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# STRESS AND ILLNESS

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## Glossary

- Adherence** The degree to which patients follow the medical recommendations of practitioners.
- Health behavior** Activity undertaken by people who believe they are healthy in order to prevent future health problems.
- Illness behavior** Activity of people who feel ill with the purpose of determining the state of their health or finding a remedy.
- Immune system** The organs and structures that protect the body against harmful substances such as bacteria and viruses.
- Neuroendocrine system** An array of glands controlled by the nervous system that secrete hormones into the bloodstream.
- Stress** The condition that results when person/environment transactions lead the individual to perceive a discrepancy between the demands of a situation and the person's resources.
- Sympathetic nervous system** A division of the autonomic nervous system that enables the body to mobilize and expend energy during physical and emotional arousal.
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**THE RELATIONSHIP** between stress and illness is the focus of a good deal of research performed in the field of health psychology. Health psychology is devoted to understanding the psychological factors associated with health and illness. One specific area of interest is determining the psychological factors related to the etiology of disease. Stress is one of the factors often studied that many people believe is related to health and disease. In fact, substantial

evidence exists for associations between increased stress and reports of symptoms of disease as well as use of health services. Provocative evidence also exists for associations between increased stress and verified organic illness. In this chapter then, we will discuss stress, and specifically, focus on the mechanisms through which it might be possible for stress to influence health and illness.

## I. DEFINING STRESS AND ILLNESS

### A. What Is Stress?

Almost everyone has experienced the surge of adrenaline that comes with something sudden and unexpected, like when a speeding car almost hits us. One often hears people say they feel "stressed" because they are overworked, or they have "too much stress" in their lives. What is stress? Is it the adrenaline surge? The overwork? The way we feel emotionally? According to Lazarus and Folkman, two psychologists who have been important in developing a psychological theory of stress, stress is defined neither by an environmental event nor by a person's physiologic response to it. Rather, stress is defined by the person's *perception* of the environmental event. This perception involves the appraisal of potential harms, threats, and challenges posed by the event, as well as the individual's perceived ability to deal (or cope) with the harms, threats, and challenges. Thus, stress arises when a person appraises a situation as threatening or otherwise demanding, perceives that it is important to respond, and does not have an appropriate coping response immediately available. When individuals experience stress, or make a stress appraisal, they also characteristically experience negative emotions (e.g., anxiety, depression), changes in physiology, and changes in behavior patterns that increase risk for disease and mortality. [See STRESS.]

## B. The Role of Social and Personal Resources

Different people respond to the same stressful event in different ways. Why might this be so? A number of investigators interested in stress and illness propose that the relationship between stress and illness varies with both the personal and social characteristics of the individual. That is, differences in social support systems, skills, attitudes, beliefs, and personality characteristics render some persons relatively protected from stress-induced illness and others relatively susceptible. Social and personal characteristics are thought to influence whether stressful events result in psychological distress (negative emotions), although they may also influence manifestations of distress such as physiologic or behavioral responses. These social and personal characteristics are commonly referred to as stress-buffering resources because they are presumed to protect or buffer people from the pathogenic effects of stress. For example, perceptions of availability of stress-responsive social support provides protection from stress-related symptomatology. People who believe that others will provide aid in times of stress are likely to believe that either they or someone they know will have the resources to meet the demands of the stressor. Personality characteristics or personal resources that have been found to be important in coping with negative events include feelings of control over one's life and self-esteem. People who have feelings of control and high self-esteem are likely to believe that they have the resources to meet the demands that require the strengths they possess. Believing that resources are available may lead a potentially stressful event to be interpreted as a challenge rather than a threat. [See CONTROL; SELF-ESTEEM.]

