

# SECTION 1 INTRODUCTION

## CHAPTER 1

### Introduction to Concepts of Pathology

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#### PATHOGENESIS OF DISEASE

*Pathology* is defined as the branch of medicine that investigates the essential nature of disease, especially changes in body tissues and organs that cause or are caused by disease.<sup>1</sup> *Clinical pathology* in medicine refers to pathology applied to the solution of clinical problems, especially the use of laboratory methods in clinical diagnosis. *Pathogenesis* is the development of unhealthy conditions or disease, or more specifically, the cellular events and reactions and other pathologic mechanisms that occur in the development of disease.

This text examines the pathogenesis of each disease or condition—that is, the progression of each pathologic condition on both its cellular level and clinical presentation whenever signs and symptoms are manifested. For the therapist, clinical pathology has a different meaning regarding the effects of pathologic processes (i.e., disease) on the individual's functional abilities and limitations. The relationship between impairment and functional limitation is the key focus in therapy.

#### Pathology and the Guide to Physical Therapist Practice

The APTA *Guide to Physical Therapist Practice*\* was developed for clinical use by physical therapists as an expert consensus document. Panels of clinicians were involved in the first step of formulating the *Guide*, and then more than 1000 therapists across the country participated in reviewing the document.

Three conceptual models are integrated throughout the *Guide*: the (Nagi) Disablement Model, the Integration of Prevention and Wellness Strategies, and the Patient/Client Management Model. The *Guide* uses an expanded version of the disablement model to provide therapists with a common language to understand and communicate about our clients. The *Guide* is currently in its second (revised) edition and being revised for a third edition.

The *Guide* includes a section of specific diagnostic groups referred to as *Preferred Practice Patterns* that represent the major body systems and are designed to facilitate a systems approach to patient/client management. The Practice Patterns are described in four sections: musculoskeletal, neuromuscular, cardiopulmonary, and integumentary. It is not possible to place all diseases included

just within these four categories at this time. The therapist will encounter multiple medical comorbidities that extend beyond the four categories of the Preferred Practice Patterns outlined in the *Guide*. However, therapists will not be devising intervention strategies for liver disease, for example, but must be aware of the impact that such diseases may have on the rehabilitation process. The most likely practice patterns associated with each disease or disorder discussed are presented in the *Special Implications for the Therapist* boxes. These patterns may vary with each episode of care, depending on clinical presentation.

Advances in medicine have resulted in a population with greater longevity but also with a more complex pathologic picture. Orthopedic and neurologic conditions are no longer present as singular phenomena; they often occur in a person with other medical pathology. We must be knowledgeable of the impact other conditions and diseases have on the individual's neuromusculoskeletal system and the necessary steps that must be taken to provide safe, effective treatment.

#### CONCEPTS OF HEALTH, ILLNESS, AND DISABILITY

##### Health

Many people and organizations have attempted to define the concept of health, but no universally accepted definition has been adopted. A dictionary definition describes health in terms of an individual's ability to function normally in society. Some definitions characterize health as a disease-free state or condition. The World Health Organization (WHO)<sup>14</sup> has defined *health* as a state of complete physical, mental, and social well-being and not merely as the absence of disease or infirmity. All of these definitions present health as an either/or circumstance, meaning an individual is either healthy or ill.

Health is more accurately viewed as a continuum on which wellness on one end is the optimal level of function and illness on the other may be so unfavorable as to result in death. Health is a dynamic process that varies with changes in interactions between an individual and the internal and external environments. This type of definition recognizes health as an individual's level of wellness.

Health reflects a person's biologic, psychologic, spiritual, and sociologic state. The *biologic* or physical state refers to the overall structure of the individual's body tissues and organs and to the biochemical interactions and functions within the body. The *psychologic* state includes the individual's mood, emotions, and personality.

The *spiritual* aspect of health addresses the individual's religious needs, which may be affected by illness or injury. The spiritual dimension in health care focuses on the integration of mind, body, and spirit, with the goal of promoting whole-person healing. The *sociologic* or social state refers to the interaction between the individual and the social environment. A high level of wellness or holistic health is achieved when the biopsychosocial-spiritual needs of a person are met.

## Illness

### Definition

*Illness* is often defined as sickness or deviation from a healthy state, and the term has a broader meaning than disease. *Disease* refers to a biologic or psychologic alteration that results in a malfunction of a body organ or system. Disease is usually a term used to describe a biomedical condition that is substantiated by objective data such as elevated temperature or presence of infection (as demonstrated by positive blood cultures).

Illness is the perception and response of the person to not being well. Illness includes disturbances in normal human biologic function and personal, interpersonal, and cultural reactions to disease. Disease can occur in an individual without he or she being aware of illness and without others perceiving illness. However, a person can feel very ill even though no obvious pathologic processes can be identified.

### Incidence and Prevalence

When discussing various diseases, disorders, and conditions, incidence and prevalence may be reported. *Incidence* is the number of new cases of a condition in a specific period of time (e.g., 6 months or 1 year) in relation to the total number of people in the population who are "at risk" at the beginning of the period. *Prevalence* measures all cases of a condition (new and old) among those at risk for developing the condition. Measures of prevalence are made at one point in time (e.g., on a specific day).

### Natural History

The natural history of a condition, disorder, or disease describes how it progresses over time. The natural history of some conditions, such as cancer, can be judged based on the stage of the tumor at the diagnosis and response to treatment. Scientists are actively engaged in identifying *predictive factors* that help tell what the patient/client's outcome might be. In medicine, predictive factors are the closest thing we have to a crystal ball.

Even with known predictive factors, the natural history is not always clear; predicting what is going to happen and when it is going to happen can have wide or narrow margins, depending on the condition. For example, indi-

viduals with some forms of muscular dystrophy have a more predictive natural history, whereas individuals with cerebral palsy may not be so easy to gauge, especially during the early years of growth and development.

The therapist must develop a plan of care keeping in mind the natural history of the condition and where the individual is in the lifespan cycle. Some thought should be given to dovetailing our view of impairments, dysfunctions, and disabilities with the natural history of the disease, condition, and illness. This is particularly important when working with individuals who have long-term, degenerative or progressive neurologic, or chronic conditions.

Improvements in treatment for neurologic and other conditions previously considered fatal (e.g., cancer, cystic fibrosis) are now extending the life expectancy for many individuals. Improved interventions bring new areas of focus such as quality of life issues. With some conditions (e.g., muscular dystrophy, cerebral palsy), the artificial dichotomy of pediatric versus adult care is gradually being replaced by a lifestyle approach that takes into consideration what is known about the natural history of the condition.

### Acute Illness

*Acute illness* usually refers to an illness or disease that has a relatively rapid onset and short duration; it is not synonymous with "severe." The condition often responds to a specific treatment and is usually self-limiting, although exceptions to this definition are numerous. If no complications occur, most acute illnesses end in a full recovery and the individual returns to the previous level of functioning.

*Subacute* refers to how long a disease has been present, but there is no set time that divides subacute from the other time descriptions (i.e., acute and chronic). Subacute describes a time course that is between acute and chronic. A symptom that is subacute has been present for longer than a few days but less than several months. Chronic conditions sometimes flare up and may be referred to as subacute.

Acute illnesses usually follow a specific sequence, or stages of illness, from onset through recovery. The first stage involves the experience of physical symptoms (e.g., pain, shortness of breath, fever), cognitive awareness (i.e., the symptoms are interpreted to have meaning), and an emotional response, usually one of denial, fear, or anxiety.

Subsequent stages of an acute illness may include assumption of a sick role as the person recognizes the problem as being sufficient to require contact with a health care professional. If the illness is confirmed, the individual continues in the sick role; if it is not confirmed, a return to normalcy may occur or the person may continue to seek health care to identify the illness.

A stage of dependency occurs when the person receives and accepts a diagnosis and treatment plan. This type of dependency in the psychologically and emotionally balanced person represents awareness, acceptance, reliance on diagnosis, and care beyond self-help. This definition of dependency differs from dependency associated with dependent personality disorder, in which the affected

person lacks self-confidence or the ability to function independently, and allows others to assume responsibility for his or her care. Depending on the severity of the illness, the individual may give up independence and control and assume a more dependent sick role. During this stage, sick people often become more passive and concerned about themselves.

Most people move from acute or subacute to the final stage of recovery or rehabilitation. During this stage, the individual gives up the sick role and resumes more normal activities and responsibilities. Individuals with long-term or chronic illnesses may require a longer period to adjust to new lifestyles.

### Chronic Illness

Chronic illness describes illnesses that include one or more of the following characteristics: permanent impairment or disability, residual physical or cognitive disability, or the need for special rehabilitation and/or long-term medical management. Chronic illnesses and conditions may fluctuate in intensity as acute exacerbations occur that cause physiologic instability and necessitate additional medical management (e.g., diabetes mellitus, fibromyalgia, rheumatoid arthritis). A person who has exacerbations of chronic illness may progress through the stages of illness described in the previous section.

### Psychologic Aspects

The most important factor influencing psychologic reactions to illness is the premorbid (before illness) psychologic profile of the affected person. For example, a person with a dependent-type personality may become very dependent, perhaps seeking unusually large amounts of advice or reassurance from the health care specialist or expecting attention beyond that required for the degree of illness present. A narcissistic (self-centered) person may be particularly concerned about the need to take medication or the loss of the ability to work. The stoic person (indifferent to or unaffected by pain) may have difficulty admitting to being sick at all.

Other factors that affect a person's psychologic reaction include the extent of the illness and the particular symptoms that develop. Extremely mild disease may have little effect, whereas completely unexpected and debilitating illness may be very distressing. A common reaction to any illness is fear or anxiety related to the loss of control over one's own body. Denial is an unconscious defense mechanism that allows a person to avoid painful reality as long as possible. Denial can be a natural part of the process of dealing with illness, which culminates in acceptance.

Noncompliance with treatment may have a psychologic basis (e.g., denial: "There is nothing wrong with me, so I do not need medical treatment."), but it may also occur as a result of previous experience. For example, noncompliance with prescribed corticosteroid therapy may be based on aversion to side effects experienced during use of this drug in a previous disease flare. With chronic autoimmune diseases (e.g., connective tissue diseases), denial may continue for years as a coping mechanism for the individual who continues to decline in physical functional capacity.

It is important to recognize that psychologic or psychiatric symptoms, such as impairment of memory, personality changes (e.g., paranoia), loss of impulse control, or mood disorders (e.g., persistent depression or elation), can have a functional or organic basis. Functional symptoms occur without significant physical dysfunction of brain cells, whereas organic symptoms can be caused by abnormal physiologic changes in brain tissue. An example of a functional symptom is depression that is considered to be the psychologic consequence of a general medical condition (e.g., myocardial infarction).

Organic symptoms occur as a direct physiologic consequence of a medication or medical condition. For example, onset of corticosteroid-induced psychologic symptoms is often dose-related, and symptoms subside as the corticosteroids are tapered. Another example of an organic basis for symptomatology is the person with systemic lupus erythematosus (SLE) who experiences symptoms of organic mental disorders secondary to SLE-mediated vasculitis, called *lupus cerebritis*, or the person with end-stage liver disease who develops hepatic encephalopathy when toxic substances in the blood, such as ammonia, reach the brain.

### Disability

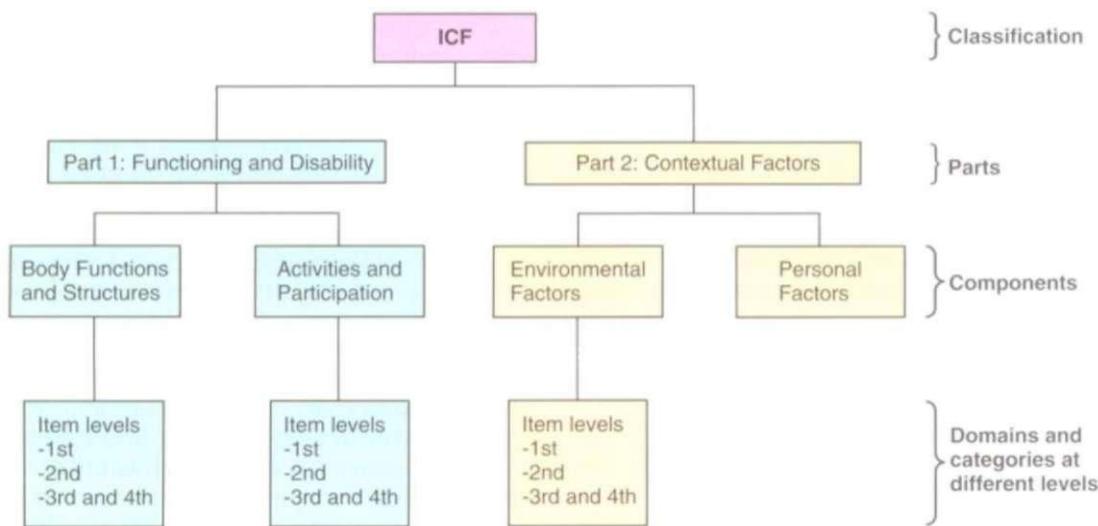
Disability is a large public health problem in the United States affecting an estimated 54 million people who report disabling conditions. This figure illustrates that nearly 20% of the U.S. population currently lives with a disability. Prevalence of disability is higher among women than men and is reported highest among people 65 years of age and older. One of the national health goals for 2010 is to eliminate health disparities among different segments of the population, including among people with disabilities. National estimates of disability range from 15% to 20% for adults over the age of 18 years, but these figures are most likely underestimated and do not account for severity or duration of disability.<sup>13</sup>

Disability is often viewed by physical therapists from a biopsychosocial model, which incorporates and integrates the traditional medical model with the less stringent and more flexible social model of disability. The medical model confines disability as a descriptor of the affected individual. In this context, disability requires intervention by others (usually health care providers) to correct the problem. The social model of disability is more likely to see an unaccommodating environment and lack of social response to individuals with disabilities as the problem requiring a social or political response.<sup>29</sup>

### Disablement and Classification Models<sup>28</sup>

There are several contemporary biopsychosocial models proposed today to describe disability classifications and give us a framework for identifying the consequences of diseases, disorders, and injuries.

**Nagi Disablement Model.** The Nagi model represents a system often used by health care professionals to classify the impact of disease or trauma.<sup>30</sup> Nagi suggests that pathology produces pain and impairments, which then lead to functional limitations and disability. It works well



**Figure 1-1**

Structure of the International Classification of Functioning, Disability, and Health (ICF). (From World Health Organization WHO): Principles and process for including classifications in the Family of International Classifications, Geneva, Revised 2004, WHO.)

for clinical practice at the level of impairment in which the therapist works and understands the client's needs. The major components of this model include the following:

- Disease or pathology
- Impairment(s)
- functional limitations
- Disability

Disease or *pathology* describes the underlying pathogenesis and abnormal cellular and physiologic processes. *Impairment(s)* refer to a loss or abnormality at the tissue, visceral, and/or body system level. An impairment can be temporary or permanent and is considered to occur at the organ level. *Functional limitations* occur at the individual level and restrict that person's performance of specific actions. *Disability* is the actual limitation of physical or mental function in a social context. Any restriction or lack of ability to perform an activity in a normal manner or within the normal range may represent a disability.

Not all disease leads to impairment and not all impairment leads to disability. For example, diabetes can result in impairment (e.g., diminished circulation), but not all people with diabetes sustain a disability (e.g., vision loss or amputation). In another example, an individual with a cardiopulmonary condition would have impairment at the level of the tissue or organ system such as ventilation, respiration (gas exchange), and circulation. The functional limitation would be the restrictions in the individual's ability to perform specific tasks such as climbing stairs or carrying groceries.<sup>16</sup> The disability occurs because the functional limitations are severe enough to prevent this individual from holding down a job or caring for children at home.

Nagi proposed that functional limitations were the result of impairments and consisted of an individual's inability to perform the tasks and roles that constitute usual activities for that individual. According to the Nagi

model, *disability* is defined as the patterns of behavior that emerge over long periods of time when functional limitations cannot be overcome to create normal task performance or role fulfillment.

**International Classification of Functioning, Disability, and Health (ICF).** The WHO's framework to classify and code information about health and provide standardized language is the *International Classification of Functioning, Disability, and Health (ICF)* established in 2001. The ICF is presented as the international standard to describe and measure health and disability from a biopsychosocial perspective by all health care professionals. The ICF is a good framework for research from a global perspective.

The ICF replaces the *International Classification of Impairments, Disabilities, and Handicaps (ICIDH)* classification established in 1980.<sup>17</sup> While traditional health indicators are based on the mortality (i.e., death) rates of populations, the ICF shifts focus to "life" (i.e., how people live with their health conditions and how these can be improved to achieve a productive, fulfilling life). Most notable in the current structure is the inclusion of "host factors" that impact the behavior of the individual such as demographic background, physical and social environments, and psychologic status. The full description of this model can be found at [www.who.int/classification/icf](http://www.who.int/classification/icf). The ICF disablement components (Fig. 1-1) include the following:

- Body functions
- Body structures
- Activities and participation
- Environmental factors
- Personal factors

The ICF describes how people live with their health condition. The ICF is a classification of health and uses these health-related domains to describe body functions and structures and activities and participation from body, individual, and societal perspectives. Because an individ-

ual's functioning and disability occur in a context, the ICF also includes a list of environmental factors.<sup>16</sup>

The ICF changes our understanding of disability, no longer presenting disability as a problem of a minority group, or just of people with a visible impairment or in a wheelchair. For example, a person living with HIV/AIDS could be disabled in terms of his or her ability to participate actively in a profession. In that case, the ICF provides different perspectives as to how measures can be targeted to optimize that person's ability to remain in the work force and live a full life in the community.<sup>18</sup>

**ICF—Language.** The ICF introduces new "enablement" language to replace older disablement terminology that implied distinctions between individuals who are healthy and those who have disabilities. The new language defines *body functions and structures* as physiologic or psychologic functions of body systems or anatomic parts (e.g., organs, limbs). *Impairments* are defined as problems in body function or structure.

*Activity* is defined as the execution of specific tasks or actions by an individual. *Activity limitations* are the difficulties that an individual might have in executing activities, and *participation* is the individual's involvement in life situations. *Participation restrictions* are problems the individual might have in real-life situations.<sup>23,56</sup>

Secondary conditions or impairments of body structures can result from limitation of activity and participation, joint contractures, disuse atrophy, and heart disease are examples of changes from inactivity. If not prevented, these changes can lead to further limitation of activity but are not part of the underlying health condition. It is important to remember that the same impairments may not result in the same extent of activity limitation or that activity limitation may not limit the participation in a life role in the same way in two different individuals.

An example of this continuum could be described this way: a person has survived a stroke in the left side of the brain and has the impairments of hemiparesis and aphasia. This person may not be able to walk or talk but can participate in work with the assistance of a walker and communication board. On the other hand, a person who survived a stroke on the right side of the brain may be able to walk but not be able to participate in work because of loss of executive function and poor judgment.

If the first individual does not have access to a walker and communication board because of lack of funding, he or she may not be able to return to work. In many cultures, it is tradition that if a person is injured or has a medical condition, it is the responsibility of the family to provide passive or palliative care; that person may never have the opportunity to rehabilitate to full potential.

