



## Accumulated Stress Presents Range of Health Risks

*Although small amounts of stress can yield benefits such as increased alertness and an improved ability to concentrate, an accumulation of stress caused by daily frustration and major life events has been associated with numerous health problems. In studies of flight crewmembers, stress has been associated with pilot error.*

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*FSF Editorial Staff*

Stress is the body's response to demands, pressures or changes. Causes of stress (stressors) can be major life events, such as a death in the family or a new job; ongoing aggravations, such as a chronic illness or an inflexible work schedule; or the annoyances of daily life, such as traffic jams or — to crewmembers — exposure to aircraft engine noise and vibration during flight.

Each encounter with a stressor causes a complex reaction that begins with a signal from the brain to the autonomic nervous system, which controls involuntary body functions such as breathing, heart rate and blood pressure. The signal from the brain also triggers the release of hormones — primarily adrenaline and noradrenaline (also known as epinephrine and norepinephrine) from the adrenal glands — into the bloodstream to prepare the body to cope with a perceived danger.<sup>1</sup>

In response to the brain's signal, the breathing rate increases to allow the body to take in more oxygen, and the heart rate increases, blood pressure rises, and some blood vessels narrow, directing blood to the muscles and brain and away from the skin and other organs not involved in the response to the perceived danger. Some blood cells (platelets) become "stickier" (more adhesive) to prevent excessive bleeding in the event of injury. Fats and glucose (sugar) are released from storage sites to provide energy, and muscles become tense.



Long ago, the stress response was vital in fighting off enemies and running from predatory beasts (the "fight-or-flight" response). However, the stress response typically occurs today in situations that are considerably less than life-threatening; repeated activation of the stress response, rather than providing the impetus to fight or to flee danger, may contribute to serious health problems.

The body "does a poor job of distinguishing between life-threatening events and day-to-day stressful situations," says a Harvard Medical School report on stress.<sup>2</sup> "Anger or anxiety triggered by less momentous sources of stress, such as financial fears or traffic jams, doesn't find a quick physical release and tends to build up as the day rolls on. Anticipation of potential problems, such as anxiety brought on by government warnings of terrorist activity or more personal worry stemming from awaiting medical [test] results, adds to the turmoil. The physical and psychological symptoms of stress — a clenched jaw, shakiness, anxious feelings — compound this, creating a negative, self-perpetuating cycle" (see "Symptoms of Stress," page 2).

### Stress Can Have Benefits

Stress cannot be avoided, and the right amount of stress is considered beneficial; it helps people stay alert, focused on the task at hand and interested in the world around them.

## Symptoms of Stress

Symptoms of stress are numerous and differ from one person to another. Common symptoms include the following:<sup>1,2,3</sup>

### Physical symptoms

- Tense muscles, especially in the neck and shoulders;
- Headache or backache;
- Stomachache, nausea, vomiting, diarrhea or constipation;
- Tiredness or difficulty sleeping;
- Unusually rapid heartbeat;
- Shakiness or excessive sweating;
- Weight loss or weight gain;
- Clenched jaw or clenched teeth;
- Fingernail-biting;
- Sighing or changes in breathing patterns; and,
- Decreased interest in sex.

### Emotional symptoms

- Frustration, irritability or anger;
- Depression or anxiety;
- Nervousness; and,
- Boredom or apathy.

### Behavioral symptoms

- Abuse of alcohol, drugs or other substances;
- Marital problems;
- Binge eating; and,
- Self-destructive behavior.

### Cognitive symptoms

- Forgetfulness, preoccupation and difficulty concentrating;
- Indecisiveness;
- Work mistakes and loss of productivity;
- Excessive worry;
- Decrease in creativity; and,
- Loss of sense of humor.♦

— FSF Editorial Staff

### Notes

1. Harvard Medical School. *Stress Control: Techniques for Preventing and Easing Stress*. Boston, Massachusetts, U.S.: Harvard Health Publications, 2002.
2. Mount Sinai Medical Center. *Stress*. <[www.mssm.edu](http://www.mssm.edu)>.
3. The Cleveland Clinic. *Keys for Managing Daily Stress*. <[www.clevelandclinic.org](http://www.clevelandclinic.org)>.