The *Type A behavior pattern*, or Type A personality, is a personal characteristic that has been the focus of much research in the context of coronary heart disease. In contrast to those attributes just described, *not* being Type A appears to protect people from the effects of stress. Type A people are involved in a constant struggle to do more and more things in less and less time, and are sometimes quite hostile or aggressive. People with Type A behavior pattern always seem to be under the pressure of time, and live a life characterized by competitiveness. They are always striving for achievement, are hasty, impatient, and very tense. When under pressure, most people exhibit some behaviors that are similar to this Type A pattern, but Type A individuals exhibit this behavior very often, even during

an objectively fun and relaxing situation. Thus, in contrast to having feelings of control or high self-esteem, where stress-buffering results from the *presence* of the personal characteristic, stress-buffering effects associated with the Type A characteristic may be attributable to its *absence*. This is due to the fact that persons with Type A behavior pattern seem more likely to appraise situations as stressful and to cope inappropriately once a stress appraisal is made. Thus, Type B people (people who do not show Type A characteristics) may have a health advantage simply because they are not Type A. Rather, they are able to relax, do not worry about time, are less hostile and less concerned with accomplishments, and are more content with themselves. [See TYPE A-TYPE B PERSONALITIES.]

In sum, there are a number of social and personal characteristics or resources that influence how people respond to stressful events. Some resources, such as social support, control, and self-esteem may lessen the effects of stressors. Other resources, such as the Type A behavior pattern may accentuate the effects of stressors.

## C. What Is Illness?

When the terms "illness" or "disease" are used in health psychology, they generally refer to a variety of health conditions, including infectious disease (colds, flu, sexually transmitted diseases), autoimmune disease (e.g., lupus, rheumatoid arthritis), cancer, hypertension, coronary heart disease, gastrointestinal disorders (e.g., ulcers, inflammatory bowel disease), asthma, and chronic headaches. Also included in these terms are medical conditions resulting from accidents and other kinds of trauma.

Research in health psychology, however, uses specific indicators of illness and disease. Typically, researchers assess disease symptomatology using one (or both) of two approaches. First, disease symptomatology can be quantified using observable *signs* of illness (e.g., rashes, swelling, blood pressure, pulse). Trained clinicians usually identify and document these observable signs. Second, disease symptomatology can be quantified using *symptoms*, which are not observable but are reported by an individual (e.g., chest pain, headaches, stomachaches). Although these self-reports may reflect underlying disease pathology, they may also reflect influences of stress on thought processes and self-perceptions that are not associated with disease. That is, people may report symptoms or illness epi-

sodes without actually experiencing clinical illness, or may not report symptoms or illness episodes when they do have clinical disease. The pathways we discuss below primarily involve those where tissue damage or disease occurs. Symptom reporting that is not based in organic disease is discussed later (see section on Illness Behavior).

#### D. Summary

Stress arises when a person appraises a situation as threatening or demanding, perceives that it is important to respond, and does not have an appropriate coping response immediately available. A number of social and personal characteristics or resources seem able to either lessen or accentuate the effects of stressors. The specific mechanisms through which stress is linked to physical illness, however, remain to be clarified. At a general level, it is assumed that stress leads to negative psychological states such as anxiety or depression. In turn, stress, as well as these negative psychological states, is thought to influence physical health, either through a direct effect on biological processes that influence susceptibility to disease or through behavioral patterns that increase risk for disease and mortality. These biological and behavioral pathways are discussed below.

## II. PATHWAYS LINKING STRESS TO ILLNESS

Figure 1 illustrates a model of the pathways through which stress is able to influence illness. The model suggests that stress can result in negative emotional

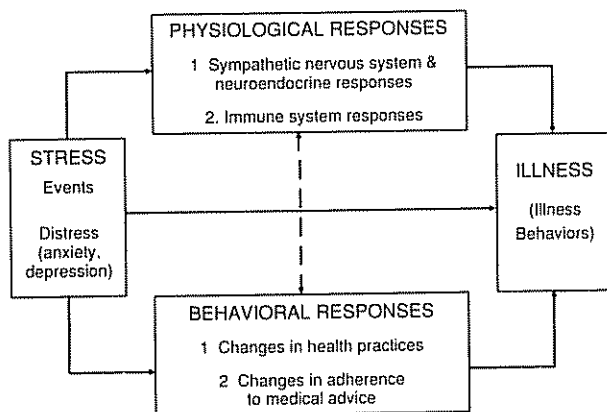


FIGURE 1 Pathways linking stress to illness

states (e.g., anxiety, depression). Next, either stress or these negative psychological states lead to physiologic responses and behavioral responses, either of which is capable of resulting in illness. For brevity, the model indicates paths moving in only one causal direction, from stress to illness. It is possible, however, for the direction to be reversed. In some cases, for example, illness might lead to further stress.

