

Psychosocial, Behavioral, and Biological Aspects of Chronic Diseases

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ABSTRACT—*Behavioral, psychosocial, and societal risk factors have been associated with several chronic diseases. Biological processes closely linked to lifestyle, stress, and psychological status appear to mediate the associations. Lifestyle and psychosocial interventions have been developed to prevent and manage chronic diseases. Field and laboratory studies help to specify causal pathways connecting lifestyle and psychosocial variables to disease processes. However, large-scale randomized clinical trials are required to determine whether interventions lower rates of illness and death.*

KEYWORDS—*chronic disease; lifestyle; physiology; stress*

Improvements in public health (e.g., through better hygiene, nutrition, and immunization) and clinical medicine (e.g., antibiotics) during the first half of the 20th century increased longevity by decreasing the incidence and prevalence of infectious diseases. As infectious diseases declined as the leading cause of death, they were supplanted by chronic diseases such as coronary heart disease (CHD), cancer, and stroke (Schneiderman & Speers, 2001). When scientists were unable to identify single causes for these diseases, they turned to probabilistic models based on the presence of risk factors. During the second half of the 20th century, many risk factors, including psychosocial and lifestyle variables, were identified. This progress, in turn, stimulated research examining behavioral and biological pathways of disease, as well as psychosocial and lifestyle interventions to decrease rates of illness and death due to chronic disease.

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BEHAVIORAL, PSYCHOSOCIAL, AND SOCIETAL RISK FACTORS

Behavioral, psychosocial, and societal risk factors have been implicated in the development and progression of chronic diseases. Behavioral, or so-called lifestyle, risk factors include cigarette smoking, lack of exercise, faulty diet, excessive alcohol use, high-risk sex, and shared use of needles for injecting recreational drugs. Psychosocial risk factors include hostility and depression. Societal risk factors include low educational or job status, being a member of an ethnic or racial minority, or being subjected to chronic occupational social stressors.

Behavioral Risk Factors

More than half of all deaths in the United States are linked to behavioral risk factors (McGinnis & Foege, 1993). Cigarette smoking is the major preventable cause of illness and death. The combination of physical inactivity and unhealthy dietary patterns, including excess caloric intake, is the second leading factor contributing to mortality, after tobacco. Long-term excessive use of alcohol increases risk of cardiovascular disease and stroke, as well as some cancers, chronic liver disease, and poor pregnancy outcomes. HIV, the virus that causes AIDS, is transmitted primarily through sexual contact or the sharing of drug paraphernalia. Other, more common, sexually transmitted infections (e.g., human papilloma virus, chlamydia) have been associated with poor health outcomes, including cancer.

Psychosocial Risk Factors

Several large-scale epidemiological studies have established that depressed affect is associated with an increased incidence of mortality from all causes combined, as well as specifically from CHD and cancer (Williams & Schneiderman, 2002). Depression has also been related to an increased rate of death in patients with established CHD, breast cancer, and HIV-AIDS,

as well as to faster disease progression to AIDS in HIV-infected individuals. Faster progression to AIDS has also been associated with stressful life events, excessive use of denial as a coping mechanism, and low satisfaction with social support (Leserman et al., 2000). Several epidemiological studies have also documented that high propensities for hostility and anger as stable personality characteristics are associated with increased incidence of CHD and rate of death in the general population (Williams & Schneiderman, 2002).

Societal Risk Factors

Social variables, including education, income, occupation, social cohesion, ethnicity, and race, have been related to health and illness. The effects of these variables on increased rates of illness and death are related both to behaviors (e.g., smoking) that influence bodily systems and to psychological-physiological interactions (e.g., stress responses) mediated by the brain. Because the relationships between social variables and disease processes are complex, detailed examination of the social context is required if societal contributions to health and illness are to be understood.

Socioeconomic position (SEP), defined by education, income, occupation, or a combination of these variables, has been linked to health outcomes in epidemiological studies carried out in many countries (Marmot, 2003). The basic finding is that across multiple measures of health outcome, individuals having the highest SEP fare best, whereas those having the lowest SEP fare worst. A striking feature of the association between SEP and poor health outcomes is that it is graded and continuous—it is not confined to people living in poverty or with poor access to health care. Thus, other factors are also involved. Although there is also an inverse relation between SEP and prevalence of behaviors that pose health risks, statistical adjustment for behavioral and biological factors attenuate, but do not eliminate, the adverse health effects associated with low SEP.

Epidemiological studies have shown that the gradient relating SEP and health outcomes can be related to occupational status. Individuals in executive positions have better health outcomes than white-collar workers, who in turn fare better than blue-collar workers. Examination of some of the factors involved indicates that job strain is related to health outcomes. Other factors, such as gender, may complicate the issue. For example, marital stress, but not work stress, appears to predict poor prognosis in working-age women with CHD, whereas for men, it is work stress, but not marital stress, that is associated with poor prognosis (Orth-Gomér et al., 2000). Another variable that appears to influence the relation between SEP and health outcomes is race. In the United States, African American men and women have a lower life expectancy than Whites at every income level (Anderson, Sorlie, Backlund, Johnson, & Kaplan, 1997). This has led investigators to examine the variables responsible. Although there does not appear to be a clear expla-

nation for the finding, contextual factors, such as racism, de facto segregation, and lack of community investment in human capital, have been implicated.

