eating disorders are also more likely to relapse if their family members make more critical comments, are more hostile, or are over-involved.^[69] Similarly, outpatients with schizophrenia or schizoaffective disorder show greater psychotic symptoms if the most influential person in their life is critical^[70] and are more likely to relapse if their familial relationships are marked by tension.^[69]

In regard to substance abuse, cocaine-dependent individuals report greater cravings for cocaine following exposure to a social stressor.^[71] Traumatic life events and social stressors can also trigger the exacerbation of the symptoms of mental health disorders. Socially phobic children who experience a stressful event can become even more avoidant and socially inactive.^[72]

Physical health

Mortality

Social status, a macro-social stressor, is a robust predictor of death. In a study of over 1700 British civil servants, socioeconomic status (SES) was inversely related to mortality. Those with the lowest SES have worse health outcomes and greater mortality rates than those with the greatest SES.^[74] Other studies have replicated this relationship between SES and mortality in a range of diseases, including infectious, digestive, and respiratory diseases.^{[75][76]} A study examining the link between SES and mortality in the elderly found that education level, household income, and occupational prestige were all related to lower mortality in men. In women, however, only household income was related to lower mortality.^[77]

Similarly, social stressors in the micro-environment are also linked to increased mortality. A seminal longitudinal study of nearly 7,000 people found that socially isolated people had greater risk of dying from any cause.^[78]

Social support, which is defined as "the comfort, assistance, and/or information one receives through formal or informal contacts with individuals or groups",^[79] has been linked to physical health outcomes. Research shows the three aspects of social support, available attachments, perceived social support, and frequency of social interactions, can predict mortality thirty months after assessment.^[80]

Morbidity

Social stress also makes people more sick. People who have fewer social contacts are at greater risk for developing illness, including cardiovascular disease.^[81] The lower one's social status, the more likely he or she is to have a cardiovascular, gastrointestinal, musculoskeletal, neoplastic, pulmonary, renal, or other chronic diseases. These links are not explained by other, more traditional risk factors such as race, health behaviors, age, sex, or access to health care.^[82]

In one laboratory study, researchers interviewed participants to determine whether they had been experiencing social conflicts with spouses, close family members and friends. They then exposed the participants to the common cold



virus and found that participants with conflict-ridden relationships were two times more likely to develop a cold than those without such social stress.^[83] Social support, especially in terms of support for socioeconomic stressors, is inversely related to physical morbidity.^[84] A study that investigated social determinants of health in an urban slum in India found that social exclusion, stress, and lack of social support are significantly related to illnesses, such as hypertension, coronary heart disease, and diabetes.^[85]

Students who are being bullied may show signs of depression, impaired academic achievement, impaired quality of sleep, and anxiety disorders.^[86]

Long-term effects

Exposure to social stress in childhood can also have long-term effects, increasing risk for developing diseases later in life. In particular, adults who were maltreated (emotionally, physically, sexually abused or neglected) as children report more disease outcomes, such as stroke, heart attack, diabetes, and hypertension^[87] or greater severity of those outcomes.^[88] The Adverse Childhood Experiences study (ACE), which includes over seventeen thousand adults, also found that there was a 20% increase in likelihood for experiencing heart disease for each kind of chronic familial social stressor experienced in childhood, and this was not due to typical risk factors for heart disease such as demographics, smoking, exercise, adiposity, diabetes, or hypertension.^[89]

Recovery and other disease

Social stress has also been tied to worse health outcomes among patients who already have a disease. Patients with end-stage renal disease faced a 46% increased risk for mortality when there was more relationship negativity with their spouse even when controlling for severity of disease and treatment.^[90] Similarly, women who had experienced an acute coronary event were three times more likely to experience another coronary event if they experienced moderate to severe marital strain. This finding remained even after controlling for demographics, health behaviors, and disease status.^[91]

With regard to HIV/AIDS, stress may affect the progression from the virus to the disease.^[92] Research shows the HIV-positive males who have more negative life events, social stress, and lack of social support progress to a clinical AIDS diagnosis more quickly than HIV-positive males who do not have as high levels of social stress.^[93] For HIV-positive females, who have also contracted the HSV virus, stress is a risk factor for genital herpes breakouts.^[94]