Individual stress responses differ; some people become stressed in response to minor daily occurrences while others cope with virtually everything with no outward indication of stress. Genetics may be partly responsible for the differences.

“The genes that control the stress response keep most people on a fairly even keel, only occasionally priming the body for ‘fight or flight,’” the Mayo Clinic said.<sup>3</sup> “Overactive or underactive stress responses may stem from slight differences in these genes.

“Life experiences may increase your sensitivity to stress as well. Strong stress reactions sometimes can be traced to early environmental factors. People who were exposed to extreme stress as children tend to be particularly vulnerable to stress as adults.”

For pilots and other crewmembers, even under ordinary conditions, the flight environment includes stressors such as noise, vibration, decreased barometric pressure, and accelerative forces. Fatigue and altered sleep-wake cycles also may be factors, especially for crewmembers on flights that span several time zones.<sup>4</sup>

## The ‘Wrong Stuff’

Moreover, a 2000 study found that the captain’s personality type also influences the amount of stress on the flight deck.<sup>5</sup>

During the study, 24 three-member flight crews performed line operations, including emergency operations, in a Boeing 737

simulator; afterward, they were tested for perceived stress. The crews that committed the fewest errors reported experiencing less stress than crews that committed more errors. The crews with the fewest errors typically were led by captains who were categorized in the report on the study as possessing the “right stuff” (for example, they were described as “active, warm, confident, competitive and preferring excellence and challenges”).

Other captains were categorized as possessing either the “wrong stuff” (for example, they were described as arrogant, authoritarian, emotionally invulnerable, impatient, irritable, preferring excellence and challenging tasks, and having limited interpersonal warmth/sensitivity) or “no stuff” (for example, they were described as “unassertive [and] self-subordinating, [with] average interpersonal [skills], low self-confidence, low desire for challenging tasks and low desire for excellence”).

### ‘General Adaptation Syndrome’

Researchers have studied stress for many decades, but it was not until the 1940s that Hans Selye, an endocrinologist at McGill University in Montreal, Quebec, Canada, developed the “general adaptation syndrome” (stress syndrome) theory. According to this theory, an encounter with stress develops in three stages:<sup>6,7</sup>

- The *alarm reaction* includes an initial shock, in which an individual’s resistance is lowered, followed by a countershock, in which the individual’s defense mechanisms are activated;
- *Resistance* is the stage of maximum adaptation; if the adaptation succeeds, the individual’s body functions return to normal; and,
- If the stressor persists or if the defense mechanisms fail, the result is *exhaustion*, in which the defense mechanisms collapse.

Later research found that one or more sources of stress — either at home or at work — in combination with personality traits such as competitiveness and impatience (typically described as elements of a “type A” personality), may lead to a variety of “stress manifestations” such as physical illness or mental illness or dissatisfaction with a job or a marriage.<sup>8</sup>

For pilots — who have been identified as having one of the most stressful occupations — on-the-job stress may occur when operational demands exceed the pilot’s physical capacity and/or mental capacity. In these situations, researchers have assumed that pilots with “an overload of information” have an increased risk of stress-related performance errors.<sup>9,10</sup>

### Study Links Stress, Pilot Error

A 1985 study of more than 700 U.S. Naval aviators who were involved in major aircraft mishaps found that the 381 aviators who were “causally involved” were more likely to have had problems with interpersonal relationships — one of the symptoms often displayed by someone who is not coping well with stress — than were the 356 aviators who “had no culpability in their mishaps.”<sup>11</sup>

A report on the study said that the data showed that aviators in the causally involved group also “are more likely to be poor leaders, to be less mature and stable, to lack an adequate sense of their own limitations, and to lack professionalism and the ability to assess troublesome situations. In addition, they are more likely to have financial problems, to have trouble with interpersonal relationships, to have trouble with superiors and peers, and to drink to excess or to have recently changed their alcohol intake. They are more likely to have recently become engaged to be married, be making a major career decision and to have undergone a recent personality change. ...

“It also appears that there are certain personality factors that render some aviators more susceptible to the adverse effects of stress, as evidenced by their higher human-error-mishap potential. Such factors as a lack of maturity, no sense of their own limitations and an inability to assess potentially troublesome situations are more prevalent among those who are subsequently assigned fault in an aircraft mishap.”