The ICF framework takes a broad biopsychosocial view that looks beyond mortality and disease to focus on how people live with their conditions.<sup>23,29</sup> The ICF framework promotes international exchange using a common and consistent framework and universal language to discuss disability and related phenomena.<sup>29</sup> Steps are being taken by some to incorporate the ICF into practice. For example, a list of intervention categories relevant for physical therapy according to the ICF has been identified.<sup>21</sup>

### Cognitive Disability<sup>19</sup>

Problems such as mental illnesses like depression, alcoholism, schizophrenia, and cognitive impairments, although responsible for only about 1% of deaths, are seriously underestimated sources of disabilities that account for 11 % of the world's disease burden.<sup>55</sup> These conditions are often undiagnosed, and although therapists cannot diagnose these impairments, recognizing the deficits is important. Only cognitive disability is discussed in this section; common mental illnesses are discussed in Chapter 3. Five types of cognitive deficit are associated with specific areas of brain damage and linked to possible causes that may be barriers to successful treatment (Table 1-1).

*Executive functions* may be described as cortical functions involved in formulating goals and in planning, initiating, monitoring, and maintaining behavior.<sup>31</sup> Behavior is defined here in its broadest terms to include not only overt motor behavior but also affective and social behavior. A person with executive function deficits typically appears inert or apathetic. Clinically, these clients typically have a right hemisphere lesion and apraxia, unilateral neglect, or both. When frontal lobe damage occurs, the effects of impaired executive functions may be attributed to depression. Although the two may occur simultaneously, depression is usually characterized by a lack of energy, whereas impaired executive functions are demonstrated by a lack of involvement.

*Complex problem solving* may be described as the effective handling of new information. Impaired problem solving results in concrete thinking, inability to distinguish the relevant from the irrelevant, erroneous application of rules, and difficulty generalizing from one situation to another. For example, when a client learns how to accomplish wheelchair transfers and then generalizes that information to various settings (bed to chair, chair to toilet, chair to car, in hospital, at home), he or she is using new information in complex problem solving.

*Information processing* involves the speed with which information travels from one part of the brain to another and the amount of information assimilated at that speed.<sup>31</sup> Whereas complex problem solving has to do with the orchestration of information, information processing involves the efficient transfer of information.

As a result of genetic, environmental, and educational factors, some people are more proficient processors than others. As a result of trauma, some people may lose processing ability and speed. Noise levels, external sensory stimulation (e.g., presence of other people and other activities), and presentation of more than one kind of information at a time (e.g., providing a written home program then discussing the time of the next appointment) are examples of distractions to people with reduced information-processing abilities.

*Memory deficits* result from a failure to store or retrieve information. Before it can be determined that the person is experiencing a memory lapse, it must be established that the material was learned in the first place. Memory problems typically are acquired rather than developmental. Depression may masquerade as memory loss, but the depressed person is usually less attentive or interactive

**Table 1-1** Types of Cognitive Deficits

Type	Lesion	Etiologic Factors	Therapist Strategies
Decreased executive functions	Right hemisphere lesion, frontal lobe damage	Car accidents, whiplash injuries, exposure to organic solvents, HIV/AIDS complications, Korsakoff's disease, Parkinson's disease, craniotomy	More active role in maintaining treatment program, educating family and client's employer, and teaching self-monitoring skills; include pacing in treatment regimen; use home trainers; closely monitor all clinic activities; teach time-management techniques; include client in group activities; do not take socially inappropriate behavior personally
Poor complex problem solving	Diffuse and/or global cortical damage	Exposure to occupational toxins, postsurgical anoxia, stroke, hydrocephalus, small-vessel disease associated with hypertension	Fragment treatment program into small pieces and reassemble pieces into coherent whole when each has been well learned; turn the new into the familiar through repetition; reduce complexity of treatment components; avoid abstract visual aids and abstract verbal explanations
Slowed information processing	Diffuse cortical or subcortical system damage, reticular activating system of the brainstem	Alcohol abuse, drug abuse, exposure to toxins, developmental delays, traumatic brain injury	Slow the rate of presentation; remove environmental distractors; do not speak loudly as though client were hearing impaired; simply present one type of information at a time, making sure the client understands you before you move on
Memory deficits	Temporal lobe damage	Alcohol abuse, temporal lobe injuries, seizures, traumatic brain injury, exposure to toxins, age-related deterioration	Make certain that no learning or emotional disorder is involved; use external aids and multichannel approaches to improve retention of information; determine which aid or approach works best for each individual
Learning disabilities	Unclear	Unknown, possibly traumatic birth or genetic predisposition, early acquired brain damage, metabolic abnormalities	Avoid written material unless it is appropriate to the person's reading level; use nonverbal modes of communication

Modified from Woltersdorf MA: Beyond the sensorimotor strip, *Clin Management* 1:2:63-69, 1992.  
HIV, Human immunodeficiency virus; AIDS, acquired immunodeficiency syndrome.

with the environment and therefore registers (or learns) less. For example, a client may appear to be suffering from a memory dysfunction when, in fact, the decreased attention span is a result of depression that has reduced learning.

*Learning disability* occurs in a person with normal or near-normal intelligence as difficulty acquiring information in specific domains such as spelling, arithmetic, reading, and visual-spatial relationships. Therapists most commonly encounter learning disabilities manifested as noncompliance with written treatment programs, repeated tardiness or absence for treatment sessions, and an overly anxious approach to the physical symptoms

that have brought the client to the therapist in the first place.

#### SPECIAL IMPLICATIONS FOR THE THERAPIST

1-1

##### **Disability Classifications**

Both the medical model and the Disablement Model are reflected in this text. Diagnosis and treatment of disease are presented after the medical model, along with the Disablement Model's assessment of the impact of acute and chronic conditions on the functioning of specific body systems (impairments) and

basic human performance (functional limitations). The Disablement Model extends the scope of the medical model of disease with its primary emphasis on diagnosis and treatment of disease by placing the focus on the functional consequences of disease. Thus the reader will see terminology reflecting these two models such as *etiology*, *pathogenesis*, *diagnosis*, and *prognosis* from the traditional medical model and *impairments*, *interventions*, *desired outcomes*, and *functional limitations* from the Disablement Model.

Using these tools and the definition of clinical pathology, we ask the following: *How does this particular disease or condition affect this person's functional abilities and functional outcome? What precautions should be taken when someone with this condition is exercising? Should vital signs be monitored during therapy for this disease? How will that information affect the plan of care or intervention?*

### **Physical Disability**

Each individual client must be evaluated on the basis of the clinical presentation in conjunction with the underlying pathology. For example, the person with osteoporosis may require joint mobilization, but this technique must be modified for the presence of osteoporosis. The individual with cardiac valvular disease may need a different exercise program than that prescribed for a healthy athlete. The adult with musculoskeletal symptoms of thoracic spine pain, muscle spasm, and loss of thoracic motion who has a primary medical diagnosis (e.g., posterior penetrating ulcer) will be unaffected by therapy techniques.

### **Cognitive Disability**

Although therapists cannot diagnose cognitive deficits, the therapist's evaluation and clinical observations may help identify cognitive deficits that might interfere with treatment. Appropriate referral is always recommended when problems beyond our expertise are suspected. Specific rehabilitation and training strategies for people with cognitive disabilities are available.<sup>53</sup>

## **THEORIES OF HEALTH AND ILLNESS**

### **Germ Theory**

Many theories exist as to the cause of illnesses. In the latter part of the nineteenth century, Louis Pasteur took medicine out of the Dark Ages. It was not "bad air" or "bad blood" that caused diseases like malaria and yellow fever but pathogens transmitted by mosquitoes.

Pasteur's germ theory promoted our understanding of infectious disease and helped reduce deaths from infection. Pasteur proposed that a specific microorganism was capable of causing an infectious disease. Infections, such as poliomyelitis, tuberculosis, human immunodeficiency virus (HIV) associated with acquired immunodeficiency syndrome (AIDS), or legionellosis (legionnaire's disease), are caused by a known agent. Once the causative agent

is identified, specific treatment methods can be determined.

Pasteur's germ theory has been labeled *Germ Theory, Part I* and has been expounded on by today's biologists in what is referred to as *Germ Theory, Part II*. Taken from Darwin's description of how an organism and its environment fit together, it is now restated that the success of an organism is relative to competing organisms. According to this theory, genetic traits that may be unfavorable to an organism's survival or reproduction do not persist in the gene pool for very long. Natural selection, by its very definition, weeds them out in short order. By this logic, any inherited disease or trait that has a serious impact on fitness must fade over time because the genes responsible for the disease or trait will be passed on to fewer and fewer individuals in future generations. Common illnesses that cannot be linked to genetics or to some hostile environmental element (including lifestyle) must have some other explanation.

The current germ theory suggests that diseases present in human populations for many generations that still have a substantial negative impact may have an infectious origin. Chronic diseases of the late twentieth century that have been considered hereditary, environmental, or multifactorial may in fact be caused by an infectious pathogen. For example, *herpesviruses* have been linked to multiple sclerosis, Kaposi's sarcoma, B-cell lymphomas, Burkitt's lymphoma, and several other forms of cancer.

*Helicobacter pylori*, found in the stomachs of a third of adults in the United States, causes inflammation of the stomach lining and can result in ulcers. In most cases, these ulcers can be cured in less than a month with antibiotics. The lymphoid tissue of the stomach can produce a low-grade gastric lymphoma under the influence of this bacterium. Eradication rates of 80% to 90% have been noted with the use of antibiotics, although antibiotic resistance may be decreasing these cure rates. However, this may be the first time in medical history that cancer has been cured with an antibiotic.<sup>1,8,34,51</sup>

Heart disease is now being linked to infections such as herpes simplex virus (HSV), enterovirus (ES), and *Chlamydia pneumoniae*, a newly discovered bacterium that causes pneumonia and bronchitis. Several studies have now shown that people who have had a heart attack have high levels of antibodies to one or more of these infections from previous exposure, often during childhood.<sup>1,2,29,41</sup>

Germ Theory, Part II also hypothesizes that clinical depression or mental illness, such as schizophrenia, may have an underlying infectious basis given how common these conditions are in the general population. According to germ theory proponents, natural selection should have eliminated any genes for these conditions to ensure survival and reproduction. No one has found a depression virus or a schizophrenia virus yet, but research continues in this area. The germ theory cannot explain all diseases, and other more complex theories have been postulated.

### **Biomedical Model**

The biomedical model explains disease as a result of malfunctioning organs or cells. Within this model, condi-

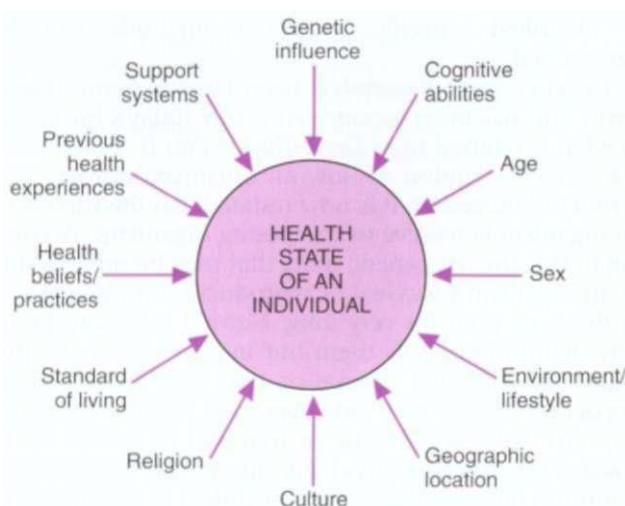


Figure 1-2

Multiple variables influence the health and illness of an individual. (From Ignatavicius DD, Workman JL, Medical-surgical nursing: critical thinking for collaborative care, ed 5, Philadelphia, 2005, WB Saunders.)

tions can be classified as diseases if they have a recognized cause, if a change occurs in structure or function of an organ, and if a consistently identifiable group of signs and symptoms is apparent. The biomedical model focuses on cause-and-effect relationships but does not take into account psychosocial components of disease, such as varying reactions to a disease because of age, lifestyle, personality, and compliance with therapy.

Neither the germ theory nor the biomedical model can explain the widespread increase in noninfectious chronic diseases that affect modern civilizations. In the past, the high death rate from epidemics of infectious diseases meant that many people did not live long enough for chronic illnesses to develop, especially those that occur with aging. With the development of penicillin in 1928 and the subsequent development of other antibiotics, people in the twentieth century have had reduced mortality from infectious disease. Heart disease and cancer—ailments that plague modern industrialized nations—have become the center of focus.

### Multicausal Theory

It is now recognized that lifestyle, diet, and stress response contribute to the development of diseases, and treatment interventions are focusing more on the relationship of the individual with his or her external and internal environment. Multicausal theories have been proposed to take into account the many additional factors associated with health and the development of illness (Fig. 1-2). Many of these variables are discussed further in Chapter 2.

### Homeostasis Theory

Homeostasis theories developed in the nineteenth century continue to be expanded on through the twenty-first century. Homeostasis is the body's ability to maintain its internal environment in a constant state of equilibrium

despite external influences that promote imbalance. Homeostasis begins at the cellular level in that the cell receives nutrients, oxygen, water, and essential minerals from the environment. It uses these resources to generate energy, maintain its own integrity, and contribute to the body's internal stability. The body's ability to maintain temperature, blood pressure, and levels of fluid and electrolytes, serum glucose, blood oxygen, and carbon dioxide within a given range are examples of dynamic homeostasis that begins at the cellular level. External stimuli can alter the body's equilibrium or homeostasis. External demands may exceed the capacity of the cell to adapt, resulting in a permanent disequilibrium and injury or illness.

*Injury* occurs when the cells or tissues have been required to adapt beyond their limitations. Like a muscle that has exceeded its ability to stretch, has ruptured, and is no longer able to contract, cells can be irreparably damaged and unable to return to the original steady state.

*Illness* is the result of a imbalance in the body's (cell's) ability to regulate the internal environment. The concept of "fight, flight, or freeze" to explain the body's reactions to emergencies was added to the homeostasis theory and continues to be used today to explain homeostasis as a dynamic equilibrium designed to maintain a steady state.

### General Adaptation Syndrome

The general adaptation syndrome continued to build on the homeostasis theory and the concept of fight, flight, or freeze by describing a response to stress that, regardless of diagnosis, has common symptoms such as appetite loss, weight loss, myalgias, and fatigue. The entire body responds to stress in an attempt to maintain or adapt through the autonomic and central nervous systems. If the demand or stress continues, the adaptive capacity of the body can be exceeded, and disease may result.

This theory suggests that stress causes disease by placing excessive demands on the body, which in turn produces high levels of adaptive hormones, such as glucocorticoids, which reduce inflammation, and mineralocorticoid hormones, which regulate electrolyte and water metabolism. These hormones lower the body's resistance to disease and cause organ damage. When stress is continuous, the adaptive capacity of the body may be exceeded, and disease (or even death) may result.

### Psychosocial Theory

Psychosocial theories of disease attempt to integrate physiologic, psychologic, and social factors to explain disease. An individual's degree of resistance to microbes depends largely on how well he or she is coping with internal and external stresses. Resistance to infectious disease, allergies, and possibly cancer depends on a well-functioning immune system. People who cope poorly with stress have significantly impaired immune responses, as manifested by a diminished activity level in natural killer cells. These are a special type of leukocyte that destroy viruses and cancer cells without having previously encountered them. Biopsychosocial concepts as

they relate to health are discussed more fully in Chapter 3.

## Psychoneuroimmunology Theory

As new research added important information, the psychosocial theory has been modified to become the Psychoneuroimmunology (PNI) Model first described in the 1980s. PNI is the study of the interactions among behavior and neural, endocrine, enteric, and immune system functions.

Those who founded the research in this area point out that PNI is a misnomer because it reveals only part of the process and redundantly includes the brain as psycho and neuro, leaving out the powerful impact of the endocrine system.<sup>12</sup> The literature refers to this theory by a variety of names, such as neuroendocrine immunology, neurogastroimmunology, or psychoimmunology, and is seemingly dependent on the system under investigation.

Illness was once thought of as the result of a breakdown within the immune system alone, but immune function is now recognized as the integrative defense mechanism of multiple systems. This theory has outlined the influence of the nervous system on immune and inflammatory responses and how the immune system communicates with the neuroendocrine systems. This information is very relevant in understanding host defenses and injury/repair processes.

Further, the integration of the hypothalamic-pituitary-adrenal axis and the neuro-endocrine-enteric axis has a biologic basis first discovered in the late 1990s. Physiologically adaptive processes occur as a result of these biochemically based mind-body connections. We now know that each thought and emotion is a message to the rest of the body, mediated by an intricate array of nerve signals, hormones, and various other substances.<sup>13</sup>

Candace Pert,<sup>32,45</sup> formerly a molecular biologist at the National Institutes of Health (NIH), made a groundbreaking discovery when she identified the biologic basis for emotions (neuropeptides and their receptors). This new understanding of the interconnections between the mind and body goes far beyond our former understanding of psychosomatic or psychosocial theories of health and illness.

It is now known that these chemical messengers (sometimes referred to as *peptides*, *neuropeptides*, *ligands*, *neurotransmitters*, or *information molecules*) move through the blood stream to every cell of the body. When these chemicals find body cells with receptors that attract them like magnets, they attach and make significant changes in that cell structure and organ system. These information molecules are the messengers the body uses to communicate between all the major body systems. For example, both the digestive (enteric) system and the neurologic system communicate with the immune system via these peptides. These three systems can exchange information and influence one another's actions.

Knowledge of PNI sheds new light on many of the previously postulated theories of health and illness, whereas understanding dysfunctions in the PNI system may highlight a wide variety of system disorders and

diseases. For example, explaining how the body maintains homeostasis through autonomic temperature regulation (Homeostasis Theory) will now have an added dimension when considering the role of these information molecules or understanding that the sympathetic nervous system controls cardiovascular and immune functions, hormones control energy balance, and neurohormones control salt and fluid balance (General Adaptation Syndrome) via the interactions of the PNI.

Continued research in this area has brought new information to light about the effects of variables, such as stress and coping, personality, mental status, socioeconomic status, and work and family life, and their role in the outcome of surgery or the development and progression of disease, morbidity, and mortality (e.g., Multi-causal Theory, Psychosocial Theory).<sup>1,20-33</sup>

## Energy Medicine

Many well-known scientists (e.g., Candace Pert, James Oschman, Larry Dossey) with extensive training and research in the areas of biophysics and biology have attempted to bring together evidence from a range of disciplines to provide an acceptable explanation for the energetic exchanges that take place in all therapies.<sup>15,43</sup> Studies in biophysics have shown that physical instabilities result in fluctuations, the quantum properties of which can be applied to regulatory control mechanisms in living organisms with promising results. The discovery of the existence of macroscopic quantum coherence in living systems has led to a new field of mind-body medicine and a new understanding of the role of natural "energy forces" within the body in maintaining normal health and well-being.<sup>21</sup>

At the same time, behavioral scientists have been exploring the concept that consciousness in the form of beliefs, expectations, and intention plays a central role in healing. Studies of prayer and the spiritual aspects of medicine have moved many health care professionals away from a biomedical model of health care to a model of whole-person caring.<sup>30</sup> This in turn has led to interest in how these energies or forces may be used to assist in healing and the restoration of normal health. The concept of energy medicine has resulted in a new discipline called *complementary and alternative medicine (CAM)* or *complementary and integrative medicine (CIM)*.

## HEALTH PROMOTION AND DISEASE PREVENTION

The topic of health promotion and disease prevention has taken front and center stage in many arenas within the health care industry. There has been a change in health care focus from intervention for cure and healing to healing, health, wellness, and prevention. Traditional health promotion has not been to take care of the sick and disabled but rather to prevent disease and disability in the healthy.<sup>22</sup> Today's concepts of health place all health on a continuum. The focus is on practicing healthy behaviors, even in the presence of disease and disability. Although disability can increase a person's risk of or

## SECTION 1 INTRODUCTION

susceptibility to secondary health conditions, the primary disability does not mean that individual is "unhealthy."