#### A. Physiological Responses

Two kinds of physiological reactions in response to stress are indicated in Figure 1: sympathetic nervous system and neuroendocrine responses, and immune system responses. In both cases, stress may be related to physiologic responses either directly or through behavioral changes resulting from stress. Here, we focus on the direct physiologic link. The behavioral link is discussed later.

##### 1. Central Nervous System and Neuroendocrine Responses

Stress appraisals affect the nervous system and the endocrine (hormonal) system. The part of the nervous system that controls the internal organs is the autonomic nervous system (ANS). The ANS has two parts: the *sympathetic nervous system*, which mobilizes the body's resources during emotional, stressful, and emergency situations (e.g., increases heart rate); and the *parasympathetic nervous system*, which generally restores the body's energies (e.g., decreases heart rate). Thus, stress appraisals following an environmental event may cause the sympathetic nervous system to signal the heart to beat faster, the energy system to make glucose available, and the blood flow to be shifted toward the muscles that will be needed to fight or flee.

The sympathetic nervous system also affects the endocrine system. It signals the adrenal medulla (a gland on the kidney) to secrete two hormones, epinephrine and norepinephrine. These hormones, more commonly known as adrenaline and noradrenaline, are part of a family of hormones called catecholamines. These hormones enter the blood, travel throughout the body, and increase the general level of arousal. [See HORMONES AND BEHAVIOR.]

The second important part of the endocrine system is the hypothalamic-pituitary-adrenocortical axis. The pituitary, which is controlled by the hypothalamus, is a gland located in the base of the brain near the hypothalamus. The hypothalamus signals the pituitary to secrete adrenocorticotrophic hormone

(ACTH). ACTH stimulates the adrenal cortex (a gland on the kidney next to the adrenal medulla) to secrete corticosteroids. The most important of these for humans is cortisol. Cortisol has an anti-inflammatory effect, providing the body with a defense against swelling from injuries that might be sustained during a fight or flight. Because the endocrine system involves the release of hormones into the blood, it is slower to respond, but has longer lasting effects, than the ANS response. [See HYPOTHALAMUS.]

Thus, the physiological responses in the context of stress are very complex. In short, when someone is threatened or challenged, the sympathetic division of the ANS rouses them from a resting state and stimulates the adrenal medulla to produce epinephrine and norepinephrine. The pituitary releases ACTH, which in turn affects the adrenal cortex. Corticosteroid release prepares the body to resist the potential effects of stress, and even to cope with injury by the release of cortisol. The sympathetic nervous system activation is rapid, as is all neural transmission, whereas the action of the neuroendocrine system is slower. Together, the two systems form the most well-documented physiological responses to stress.

How might sympathetic nervous system arousal or the release of epinephrine, norepinephrine, or corticosteroids lead to illness? One route is through their effect on the immune system, and this is discussed later. Another route is through their effect on the cardiovascular system. For example, an intensely stressful situation may result in extremely high levels of arousal, which can cause the heart to beat erratically or quickly, which may lead, in turn, to cardiac arrest or sudden death in a person with pre-existing heart disease. In addition, chronically high levels of epinephrine, norepinephrine, and corticosteroids appear to increase the growth of plaques (fatty patches) on artery walls. This condition, called atherosclerosis, narrows the inside diameter of the arteries. As the plaques harden, the narrowing and hardening of the arteries increase the blood pressure of the cardiovascular system. Less oxygen is allowed to reach the heart muscle, causing pain (angina) for the individual, and in some cases, muscle death (i.e., heart attack or myocardial infarction). In this context, it is interesting to note that people with the Type A behavior pattern show a heightened vulnerability to developing atherosclerosis and other coronary heart diseases. People with Type A behavior pattern are also more likely to show an increased epinephrine and norepinephrine response when sub-

jected to environmental challenge and have higher blood levels of cortisol in such situations. This is an example of the way a personal characteristic might exacerbate the effects of stress on physiologic processes.