### Home Stress Adds to Job Stress

Researchers have studied the effects on pilot performance of both job-related stress and stress at home.

A study based on a questionnaire administered to 19 U.S. Coast Guard helicopter pilots in 2000 found that, as stress at home increased, stress on the job also increased.<sup>12</sup>

“Pilots under stress at home felt tired and worried ... at work,” said the U.S. Federal Aviation Administration (FAA) report on the study.<sup>13</sup> “Pilots indicated that as the home stress experienced at work increased, self-perceptions of flying performance decreased, especially the sense of ‘not feeling ahead of the game.’”

Authors of the FAA report said that their findings were that the pilots surveyed identified their primary coping strategies as a stable spousal relationship, a stable home life and the ability to talk with an understanding partner.

“The first warning signs of home-based psychological distress may be more evident in the daily work activities rather than in cockpit error,” the report said. “If support services and management recognized the early warning signs at work that were symptomatic of home-based stress, they could provide

timely intervention before the occurrence of more serious flying performance decrements.”

## Results of Stress

Researchers estimate that more than 40 percent of adults experience adverse health effects associated with stress and that more than 75 percent of visits to physicians’ offices are for stress-related problems.<sup>14</sup>

These problems can be relatively minor, such as clenched teeth or tiredness, but they also can be life-threatening. For example, stress is associated with heart disease and diseases involving the immune system, as well as accidents and suicides. Stress also can exacerbate a number of medical conditions, including gastrointestinal disorders and asthma; some medical specialists believe that stress can be a factor in the development of cancer.

The Harvard Medical School report said that the widespread implications of stress include direct effects, “such as ... long-term suppression of the immune system, causing stickier-than-normal platelets, slowing wound-healing, or constricting major blood vessels, and indirect effects on behavior. Overeating, smoking, drinking too much, not exercising enough and engaging in other risky behavior can certainly take a toll.”<sup>15</sup>

More specifically, stress influences heart disease in several ways:<sup>16</sup>

- The stress-related release of adrenaline and other hormones into the blood increases the amount of cholesterol manufactured by the body. (For example, one study found that the blood cholesterol levels of medical students increased by about 25 percent during their final exam period.) Elevated blood cholesterol levels contribute to atherosclerosis, the narrowing of blood vessels, which can lead to chest pain, heart attack or stroke;
- Stress-related increases in blood pressure can contribute to hypertension (high blood pressure), which — by placing extra pressure on the blood vessels — can result in injury to the vessels and can force more cholesterol into the artery walls, increasing the risk of atherosclerosis; and,
- The stickier-than-normal blood platelets, which speed blood clotting, also increase the risk that a clot will form within a blood vessel — a problem that could increase the risk of heart attack, especially in an individual with atherosclerosis.

Chronic stress reduces the effectiveness of the body’s immune system. The immune system typically responds to an infection by releasing substances to fight the infection; after the infection subsides, the adrenal glands release the hormone cortisol to stop the body’s infection-fighting response. During periods of

stress, cortisol is among the hormones that remain elevated; at the elevated level, cortisol can suppress the immune system, preventing a response to infection.<sup>17</sup>

However, in some cases, stress causes the immune system to overreact. The result is an increased risk of autoimmune diseases, such as lupus, in which the immune system attacks healthy cells. Stress also can exacerbate the symptoms of existing autoimmune diseases.

Some medical specialists believe that chronic stress — because of its effects on the immune system — may influence the development of cancer by restricting the body’s ability to stop the spread of cancer cells. Their theory is that cancerous changes in the body’s cells occur often and for many reasons but that the immune system destroys these altered cells; when the immune system cannot do its job, the cancer cells spread.<sup>18</sup>

Stress is one of several factors that can contribute to gastrointestinal ailments. For example, stress can cause an increase in the secretion of gastric acid, which can lead to heartburn. Studies have found that a combination of stress and other psychological factors and physical factors can cause gastrointestinal pain and abnormal contractions in the intestines that often are symptoms of irritable bowel syndrome. Another study found that people who considered their lives stressful were about twice as likely to have ulcers as people who did not believe that they were experiencing stress. Earlier findings identified a bacterium as the primary cause of ulcers, but some medical specialists now believe that stress could delay the healing of ulcers.<sup>19</sup>

Stress is one of dozens of factors that can trigger an asthma attack. The stress response causes small airways in the lungs to contract (tighten), interfering with the flow of air into and out of the lungs. Some specialists also believe that a person’s exposure to intense stress when very young can contribute to the development of asthma.<sup>20</sup>

## How to Cope

People cope with stress in many ways. Specialists say that the first step in coping is to identify stressors and the symptoms that occur after exposure to those stressors.