Research has proved without a shadow of a doubt that many of today's illnesses, disorders, and conditions can be prevented altogether. Diseases of longevity, lifestyle, and health behaviors are prevalent, and more people are living longer with chronic diseases, all of which drive up the cost of health care. The health care industry as a whole and especially third party payers have been slow to respond with ways to change our approach to this information.

The first set of national health targets was published in 1979 in *Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention*. *Healthy People 2000* was released in 1990 as a management tool with goals to reduce mortality, increase independence among older adults, reduce disparities in health among different population groups, and achieve access to preventive health services.

This program has become an ongoing comprehensive program of public health planning now called *Healthy People 2010* that is a tremendously valuable asset to all who work to improve health. *Healthy People 2010* (available at <http://health.gov/healthypeople/>) has a series of objectives to bring better health to all people in this country and to eliminate disparities among different segments of the population. These include differences that occur by gender, race or ethnicity, education or income, disability, residence in rural localities, and sexual orientation. This program has a built-in means to measure progress toward achieving 10-year targets across a broad range of health behaviors and outcomes.

### Health Promotion

Health promotion as a concept and as an active process is built on the principles of self-responsibility, nutritional awareness, stress reduction and management, and physical fitness. Health promotion is not limited to any particular age or level of ability but rather extends throughout the lifespan from before birth (e.g., prenatal care) through old age, including anyone with a disability of any kind.

Health promotion programs that encompass the entire lifespan are applicable to people of both genders and all socioeconomic and cultural backgrounds, to those who have no health problems, and to those with chronic illnesses and disabilities. Many types of health promotion programs are in existence such as health screening, wellness, safety, stress management, or support groups for specific diseases.

### Disease Prevention

Even since the last edition of this text, disease prevention has gained momentum and today is at the forefront of the health care industry. It is now recognized and addressed by greater numbers of health care professionals that preventing disease is more cost-effective than treating disease. Many new areas of study have developed as a result of this paradigm shift in focus from treatment to prevention. Scientists are revolutionizing the way we fight infection, manage chronic illness, and stay well. For

example, one group has coined the term *immunotics* to describe this new approach to preventing and treating disease.<sup>14</sup>

Immunotics is to the twenty-first century what antibiotics were to the twentieth century—but perhaps even better. Whereas antibiotics are used to treat illness after it occurs, immunotics is designed to prevent illness in the first place. Unlike antibiotics, which can have serious side effects, immunotics has no side effects; at the very least it adopts the Hippocratic philosophy of *do no harm*.<sup>14</sup>

In another area, cancer prevention strategies to reduce the incidence of cancer occurrence and recurrence have commanded the attention of oncology researchers. Chemoprevention, the use of agents to inhibit and reverse cancer, has focused on diet-derived agents. Another term, *preventive oncology*, is a relatively new branch of medicine that includes both primary and secondary prevention.

Preventive medicine as a branch of medicine is categorized as primary, secondary, or tertiary. Primary prevention is geared toward removing or reducing disease risk factors, for example, by maintaining adequate levels of calcium intake and regular exercise as a means of preventing osteoporosis and subsequent bone fractures or by giving up or not starting smoking to reduce multiple causes of morbidity. Use of seat belts, use of helmets by motorcyclists and bicyclists, and immunizations are other examples of primary prevention strategies.

Secondary prevention techniques are designed to promote early detection of disease and to employ preventive measures to avoid further complications. Examples of secondary prevention include skin tests for tuberculosis or screening procedures such as mammography, colonoscopy, or routine cervical Papanicolaou smear.

Tertiary prevention measures are aimed at limiting the impact of established disease (e.g., radiation or chemotherapy to control localized cancer). Tertiary prevention involves rehabilitation and may end when no further healing is expected. The goal of tertiary prevention is to return the person to the highest possible level of functioning and to prevent severe disabilities.

Specific therapy interventions are not the focus of this text but whenever possible, risk factor reduction strategies are offered because risk factors are a part of the discussion surrounding each disease and therapists play an important role in disease prevention and health promotion.

### SPECIAL IMPLICATIONS FOR THE THERAPIST

1-2

#### Health Promotion and Disease Prevention

The practice of physical and occupational therapies is becoming increasingly complex. Rapid changes in the health care system are placing increased pressure on therapists for effective and efficient management of clients amidst fast client turnover. Diagnosis, prediction of prognosis, intervention, and client-family education must be done quickly and accurately. The integration of examination, evaluation, diagnosis, prognosis, and intervention (including health promotion and prevention education) is an important part of routine client management.<sup>27</sup>

In many hospitals, decreased acute care length of stay (LOS) means that physical and occupational therapists are being consulted or called on to treat clients earlier in the course of the hospitalization to help prevent secondary complications of immobility. Additionally, many individuals seeking physical and occupational therapy services have extensive medical histories requiring careful evaluation.

Understanding the diseases, surgeries, and medications frequently encountered in practice is necessary for safe and appropriate interventions and establishing a reasonable prognosis. The APTA *Guide to Physical Therapist Practice*<sup>1</sup> describes the components that make up the history portion of an examination. These components include the investigation of a client's coexisting health problems, such as illnesses, surgeries, and medications that have implications for health promotion, disease prevention, and direct treatment interventions.<sup>9</sup>

#### Role in Secondary and Tertiary Care<sup>1</sup>

Physical and occupational therapists play major roles in secondary and tertiary care. Clients with musculoskeletal, neuromuscular, cardiopulmonary, or integumentary conditions are often treated initially by another health care practitioner and then referred to the therapist for secondary care. Therapists provide secondary care in a wide range of settings from hospitals to preschools.

Tertiary care is provided by therapists in highly specialized, complex, and technologically based settings (e.g., transplant services, burn units, emergency departments) or when supplying specialized services (e.g., to clients with spinal cord lesions or closed-head trauma) in response to requests for consultation made by other health care practitioners.

#### Role in Prevention and Wellness<sup>1</sup>

Physical and occupational therapists are involved in prevention and wellness activities, screening programs, and the promotion of positive health behavior. These initiatives decrease costs by helping clients achieve and restore optimal functional capacity; minimize impairments, functional limitations, and disabilities related to congenital and acquired conditions; maintain health and thereby prevent further deterioration or future illness; and create appropriate environmental adaptations to enhance independent function.

Prevention is not confined to a single form of presentation but rather takes one of three forms: primary, secondary, or tertiary. All individuals are included—even those who already have one or more primary disabilities.

Primary prevention involves preventing disease in a susceptible or potentially susceptible population through general health promotion. Secondary prevention comprises decreasing duration of illness, severity of disease, and sequelae through early diagnosis and prompt intervention. Tertiary prevention includes limiting the degree of disability and promoting rehabilitation and restoration of function in clients with chronic and irreversible diseases.

The beneficial role of prescriptive exercise for health and disease has been documented many times and in many ways. When prescribed appropriately, exercise, including cardiovascular training, endurance training, and strength training, is effective for developing fitness and health, for increasing life expectancy, for the prevention of injury and disease, and for the rehabilitation of impairments and disabilities (Box 1-1).

Prescriptive exercise programs to develop and maintain a significant amount of muscle mass, endurance, and strength contribute to overall fitness and health. Exercise plays a significant role in reducing risk factors associated with disease states (e.g., osteoporosis, diabetes mellitus, heart disease), the risk of falls and associated injuries, and the morbidity associated with chronic disease.<sup>20</sup>

Although not as abundant, the evidence also suggests that involvement in regular exercise can provide a number of psychologic benefits related to preserved cognitive function, alleviation of depression symptoms and behavior, and an improved concept of personal control and self-direction. It is important to note that although participation in physical activity may not always elicit increases in the traditional markers of physiologic performance and fitness in older adults (e.g.,  $\text{VO}_{\text{max}}$ , body composition, blood pressure changes), it does improve health as measured by a reduction in disease risk factors and improved functional capacity and quality of life in the aging population.<sup>3</sup>

As always, when planning treatment interventions, including client education, the therapist must take into consideration the comorbidities and pathologic processes present. This requires identification of lifestyle factors (e.g., amount of exercise, stress, weight) that lead to increased risk for serious health problems, identification of risk factors for disease or injury, and performance of screening examinations (e.g., osteoporosis, skin cancer).

As a final reminder, the study and understanding of basic mechanisms of disease physiology and pathophysiology along with the identification of lifestyle or risk factors are necessary but insufficient guides for clinical practice. Many variables affect the relationships among pathology, impairments, and disability. Attention must be paid to the psychosocial, spiritual, educational, and environmental variables that can modify client outcomes.<sup>18</sup>

## GENETIC ASPECTS OF DISEASE

Advances in immunology and molecular genetics have accelerated our understanding of the genetic and cellular basis of many diseases. Remarkable progress has been made in recombinant deoxyribonucleic acid (DNA) technology, making it possible to offer molecular and cellular treatments for infectious diseases, inherited disorders, and cancer. Development of the monoclonal antibody technique is finding ever-increasing uses in the treatment

**Box 1-1****POTENTIAL USES OF GENE THERAPY\***

- Acquired immunodeficiency syndrome (AIDS)
- Adenosine deaminase (ADA) deficiency
- Alzheimer's disease
- Arthritis
- Cancer (not all forms)
- Chronic pain
- Congenital heart defects
- Cystic fibrosis
- Diabetes mellitus
- Familial hypercholesterolemia
- Heart disease
- Hemophilia
- Hepatitis
- Hepatocellular carcinoma (liver cancer)
- Huntington's disease
- Liver failure
- Marfan syndrome
- Mesothelioma
- Muscular dystrophy (Duchenne)
- Neurofibromatosis
- Peripheral vascular disease
- Schizophrenia
- Severe combined immunodeficiency (SCID)
- Sickle cell anemia

This is only a partial list of diseases or disorders being studied and compiled from research reported but should give the reader an idea of the broad and varied applications of genetic manipulation.

of diseases such as rheumatoid arthritis, cancer, and AIDS.<sup>33</sup>

At the same time, innovations in gene therapy have advanced the field of vaccine development, especially recombinant vaccine technology. Although the field of vaccination has historically focused on the prevention of infectious diseases, this technology provides a broader base for immune modulation of pathologic responses underlying other conditions.<sup>18</sup>

The completion of the Human Genome Project just 50 years after the discovery of the structure of DNA, combined with advances in technology, has enabled researchers to begin identifying the actual genes that encode particular disorders.<sup>40</sup> It may be possible in the near future to treat altered gene structure (*gene therapy*) in an attempt to cure or control previously incurable diseases. The laboratory studies and advances in the collection of immune cells made it possible to begin clinical trials of gene therapy in the early 1990s. The recent explosion in biotechnology has advanced the field of genetic testing, which is a necessary component in the genetic treatment of diseases and disorders.

### The Human Genome Project

The Human Genome Project, an international project led in the United States by the National Human Genome Research Institute (NHGRI) and the Department of Energy, was completed in April 2003 and provides a reference DNA sequence of the human genome. Researchers identified all 100,000 genes existing in 23 pairs of chro-

mosomes and deciphered the genetic code by sequencing the 3.1 billion base pairs of human DNA and mapping their location in the chromosomes.

The goals of this project have been to identify all human genes, map the genes' locations on chromosomes, and ultimately provide detailed information from the genetic coding about how the genes function. Because virtually every human illness and even many lifestyle-related conditions have a hereditary component, the Human Genome Project may hold the key to the prevention or cure of many, if not all, diseases and disorders.<sup>47</sup>

The Human Genome Project dispelled the idea that race or ethnic-based biologic differences existed when they discovered that 99.99% of the genome is the same across the human population, regardless of race or ethnic origin. Individual variations can increase the risk of disease as some people can become more vulnerable to bacteria, viruses, toxins, and chemicals, but the Human Genome Project disproved many previously held beliefs about biologically based racial differences.

Knowing the order in which these chemical units are arranged on each strand of DNA does not tell where the genes are located within the genome, the specific function of each gene in the sequence, or which genes make which proteins. The study of genomes has been labeled *genomics*, which includes the investigation of an organism's entire hereditary information encoded in the DNA. The term comes from the words "gene" and "chromosome."

The genome of any organism (including humans) is a complete DNA sequence of one set of chromosomes. Genomics is different from genetics, which is generally the study of single genes or groups of genes. Genomics with its unfolding of the complete DNA sequences will provide a basis for the study of susceptibility to disease, the pathogenesis of disease, and the development of new preventive and therapeutic approaches.

Additionally, the completion of the Human Genome Project has enhanced the widespread use of prenatal diagnosis and DNA chip technology and will make it possible to analyze a sample of DNA collected from saliva. Drugs designed and prescribed to accommodate individual differences in metabolism may be possible from the data derived from this project. All of these areas of interest will be the substance of future studies.

Information about the genes is made available immediately on the Internet to scientists, clinicians, librarians, educators, and the general public. The cataloging and filing of this information are under the auspices of the Cancer Genome Anatomy Project (CGAP). The Human Cancer Genome Project is another program that is attempting to develop a comprehensive description of the genetic basis of human cancer and specifically the complete identification and characterization of genetic alterations present in a large number of major types of cancer (Fig. 1-3).

### Gene Therapy

Genes are the chemical messengers of heredity. Two hundred thousand (200,000) human genes composed of

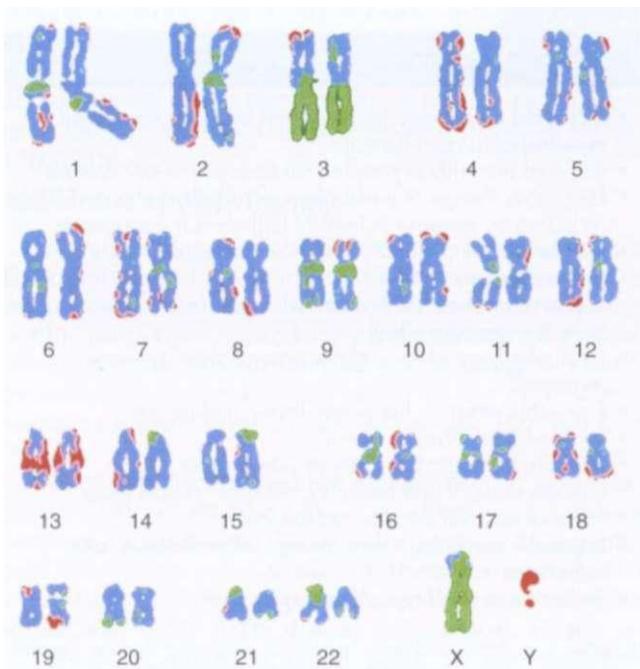


Figure 1-3

Example of genetic basis for cancer found in early cervical carcinoma. The gain of chromosome 3q (tumor DNA seen as green) that occurs with HPV16 infection defines the transition from severe dysplasia/carcinoma in situ to invasive carcinoma of the uterine cervix. Genetic testing can help identify chromosomal aberrations such as this that occur during carcinogenesis. (From Heselmeyer K, Schrock E, du Manoir S, et al: Gain of chromosome 3q defines the transition from severe dysplasia to invasive carcinoma of the uterine cervix, *Proc Natl Acad Sci USA* 93:479-484, 1996.)

DNA molecules along a double helix and carrying instructions for synthesizing every protein that the body needs to function properly (Fig. 1-4) have been identified. Their order determines the function of the gene. Genes determine everything from appearance to the regulation of everyday life processes (e.g., how efficiently we process foods, how effectively we fight infection).

DNA is composed of different combinations of molecules called *nucleic acids*. The sequence of nucleic acids provides instructions for assembling amino acids, which are the basic structural units of proteins (Fig. 1-5). A change in the normal DNA pattern of a particular gene is called a *mutation*. Some illnesses are caused by a tiny change in the DNA of just one gene, whereas others are caused by major changes in the DNA of multiple genes.

Most illnesses, including most cases of cancer, are caused by acquired mutations. Acquired mutations arise during normal daily life, usually during the process of cell division. Each day the body replaces thousands of worn-out cells. Some genetic errors are inevitable as old cells replicate and pass DNA flaws along to replacement (daughter) cells. When all goes well, daughter cells recognize these mutations and repair them, but the repair mechanism can fail or be disabled by environmental toxins and diet. Although acquired mutations can be passed on to daughter cells, they cannot be inherited.

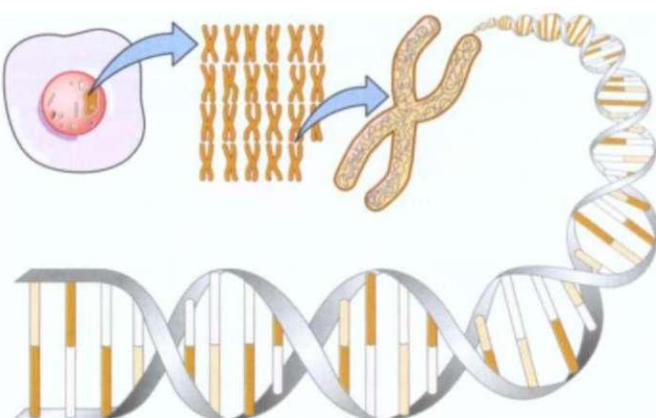


Figure 1-4

Schematic diagram of deoxyribonucleic acid (DNA). Inside the nucleus of nearly every cell in the body, a complex set of genetic instructions, known as the *human genome*, is contained on 23 pairs of chromosomes. Chromosomes are made of long chains of a chemical called DNA, packaged into short segments called *genes*. Every cell of every human body contains a copy of the same DNA. Genes contain instructions to direct all body functions written in a molecular language. This molecular language is made up of four letters; each letter represents a molecule on the DNA: adenine, cytosine, guanine, thymine. The As, Cs, Gs, and Ts form in triplets, constituting a code; each triplet of letters instructs the cell to attach to a particular amino acid (e.g., TGG attaches to amino acid tryptophan). Amino acids combined together form proteins. If the DNA language becomes garbled or a word is misspelled, the cell may make the wrong protein or too much or too little of the right one—mistakes that often result in disease.