PATHWAYS OF DISEASE

Exact causal pathways linking behavioral, psychological, and societal variables to chronic disease have not yet been mapped, but plausible biological pathways have been identified. These pathways to disease involve lifestyle, stress, and psychological status. Given current information about the effects of multiple risk factors on disease, it appears that some of the segments along these paths are shared.

Pathways Linking Lifestyle and Disease

An example of a pathway linking lifestyle and disease involves diet and CHD (Schneiderman & Skyler, 1996). The hormone insulin controls the absorption of sugar by the body. This sugar is necessary to maintain a balance between the body's metabolic needs and energy expenditure. If more calories are consumed than are needed to maintain the balance, the excess sugar is stored as fat, which becomes available as an energy source during periods of fasting or physical exertion. The temporary storage of fats has an important adaptive significance, but long-term storage of large amounts of fat can be harmful to health. Studies have documented important connections relating dietary patterns and psychological stress to insulin metabolism and sympathetic nervous system (SNS) activity, which in turn are related to lipid profiles and development of CHD.

Stress can play an indirect role in the pathway between lifestyle and disease when it leads to diet changes that result in obesity. Stress can also promote CHD more directly by activating the SNS, thereby increasing the circulation of fats in the absence of physical exertion. This, in turn, can lead to these fats becoming deposited in the coronary arteries, causing atherosclerosis, which is the anatomical substrate of the disease process underlying CHD. The interaction of psychological stress and diet in the development of CHD has been studied under experimental conditions in cynomolgus monkeys (Kaplan & Manuck, 2003). Briefly, Kaplan and Manuck found that coronary atherosclerosis is significantly enhanced by a high-fat diet, together with a stressful living environment that promotes excess SNS activation.

Pathways Linking Stress and Disease

Humans, as well as other animals, respond to threat with a number of biological adjustments. In response to threat, the SNS releases epinephrine and norepinephrine, while the adrenal cortex, which is part of the adrenal gland, releases cortisol. In threatening environments involving the fight-or-flight response, these stress hormones have transitory adaptive and protective effects, including maximizing the possibilities for muscular exertion. If the threat is too persistent, however, the long-term

effects of SNS and adrenal activation may damage health. Adverse effects of persistent stress on health are particularly common in humans, whose high capacity for symbolic thought may elicit chronic stress responses to a broad range of adverse living and working conditions. The relation between psychosocial stressors and chronic disease is complex and is affected, for example, by a person's biological vulnerability (i.e., genetics, constitutional factors) and learned patterns of coping.

HIV provides an example of the role of stress in disease progression, as elevated levels of cortisol have been related to changes in immune function that favor HIV replication and decrease protection against foreign pathogens. Indeed, chronically high levels of cortisol are associated with faster progression of HIV to AIDS (Leserman et al., 2000). More generally, stress-induced modulation of the immune system has been linked to the expression of inflammatory, infectious, and autoimmune diseases. The role of the endocrine and immune systems in mediating the link between psychosocial stressors and chronic diseases is currently an active area of investigation.

Pathways Linking Psychological Status and Disease

There is strong epidemiological evidence that psychological variables such as depression are associated with disease outcomes for CHD, cancer, and HIV-AIDS. One pathway to poor CHD outcome in depressed individuals, for example, involves poor lifestyle habits, such as smoking and excessive use of alcohol. An alternative pathway may involve physiological changes associated with depression, such as increased cortisol production, or an increased tendency for blood to clot.

Another point of view, expressed by Appels, Bar, Bar, Bruggeman, and de Bates (2000), is that exhaustion or fatigue, masking as depression, may be a symptom of subclinical heart disease involving inflammation of the coronary arteries that supply blood to heart muscle. Inflammation is also associated with heart attacks, referred to as myocardial infarctions. Pro-inflammatory substances (cytokines) are released from damaged arteries and heart muscle and make their way to the brain, producing "sickness behavior." Sickness behavior refers to subjective feelings of fatigue, weakness, malaise, and listlessness, which can be accompanied by changes in appetite and weight, altered sleep patterns, diminished interest in one's surroundings, and difficulties in concentration. It was once thought that these symptoms were caused by infection, but it now seems that they can be caused in the absence of infection by the body's own inflammatory response to damaged coronary arteries or to heart attack. It thus appears that psychosocial and biobehavioral factors not only contribute to chronic diseases, but also can themselves be influenced by disease processes.