Other recommendations involve development or maintenance of a healthy lifestyle, with adequate rest and exercise, a healthy diet, limited consumption of alcoholic drinks and avoidance of tobacco products.

More specific recommendations include the following:<sup>21,22</sup>

- Remove the stressor, or change your way of thinking about the stressor;
- Seek training in common stress-reduction techniques such as meditation, yoga, tai chi; and biofeedback-assisted relaxation. Some people also find relief in prayer;

- Perform progressive muscle-relaxation or deep-breathing exercises (see “Relax ...”);
- Talk to someone else about the situation. Psychiatrists, psychologists and licensed clinical social workers all have training to help people cope with situations that trigger a stress response;
- Visit a massage therapist, use a hot tub, or take a bath or shower;
- Exercise or play sports;
- Go outdoors; or,
- Listen to music, read a book, write in a journal or write a list, engage in a hobby or other enjoyable activity.

Major life events and the frustrations of daily living result in an accumulation of stress that has been associated with

### Relax ...

Progressive muscle relaxation and deep breathing, also known as relaxed breathing or abdominal breathing, are techniques designed to help manage stress.

To perform progressive muscle relaxation, assume a comfortable position, with support for your head and neck. Close your eyes and tense the muscles in the hands and arms to 25 percent to 50 percent of maximum tension; maintain the tension for a few seconds as you continue to breathe, then release the tension and focus your attention on the contrast between tense muscles and relaxed muscles. Repeat the muscle-tensing and tension-releasing process once for each of six other muscle groups: muscles in the face; in the neck and shoulders; in the stomach and abdomen; in the buttocks and thighs; in the calves of the legs; and in the toes. Sit quietly for several minutes and focus your attention on the feeling of relaxation. Slowly open your eyes.<sup>1</sup>

To perform deep breathing, inhale through your nose while mentally counting to 10. As you inhale, your upper abdomen — not your chest — should rise. Exhale slowly and completely, again mentally counting to 10. Repeat between five times and 10 times.<sup>2</sup>◆

— FSF Editorial Staff

### Notes

1. Mount Sinai School of Medicine. *Stress*. <[www.mssm.edu](http://www.mssm.edu)>. The technique is one suggested by the American Heart Association.
2. Mayo Clinic. *Stress: Why You Have It and How It Hurts Your Health*. <[www.mayoclinic.com](http://www.mayoclinic.com)>.

numerous health problems, as well as with pilot error. With a healthy lifestyle, an understanding of what causes stress and selection of appropriate coping mechanisms, people can learn to alleviate their stress.◆

### Notes

1. Harvard Medical School. *Stress Control: Techniques for Preventing and Easing Stress*. Boston, Massachusetts, U.S.: Harvard Health Publications, 2002.
2. Ibid.
3. Mayo Clinic. *Stress: Why You Have It and How It Hurts Your Health*. <[www.mayoclinic.com](http://www.mayoclinic.com)>.
4. Rayman, Russell B. “Aircrew Health and Maintenance.” Chapter 14 in *Fundamentals of Aerospace Medicine*, Second Edition (DeHart, Roy L., editor). Baltimore, Maryland, U.S.: Williams & Wilkins, 1996.
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11. Alkov, Robert A.; Gaynor, John A.; Borowsky, Michael S. “Pilot Error as a Symptom of Inadequate Stress Coping.” *Aviation, Space, and Environmental Medicine* Volume 56 (March 1985).
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17. Mayo Clinic.
18. Harvard Medical School.
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21. Mayo Clinic.
22. Mount Sinai School of Medicine. *Stress*. <[www.mssm.edu](http://www.mssm.edu)>.



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