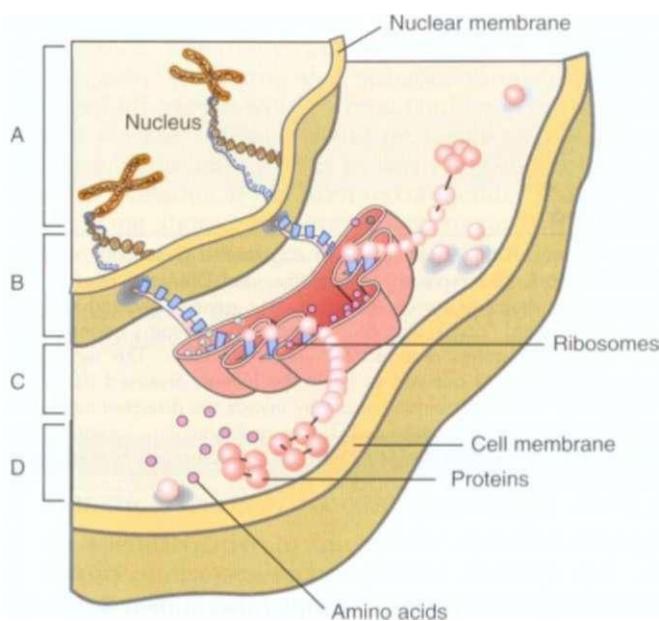
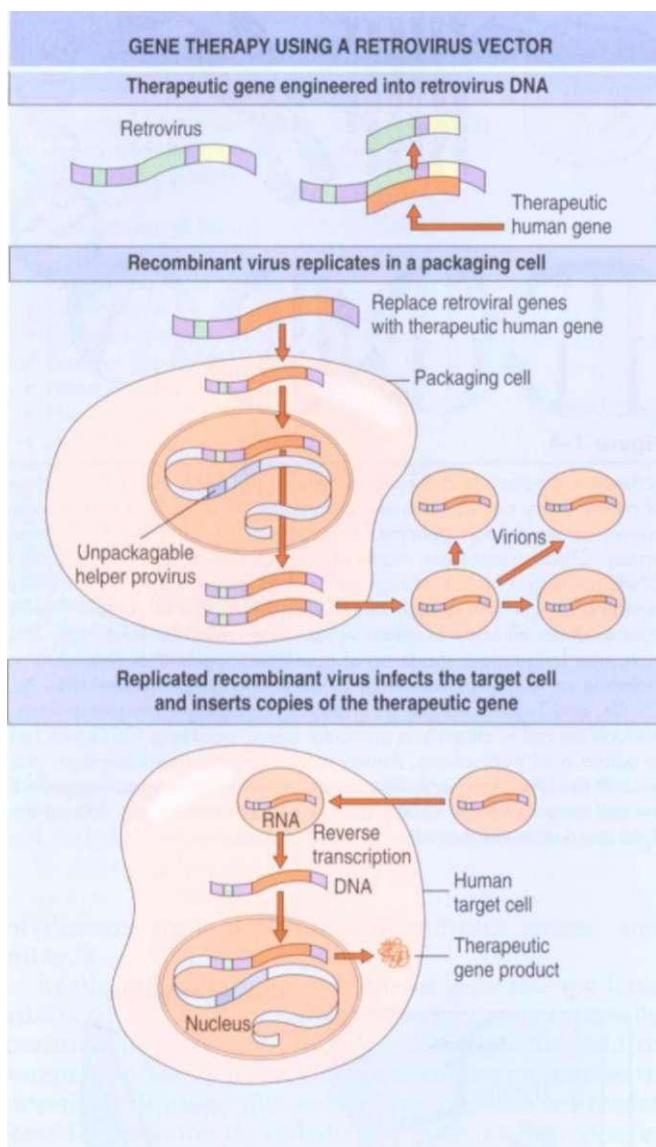


Figure 1-5

The chain of events from DNA; this is how the DNA directs the cell. A, Ribonucleic acid (RNA) receives instructions from the DNA code in the chromosomes. B, The RNA travels from the nucleus to link up with ribosomes (protein-making units). C, Instructions from the code contained within the DNA are used by the RNA-ribosome complex to assemble amino acids. D, Cellular function is now directed by proteins containing the amino acids.



**Figure 1-6**

Gene therapy. A therapeutic gene is engineered genetically into the retrovirus DNA and replaces most of the viral DNA sequences. The recombinant virus that carries the therapeutic gene is allowed to replicate in a special "packaging cell," which also contains normal virus that carries the genes required for viral replication. The replicated recombinant virus is allowed to infect the human diseased tissue, or "target cell." The recombinant virus may invade the diseased tissue but cannot replicate or destroy the cell. The recombinant virus inserts copies of the normal therapeutic gene into the host genome and produces the normal protein product. (From Yanoff M, Duker JS: *Ophthalmology*, ed 2, St Louis, 2004, Mosby.)

More specifically, gene therapy (also known as *human genetic engineering*) is the process in which specific malfunctioning cells are targeted and repaired or replaced with corrected genes (Fig. 1-6). A gene can be delivered to a cell using a carrier known as a "vector." The most common types of vectors used in gene therapy are genetically altered viruses, but nonviral vectors are being developed as potential gene delivery vehicles as well. Essentially, DNA is used like a drug, allowing it to replace or repair

### Box 1-2

#### BENEFITS OF EXERCISE

- Increased cardiovascular functional capacity, decreased myocardial oxygen demand
- Reduced mortality in people with coronary artery disease
- Favorable change in metabolism of carbohydrates and lipids, including an increase in level of high-density lipoproteins
- Improved hemodynamic, hormonal, metabolic, neurologic, and respiratory function
- Improves immune function (stressful or excessive exercise can have the opposite effect)
- Facilitates biorhythms and thermoregulation; prevents insomnia
- Favorable effect on fibrinogen levels in older men
- Increased sensitivity to insulin
- Increase bone density; prevent osteoporosis
- Greater strength and flexibility; maintain muscle mass
- Improve postural stability; reduce falls
- Improved psychologic functioning, self-confidence, and self-esteem
- Reduction in some type A behaviors

Modified from American Heart Association: Recommendations: benefits of exercise, and guidelines for becoming—and remaining—active, *J Musculoskel Med* 14(5):60–65, 1997.

defective genes. It is hoped that the altered cells will yield daughter cells with healthy genes; these offspring cells will help eliminate the diseased cells. Alternately, cells can be genetically altered to contain a toxin-producing suicide gene to treat some cancers.<sup>13</sup>

#### Uses for Gene Therapy

Research is ongoing into such cures for a wide variety of hereditary disorders and diseases caused by aging (Box 1-2); some diseases, such as hemophilia, are being studied as a good model for gene therapy. Gene therapy for the treatment of diseases in children before birth is being actively pursued at many medical centers using animal models. In utero gene therapy (IUGT) could be beneficial for those with genetic diseases if gene therapy is performed before symptoms are manifested.<sup>39,52</sup>

Gene therapy is being investigated as a means of helping injuries heal, replacing worn-out tissue, reducing scar tissue, or fusing spinal segments together. The gene for bone growth has been injected into the disk space and shown to signal enough bone growth to bridge the bone on either side of the space. Investigational studies using animals may find an injectable method to fuse bone to replace the costly and complicated spinal fusion surgery.<sup>48</sup>

Gene insertion has been used to successfully treat humans with inoperable coronary artery disease. Researchers injected a gene that makes a protein called *vascular endothelial growth factor* (VEGF) into the hearts of candidates with severe chest pain caused by ischemia that could not be corrected with bypass surgery or angioplasty.

Tests suggest that once installed, the gene produces blood vessel-promoting proteins for 2 or 3 weeks (enough to grow a permanent new blood supply) before

ceasing to work. The heart actually sprouts tiny new blood vessels (therapeutic angiogenesis) too small to be seen but with improved blood flow to the heart readily demonstrated.<sup>25-49</sup> Investigations continue to examine gene therapy strategies to deliver genes coding for the angiogens.

### Approaches to Gene Therapy

Gene therapy may take a number of different approaches. The original design was to inject one or more genes into the person to replace those that are absent or not functioning properly. A second approach called *small-molecule therapy* injects a small molecule (i.e., a drug) to modify the function of one or more genes in the body that is making a normal product but just too much or too little of it.

Other approaches include transferring a gene into cancer cells to sensitize them to drugs<sup>19</sup> or restoring immune function in HIV by transferring a therapeutic gene into target cells, rendering them resistant to HIV replication. Infusion of protected cells may limit virus spread and delay AIDS disease progression. Efforts are underway to deliver antiviral genes to hematopoietic stem cells to ensure a renewable supply of HIV-protected cells for the life of the individual.<sup>12,32</sup>

Germ-line gene therapy is an approach that delivers genes to sperm or egg (or to the cells that produce them). It might prevent defective genes from being transmitted to subsequent generations by repairing the original genetic defect in germ cells. Gene modification at an early stage of embryonic development might also be a way of correcting gene defects in both the germ-line and body cells. This therapy is highly controversial because it carries an unknown level of risk (interference with another gene, specificity of the insertion). As a consequence, germ-line gene therapy is not being considered for application to humans at this time. In the future, if scientists determine ways to make sure that a transferred gene goes into the cell's genome at the same position as the already mutated gene, then the safety of germ-line gene therapy procedures might be dramatically increased.

### Obstacles to Gene Therapy

Some obstacles to gene therapy must be overcome before this procedure is considered a viable treatment option. Examples include finding appropriate harmless viral vectors to carry the normal gene to the target cells that do not provoke an immune response against them as foreign invaders or cause toxic side effects, engineering the transplanted genes to be efficient and effective, and finding ways to modify retrovirus vectors so they can carry the genes into nondividing cells (presently, genes can only be delivered to actively dividing cells when delivered by retrovirus vectors).

Ethical concerns have also been raised about the use of human genetic engineering for purposes other than therapy (e.g., eugenics). These include the use of genes to improve ourselves cosmetically, increase intelligence (a gene has been discovered that seems to make mice more intelligent), accomplish ethnic cleansing ("designer babies" genetically engineered before birth), or cause permanent changes in the gene pool. Some researchers are

advocating the use of human genetic engineering for the treatment of serious diseases only.<sup>50</sup>

**Gene Doping.** Gene therapy in sports athletes, called *gene doping*, involves transferring genes directly into human cells to blend with an athlete's own DNA, enhancing muscle growth and increasing strength or endurance. Gene doping is banned in sports, and although there has been no direct evidence yet to prove it, there is some concern that gene doping has already begun.

Concerns have been raised about long-term effects such as leukemia, other forms of cancer, and unknown effects, including the potential harm in passing changes on to the athlete's children. Although not currently in use, the potential for gene doping to enhance performance has been discussed in the literature.<sup>24,50</sup>

### Gene Testing

The new and rapidly expanding field of genetic testing holds great promise for detecting many devastating illnesses long before their symptoms become apparent. Such testing identifies people who have inherited a faulty gene that may (or may not) lead to a particular disorder. In the last 15 years, such predictive tests have been developed for more than 200 of the 4000 diseases thought to be caused by inherited gene mutations. The result has been earlier monitoring, preventive treatments, and in some cases, planning for long-term care.

However, gene testing is not without its difficulties. For example, the presence of a particular mutation does not mean that illness is inevitable, making the interpretation of test results a highly complex task. The psychologic implications of predictive testing must be considered. Identifying who is a candidate for testing remains to be determined. Inheritance accounts for a limited number of diseases, suggesting that genetic testing should be reserved for people with a strong family history of a particular disease. Safeguards and protocols are not always in place before testing finds its way into general practice. For these reasons, it has been recommended that predictive testing should be confined to research or clinical settings where skilled counseling is available.

Other ethical issues and privacy concerns, such as the potential use of genetic testing to screen job applicants or to qualify for insurance coverage, must also be settled.

### SPECIAL IMPLICATIONS FOR THE THERAPIST

1-3

#### *Genetic Aspects of Disease*

As scientists strive to unravel the complex etiologic factors of diseases, such as obesity, diabetes, and cardiovascular disease, through the use of molecular and genetic tools now available, understanding the interaction and influence of environmental factors, such as exercise, on gene expression and function has taken on increasing importance.

The Human Genome Project emphasizes the importance of other factors in disease susceptibility when genetic differences are eliminated. For example, regular

*Continued.*

exercise has been shown to improve glucose tolerance, control of lipid abnormalities, diabetes mellitus, hypertension, bone density, immune function, psychologic function, sleep patterns, and obesity, with the greatest benefits realized by sedentary individuals who begin to exercise for the first time or after an extended period of inactivity. Responses to exercise interventions are often highly variable among individuals, and research has indicated that response to exercise may be mediated or influenced in large part by variation in genes.<sup>10</sup>

The study of acute and chronic effects of exercise on the structure and function of organ systems is now a field of research referred to as *exercise science*. During the last 30 years, exercise-related research has rapidly transitioned from focus on an organ to a subcellular/molecular focus. It is expected that genetic research will focus on translating fundamental knowledge into solving the complexities of a number of degenerative diseases influenced heavily by activity/inactivity factors such as cardiopulmonary disease, diabetes mellitus,

obesity, and the debilitating disorders associated with aging.<sup>7</sup>

Individual genotypes and other genetic information may eventually help therapists assess a client's risk for conditions, enable us to understand why some people respond to the same intervention faster or better than others who have the same diagnosis, and develop and execute an appropriate plan of care. Gene therapy and the elimination of some diseases and conditions may contribute to the continued trend to focus on health and fitness for physical therapists of the future.<sup>47</sup>

## References

To enhance this text and add value for the reader, all references are included on the companion Evolve site that accompanies this textbook. The reader can view the reference source and access it online whenever possible. There are a total of 59 cited references and other general references for this chapter.

## CHAPTER 2

# Behavioral, Social, and Environmental Factors Contributing to Disease and Dysfunction

SUSAN A. SCHERER • IRA GORMAN • CATHERINE C. GOODMAN

### OVERVIEW

The biomedical model of health care has governed the thinking of most health practitioners for the past three centuries holding to the premise that all illness can be explained based on disorder and disease of bodily anatomy and physiologic processes. This model assumes that psychologic, social, and spiritual influences are independent of the disease process.

By contrast, the biopsychosocial model of health and illness supports the idea that biologic, psychologic, and social variables are key factors in health and illness. The mind and body cannot be separated since they both influence the state of health. The biopsychosocial model emphasizes health and illness, rather than considering illness as a deviation of the healthy state.

During the 1980s, the medical model was influenced by a movement toward what was then called *holistic health*, the notion that the physical, mental, social, and spiritual aspects of a person's life must be viewed as an integrated whole. Since that time, it has become well established that social support plays a key role in promoting health, decreasing susceptibility to disease, and facilitating recovery from illness or injury.

During the 1990s, basic scientists and clinicians continued to recognize the healing potential of faith, spirituality, and religious beliefs and started to consider the complex biopsychosocial-spiritual phenomena associated with disease, illness, and injury. Multidisciplinary team and managed care approaches to such conditions address the needs of the client in terms of the emotional and psychologic impact, social and spiritual needs, and comprehensive biologic picture that goes beyond medication and surgical intervention as the primary forms of medical treatment.

### Behavioral, Social, and Environmental Factors

Aside from the pathology itself, many behavioral, social, and environmental factors influence health and may mitigate or enhance the effects of disease. The impact of these factors on the disease process or the consequences

of disease will be a major focus of this chapter. The influence of selected behavioral, social support, and environmental factors on health will be reviewed separately with models or theories described that integrate these components in defining and characterizing health.

Traditionally, physical therapists have approached rehabilitation from a medical model mediated through the mechanism of physiologic impairments. The medical model generally considers the underlying assumptions that pathology should be treated or cured and that pathology leads directly to consequences, including impairment, limitations in physical function, and diminished quality of life. The medical model is then logically focused on eliminating pathology or the resulting impairments, which would then lead to improved function.

Although this model is important for understanding medical care, it does not address the other factors that influence a person's physical or mental health. The medical model focuses on factors internal to the individual that directly affect an individual's health status; however, considerable information now indicates that factors external to an individual also play a significant role in a person's health status.

During the last two decades of the twentieth century, health care professionals developed a better understanding of the importance of behavioral and social issues and how unhealthy behaviors are linked to many conditions and diseases. This shift in emphasis encourages the development of new treatments or interventions that impact an individual's health. The Centers for Disease Control and Prevention (CDC) has responded to a growing awareness of these changes and established three new internal units to deal with them directly: (1) the National Center for Chronic Disease Prevention and Health Promotion; (2) The National Center for Injury Prevention and Control; and (3) the National Center for HIV, SID, and TB Prevention. The task of these groups is to focus on conditions, diseases, and injuries with clear behavioral risks.<sup>123</sup>

Other areas of behavioral and social research have focused on social forces affecting the environment that could impact health and the influence of class, family structure, and ethnicity on health and illness.<sup>125</sup> In keeping

with these changes in the direction of behavioral and social sciences in public health, the intent of this chapter is to increase the physical therapists' understanding of behavioral, social, and environmental issues in addition to the pathology that can affect health and physical function.

Much work has been done to develop methods to classify the effects of disease on health at all levels. Using the concepts of health and disease presented in Chapter 1, we recognize that the consequences of disease include effects on tissues (pathology), on organs or organ systems, (impairments), and on the person's ability to function in daily life (disability, activity limitations) and function in society (handicap, participation restrictions). These categories should be useful to rehabilitation specialists as well, who look to mitigate (i.e., reduce the impact of) the effects of disease by focusing on improving physical function and/or performance of daily activities. In addition, this viewpoint reminds us that the adverse effects of pathology may be mediated by other social and environmental factors.

## CLINICAL MODELS OF HEALTH

The principles presented in Chapter 1 regarding disablement or enablement models may also be used in clinical practice. The clinical practice perspectives may be characterized by a broad approach to health. From a biopsychosocial point of view, models of health can be narrowed down to the following three main approaches:

- Biomedical model focuses on the disease process.
- Biopsychosocial model describes the role of biological, psychological, and social factors on a person's health.
- Social-ecologic model describes multiple levels of interaction that influence health.

### Biomedical Model

From our discussion in Chapter 1, we know the traditional biomedical model is based on the premise that health is primarily influenced by the person's biologic state, or whether there is an abnormality at the cellular (pathology) or organ system level (impairments). In this model, in order to improve health, one must cure or treat the underlying disease process.

### Biopsychosocial Model

The biopsychosocial model combines knowledge from the disciplines of behavioral medicine, behavioral health, and health psychology.<sup>254</sup> In this model, a person's psychologic system, including aspects of cognition, emotion, and motivation, interacts with biologic factors to produce various states of health. Likewise, how an individual interacts with family, community, and society also influences health outcomes.

Compared to the biomedical model, the benefit of this approach is that it includes factors other than physical condition that influence health. The negative effect of this

approach is to place blame on the individual for his or her health status, while neglecting the influence of social or environmental factors on the individual.

### Social-Ecologic Model

From the field of social community health and health promotion, the social-ecologic model was developed on a broader view of health issues. Social ecology is viewed as an overarching framework or a set of theoretic principles for understanding the interrelations among diverse personal and environmental factors in human health and illness.<sup>274</sup> Social-ecologic theory, an extension of the biologic concept of ecology, creates a framework in which to place and discuss health at a level beyond the individual.

Four primary assumptions regarding social-ecologic theory have been outlined.<sup>235,236</sup> First, intrapersonal, social, and physical environments work jointly to influence health behavior. Second, environmental influences on health are the result not only of physical and social components but also the perception of these variables by the individual. Recognition of various collective levels of human interaction with the environment (e.g., individual-environment, community-environment, or population-environment) comprises the third assumption.

The fourth and critical assumption of social-ecologic theory is the relationship between environmental levels and collections of individuals. In short, altering behaviors among individuals will influence environmental level characteristics, which will in turn further influence groups of individuals within a community or population.

Various models of social ecology have been described and applied in intervention programs. The most common construction of social ecology, provided by Sallis and Owen,<sup>219</sup> proposes that behaviors are influenced by *intrapersonal*, *sociocultural*, *policy*, and *physical-environmental* factors.

Bronfenbrenner's<sup>35</sup> model describes three levels of environmental-individual interaction, the *microsystem* (i.e., interpersonal interactions), the *mesosystem* (i.e., interactions among various settings such as work, family, and social networks), and the *exosystem* (i.e., cultural, political, and economic forces).

The model proposed by McLeroy et al in 1988<sup>168</sup> is composed of five classes of factors: *intrapersonal factors*, *interpersonal processes* and *primary groups*, *institutional factors*, *community factors*, and *public policy*. Behavior is the outcome of interest and is determined by the five classes, with four of the five pertaining to the person's environment and clearly beyond the intrapersonal. Moos'<sup>176</sup> ecologic model is geared toward health behavior and constructed of *physical settings*, *organizational factors*, *human aggregates*, and *social climate*.