LIFESTYLE AND PSYCHOSOCIAL INTERVENTIONS

Lifestyle and psychosocial interventions have been developed to lower the risk that healthy individuals will contract chronic

diseases such as HIV-AIDS and CHD (primary prevention), as well as to improve health outcomes among patients who already have these diseases (secondary prevention). Traditionally, two strategies have been used to prevent and treat chronic diseases. One of these is a clinical approach that is aimed at people who already have disease or are at high risk. The second strategy is a public-health approach that is aimed at prevention in the general population. Although special interests have advocated each strategy to the exclusion of the other, comprehensive prevention of chronic disease often requires both approaches.

Lifestyle Interventions

Cigarette smoking is the major preventable cause of chronic illness (e.g., cancer, CHD) in the United States. Although highly addictive, and still a major health problem, cigarette smoking declined dramatically during the second half of the 20th century because of a multilevel approach to the problem. At the individual level, aimed at people at high risk, smoking-cessation programs helped smokers quit. Educational programs offered through the schools provided interventions at an organizational level. And at the community and societal levels, increases in cigarette taxes and bans on smoking in restaurants, workplaces, and public buildings and conveyances were aimed at reducing smoking in the general population.

As previously noted, the combination of physical inactivity and unhealthy dietary patterns, including excessive caloric intake, is the second leading factor contributing to mortality in the United States, after tobacco (McGinnis & Foege, 1993). Recently, a large randomized clinical trial examining behavioral and pharmacological strategies for preventing Type 2 diabetes in people at high risk provided evidence for the efficacy of a behavioral intervention (Diabetes Prevention Program Research Group, 2002). The intervention included one-on-one counseling about diet, exercise, and behavior-modification techniques. Although medication also reduced risk of developing diabetes, it was not as effective as the behavioral intervention. The lifestyle intervention was effective in both men and women across racial and ethnic groups. Although this clinical intervention in a high-risk group proved to be successful, community and societal interventions, facilitating improved diet and increased exercise in the general population, could prove useful in the prevention of Type 2 diabetes and CHD.

Psychosocial Interventions

Psychosocial interventions, such as cognitive-behavioral stress management, have been shown to have a positive effect on the quality of life of patients with chronic disease (Schneiderman, Antoni, Saab, & Ironson, 2001). Such interventions have been shown to decrease negative mood (e.g., depression), improve perceived social support, facilitate problem-focused coping, and change interpretations of experience, as well as decrease SNS arousal and the release of cortisol from the adrenal gland.

Psychosocial interventions also appear to help chronic-pain patients, not only reducing their distress and perceived pain, but also increasing their physical activity and ability to return to work, and decreasing their use of medication and overuse of the health care system (Morley, Eccleston, & Williams, 1999). There is also some evidence that psychosocial interventions can have a positive influence on a number of biological variables (e.g., some immune measures), disease progression (e.g., increased survival in melanoma patients), and cardiac mortality (Schneiderman et al., 2001).

Clinical trials have reported both positive and null results for psychosocial treatment of patients following heart attack (Schneiderman et al., 2001). Several meta-analyses (i.e., statistical analyses combining the results of multiple studies) of such interventions have reported significant decreases in heart attack recurrence and death after myocardial infarction. The largest randomized clinical trial reporting positive results was the Recurrent Coronary Prevention Project (Friedman et al., 1986), whereas the most recent study reporting null results was the Enhancing Recovery in Coronary Heart Disease trial (ENRICH, 2003). Psychosocial interventions related to cancer have also had mixed results.

CONCLUSIONS

Epidemiological studies have established important associations between lifestyle factors (e.g., diet, exercise) and disease (e.g., Type 2 diabetes). To the extent that scientists have developed effective strategies for changing health behaviors, lifestyle interventions have proven useful in preventing chronic disease (Diabetes Prevention Program Research Group, 2002). Sustained success for such interventions will likely depend on effective coordination of behavioral strategies at the individual, organizational, and societal levels.

Epidemiological studies have also established robust associations between psychosocial factors (e.g., depression, hostility) and disease (e.g., CHD, HIV-AIDS). Development of effective psychosocial interventions may depend on identifying and intervening in pathways linking psychosocial variables with disease processes. Thus, for example, studies with HIV-infected people have shown that psychosocial interventions that increase social support and decrease depressed mood can cause decreases in SNS activity and lower cortisol levels, changes that in turn can influence immune status and disease progression (Schneiderman et al., 2001).

Thus far, randomized clinical trials have reported both positive and null results for the effects of psychosocial treatment on the incidence and progression of chronic disease. Paradoxical results in randomized clinical trials are not unusual and often stimulate fine research. The null findings in ENRICH (2003) have led to provocative secondary analyses. These analyses, although exploratory, suggest that future randomized clinical

trials on CHD patients might profitably be tailored to particular subgroups of patients and utilize group therapy.

In conclusion, it appears that lifestyle and psychosocial variables are associated with disease outcomes, influence disease processes, and play an important role in the prevention and management of chronic diseases.

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