Physiology

Social stress leads to a number of physiological changes that mediate its relationship to physical health.^[95] In the short term, the physiological changes outlined below are adaptive, as they enable the stressed organism to cope better. Dysregulation of these systems or repeated activation of them over the long-term can be detrimental to health.^[96]

Sympathetic nervous system

The sympathetic nervous system (SNS) becomes activated in response to stress. Sympathetic arousal stimulates the medulla of the medulla to secrete epinephrine and norepinephrine into the blood stream, which facilitates the fight-or-flight response.^[97] Blood pressure, heart rate, and sweating increase, veins constrict to allow the heart to beat with more force, arteries leading to muscles dilate, and blood flow to parts of the body not essential for the fight or flight response decreases. If stress persists in the long run, then blood pressure remains elevated, leading to hypertension and atherosclerosis, both precursors to cardiovascular disease.^[95]

A number of animal and human studies have confirmed that social stress increases risk for negative health outcomes by increasing SNS activity. Studies of rodents show that social stress causes hypertension and atherosclerosis.^[97] Studies of non-human primates also show that social stress clogs arteries.^{[98][99]} Although humans cannot be randomized to receive social stress due to ethical concerns, studies have nevertheless shown that negative social interactions characterized by conflict lead to increases in blood pressure and heart rate.^[100] Social stress stemming from perceived daily discrimination is also associated with elevated levels of blood pressure during the day and a lack of blood pressure dipping at night.^{[101][102]}



Hypothalamic-pituitary adrenocortical axis (HPA)

In response to stress, the hypothalamus releases corticotropin-releasing hormone (CRH), stimulating the anterior pituitary to release adrenocorticotropic hormone (ACTH). ACTH then stimulates the adrenal cortex to secrete glucocorticoids, including cortisol.^[59] Social stress can lead to adverse health outcomes by chronically activating the HPA axis or disrupting the HPA system.^[95] There are a number of studies that link social stress and indications of a disrupted HPA axis; for instance, monkey infants neglected by their mothers show prolonged cortisol responses following a challenging event.^[103]

In humans, abused women exhibit a prolonged elevation in cortisol following a standardized psychosocial laboratory stressor compared to those without an abuse history.^[104] Maltreated children show higher morning cortisol values than non-maltreated children.^[105] Their HPA systems also fail to recover after a stressful social interaction with their caregiver.^[106] Over time, low-SES children show progressively greater output of cortisol.^{[107][108]} Although these studies point to a disrupted HPA system accounting for the link between social stress and physical health, they did not include disease outcomes. Nevertheless, a dysfunctional HPA response to stress is thought to increase risk for developing or exacerbating diseases such as diabetes, cancer, cardiovascular disease, and hypertension.^[109]

Inflammation

Inflammation is an immune response that is critical to fighting infections and repairing injured tissue. Although acute inflammation is adaptive, chronic inflammatory activity can contribute to adverse health outcomes, such as hypertension,^[110] atherosclerosis,^[111] coronary heart disease,^{[112][113]} depression,^[114] diabetes,^[115] and some cancers.^{[116][117]}

Research has elucidated a relationship between different social stressors and cytokines (the markers of inflammation). Chronic social stressors, such as caring for a spouse with dementia, lead to greater circulating levels of cytokine interleukin-6 (IL-6),^[118] whereas acute social stress tasks in the laboratory have been shown to elicit increases in proinflammatory cytokines.^[119] Similarly, when faced with another type of social stress, namely social evaluative threat, participants showed increases in IL-6 and a soluble receptor for tumor necrosis factor- α .^{[120][121][122]} Increases in inflammation may persist over time, as studies have shown that chronic relationship stress has been tied to greater IL-6 production 6 months later^[123] and children reared in a stressful family environment marked by neglect and conflict tend to show elevated levels of C-reactive protein, a marker of IL-6, in adulthood.^[124]

Interactions of physiological systems

There is extensive evidence that the above physiological systems affect one another's functioning. For instance, cortisol tends to have a suppressive effect on inflammatory processes, and proinflammatory cytokines can also activate the HPA system.^[125] Sympathetic activity can also upregulate inflammatory activity.^{[126][127]} Given the relationships among these physiological systems, social stress may also influence health indirectly via affecting a particular physiological system that in turn affects a different physiological system.

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