The important point in recognizing the diversity of the models used to describe social-ecologic theory is to observe the common threads that run between them. Each reflects the interrelationship between individual level characteristics and large-scale social forces (Fig. 2-1). Increasingly larger social structures influence the indi-

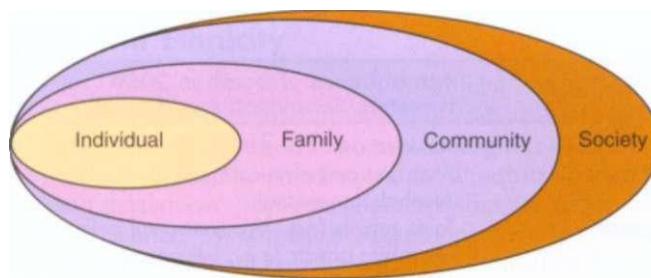


Figure 2-1

Social structures influencing the individual. Aside from the pathology itself, many behavioral, social, and environmental factors influence health and may mitigate or enhance the effects of disease. The individual is influenced in various ways by family, community, and society. Each of these nested social structures influences the individual and can shape behavior, including the ability to make health decisions, compliance with regimens, or even initial health choices. (Courtesy Ira Gorman, PT, MSPH, Regis University, Department of Physical Therapy, Denver, CO.)

vidual and can shape behavior, including the ability to make health decisions such as compliance with regimens or even initial health choices.

This model attempts to identify the various levels of influence that have an impact on health, from the individual to the environment. This view greatly broadens the types of interventions that can improve health and helps us understand the role pathologic processes have at the cellular level as they interact with the environment to cause disease, impairment, functional limitations, and disability.

## VARIATIONS IN CLIENT POPULATIONS

*Healthy People 2010*<sup>10</sup> recognizes the need for all Americans to benefit from advancements in quality of life and health, regardless of race, ethnicity, gender, geographic location, disability status, income, sexual or spiritual orientation, or educational level. Recognizing variations in client populations is important in helping all health care professionals to provide health-promoting and preventive programs.

## Sociodemographics

Sociodemographic information and the results of the 2000 census have provided us with a composite picture of America never before so broad based or so complete. Americans are more diverse ethnically, with an estimated ethnic racial mix of 72% white, 12% African American, 12% Hispanic, and 4% Asian and Pacific Islander. By the year 2020 the number of people of Asian descent will double from 10 million to 20 million, and by 2050, whites will comprise only 53% of the U.S. population.

Rapid population shifts to the mountain states and resurgent growth in suburbs have changed the urban/rural configurations. More than 10% of all rural counties gained population in the last decade.

Finally, the percentage of Americans who are married continues to drop—most recently from 58.1% of those age 15 and older in 1992 to 56.4% in 1998.<sup>110</sup> Since the census was completed, new reports indicate that the percentage of single heads of households (52%) has now surpassed married households.

## Health Status

The health status of the United States is a description of the health of the total population using information that is representative of most people living in this country. However, it must be noted that our current epidemiologic system does not keep data on people who do not obtain treatment; no universal or uniform registry is available in the United States.

Health status of a nation can be measured by birth and death rates, life expectancy, quality of life, morbidity from specific diseases, risk factors, the use of ambulatory care and inpatient care, accessibility of health personnel and facilities, financing of health care, health insurance coverage, and many other factors.

The leading causes of death are often used to describe the health status of a nation. For example, in the United States, obesity, alcoholism, sedentary lifestyle, and tobacco use have contributed significantly to the most common causes of morbidity and mortality in 2000, compared with the year 1900, when infectious diseases ran rampant in the United States and worldwide and topped the leading causes of death. In the year 2000, 65% of all deaths were caused by cardiovascular disease, cancer, and diabetes.<sup>111</sup>

Deaths, permanent disability, and unnecessary suffering from medical errors are an escalating problem that remains largely unreported. According to the Institute of Medicine (IOM),<sup>112</sup> medical errors kill over 44,000 people in U.S. hospitals each year. Statistics are not available for similar errors in other health-related settings such as same-day surgery centers, outpatient clinics, retail pharmacies, nursing homes, and in-home care. Deaths from medication errors that occur both in and out of hospitals (more than 1000 annually) exceed those caused by injuries in the workplace.

## Chronic Diseases

Over the last century, a shift from infectious to chronic diseases has occurred. As a result of the control of many infectious agents, eradication of childhood diseases, and the current increasing age of the population, chronic diseases now top the list as causes of morbidity and mortality in the United States (Table 2-1). Many of these illnesses are modifiable through changes in behavior and lifestyle. This trend has led to a new focus in rehabilitation: chronic disease management. In some places, chronic disease management is a new term for rehabilitation.

Cost of health care delivery has increased exponentially with the rise in aging, risky lifestyle behaviors, and associated medical conditions. Chronic conditions, such as heart disease, hypertension, diabetes, and mental disorders, are costing billions of dollars—more than even 20 years ago. Up to half of Medicare patients aged 65 and

**Table 2-1** Leading Causes of Death in the United States\*

Cause of Death in 1900	Cause of Death in 2000	Actual Cause of Death in 2000 (Lifestyle/Behaviors: modifiable)
Pneumonia, influenza	Heart disease	Tobacco use
Tuberculosis	Cancer	Poor diet and physical inactivity
Heart disease	Stroke	Alcohol consumption
Diarrhea, enteritis	Chronic lower respiratory disease	Toxic agents (e.g., environmental pollutants)
Stroke	Pneumonia, influenza	Microbial agents (e.g., influenza)
	Alzheimer's disease	Motor vehicle accidents
	Kidney disease	Firearms
	Accidental injuries	Sexual behavior
		Illicit drug use

Data from Mokdad AH: Actual causes of death in the United States, 2000, JAMA 291 (10): 1 238-1 245, 2004.

\* Listed in descending order of incidence.

older have at least three chronic medical conditions, and one-fifth has five or more.<sup>243</sup>

Medical spending has increased as more people are suffering from chronic disorders with multiple complex comorbidities. In addition, some conditions have become more expensive to treat, and the number of people diagnosed with these conditions has increased.<sup>244</sup>

With modifiable behavioral risk factors as leading causes of mortality in the United States, identifying trends and gearing prevention strategies and opportunities toward these specific behaviors may help offset escalating health care costs.<sup>13</sup>

Despite all the evidence supporting the medical and economic benefits of prevention and early detection, current disease control efforts are underfunded and fragmented. While health care costs are skyrocketing, the national investment in prevention is estimated at less than 3% of the total annual health care expenditures.<sup>48</sup>

### Americans with Disabilities

There were 49.<sup>1</sup> million Americans reported in the 2000 U.S. Census with some disability. This number increased by the mid-2000s to over 54 million. Rates of disability are higher among older adults who also have higher rates of chronic diseases.

Almost half of all seniors (over age 65) have a physical, sensory, mental, or learning disability of some kind. There is a wide range of definitions for disability used in social research situations. In some cases, disability is any difficulty with activities of daily living or limitations associated with over 30 associated health conditions. Other definitions include those receiving federal benefits on the basis of an inability to work or those with any limitation in the ability to work at a job or business, yet over half (56%) of working-age individuals with a disability are employed.<sup>245</sup>

Until the census in 2000, the number of American veterans was declining. With the American involvement in the Middle East in the new century, 2010 census figures may show an increase in these statistics. Therapists may expect to see a greater number of combat-related disabilities among men and women in the military, as well as in the civilian sector once they are discharged.

With increasing life expectancy and the aging of America, health issues related to disability are likely to

increase in prevalence and importance over the next few decades. Living longer means increasing percentages of individuals with disabilities.

### Geographic Variations

The concept of "community" as it relates to where individuals live geographically and the characteristics of that place has a definite impact on the status of people's health. For example, based on statistics pertaining to crime, divorce, population density, unemployment, and average commuting time, the most stressful cities and jobs have been identified, as well as the least stressful locations and occupations.<sup>54</sup>

Other factors, such as urban pockets of minority groups (usually associated with increased levels of poverty), access to fresh fruits and vegetables (or lack thereof), and even local smoking ordinances, contribute to the geographic variations people experience that can impact their health.<sup>201</sup>

The geographic and political climates of countries also play a role in determining how people live and the health problems that commonly develop. A half-century ago, a few physicians cultivated an interest in diseases that seemed to have strict geographic boundaries. As a result, a discipline called *geographic pathology* developed. Geographic pathology was concerned with diseases endemic (present in a community at all times) to certain areas of the world, most often parasitic and infectious diseases that seemed unique to individual geographic regions. A component called *occupational disease* was added with the discovery that chemical agents are mediators of a variety of tissue changes and the recognition that many of these causative agents are environmental contaminants. Disease caused by contaminants was included to constitute the field of *environmental pathology*. For further discussion, see Chapter 4.

One other issue related to geographic variations is the fact that treatment for a single medical condition can vary significantly from one geographic location to another. Rates and types of surgical procedures differ from one geographic location to another, depending on the prevailing health care system, physician and hospital preferences (not client preferences or needs), and where the physician was trained.<sup>30,195</sup>

## Race and Ethnicity

The use of the terms "race" and "ethnicity" are seldom well defined and are generally thought to have less scientific and biologic significance than sociologic and cultural importance. The CDC defines race as "an arbitrary classification based on physical characteristics; a group of persons related by common descent or heredity." The CDC defines ethnicity as "an arbitrary classification based on cultural, religious, or linguistic traditions; ethnic traits, background, allegiance, or association."<sup>185</sup>

Identification of race and ethnicity is widely used when collecting vital statistics and demographic data for documenting health patterns among population groups living in the United States and globally. The National Health and Nutrition Examination Survey (NHANES) I, II, and III (developed in 1959, the 1970s, and the 1980s, respectively) used race and ethnicity data when evaluating the health and nutrition status of the civilian, noninstitutionalized population of the United States. This survey is updated annually.<sup>186</sup>

The Hispanic HANES (HHANES) was conducted to obtain sufficient numbers to produce estimates of the health and nutritional status of Hispanics in general, as well as specific data for Puerto Ricans, Mexican Americans, and Cuban Americans. Included in the survey were Mexican Americans from Texas, Colorado, New Mexico, Arizona, and California; Cuban Americans from Dade County, Florida; and Puerto Ricans from the New York area, including parts of New Jersey and Connecticut.<sup>183,187</sup>

In planning for the U.S. Census 2000, the Office of Management and Budget (OMB) revised the Race and Ethnic Standards for Federal Statistics and Administrative Reporting. The revised standards include five minimum categories for data on race: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, and White. There are two categories for data on ethnicity: "Hispanic or Latino" and "Not Hispanic or Latino."<sup>186</sup>

The CDC has developed unique identifiers for race and ethnicity. The CDC data collection and reporting system is standardized and includes data elements that describe a unique identifier code set for race and ethnicity information and provides guidance for recording and exchanging this type of information. The unique identifier code set combines current federal standards for classifying data based on minimum race and ethnicity categories as defined by the OMB and a more detailed set of race and ethnicity categories from the U.S. Bureau of Census.<sup>184</sup>

In the past, it was believed that race or ethnic background predisposed people to certain diseases and chronic conditions. However, during the last 50 years, "race" has been scientifically disproved—that is, race is not a real, natural phenomenon. Data on human variation come from studies of genetic variation, which are clearly quantifiable and replicable. Genetic data show that no matter how racial groups are defined, two people from the same racial group are as different as two people from any two different racial groups.

Current information about biologic and genetic characteristics of various groups (e.g., blacks, Hispanics,

Native Americans, Alaskan Natives, Native Hawaiians, or Pacific Islanders) does not explain the health disparities experienced by these groups. These differences are believed to be the result of the complex interaction among genetic variations, environmental factors, and specific sociocultural and health behaviors.

Data indicate that some conditions are more prevalent in certain groups; for example, nonwhite people (black, Native Americans, and Asians) are three times more likely to die of hypertension than whites of the same age group. In the past, causes of death were identified that together accounted for more than 80% of mortality in nonwhite people, including cancer; cardiovascular disease and stroke; chemical dependency; cirrhoses; diabetes; homicides, suicides, and accidents; and infant mortality.<sup>188</sup>

Other conditions that are peculiar to ethnic or racial groups include Tay-Sachs disease (Jewish people of northeastern European origin are most susceptible); cystic fibrosis (incidence is highest in whites and rare in Asians); and sickle cell anemia, which affects blacks, especially Africans.

## Health Disparities

Although it is a well-known fact that over the last 100 hundred years health care has dramatically improved the lifespan and the quality of life for many through advances in public health, medical discoveries, and technology, it is less known that not every segment of the population has benefited equally from the advances in health care.

Social factors, such as socioeconomic status, access to health care, language differences, place of birth, residential segregation, and access to nutrition, have all been variables that help explain the disparities in health care that result in higher morbidity and mortality rates among groups of Americans. For example, statistics show a broad gap between the death rates for blacks and whites, but blacks differ more from each other than they do from whites.<sup>189</sup> Whites living in higher socioeconomic areas have lower mortality rates than whites living in predominantly black areas for all age groups, and elderly blacks living in black areas (despite their less favorable socioeconomic status) have lower mortality rates for all causes than those living in white areas.<sup>190</sup>

Although cancer death rates are declining nationally, ethnic groups and medically underserved populations have a higher incidence and lower survival rate. Racial differences in the surgical treatment of blacks as compared with whites have been documented.<sup>191</sup>

Available education and health care resources are not accessible to minorities and rural residents with limited financial means. Routine programs, such as antismoking campaigns and cancer screenings (e.g., breast, prostate, or colon), tend to be focused on affluent Americans who are better educated and can afford regular medical care.<sup>192</sup> The general understanding regarding health care was that those who could afford health care had access to health care and those who could not afford health care did not have access to health care. Thus there was disparity in health care related to access based on socioeconomic factors.

In the 1990s, it became apparent that despite the improved access to health care through the national

Medicare health system, there were persistent health disparities. In 1999 the U.S. Congress mandated the IOM to conduct a study to assess differences in the kinds and quality of health care received by U.S. racial and ethnic minorities and nonminorities. The IOM was charged to assess the extent of racial and ethnic differences in health care not otherwise attributable to known factors such as access to care (ability to pay for insurance coverage). The IOM was to evaluate potential sources of racial and ethnic disparities in health care, including the role of bias, discrimination, and stereotyping at the individual (patient and provider), institutional, and health systems level. The IOM was also charged to provide recommendations regarding interventions to eliminate health care disparities.

The IOM committee reviewed over 100 studies that assessed the quality of health care for various racial and ethnic minority groups. The research studies reviewed controlled for variations in insurance status, patient income, and other access-related factors.<sup>231</sup>

Racial and ethnic disparities remain even after adjustment for socioeconomic differences and other health care access-related factors. According to the IOM report,<sup>231</sup> there is a difference in the quality of health care provided to racial and ethnic minorities even when there is equal access to health care.

The IOM report findings indicate "despite steady improvement in the overall health of the U.S. population, racial and ethnic minorities, with few exceptions, experience higher rates of morbidity and mortality than non-minorities."<sup>232</sup> Minorities are less likely than whites to receive needed health services, including clinically necessary procedures.

Racial and ethnic health disparities exist in different disease conditions such cardiovascular disease, cancer, human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS), mental illness, and diabetes. Racial and ethnic minorities are less likely than whites to receive angioplasty, coronary artery bypass graft surgery, mammography, and hip fracture repair.

African Americans are 2.5 times more likely than whites to have radical surgeries, such as bilateral orchectomy as a result of cancer and limb amputation secondary to peripheral vascular disease, when compared to other racial groups with similar medical conditions. Disparities are found across a range of clinical settings, including public and private hospitals and teaching and nonteaching medical centers. Health disparities result in higher morbidity and mortality rates among minorities.

### **Disparities in Rehabilitation Services**

Specific to health care practices in rehabilitative services, three research studies reviewed by the IOM identified the following information on health disparities:

- Harada, Chun, Chui, et al<sup>105</sup> assessed sociodemographic and clinical characteristics associated with the use of physical therapy in acute hospitals, skilled nursing facilities, or both. The records of 18,900 hip fracture patients were reviewed. African-American patients were less likely than whites to receive acute physical therapy, were less likely than whites

to receive physical therapy in both acute care and skilled nursing facilities, and were more likely to receive no physical therapy at all.<sup>231</sup>

- Horner, Hoenig, Sloane, et al<sup>124</sup> assessed racial differences in the utilization of inpatient rehabilitation services among elderly stroke patients. The records of 249 African-American and white Medicare patients hospitalized after stroke at any of 29 acute care hospitals in five states were reviewed. After adjusting for clinical and socioeconomic factors associated with the use of physical and occupational therapy, no racial differences were found in the likelihood of use of therapy or time to initiate therapy. No differences were found in length of physical or occupational therapy in days or as a proportion of hospital stay.<sup>231</sup>
- Hoenig, Rubenstein, and Kahn<sup>120</sup> assessed racial and other sociodemographic and geographic differences in use of physical and occupational therapy in elderly Medicare patients with acute hip fracture. The records of 2,62 African-American and white Medicare patients treated in 29 randomly selected hospitals from five states were reviewed. After controlling for clinical factors, African-American patients and dual eligible Medicare/Medicaid patients were less likely to receive high-intensity physical or occupational therapy. No racial differences were found in time to initiate therapy.<sup>231</sup>

The first National Healthcare Disparities Report (NHDR) issued by the Agency for Healthcare Research and Quality (AHRQ) in 2003 reported: "There are clear disparities in lifespan, health status, and health care use among different racial, ethnic, socioeconomic, and geographical groups. These individuals suffer a disproportionate burden of illness and disability from preventable or treatable chronic conditions."<sup>190</sup>

### **Factors Contributing to Health Disparities**

The IOM report identified several factors that contribute to health disparities, first, health systems have financial expectations that influence health care practice. For example, increased productivity demands utilize scheduling practices that often limit health practitioner contact with clients and require health care practitioners to engage in multiple duties at the same time. Health systems also provide financial incentives to physicians for limiting services including diagnostic procedures and interventions.

Second, the organizational structure of health care delivery can contribute to health disparities. Care may be provided by health care professionals, such as nurse practitioners, physician assistants, and physicians in training, who may not be qualified to address the individual's needs. According to one study, African Americans who do not receive health care from a physician are more likely to feel distrustful.<sup>103</sup> More research is needed to compare level of trust with degree of compliance when given advice and recommendations by the health care professional.

Third, clients are not always followed by the same health care provider, and inconsistencies exist when one health practitioner orders certain tests and procedures for a medical work-up while another practitioner does not.

There is evidence of this type of fragmentation of health care along socioeconomic lines. Clients in lower socioeconomic groups are less likely to receive a complete array of medical tests routinely ordered for individuals with a higher socioeconomic status.

Other factors contributing to racial and ethnic health disparities include cultural and linguistic barriers, discrimination, bias, stereotyping, and uncertainty on the part of the health practitioner. Despite best intentions to avoid such practices, health practitioners engage in stereotyping and bias that may be conscious or unconscious. The health care provider may experience uncertainty in the clinical encounter and rely on a previous experience as the basis for the clinical decision making. The bias, stereotyping, and uncertainty may be the result of cultural differences and linguistic issues and affect the clinical management and health outcomes.

### Strategies to Eliminate Disparities

Every effort must be made to eliminate racial and ethnic disparities in health care. The IOM has recommended the following strategies to eliminate or reduce health disparities:

- Education to address discrimination, bias, stereotyping, and uncertainty that contribute to health disparity; engage health practitioners in reflective practice that can alter conscious and unconscious behavior.
- Cross-cultural education provided to current and future health care practitioners to develop attitudes, knowledge, and skills in working with diverse populations.
- Standardize data collection to include race and ethnicity data for both the client and the provider, primary language data, socioeconomic data, and monitoring of performance outcomes.
- Policy and regulatory strategies that address:
  - Reduction in fragmentation of health plans along socioeconomic lines
  - Use of clinical guidelines and best practice recommendations
  - Increases in the number of racial and ethnic minorities in health professions
  - Use of interpreter services for health care

The health of individuals within the society directly influences the health of the nation in the collective. Citizens contribute to the culture and the society to create the fabric of national life. Thus the health of the citizens of the nation is of paramount importance and is being addressed through a variety of federal and nonfederal initiatives (Box 2-1).