## 2. Immune System Responses

The immune system protects people from disease-causing microorganisms and other harmful materials (antigens). Cells of the immune system (i.e., white blood cells) circulate throughout the body in the blood and are also located in various organs of the body, including the bone marrow, thymus, lymph nodes, and spleen. There are a number of different kinds of white blood cells, but those most important for this discussion are lymphocytes. Several different types of lymphocytes exist, including natural killer, T, and B cells.

A variety of ways to test the integrity of the immune system exist. For example, some tests simply assess the number of specific cell types or the quantity of specific substances circulating in the blood. One substance often quantified is the amount of antibody in circulation. Antibodies are substances produced by white blood cells (B lymphocytes) when a specific antigen invades the body. Once the antibodies are produced, they attach to the antigen, mark it for destruction by other white blood cells, and prevent it from causing infections.

Another popular test of the immune system is to determine how well specific kinds of white blood cells are functioning. One functional test assesses "lymphocyte proliferative response." In this test white blood cells are incubated for several days with substances that cause them to divide (proliferate). More proliferation is thought to reflect better white blood cell (primarily T and B lymphocyte) functioning. Proliferation is important because when an antigen invades the body, immune cells must divide to increase their numbers before they can successfully eliminate the antigen. Another functional test assesses "natural killer cell cytotoxic activity." In this test white blood cells are incubated for several hours with tumor cells, and the effectiveness of the immune cells (natural killer cells) in killing tumor cells (i.e., their cytotoxicity) is determined. More killing is thought to reflect better natural killer cell functioning. The killing potential of natural killer cells is important because they are one of the fastest responders of the immune system in the fight against viruses and tumor cells.

Many studies have been conducted to determine the relation between stress and the immune system

in humans. Studies have investigated the effects of stressors as diverse as medical school examinations, bereavement, divorce, unemployment, and caregiving of a relative with Alzheimer's disease. In general, these studies find that stress is related to changes in both the numbers and quantities of substances in blood, as well as changes in the functioning of the immune cells. Thus, in the context of these kinds of stressors, antibody levels change, as do the number of white blood cells circulating in blood. Moreover, stress is associated with relatively large decreases in both measures of cellular immune function (i.e., lymphocyte proliferative response and natural killer cell cytotoxic activity).

A body of research has also explored connections between negative psychological states (e.g., anxiety and depression) and immune system variables. This research suggests that depressed and anxious mood states are associated with decreased white blood cell function (lymphocyte proliferative response and natural killer cell cytotoxic activity). Negative mood states are also related to changes in the numbers of immune system cells and quantities of substances circulating in blood. Moreover, it appears that the body's ability to produce antibody to an antigen is related to the level of anxiety individuals report—the more anxious someone is, the less antibody they produce after they are injected with the antigen. [See ANXIETY AND FEAR; DEPRESSION.]

How could stress alter the immune system? Both physiologic and behavioral pathways are plausible. In the case of physiologic mechanisms (behavioral pathways are described below), stress may influence the immune system because some sympathetic nervous system nerves end on the organs of immune system. In fact, a number of direct pathways linking the sympathetic nervous system to the immune system have been identified. This is important because neurotransmitters released from nervous system fibers (like norepinephrine) can influence immune cells directly. Stress may also influence the immune system through neuroendocrine pathways (i.e., release of more far-reaching hormones). A wide range of hormones released under stress have been implicated in influencing the immune system. Examples include epinephrine, norepinephrine, and cortisol, as well as growth hormone, prolactin, and the natural opiates ( $\beta$ -endorphin and enkephalin). At a cellular level, these hormones have been shown to be able to affect immune cells, because there are receptors on white blood cells that allow hormones to attach to and to affect the immune cells. Blood levels

of these hormones are also related to immune functioning. For example, acute increases in blood levels of cortisol and epinephrine are related to decreases in the number of lymphocytes in circulation. Immune cell function (lymphocyte proliferative response and natural killer cell cytotoxic activity) also decreases with acute increases in the blood levels of cortisol and epinephrine.

Although both functional and quantitative measures of the immune system are altered by stress, interpreting these changes with respect to health is difficult. The health consequences of changes in the quantitative immune parameters, such as numbers of lymphocytes circulating in blood, have not been determined in otherwise healthy populations. Even though decreased natural killer cell cytotoxic activity has been implicated in certain human diseases (e.g., progression of cancer, chronic viral infection, autoimmune diseases), the direct health consequences of a decrease in natural killer cell cytotoxic activity have not been established. A decreased lymphocyte proliferative response is associated with increased levels of mortality and an increased number of hospitalizations among the elderly. There appears to be no relation, though, between the decreased lymphocyte proliferative responses and mortality or hospitalization due to specific disease entities that are clearly mediated by the immune system. At this point, therefore, it is difficult to outline the implications that stress-induced immune alterations have for health.

### B. Behavioral Responses

Two kinds of behavioral responses to stress are indicated in Figure 1: changes in health practices and changes in adherence to medical advice. Changes in behavior in the face of stress can be seen in many upsetting situations. For example, when the spouse of an elderly person dies, lifestyle, habits, and routines are often disrupted. Thus, meals might become haphazard and less healthful, sleep might be more irregular, and more alcohol might be consumed. These changes might be especially problematic if, for example, the surviving person was supposed to be following a strict medical program for his own health condition (e.g., diabetes, heart disease). Thus, stress can influence health by increasing the frequency of unhealthful behaviors, by decreasing the frequency of healthful behaviors, or by disrupting needed and prescribed healthful patterns and regimens. The pathways through which these behav-

ioral responses, in turn, can affect illness include neuroendocrine or immune processes. Behavioral responses can also have more direct effects on health or illness, for example, if someone does not take their medication in the way that was suggested by their physician.

### 1. Changes in Health Practices

One often hears people saying that they are attempting to lead a healthy lifestyle, "keep fit," or "stay in shape." There are a variety of behaviors that people engage in for the purpose of staying fit. These activities, or health behaviors, include exercising, eating a healthful diet, sleeping regularly, avoiding alcohol, cigarettes, and other illicit drugs, engaging in breast self-examination, wearing seat belts, and having regular dental checkups. Research shows, however, that people who experience high levels of stress tend to perform behaviors that increase their risk of becoming ill or injured. For example, stressed people tend to consume more alcohol, cigarettes, and coffee than people who experience less stress. Thus, it is assumed that persons' psychological responses to stress lead them to engage in unhealthful practices such as cigarette smoking, excessive alcohol consumption, poor diet, and lack of rest and exercise.

Engaging in these unhealthful behaviors as a result of stress, or not engaging in healthful behaviors because of stress, may then result in disease or trauma. For example, there is a well-documented relation between smoking and the development of lung cancer. Cigarette smoking has also been linked to coronary heart disease, strokes, ulcers, infectious diseases, and periodontal disease. Excessive alcohol consumption is also linked to a variety of organic diseases, including those of the liver, cardiovascular system, specific cancers, as well as to bacterial infections. In addition, failing to engage in a regular program of exercise has been linked to coronary heart disease as well as osteoporosis. Exercise also has been reported to increase feelings of self-esteem, as well as alleviate feelings of anxiety and depression—effects that might help to prevent a stress appraisal from occurring in the first place. Changes in health practices due to stress may also influence the duration or severity of disease by directly affecting disease-involved tissue. For example, if an individual with a cold increases the number of cigarettes smoked daily because they are under stress, nasal and lung tissues will become more inflamed and irritated.