### Beyond Cultural Competence: Transnational Competence

Understanding of cultural diversity and cultural competence has become a familiar topic in the physical therapist's education. Likewise, some consideration of these topics has become a part of all U.S. medical schools. Cultural competence has been linked with quality assurance and cost-containment programs to help reduce disparities in health care.<sup>142</sup> A new goal is to prepare students for multiple (international) practice sites.<sup>142</sup>

#### Box 2-1

#### STRATEGIES TO ELIMINATE HEALTH DISPARITIES

- The Executive Office of the President of the United States, Office of Management and Budget (OMB) has mandated guidelines for aggregation of data on race for use in civil rights monitoring and enforcement. The guidelines do not mandate the collection of race data, but standardize the way that race data are collected for agencies that choose to use the data. <http://www.cdc.gov/omh/Populations/populations.htm>
- *Healthy People 2010*, through the U.S. Department of Health and Human Services (DHHS), identified the following specific goals and objectives to help achieve national health standards that are beneficial to all Americans:
  - Goal 1: To increase quality and years of healthy life
  - Goal 2: To eliminate health disparities<http://www.healthypeople.gov/>
- The U.S. DHHS and the American Public Health Association (APHA) announced in 2000 a partnership to eliminate health disparities. <http://www.healthypeople.gov/Implementation/Council/council9-12-00/Partnership.htm>
- The Cross Cultural Health Care Program (CCHCP) assists health care institutions to assure that individuals receive access to health care that is culturally and linguistically appropriate. The program facilitates cultural competency training for providers and medical staff, interpreter training for community interpreters and bilingual health care workers, outreach to underrepresented communities, and information and education relating to cross-cultural education. <http://www.xculture.org/>
- Public Law 106-525 Minority Health and Health Disparities Research and Education Act of 2000 created the National Center for Minority Health Disparity (NCMHD) to investigate factors leading to minority health disparities and to work toward eliminating health disparities. State health agencies are seeking ways to address health issues affecting residents in rural and urban locations of diverse racial and ethnic groups. <http://www7.nationalacademies.org/ocga/showLaws.asp?sort=bynumber>
- The NCMHD promotes minority health and leads, coordinates, supports, and assesses the effort of the National Institutes of Health (NIH) to reduce and ultimately eliminate health disparities. The NCMHD works independently and in partnership with the NIH institutes and centers and with other federal agencies and grassroots organizations in minority and other medically underserved communities to meet the mission of the center. <http://www.nih.gov/about/almanac/organization/NCMHD.htm>
- The NIH Roadmap to Medical Research is an innovative approach to advancing the science needed to improve health and eradicate disease. <http://nihroadmap.nih.gov/>
- The NIH has also developed the Patient-Reported Outcome Measurement Information System (PROMIS) that will develop ways to measure patient-reported symptoms, such as pain and fatigue, and aspects of health-related quality of life across a wide variety of chronic diseases and conditions. This trans-NIH initiative, managed by the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), provides improved methods for quantifying important symptoms and outcomes that are difficult to measure. With the development of Centers of Excellence, improved data collection systems, and improved outcome measurement information systems, the ability to evaluate quality and equality of health care will be easier and will hopefully

*Continued.*

**Box 2-1****STRATEGIES TO ELIMINATE HEALTH DISPARITIES—cont'd**

achieve the desired goal of eliminating racial and ethnic disparities in health care. <http://nihroadmap.nih.gov/clinicalresearch/promis.asp>

- The Centers for Disease Control and Prevention (CDC) developed unique identifiers for race and ethnicity. <http://www.cdc.gov/nchs/>
- Public Law 106-129, the Healthcare Research and Quality Act of 1999, directs the Agency for Healthcare Research and Quality (AHRQ) to develop two annual reports: a National Healthcare Quality Report (NHQR) and this National Healthcare Disparity Report (NHDR). [http://www.qualitytools.ahrq.gov/disparitiesreport/2003/download/download\\_report.aspx](http://www.qualitytools.ahrq.gov/disparitiesreport/2003/download/download_report.aspx)

Given rapidly changing global demographics and the continued health disparities, social scientists propose a need to move beyond cultural competence to embrace *transnational competence* (TC). TC teaches the health care professional how to address issues of physical and mental health along with experiences related to geographic dislocation and adaptation to unfamiliar settings.<sup>142</sup>

Demographic patterns are changing rapidly in the United States. Disparities in health and health care are increasing. More than 35 million foreign-born persons are living in the United States—more than 12% of the total population. Currently, 6 out of every 10 babies born in New York City have at least one foreign-born parent.<sup>29</sup>

It is not enough to consider lists of ethnocultural characteristics and single-factor explanations such as health-belief systems. Relevant links between health and postmigration stressors may include employment status and experiences, discrimination, insecurity of immigration status, or family fragmentation.<sup>141</sup> TC requires a multidimensional approach that takes into account our current era of globalization and migration and their impact on health beliefs, disparities, and diversity within ethnic groups.

## Age and Aging

Age and gender play important roles in the development of most diseases. Age often represents the accumulated effects of genetic and environmental factors over time. Intrinsic cellular mechanisms play a role in aging, though these can be modulated by extracellular factors such as hormones. Discriminating between causes and effects of aging is often impossible. Separating aging from pathology remains a major challenge in our understanding of these two concepts.

There are many theories to explain what changes occur that lead to aging, but no universal theory of aging or consensus over what causes aging or determines the rate of aging exists. Theories of aging that have gathered more experimental support than others are presented here.

## Theories of Aging

Senescence, the process or condition of growing old, may be the result of continuous cellular metabolism, cellular damage, and inefficient repair systems throughout the entire lifespan. Some researchers in gerontology (specifically biogerontologists) regard aging itself as a "disease" that may be curable. Understanding aging from this framework is referred to as a *damage-based theory*. *Error theory*, the *wear and tear theory*, the *free radical theory*, the *neuroendocrine theory*, and the *waste accumulation theory* are examples of damage-based explanations of aging. To those who accept the damage-based view, aging is an accumulation of damage to macromolecules, cells, tissues and organs.

Examples of environmentally induced damage range from alterations to deoxyribonucleic acid (DNA), formation of free radicals from oxidative processes causing damage to tissues and cells, and increased cross-linking of tendon, bone, and muscle tissue reducing tissue elasticity and obstructing the passage of nutrients and waste between cells. These concepts are discussed in greater detail in Chapter 6.

An alternate explanation for the aging process is *programmed-based*, which presumes that aging is a genetically driven process and not primarily the result of ongoing and accumulated cellular or environmental processes. In other words, aging is regulated by a biologic clock. Changes in gene expression are either preprogrammed or derived from DNA structural changes and affect the systems responsible for maintenance, repair, and defenses.<sup>39</sup> Examples of the programmed-based explanation of aging include the *gene mutation theory*, the *genetic control theory*, and the *planned obsolescence theory*. Both damage-based and programmed-based theories acknowledge that aging is influenced to some degree by intrinsic and extrinsic factors. It is also possible that elements of both theoretic models apply.

A newer theory in the field of antiaging medicine is the *telomerase theory* of aging. The basis of this theory is the shortening of telomeres in the process of DNA replication during cell division. Telomeres are sequences of nucleic acids extending from the ends of chromosomes. Telomeres act to maintain the integrity of our chromosomes. Every time our cells divide, telomeres are shortened, leading to cellular damage and cellular death associated with aging.

Researchers also found that the enzyme *telomerase* is a key factor in rebuilding the disappearing telomeres. Telomerase is found only in germ cells and cancer cells. Telomerase may be manipulating the biologic clock that controls the lifespan of dividing cells, future development of telomerase inhibitor may be able to stop cancer cells from dividing. The hope is to convert them back into normal cells.

## Life Expectancy

Life expectancy at birth is now about 80 years for women and 75 years for men, compared with 48 years at the turn of the last century.<sup>186</sup> Until recently, these estimates were expected to continue increasing for both genders. But some researchers predict a decline in U.S. life expectancy

later this century based on the dramatic rise in obesity, especially among young people and minorities.<sup>18</sup>

Whites and blacks have similar life expectancies at age 65, but a higher death rate exists among younger blacks. Once adults reach age 65, men can expect to live an additional 15.8 years, and women can expect an additional 16.6 years. Individuals 5 years of age can be expected to live an average of 11 more years for a total of 86

<sup>249</sup>

years.

The majority of cancers occur in adults over the age of 65, with about 50% of all cancer deaths in this population. For many cancers, a person's advanced chronologic age is considered a major adverse prognostic factor. Many older adults tolerate cancer treatment, but they experience delayed recovery and are at increased risk of serious infectious and bleeding complications.<sup>278</sup>

### Centenarians

A dramatic extension of longevity has occurred in the last 100 years. In 1900, people over age 65 constituted 4% of the U.S. population. By 1988, that proportion was up to 12.4%, and it is predicted that by 2025, one-third of all Americans will be age 65 or older, and 30% of the over-65 population will be nonwhite by 2050, representing an even greater cultural diversity among the aging.<sup>12</sup>

The most rapid population increase over the next decade will be among those over age 85 and the "oldest old" over 100 years of age (centenarians). This aging trend of the U.S. population is reflected in the kinds of clients and problems therapists will treat in the coming decades. Confusion; fractures and other injuries related to falls; strokes; infections; and effects of polypharmacy, inappropriate medications, and decline in drug clearance are just a few of the more common characteristic problems this group of older adults faces.

Finally, the older adult can be assessed for modifiable risk factors that contribute to functional decline. Slow gait, short-acting benzodiazepine use, depression, low exercise level, and obesity are significant modifiable predictors of functional decline in both vigorous and basic activities. Weak grip predicts functional decline in vigorous activities, whereas long-acting benzodiazepine use and poor visual acuity predict decline in basic activities. Known nonmodifiable predictors of functional decline include age, education, medical comorbidity, cognitive function, smoking history, and presence of previous spine fracture.<sup>223</sup>

### Children and Adolescents

Research has produced dramatic advancements in children's health that have an impact on adulthood. The long-term benefits of childhood intervention to prevent adult disease are documented. For example, preventing osteoporosis in the aging adult begins by providing necessary dietary calcium intake during bone development and calcification in childhood.

Preventing tobacco-related cancer and lung diseases begins with educating children about the risks of initiating smoking. *Healthy People 2010* leads the country in trying to develop effective and economic self-management strategies and interventions for children and families to prevent disease and improve health.

As the young and the aging continue to garner attention, teenagers are falling between the cracks of medical care. Prenatal and well-child prevention programs have boosted the care given to the under-12 age group, but most physicians do not categorize teenagers as adults and may not be adequately addressing the needs of this group.

Adolescents as a group are the primary users of illicit drugs, tobacco, and alcohol and comprise the largest group with unwanted pregnancies, abortions, and sexually transmitted diseases. Preventive health care and intervention among this age group are the next targets for the *Healthy People 2010* campaign.

## Gender

Increasingly, research efforts are finding that the differences between men and women go far beyond the reproductive organs to affect every physiologic function and organ in the body, including the aging process. Physiologic or biologic differences between males and females are sometimes referred to as *sex-related*. Behavioral or social role differences are more often referred to as *gender-related*.

### Gender-Based Biology

Gender-based biology has demonstrated major gender differences in such things as risk factors, response to medications, response to surgical procedures, and response to treatment. Striking physiologic differences exist between men and women. For example, sports injuries linked with neuromuscular imbalance are more common in women, especially young female athletes.

Women's hearts beat faster, which is now recognized as a result of the configuration and activity of the cardiac cell membrane as they function differently between the genders. Men's brains are larger than women's, but women have more brain cells. Diagnostic scanning shows that different areas of the brain light up in response to an identical task between men and women. Age-related changes that differ in men and women are just now coming to the forefront of science.

Men generally experience poorer health than women and have a decreased life expectancy compared with women. Prostate and testicular cancer rates are increasing, while male fertility may be declining; male sexual dysfunction, including erectile dysfunction (ED), is common.<sup>15</sup>

### Gender Bias and Gender Equity

Until the late twentieth century, evidence for gender bias, usually against women, was seen in three areas: (1) the historical use of public monies to fund research predominantly in men, (2) the perpetuation of the view in medicine that the 50-kg man is the norm for representing all humans in medicine, and (3) the use of federal funds through Medicare to provide better reimbursement for conditions more prevalent in men compared with those more prevalent in women.<sup>42</sup>

The National Institutes of Health (NIH) issued guidelines in 1990 requiring the inclusion of women and minorities in all NIH-sponsored clinical research and

revised these guidelines in 1994 to require analysis of clinical trial outcomes by gender. Although most clinical studies since that time have included women as study subjects, only a small percentage of research findings are analyzed by gender.<sup>253</sup>

New studies evaluating differences between the genders regarding a variety of factors are currently underway.<sup>254</sup> The importance of gender equity in health is receiving more attention, with increasing focus on gender roles linked with health-related problems. For example, because men may perform more physically challenging jobs in the workplace, they are at increased risk for work-related accidents.<sup>15</sup>

### Gender-Based Patterns of Disease

It is clear now that men and women experience different patterns of disease. Some gender differences may represent either environmental or genetic factors. Diseases with rates of occurrence that differ between men and women may reflect lifestyle or environmental differences or anatomic and hormonal differences.

Women are twice as likely as men to contract a sexually transmitted disease (STD) and 10 times more likely to contract HIV, in particular during unprotected sex with an infected partner. Women smokers are more likely to develop lung cancer than men who smoke. Women are more likely to have a second heart attack within a year of the first, and nearly one-half of men but only one-third of women survive 1 year after a heart attack.

Women constitute 80% of those who have bone loss (osteoporosis) severe enough to increase fracture risk significantly; women have higher blood alcohol levels than men after both consume the same amount; and women tend to regain consciousness after anesthesia more quickly than men.<sup>10</sup> Additionally, the incidence of health risks to women, such as depression, anxiety, alcoholism, and eating disorders, is increasing.<sup>64,112</sup>

Men, however, face some unique health challenges. Deaths from malignant melanoma are 50% higher in men than in women, despite a 50% lower incidence of the disease in men. In general, men die an average of 5 years earlier than women, develop heart disease a decade earlier, and are more likely to participate in dangerous jobs and recreational activities. Men are two times more likely than women to die from unintentional injuries and four times more likely to die from firearm-related injuries.

Additionally, researchers are now examining whether people are more vulnerable to environmental and biologic challenges during periods of critical biochemical change than in times of relative quiescence. For example, are social, biologic, or psychologic changes that affect health influenced during hormonal fluctuations associated with puberty, premenstrual cycles, pregnancy, and menopause, compared with other periods in a woman's life cycle?

### Gender Roles in Health

Gender expectations play a role in response to health issues in most cultures in the United States. The familiar male stereotype, which places a high value on stoicism and self-reliance, may make asking for medical help a

sign of weakness. Men are vulnerable to social pressures that lead to eating disorders, an increasingly prevalent problem among men in the United States. Males are expected to show less expression of pain than females, and in most cultures, men will be less expressive in describing pain. In some cultures, male children are held in higher regard than female children and are more likely to receive any necessary care and follow-up prescribed.

Men also tend to take greater risks with their health: many drink excessively, smoke, practice unsafe sex, drive dangerously, or participate in high-impact sports (competitively and recreationally). Risk-taking behaviors may be intended to prove masculinity. Men are less likely than women to seek medical care or practice preventive medicine, and men are less likely to have a primary care physician. They are more likely to delay medical evaluation until later in the course of an illness compared with women.<sup>15</sup>

Men who have sex with men (MSM) have health concerns beyond HIV, including a higher rate of suicide, self-harm, problems with alcohol and other drug abuse, tobacco use, and a wide range of other mental and sexual health problems. Expanded knowledge and understanding of the unique health problems of this group are advocated.<sup>271,274</sup>

### Gender and Exercise

Previously, it was taught that few differences between men and women exist in response to exercise, so few adjustments were made when prescribing exercise for the female as opposed to the male. New research results document significant differences that exist in neuroendocrine, metabolic, and cardiovascular counter-regulatory responses in men and women to prolonged moderate exercise.

How these differences will affect exercise programs or recommendations remains to be determined.<sup>66</sup> It is important to match the intensity of the exercise to the capacity of the individual. When training heart rate has not been determined through prescreening exercise testing, an exercise protocol should progress in slow step-wise increments.

## LIFESTYLE FACTORS THAT INFLUENCE HEALTH

### Overview

According to the World Health Organization (WHO), the highest number of deaths are attributed to the risk factors of tobacco use, high blood pressure, high body mass index, high cholesterol, low fruit and vegetable intake, alcohol consumption, and lack of physical activity, in that order.<sup>202</sup> More than half of deaths from the leading causes in the United States (see Table 2-1) result from behavioral and lifestyle factors such as diet, exercise, smoking, and substance abuse. These factors not only contribute to the number of deaths but also contribute significantly to disability and the burden of disease.

More than any other intervention, changing behavior and lifestyle could help prevent death, enhance the

quality of life, and reduce the escalating costs of treating chronic illnesses. For example, although heart disease remains the number one cause of death in the U.S. adult population, the cardiac death rate has been reduced by 52% over the last 2 decades as a result of changes in diet and lifestyle.

Other risk factors in lifestyle affecting health status and health care are considered individually modifiable and include personal habits such as rest and sleep; diet, including calcium, fat, and fiber intake; level of activity and exercise (fitness); stress and coping ability; substance abuse; travel; environmental or occupational status; and high-risk sexual activity.

The gay and lesbian population comprises a diverse community with disparate health concerns. Major health issues for gay men are HIV/AIDS and other STDs, substance abuse, depression, and suicide. Gay male adolescents are two to three times more likely than their peers to attempt suicide. Some evidence suggests lesbians have higher rates of smoking, obesity, alcohol abuse, and stress than heterosexual women. The issues surrounding personal, family, and social acceptance of sexual orientation can place a significant burden on mental health and personal safety.<sup>6</sup>

This section examines selected lifestyle and behaviors that affect health and directly influence physical therapy practice. Psychologic and behavioral risk factors that influence health outcomes presented include physical activity, nutrition, tobacco use, alcohol and other drug use, stress and coping, and domestic violence. Some current theories about health behavior change that can influence effectiveness of physical therapy interventions will also be discussed.

### Cultural Influences

Variations in lifestyle influencing clients' perceptions of health care may occur as a result of cultural, religious, socioeconomic, or even age factors. Although clinical manifestations of a disease or condition are essentially the same across cultures, how a person (or family member) responds or interprets the experience can vary.

This phenomenon of response based on cultural influence is called *cultural relativity*—that is, behavior must be judged first in relation to the context of the culture in which it occurs. For example, some groups consider health as a function of luck (good or bad), whereas others see health problems as a punishment for bad behavior and good health as a reward for good behavior.

Cultural factors may also prevent illness. For example, people belonging to religious faiths that forbid drinking or smoking have lower cancer rates than the general population. Religious beliefs related to health must be recognized and respected. Research to study the effects of religiosity as a predictor of outcome in a variety of disorders is beginning to draw definitive conclusions about the efficacy of prayer, religious practices and activities, and philosophic orientation toward health.<sup>10,143,229</sup> Research suggests that one of the principal reasons people are attracted to alternative medicine is that they find many of these therapies in keeping with their personal beliefs.<sup>6</sup>

### Demographics by Generation

Generational differences are seen among groups such as the Matures, also known as postwar/depression-era (born from 1900 to 1946); the baby boomers (born from 1946 to 1964); the Generation X-ers (born from 1965 to 19'9); and the Millennials, also referred to as Generation Y (born from 1980 to 1999).