In addition, behavioral factors, such as alcohol use and carelessness, probably play a role in the relatively high accident rates of people under stress. Studies have found that children and adults who experience high levels of stress are more likely to suffer accidental injuries at home, in sports activities, on the job, and while driving a car than individuals under less stress. A simple example would be an accident that happened because someone was driving while they were distracted by thinking about a stressful occurrence. Another example involves traumatic injury, that is, stress may lead to alcohol consumption, which may lead to careless or fast driving, which can then lead to injury in an automobile accident.

Finally, in the context of infectious disease, behavioral changes under stress may also influence susceptibility to infection by influencing whether and for how long persons are exposed to infectious agents (e.g., viruses). For example, stressed persons often engage in social coping, that is, they draw on the resources of their social networks. Increased interaction with others results in greater probability of exposure to infectious agents and consequent infection. Other behaviors that may be more likely when an individual is experiencing stress, for example, unsafe sexual practices or poor hygienic practices, could also increase exposure to infectious agents.

### 2. Changes in Adherence to Medical Advice

Adherence refers to the extent to which a person's behavior (in terms of taking medications, following diets, or executing lifestyle changes) coincides with medical or health advice. Thus, adherence can be viewed in specific terms (e.g., taking medications) as well as in more general terms (e.g., maintaining healthy lifestyle practices). For some individuals, maintaining a healthy lifestyle or practicing a daily regimen is a medical necessity rather than a way of "keeping fit." For example, it is critical that a person who is diagnosed with cancer not smoke, just as it is necessary that a person with insulin-dependent diabetes monitor their blood glucose levels and inject insulin on a regular and prescribed basis. In these and other cases, adherence to a medical regimen is very important, if not life-saving.

The average rate of patient nonadherence to medical advice across a variety of conditions is about 40%. That is, two of every five patients fail to follow the advice of their physicians regarding a desirable

medical program. Nonadherence can take many forms, all of which are more likely to occur when an individual is experiencing stress. For example, patients may fail to take their medication as directed, may not show up for a recommended appointment, may skip or stop doing rehabilitation exercises, or may "cheat a little" in following a specific diet or other lifestyle change that was advised. Moreover, each of these forms of nonadherence can itself have many faces. In failing to take medication as directed, for example, persons might omit some doses, use a drug for the wrong reasons, take medication in the wrong amount or at the wrong time, or discontinue the drug before the prescribed course of therapy ends.

Adherence varies considerably, depending on the type of medical advice, and the duration and complexity of the recommended regimen. In addition, long-standing habits are very hard to change. Someone quitting smoking because of cancer or heart or lung disease, for example, might have an especially difficult time not smoking during stressful times. Smoking, after all, was one of the behaviors this individual used to cope with stress. A new or alternative coping mechanism needs to be developed for this person to be successful in adhering to their regimen.

Failure to adhere to medical advice under stress could result in more severe and longer-lasting illness through influences on immune function or through influences on disease-involved tissue. For example, existing problems might be aggravated if an individual engages in restricted behaviors (like smoking cigarettes or drinking alcohol). In addition, failure to perform prescribed behaviors or to adhere to medical programs (e.g., insulin injection schedule) can result in disease progression (e.g., complications due to diabetes).

### C. Illness Behaviors

An illness behavior (subsumed in Fig. 1 under Illness) is any activity undertaken by a person who feels ill, to define the state of their health and to discover a suitable remedy. These activities generally include talking or complaining about symptoms and seeking help or advice from relatives, friends, and medical practitioners. Of course, before one can talk about either a symptom or seeking help for it, the symptom needs to be identified and interpreted. There are a number of cultural, social, and individual determinants of illness behaviors. However, stress and other psychological factors are able to indepen-

dently influence illness behaviors, and this is our focus here.

Unlike the physiologic and behavioral factors described earlier, illness behaviors do not *necessarily* reflect organic conditions such as heart disease, infectious disease, or cancer. That is, people sometimes perceive symptoms with no actual physical basis. These stress-triggered illness behaviors are actually thought to be general in nature, that is, they do not fall within the domain of a single disease. Therefore, to the extent that stress effects on illness behaviors are not disease specific, there is reason to assume that they are caused by psychological processes influencing symptom reporting and care seeking rather than by underlying organic pathology. These processes are discussed below. Physiologic and behavioral mechanisms may also operate in conjunction with stress-induced pathology, however, to influence illness behaviors.

#### 1. Labeling Symptoms

Labeling symptoms really involves two processes. The first thing that has to happen is that symptoms must be noticed. Because psychological stress often triggers physiologic arousal, people under stress may be more attentive to their internal physical states. Just because individuals are more attentive, however, does not mean that they are more accurate about their internal states. On the contrary, research shows that people who are internally focused overestimate changes in their bodily functions (e.g., heart rate). Stress may also facilitate the labeling of sensations as symptoms because people are reminded of previous times when stress was associated with symptoms, or simply because they believe that stress triggers symptoms.

Once symptoms are noticed, the second process that occurs is their interpretation. Here, stress may result in physical sensations being mistakenly attributed to disease symptoms. For example, stress results in sympathetic nervous system arousal which, in turn, results in an increase in heart rate. A person with a history of coronary heart disease, however, may interpret this stress-induced increase in heart rate as a symptom of their disease. Symptoms may also be interpreted as disease because people believe that certain symptom constellations represent certain diseases. For example, many people believe that stress is a major cause of heart attacks. Therefore, under stress, minor chest pains that would be ignored under nonstressful conditions may be defined as possible disease recurrence. Of course, the opposite scenario also occurs. That is, individuals



under stress might sometimes ignore pain or other signs of disease in order to focus on the stressful tasks at hand. Finally, reports of symptoms and illness are ways to avoid stressful situations. The prototypic example is the child who reports symptoms to avoid attending school on an especially stressful day (i.e., playing ill).

## 2. Seeking Health Care

Seeking medical care involves first defining a constellation of symptoms as an illness, discussed above, and then deciding to seek care. Again, such behavior may be driven by underlying organic conditions but can also occur independent of pathology. Stress may influence the seeking of health care in several ways. First, stress may influence the decision to seek medical care when persons label themselves as ill by interfering with the decision to seek care. Stress could also increase care seeking for minor symptoms because people are more likely to notice symptoms under stress, or decrease care seeking for serious ones because the time demands of many stressors make medical care visit inconvenient. Once a person makes the decision to seek health care, stress may also influence the amount of time it takes before they actually do it. Finally, persons under stress may also seek medical care unnecessarily because medical providers are viewed as persons to whom one can confide problems.

## D. Summary

In sum, Figure 1 depicts a model of the pathways through which stress is able to influence illness and illness behaviors. We described the way stress and the negative emotional states resulting from stress can lead to changes in the sympathetic nervous system, the neuroendocrine system, and the immune system, as well as the way health practices and adherence to prescribed medical advice are affected. The relation of stress to changes in illness behaviors in the absence of organic pathology were also described. We would like to again point out that it is plausible for the pathways in the model to move in the opposite direction, for example, for illness to lead to further stress.

## III. CONCLUSIONS

We have focused on relations between stress and illness, and the pathways by which these relations

might exist. In general, it can be concluded that stress arises when a person appraises a situation as threatening or demanding, perceives that it is important to respond, and does not have an appropriate coping response immediately available. Stress may then lead to negative psychological states such as anxiety or depression. These negative psychological states are then thought to influence physical health, either through a direct effect on biological processes that influence susceptibility to disease or through behavioral patterns that increase risk for disease and mortality. Negative psychological states can also influence symptom reporting and seeking medical care without directly influencing organic conditions.

It is important to point out that stress is not the primary etiologic agent in disease, but rather, may be but one of many contributors. Other factors that also influence risk for disease include social and personal resources, immunity (in the case of infectious and neoplastic disease), nutritional status, previous history of illness, presence of other disease, genetic factors, age, race, gender, pregnancy, biological rhythms (e.g., circadian, menstrual phase, annual), and seasons of the year (e.g., temperature, light exposure). Thus, although the association between stress and illness is one that is often studied, it is clear that it represents only one small piece of the puzzle of psychological factors and disease.

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