Many people born before 1946 tend to assume a passive role in their own health and in receipt of health care by accepting whatever happens to them and whatever treatment is outlined. However, baby boomers have grown up questioning authority, and their offspring are even more likely to consider themselves consumers asking for treatment rationales, seeking second opinions, and combining allopathic treatment with alternative medicine (e.g., naturopathy, aroma therapy, acupuncture, massage therapy).

### Socioeconomic Status

The most adverse influence on health is socioeconomic status, with a higher percentage of low-socioeconomic class members experiencing health-related problems than any other group. Adults with higher incomes tend to experience better health and can expect to live more than 3 years longer than those in the lowest income bracket.

The percentage of people in the lowest income families reporting limitation in activity caused by chronic disease is three times that of people in the highest income families.<sup>110</sup> Lack of health insurance coverage and/or access to quality health care may result in delayed or postponed diagnosis and treatment of health problems.

Differences in attitudes toward health have been found to be greater between social classes than between races or ethnic groups. Ninety percent of all health care dollars is spent on extraordinary care in the last 2 to 3 years of life. This style of death-based medicine assigns the greatest financial and professional resources to treating the diseases of aging.<sup>138</sup>

The homeless have become one of the fastest growing populations in need of health care in the United States. Traditionally, the homeless consisted primarily of older, single men, often alcoholics, but now this group includes families and children who are runaways or adolescent throwaways.

Declining public assistance, a shortage of affordable rental housing, and an increase in poverty are additional contributing factors to the rise in homelessness. Although estimates of homeless people vary, the National Coalition for the Homeless<sup>188\*</sup> reports that on any given night, 700,000 Americans are homeless and up to 2 million homeless people are reported in a year's time. This number includes an estimated 100,000 children in the United States who are homeless; more than half are under age 5.

### Adverse Childhood Experiences

Adverse experiences in childhood are linked to the development of problems later in life, including alcohol and other drug use, drug and/or tobacco addiction or addictions, obesity, fibromyalgia, or other autoimmune disorders. Children who have been exposed to four or more adverse experiences in childhood are more likely to have

attempted suicide and to have had multiple sex partners, increasing their risk of STDs. Dangerous or apparently counterproductive behaviors can serve a purpose (e.g., coping mechanism, barrier against social contact).

The strong relationship between exposure to abuse or household dysfunction during childhood and multiple risk factors for several of the leading causes of death in adults is beginning to be recognized in the health care setting.<sup>5-78</sup> *Healthy People 2010* has set goals of primary prevention of adverse childhood experiences and improved treatment of exposed children to reduce self-destructive behaviors, such as smoking, among adolescents and adults. For a more complete understanding of the impact of adverse experiences in general, see Chapter 3.

### SPECIAL IMPLICATIONS FOR THE THERAPIST 2-1

#### *Variations in Lifestyle: Adapting Treatment Intervention to the Individual*

In the final decades leading to the twenty-first century, the demographics of the United States changed rapidly, bringing with it a better understanding of the biopsychosocial-spiritual variables that affect the episode of care seen in a therapist's practice, especially health care issues centered around minorities and economic variables. The therapist's role in education and prevention has never been more important as we come to understand the effect individual modifying (risk) factors have on pathology and recovery. A biopsychosocial-spiritual model is essential because risk factors correlate with results, especially in chronic disease/disorders.

##### Cultural Awareness

Race/ethnicity, culture, and religion are important factors in an individual's response to pain, disability, and disease. It is essential to remember that people of any culture may deal with pain, impairment, movement dysfunctions, and disability differently than expected.

The culturally sensitive health professional must screen for cultural practices, such as fasting or the use of alternative remedies; document these practices; and communicate appropriate information to other members of the team providing care for that individual. This is especially important for the client who may have a medical condition (e.g., diabetes mellitus, hypertension) that could be compromised by these practices.

The American Physical Therapy Association (APTA) is committed to assuring equality in physical therapy services through education of physical therapy professionals who are knowledgeable about the inequalities that currently exist in health care and in the education of culturally competent and transnational professionals who engage in evidence-based physical therapy that eliminates racial, ethnic, geographic, and socio-economic health disparities.

In any setting, it is important for therapists to be aware of their own attitudes and values regarding lifestyle choices; responses to pain, illness, and disability; and health practices. It may be beneficial to adapt the

individual intervention program to ethnic practices and beliefs. Health care education may be most effective if provided without trying to change the individual's or family's longstanding beliefs. Knowing what is needed to effectively rehabilitate an individual does not assure success unless provided within a cultural and socioeconomic framework acceptable to the individual or family.

Some cultures have a very conservative view of physical contact, requiring a modified approach to the hands-on or manual therapist. In all situations where control may be an issue, the rationale and specifics for direct intervention must be clearly communicated and acceptable to the client.

Illness, especially life-threatening illness, often results in feelings of loss of control. Control, modes of control (e.g., passive acceptance, positive yielding or acceptance, or assertive control), and the desire for control are considered important variables that may influence physiologic function and health outcomes. Balancing active and yielding control styles and matching control strategies to client control styles and preferences may lead to optimal psychosocial adjustment and quality of life in the face of life-threatening illnesses.<sup>23,32</sup>

Language barriers make health care literature unavailable to many individuals who do not speak English and who require an interpreter (often unavailable) or for whom English is a second language, especially if English is spoken but not read. Keeping an open mind, asking questions, and respecting cultural differences are other ways to improve health care quality and delivery among minority groups.

##### Disabilities

The Americans with Disabilities Act of 1990 was designed to improve access to health care for people with disabilities, but barriers still exist for many people in receiving full age-appropriate primary care services. Disabled individuals, especially disabled women age 65 and older, often do not receive appropriate primary care. The more severe the disability, the less likely a person is to receive adequate care and undergo health screening.<sup>36</sup>

The therapist can be very instrumental in assessing the disabled person's access to important screening and prevention services, advocate for the care of the disabled, encourage these people to become their own advocates for health care, and conduct research on people with disabilities.

##### Homelessness

Therapists are increasingly faced with addressing the needs of the homeless, who often experience frostbite, poor nutrition and hygiene, fatigue, mental illness, and a host of other minor medical problems. Many have additional secondary diagnoses (e.g., diabetes mellitus, hypertension, peripheral vascular disease, HIV, previous or present untreated orthopedic injuries) that complicate rehabilitation services. A third of the homeless clients have histories of past (and current) alcohol addiction and substance abuse.<sup>38</sup>

## Physical Activity

The benefits of physical activity have been recognized since the time of Hippocrates, as evidenced by this quote attributed to Hippocrates (460-311 BC): "All parts of the body which have a function, if used in moderation and exercised in labours in which each is accustomed, become thereby healthy, well-developed and age more slowly; but if unused and left idle they become liable to disease, defective in growth, and age quickly." The importance of physical activity seems to be as relevant today as it was then.

*Physical activity* is defined as any bodily movement produced by skeletal muscles that results in an expenditure of energy.<sup>62</sup> Physical activity behaviors are different than other lifestyle behaviors, in that all individuals have to move, although some move more and some move less. Physical activity contributes both directly and indirectly to health status and outcomes. Physical activity levels appear to contribute directly to disease mortality and morbidity, as well as indirectly by the influence of physical activity on conditions such as obesity, diabetes, and osteoporosis.

*Physical fitness* may be defined as "a set of attributes a person has in regards to a person's ability to perform physical activities that require aerobic fitness, endurance, strength, or flexibility and is determined by a combination of regular activity and genetically inherited ability."<sup>162</sup> Physical fitness and physical activity are related since increased physical activity is required to improve physical fitness, although one can perform a modest amount of physical activity without seeing improvements in fitness.

### Effects of Physical Activity on Morbidity and Mortality

Much has been learned in the last decade about the adaptability of various biologic systems and the ways that regular physical activity and exercise can influence them. Participation in regular physical activity (both aerobic and strength training) is an effective intervention modality to reduce and/or prevent a number of functional declines associated with aging and to elicit a number of favorable responses that contribute to healthy aging<sup>63</sup> (Box 2-2).

The effect of training intensity, psychosocial variables influencing exercise, and the breadth of emotional benefit from physical activity has not been fully determined, although studies in this area are ongoing. The risks and benefits of exercise among people with disabilities remain unknown. As people with disabilities live longer, the need for addressing long-term health issues, assessing the risk for secondary disability, and prescribing exercise from the perspective of disease prevention while reducing the risk for injury is needed.<sup>58</sup>

Other research to determine the potential links between oxidative stress and physical activity/exercise in the aging adult is ongoing. Exercise, especially when performed strenuously, is associated with increased free radical formation (see Fig. 6-2) that damages key cellular components.<sup>210</sup> In the older adult the benefit of exercise is influenced by sedentary lifestyle, nutritional deficiencies,

### Box 2-2

#### BENEFITS OF REGULAR PHYSICAL ACTIVITY AND EXERCISE

- Reduces/prevents functional declines associated with aging.
- Maintains/improves cardiovascular function; enhances submaximal exercise performance; reduces risk for high blood pressure; decreases myocardial oxygen demand.
- Aids in weight loss and weight control.
- Improves function of hormonal, metabolic, neurologic, respiratory, and hemodynamic systems.
- Alteration of carbohydrate/lipid metabolism results in favorable increase in high-density lipoproteins.
- Strength training helps to maintain muscle mass and strength, especially in the aging group.
- Reduces age-related bone loss; reduction in risk for osteoporosis.
- Improves flexibility, postural stability, and balance; reduction in risk of falling and associated injuries.
- Psychologic benefits (e.g., preserves cognitive function, alleviates symptoms/behavior of depression, improves self-awareness, promotes sense of well-being).
- Reduces disease risk factors.
- Improves functional capacity.
- Improves immune function (excessive exercise can inhibit immune function).
- Reduces age-related insulin resistance.
- Reduces incidence of some cancers (e.g., colon, breast).
- Contributes to social integration.
- Improves sleep pattern.

From American College of Sports Medicine (ACSM) Position stand: exercise and physical activity for older adults, *Med Sci Sports Exerc* 30(6):992-1008, 1998.

and comorbidities that can all deplete the individual's antioxidant reservoir.

Aging adults face additional problems of deconditioning or loss of balance and stability as a result of disease or illness. The most successful exercise programs take into consideration the person's functional capacity, medical status, and personal interests. Some helpful strategies for facilitating an exercise program (whether for a specific body part or as an overall fitness program) are listed in Box 2-3.

**Morbidity.** Physical inactivity contributes to the incidence of some chronic diseases. According to the WHO, there is convincing evidence that physical inactivity increases the risk of obesity and type 2 diabetes. In other words, regular physical activity decreases the risk of cardiovascular disease, type 2 diabetes, obesity, and osteoporosis and decreases the risk of some types of cancers (e.g., colorectal).<sup>238</sup>

Regular physical activity appears to modify or reverse cardiovascular disease severity in individuals with known cardiovascular disease.<sup>242</sup> These effects include decreased risk of death from cardiovascular causes,<sup>243</sup> decreased atherosclerotic plaque formation,<sup>104</sup> and improved health status.<sup>200</sup>

Aerobic and resistive exercise appear to be associated with a decreased risk for type 2 diabetes, even among people at high risk for the disease.<sup>114</sup> In one large study,

**Box 2-3****STRATEGIES TO FACILITATE SUCCESSFUL EXERCISE PROGRAMS**

- Ask the client if he or she is currently exercising regularly (or was before illness or injury). Provide a brief description of benefits that the person could achieve from such a program.
- Stress exercise benefits of improving health rather than achieving weight loss.
- Allow the person to respond to the recommendation for an exercise program. Encourage the person to verbalize any thoughts or reactions to your suggestions.
- Determine whether the person believes that an exercise program will benefit him or her personally. Help the individual set personal goals for exercise.
- Establish a patient/client self-charge contract and plan to monitor one's own success.
- Be aware of any cultural or philosophical beliefs the person may have regarding exercise.
- If resistance to the idea of an exercise program is encountered, give the person an opportunity to list potential barriers to exercise. Ask the person to suggest ways to overcome potential barriers.
- Whenever possible, provide a written (preferably just pictures because of the potential of undisclosed illiteracy) of the proposed exercise program. Review progress and reward attempts, successes, and progression of the exercise program.
- Make it fun to foster a lifestyle approach characterized by long-term adherence.

the risk of type 2 diabetes decreased 6% for every increase in energy expenditure of 500 kilocalories (kcal)/week.<sup>113</sup> In addition, moderate physical activity was shown to be as effective as one type of diabetes medication (metformin) in reducing risk of diabetes.<sup>140</sup>

Osteoporosis is associated with increased disability and frequency of some types of fractures. The greatest benefits to bone mineral density and the incidence of osteoporosis appear to come from resistance training.<sup>251</sup> Exercise training programs have been found to prevent the 1% of bone loss per year observed in the lumbar spine in premenopausal and postmenopausal women.<sup>268</sup>

In regard to cancer, physical activity has an effect on some kinds of cancers.<sup>152</sup> Physical activity decreased the risk of colon cancer for men and women by 30% to 40% and also demonstrated a risk reduction of 20% to 30% for breast cancer in physically active women.<sup>152</sup>

Since there is an association of improved health with increased physical activity, it is important to define how much physical activity is beneficial. There is debate over the optimal amount of exercise needed for health benefits, although the general agreement is that more is better. Current discussion centers on whether the volume or intensity of exercise is most important for health.<sup>75</sup> Given that moderate exercise appears to provide significant health benefits and that vigorous exercise is difficult for individuals to achieve, public health policy has empha-

sized regular moderate exercise as an achievable goal for the greatest number of individuals.

The current recommendation of the U.S. Surgeon General indicates that individuals should accumulate 30 minutes of moderate exercise on most days of the week. Minimum increments of 10 minutes are advised. Additional wording indicates that people who are already active may benefit from more intense levels of physical activity.<sup>62</sup>

**Mortality.** Physical activity patterns appear to have a direct effect on deaths. In the 1990s, activity patterns and nutrition contributed to 14% of all deaths in the United States.<sup>166</sup> In addition, 23% of deaths from major chronic diseases were also linked to lack of physical activity.<sup>102</sup> Increased levels of physical activity appear to reduce the relative risk of death in both men and women by 20% to 35%.<sup>163,164</sup> In addition, increased physical activity by 1000 kcal/week or 1 metabolic equivalent (MET) of fitness is associated with a 20% decrease in mortality, at least among women.<sup>126,153</sup>

Physical fitness appears to confer a greater benefit than physical activity alone. A clear relationship between fitness and all-cause mortality and deaths from cardiovascular disease has been established.<sup>69</sup> These studies demonstrate that death rates are highest in the lowest quartile of fitness. The greatest improvement in mortality occurs between the lowest and next lowest category of fitness, suggesting there is a graded effect of improved fitness on mortality. This is consistent with other research that demonstrates that small improvements in fitness are associated with significant reduction in risk of cardiovascular events and death.<sup>255</sup>

**Occupational Versus Leisure Time Physical Activity**

Early investigation of the role of physical activity in mortality compared people in sedentary versus physically active occupations.<sup>178</sup> Much of the recent literature, including the Surgeon General's report, has investigated leisure time physical activity.<sup>62</sup> Taking the evidence together, it appears that the overall volume and intensity of physical activity are most important, whether at work or during leisure time. However, there may be additional effects of strenuous work on health status or musculoskeletal pathology. For example, self-reported health was lower in people with active and strenuous jobs.<sup>203</sup>

In a study of industrial workers over a 28-year period of time, vigorous leisure time activity was associated with low risk of poor physical function, but strenuous work activity increased the risk of poor physical function.<sup>154</sup> In addition, low levels of physical activity were associated with higher rates of low back pain.<sup>115</sup> Future investigations may clarify the various effects of leisure versus occupational physical activity.

**Aerobic Capacity Versus Musculoskeletal Fitness**

Physical activity, regardless of aerobic capacity level, appears to provide health benefits. Musculoskeletal performance is increasingly linked to improved physical function and prevents or modifies disability.<sup>177</sup> Many activities of daily living (ADLs) require more musculo-

skeletal performance and rely less on aerobic capacity.<sup>258</sup> Furthermore, a decline in physical performance, defined by activities such as rising from a chair and climbing stairs, is associated with dependence in ADLs and assisted living placement.<sup>101</sup>

### Prevalence of Physical Activity Behaviors

Two behavioral strategies for reducing the risk for chronic disease have been identified: (1) consuming fruits and vegetables five or more times per day and (2) engaging in regular physical activity. Despite the importance of physical activity, only a minority of Americans are meeting physical activity guidelines.

Data for the prevalence of physical activity behaviors are available from a variety of population surveys. One common source of information is the Behavioral Risk Factor Surveillance System<sup>45</sup> (BRFSS), a population-based, random digit-dialed telephone survey of the U.S. population greater than 18 years of age conducted by the CDC.<sup>174</sup> Information regarding health risk behaviors, clinical preventive health practices, and health care access, primarily related to chronic disease and injury, is obtained from a representative sample of adults in each state.<sup>174</sup> Respondents are asked to recall the overall frequency and time spent in a variety of leisure time activities, as well as in moderate and vigorous physical activity.

In the Surgeon General's 1996 report, which used a variety of population-based surveys, most adults were not meeting current physical activity guidelines.<sup>62</sup> About 25% of adults reported no physical activity during leisure time. Approximately 22% of adults engaged in physical activity of any intensity for 30 minutes, 5 days a week. Only 15% of adults engaged in vigorous physical activity for 20 minutes, 3 times a week.

An update on physical activity in 2000 to 2001 from the BRFSS indicated that approximately 26% of adults had no form of physical activity during their leisure time, a number that is slightly higher than the 1996 data. The BRFSS lifestyle activity questions were modified in 2000 to 2001. Based on the new wording of the questions, 45% of adults participated in physical activity that met the new guidelines of the Surgeon General. These numbers indicate there is much work to be done to increase physical activity within our country.

There are differences in physical activity and nutrition reported by ethnicity. Among men, engaging in regular physical activity was significantly less common for non-Hispanic blacks, Hispanics, and Asian/Pacific Islanders than for non-Hispanic whites. Among women, regular physical activity was significantly lower among non-Hispanic blacks and Hispanics than among non-Hispanic whites.<sup>146</sup>

Compared with non-Hispanic white men, the combined prevalence for eating fruits and vegetables five or more times per day and engaging in regular physical activity was significantly higher for men of multiple/other races. Among women, the combined prevalence of eating fruits and vegetables five or more times per day and engaging in regular physical activity was significantly lower for non-Hispanic blacks and Hispanics than for non-Hispanic whites.<sup>146</sup>

Based on the Surgeon General's report, which used a variety of population-based surveys, most children and youth are not meeting current physical activity guidelines. About 15% of children reported no recent physical activity of any intensity during leisure time. Inactivity is higher in girls versus boys and in black girls versus white girls.

Approximately 25% of youth reported no vigorous physical activity; however, 25% also report walking or biking nearly every day (equivalent to light or moderate activity). Participation in physical activity decreases significantly as age or grade in school increases.<sup>62</sup> Youth Risk Behavior Surveillance System (YRBSS) reports one-third of all students grades 9 to 12 did not meet national guidelines for physical activity in 2003.<sup>100</sup>

Regular physical activity is beneficial in improving both physical and mental health outcomes. There is evidence that physical activity decreases blood pressure, improves lipid profile by decreasing triglycerides and total cholesterol while increasing high-density lipoprotein (HDL), improves insulin sensitivity, and enhances endothelial function, all of which contribute to decreasing cardiovascular risk.<sup>258</sup> In addition, regular physical activity is associated with an increased sense of well-being, can modify the symptoms of depression, and increase self-efficacy (the ability or confidence of a person to implement an effective behavior).<sup>266</sup>

### Interventions for Increasing Physical Activity

Given the benefits of physical activity, it is helpful to know what type of interventions are successful in increasing physical activity. There are a variety of strategies used to encourage physical activity, including self-directed behavior, supervised programs, or combined approaches. However, it is difficult to compare the success of interventions since they are so varied. A review of physical activity interventions examined randomized controlled trials for different interventions for community living adults with a 6-month follow-up and no more than 20% participant loss over the time period.<sup>119</sup>

All types of interventions were successful at increasing physical activity levels, including individual and positive encouragement and group or individual exercise programs.<sup>119</sup> This implies that all medical practitioners, including physical therapists, should encourage individuals to exercise. Cardiopulmonary fitness also improved in people who exercised, as compared to controls. However, few studies were able to demonstrate success for individuals in achieving a predetermined amount of physical activity.<sup>160</sup>

The interventions that appear to improve physical activity the most include physician advice; counseling from a health educator on action planning and follow-up phone calls, emails, monitoring cards; and a pedometer.<sup>119</sup> Adding weekly classes on skills for increasing physical activity and educational materials appears to help women achieve higher fitness goals, though these additions do not significantly influence men.<sup>277</sup> Success appears to increase with ongoing support in which there are four or more contacts among exercise participants and staff.<sup>119</sup>

## SPECIAL IMPLICATIONS FOR THE THERAPIST

2-2

**Physical Activity****PREFERRED PRACTICE PATTERNS**

Many preferred practice patterns associated with risk factor reduction and prevention of musculoskeletal, neuromuscular, cardiovascular/pulmonary, and integumentary conditions, disorders, and diseases are appropriate and too numerous to list.

**Promoting Physical Activity**

Reports indicate that few adults combine consuming fruits and vegetables frequently and engage in regular physical activity, thus missing an opportunity to help reduce their risk for chronic disease. The therapist can participate in promoting healthy behaviors by including each of the following steps.

- Assess physical activity along with other health indicators and risk factors such as smoking, heart disease, and hypertension
- Work with other public health groups to address the importance of increasing physical activity
- Recommend physical activity as part of a physical therapy plan of care

**Physical Activity Recommendations<sup>22</sup>**

- Accumulating 30 minutes of physical activity has been shown to have health benefits; however, the minimum amount of time to be spent in physical activity is 10 minutes.
- Moderate exercise is defined as reaching a certain threshold of energy expenditure. Energy expenditure estimated in METs gives a guideline for energy expenditure. By definition, 1 MET is equivalent to the amount of oxygen consumed at rest, averaged at  $3.5 \text{ ml/kg}^{-1}/\text{min}^{-1}$ . Moderate activity ranges from 3 to 6 METS, or  $10.5$  to  $21.0 \text{ ml}$  of oxygen consumed for each kilogram of body weight per minute. This leads to approximately 100 calories burned for 30 minutes of exercise in an individual who weighs 150 lbs.
- How can physical therapists estimate energy expenditure?

Table 2-2 provides some estimates of energy expenditure for the average person that can be used in physical therapy settings.

**Nutrition**

Nutrition is a modifiable risk factor for chronic disease; there is increased evidence that diet has significant effects (positive or negative) on health. Studies by the WHO indicate that diet has an important role in preventing and controlling both morbidity and mortality.<sup>23</sup> The chronic diseases most influenced by diet and creating the greatest cost in deaths or disability include obesity, diabetes, cardiovascular disease, cancer, and osteoporosis.

The National Cholesterol Education Program and the American Cancer Society both emphasize lifestyle modifications that include diet and physical activity to reduce disease risk. Diets high in fruits and vegetables combined with participation in regular physical activity are associated with a lower risk for several chronic diseases and conditions. These are also two of the strategies implemented by states participating in the CDC Nutrition and Physical Activity Program to Prevent Obesity and Other Chronic Diseases.<sup>24</sup>

Significant changes have occurred in the world food economy with profound effects on diets and lifestyles. These shifting dietary patterns include increased consumption of energy-dense foods high in saturated fat and low in unprocessed carbohydrates. Nutritional patterns indicate that in industrialized countries, energy intake averages 3380 kcal per capita per day, with a large increase (26%) from 1969 to 1999 in energy supplied by animal fat. North America remains above the recommended average of fat-to-energy ratio defined as the percent of energy derived from fat in the total number of calories supplied, as well as above the recommended amount of saturated fat per total calories (10%).<sup>25</sup>

**Obesity****Definition**

Obesity is defined by an excessive accumulation of fat in the body that contributes to numerous chronic diseases and early mortality and morbidity. *Bariatrics* is a branch of medicine concerned with the management of obesity.<sup>26</sup>

Body mass index (BMI), a ratio of height to weight, further classifies obesity in a clinically feasible manner as both are easily measured (Table 2-3). The NIH<sup>27</sup> clinical guidelines and the WHO<sup>28</sup> have stated that overweight is defined as having a BMI equal to or greater than  $25 \text{ kg/m}^2$ . Obesity, defined as a BMI greater than or equal to  $30 \text{ kg/m}^2$ , is further divided into three classes.

**Table 2-2** Estimates of Energy Expenditure

METs	Oxygen Consumption	Kcal/min	Kcal for 30-Minute Exercise	Walking Speed
3	$10.5 \text{ ml/kg}^{-1}/\text{min}^{-1}$	3.5	100	2.6 mph
4	$14 \text{ ml/kg}^{-1}/\text{min}^{-1}$	4.5	135	2.9
5	$17.5 \text{ ml/kg}^{-1}/\text{min}^{-1}$	5.75	175	3.0 mph 4.2% grade
6	$21 \text{ ml/kg}^{-1}/\text{min}^{-1}$	7	210	3.0 mph 9.2% grade

METs, Metabolic equivalents; Kcal/min, kilocalories per minute; mph, miles per hour.

**Table 2-3** Body Mass Index (BMI) to Determine Obesity Classification

NHLBI Terminology	BMI Range (kg/m <sup>2</sup> )	WHO Classification
Underweight*	<18.5	Underweight
Normal	18.5-24.9	Normal
Overweight	25.0-29.9	Preobese
Obesity Class 1	30.0-34.9	Obese Class 1
Obesity Class 2	35.0-39.9	Obese Class 2
Obesity Class 3	≥40.0	Obese Class 3

NHLBI, National Heart Lung and Blood Institute; WHO, World Health Organization.

\*BMI less than 17.5 is classified as anorexic.

To calculate your BMI using pounds (lbs) and inches (in), multiply your weight (lbs) x 700 and divide the product by your height in inches squared. NOTE: you can easily calculate your BMI on-line at <http://www.nhlbisupport.com/bmi/bmicalc.htm>.

A BMI greater than or equal to 25 is associated with increased risk for premature death and disability. As one progresses to a higher class of obesity, health risk and morbidity increase.<sup>18</sup> The term *morbid obesity* has been used by some authors to refer to a BMI greater than 40.<sup>130</sup>

In addition to the use of BMI, medical professionals may still define obesity as weight greater than 20% of desirable weight for adults of a given gender, body structure, and height. A more precise classification has been suggested, with overweight describing someone weighing 10% more than his or her optimum weight; obese describing individuals weighing 15% more; and grossly obese describing persons weighing 20% or more above the optimum weight for height and body type.

BMI, however, is currently the most common measure of obesity and is an internationally accepted and understood definition of the condition. Regardless of the measure used, obesity is a condition that is inherently risky for health and longevity, especially if the distribution of such fat is in and around the abdomen (see Fig. 11-8). Although a highly muscular person may have a higher than desirable BMI, health risk occurs only if BMI is indicative of excess body fat.

BMI varies with age and sex in children and adolescents, necessitating the CDC to develop BMI charts that uniquely account for growth using weight and height. Pediatricians should track growth regularly and confer with parents when a child or adolescent presents with a BMI greater than or equal to the 85th percentile. BMIs greater than or equal to the 85th and less than or equal to the 95th percentile signify a risk for being overweight; BMI greater than or equal to the 95th percentile signifies risk for being obese.

### Incidence and Prevalence

Obesity is now regarded as a pandemic with implications for 300 million people across the world.<sup>217</sup> Obesity has begun to replace other known causes of mortality (e.g., undernutrition and infectious diseases) as the most significant contributor to ill health. It is second only to cigarette smoking as a leading cause of preventable death in

the United States and contributes to 500,000 deaths annually; out of these deaths the CDC reports that 30,000 are premature deaths. In the United States, it is estimated that 65% of adults can be categorized as overweight or obese.<sup>82</sup>

The prevalence of obesity among adults continues to increase.<sup>33</sup> From 1980 to 2002, obesity has doubled in adults and overweight prevalence has tripled in children and adolescents.<sup>197</sup> In 2003 to 2004, 17% of children and adolescents aged 2 to 19 years were overweight and 32.2% of adults were obese.<sup>199</sup> This growth in the percentage of people who are now overweight or obese is occurring across all age groups and of significant concern in the pediatric and geriatric populations.

The U.S. Department of Health and Human Services (DHHS) reports that one out of every five children is obese and the obesity rates have increased 14% from 1991 to 1994 among children ages 6 to 11.<sup>146</sup> The increase in numbers of people who are obese is paralleled by a considerable reduction in daily energy expenditure and physical activity that leads to a decrease in aerobic capacity and deficiencies in the ability to perform physical activities.<sup>33,166,192,247</sup>

Existing evidence indicates that physical inactivity is strongly associated with body weight gain and that the conduct of purposeful and regular exercise and maintenance of a physically active lifestyle can be effective in maintaining a healthy body weight.<sup>52,89,265</sup> Although sedentary lifestyles have not been causally linked to BMI, the risk of becoming sedentary increases with BMI.<sup>130</sup> Research has confirmed the importance of physical activity to maintain weight loss, especially if exercise commitment reached or exceeded 200 minutes per week.<sup>131,134</sup>

### Etiologic and Risk Factors

The development of obesity depends on an imbalance between energy intake and energy expenditure, with more energy consumed than is expended. Inactivity and a high-fat, low-carbohydrate diet with excess intake of refined sugar are contributing factors to excess adipose tissue and weight gain.

Hill and colleagues,<sup>116</sup> using National Health and Nutrition Examination Survey (NHANES)<sup>116-185</sup> data over an 8-year period, have determined that the median energy accumulation is 15 kcal/day and that 90% of the population accumulates less than 50 kcal/day. This means that an intervention that reduced energy gain by 50 kcal/day could offset weight gain in about 90% of the population.

In other words, for every excess 100 kcal consumed, at least 50 kcal of energy are deposited in energy stores. On the basis of this information, most of the weight gain seen in the population could be eliminated by some combination of increasing energy expenditure and reducing energy intake by 100 kcal/day, closing the energy gap.<sup>64</sup> This can be accomplished by simply walking an extra mile per day or for 15 to 20 minutes, or by reducing intake with smaller portions of food. The reason an energy imbalance leads to obesity remains unknown. However, factors that are associated with the development of the energy imbalance and that may lead to excessive fat deposition and obesity are listed in Box 2-4.

**Box 2-4****RISK FACTORS FOR OBESITY**

- Sedentary lifestyle
- High glycemic diet
- Underlying illness (e.g., hypothyroidism, polycystic ovary syndrome)
- Genetic disorder (Prader-Willi syndrome)
- Genetic, familial, or biologic factors
- Medications (e.g., increased appetite or food cravings associated with prescription medications)
  - Corticosteroids (see Box 5-5)
  - Antidepressants
  - Antihypertensives
  - Anticonvulsants
  - Diabetes medications (short-acting insulin)
- Environmental or psychosocial/behavioral factors (e.g., history of sexual abuse, socioeconomic status, eating disorders, lack of sleep, stressful lifestyle, smoking cessation)

In addition to the failure of aging people to adjust food intake in response to lowered metabolism and diminished activity, weight cycling with fluctuations of body weight produced by repeated cycles of weight loss and gain appears to contribute to the inability to lose weight on a long-term basis.

Medication-induced weight gain may occur as a result of increased appetite, episodes of hypoglycemia, or water retention. Other drugs, such as corticosteroids, make the body less able to absorb blood glucose, leading to increased fat deposits in the trunk. Antihypertensive medications, such as beta-blockers, may produce fatigue or shortness of breath, leading to reduced activity levels and increased weight gain.

A growing body of evidence suggests that some forms of obesity are more likely the result of biochemical defects rather than consumption of excess calories.<sup>225</sup> After a 40-year search, scientists originally found three genes linked to obesity (*ob*, neuropeptide Y [Npy], and the *Beacon* gene). Npy and the *Beacon* gene produce a protein that stimulates the appetite, whereas the *ob* gene produces a protein (leptin) that switches off the appetite. In some obese people, the body does not respond to leptin; in others, the *Beacon* gene is working in overdrive, producing too much appetite-stimulating protein.<sup>226</sup> Preliminary studies show that the *Beacon* gene is the same across various regions and ethnicities.

More recently, more genes and digestive tract hormones have been found that may influence why some individuals become obese and others do not. Newer genes being investigated are *Insig-1* and *Foxa-2* and the hormone known as *peripheral hormone peptide YY* (PYY). *Insig-1* blocks the formation of new fat cells and is suspected to be more active in various parts of the body, thus accounting for different body contours and deposits of fat tissue.<sup>226</sup> *Foxa-2* is known to prevent immature cells from developing into new fat cells.<sup>229</sup> Location and lack of *Insig-1* and *Foxa-2* genes may influence where fat is deposited and if more than normal fat deposits occur.

*Peripheral peptide YY* or hormone PYY is produced by cells in the stomach and intestines after a meal. PYY is thought to act on the brain to reduce appetite. PYY and many gastrointestinal hormones are being investigated as potential weight loss drug targets.<sup>20,215,230</sup>

Despite the new discoveries of single-gene mutations resulting in obesity, most cases of obesity are more likely the result of subtle interactions of several related genes with environmental factors, which favor the net deposition of calories as fat resulting in obesity. The increasing rates of obesity cannot be exclusively explained by changes in the gene pool, although genetic variants that were previously silent are now being triggered by the high availability of energy- and fat-dense foods and by the increasingly sedentary lifestyle of modern societies.<sup>165</sup>

**Pathogenesis**

The mechanisms proposed to explain the development or effects of obesity on the human body target neurologic, metabolic, and energy regulation systems.

Accumulating evidence indicates that obesity is a central nervous system-mediated *neuroendocrine dysfunction*. Since the central nervous system plays a key role in the regulation of food intake and energy balance, one explanation may be that either spontaneous genetic mutations or targeted gene deletions that impair central nervous system signaling cause disrupted food intake and body-weight control.<sup>231</sup> Researchers are studying the highly complex process of signaling molecules involved in the regulation of food intake and how inherited or acquired defects in the function of these hormonal and neuropeptide signaling pathways contribute to obesity.<sup>226,230</sup>

Another explanation involves the neuroendocrine system and suggests that *hormonal dysfunction* affecting the hypothalamic-pituitary-adrenal (HPA) axis results in a complex series of events. Stress stimulates daily, periodic elevations of Cortisol secretion and results in impaired Cortisol secretion, prolonged stimulation of the sympathetic nervous system, and subsequent hypothalamic arousal. The net effects of this neuroendocrine-endocrine cascade are poorly regulated Cortisol secretion, insulin resistance, elevated blood pressure, and visceral accumulation of body fat (central obesity)<sup>231</sup> The result can be a collection of metabolic risk factors, referred to as the *metabolic syndrome*, which includes abdominal obesity, atherogenic dyslipidemia, elevated blood pressure, insulin resistance, and prothrombotic and proinflammatory state of the blood (see further discussion of the Metabolic Syndrome in Chapter 11).

*Energy regulation* also has been a target for explaining the mechanism(s) of obesity. In this case, the sodium (Na<sup>+</sup>)/potassium (K<sup>+</sup>)/adenosine triphosphatase (ATPase) pump is believed to play a major role in the development of obesity. This enzyme pump transports sodium out of the cell and potassium into the cell at the expense of cellular energy in the form of adenosine triphosphate (ATP). Obese people are believed to have fewer ATPase pumps than the nonobese; the obese person uses less energy and expends fewer calories, keeping a state of equilibrium within the body.

The *adipose cell* theory postulates that some people inherently have an excessive number of fat cells (adipo-

**Box 2-5****COMPLICATIONS ASSOCIATED WITH OBESITY**

- Metabolic syndrome
- Type 2 diabetes mellitus
- Liver diseases
- Osteoarthritis
- Sleep apnea
- Atherosclerosis; hypertension; cardiovascular diseases
- Stroke
- Asthma
- Cancer
- Menstrual disorders and infertility
- Impaired mobility
- Gallbladder disease
- Psychologic disturbances such as irritability, loneliness, depression, binge eating, and tension
- Premature death

Data from Deusinger SS et al: The obesity epidemic: health consequences and implications for physical therapy, *PT Magazine* 1 2161:82-104, 2004.

cytes) and the size of the fat cells is increased. Similarly, the *lipoprotein lipase (LPL)* theory suggests that LPL (the enzyme that helps fat to be deposited in adipocytes) is elevated in obese persons and weight reduction stimulates even more production of LPL, causing fat cells to return to their hypertrophic size.

More recently, researchers have proposed the theory that for some people, obesity is the result of intestinal microorganisms. The *microbial* theory of obesity suggests a biologic cause of weight gain from an altered level of bacterial intestinal microbes called *gut microflora*, which may be responsible for regulating energy intake, absorption, and storage.<sup>14,155</sup>

### Clinical Manifestations

Regardless of the mechanisms on the condition, the outward signs and symptoms of obesity are readily observable (excess body fat). However, the effects and complications of obesity are less easily identified at onset.

Obesity is associated with significant increases in both morbidity and mortality from many conditions (Box 2-5) and is associated with three leading causes of death: cardiovascular disease, cancer, and diabetes mellitus. The role of obesity in inflammation is discussed in Chapter 11, and fat (adipose tissue) as an endocrine gland and its role in cancer is discussed in Chapter 11.

Other complications may include nephrotic syndrome and renal vein thrombosis; other thromboembolic disorders; digestive tract diseases, such as gallstones and reflux esophagitis; asthma; obstructive sleep apnea; carpal tunnel syndrome; and subsequent pulmonary compromise with decreased gas exchange, vital capacity, and expiratory volume.

Diet accounts for about 35% of all cancers<sup>8</sup>; obesity is a known risk factor for hormone-related cancers such as breast, cervical, endometrial, and liver cancer in women and prostate, colon, and rectal cancer in men.<sup>2,145</sup> Obesity may increase the risk of Hodgkin's lymphoma, especially

among men.<sup>262</sup> See further discussion on the influence of obesity on cancer in Chapters 9 and 11.

As discussed, dietary patterns (highly processed and refined foods without fiber) in combination with physical inactivity contribute to obesity and metabolic consequences. Nutritional modulation of growth-enhancing and differentiating hormones is discussed further in Chapter 9.

Some scientists believe that there is a causal relationship of obesity with asthma.<sup>51,221</sup> The mechanism for the causality is thought to be related to an inability of the person to take deep breaths, which leads to more reactive airways and, if severe enough, asthma. Research is mixed as to whether the link between obesity and asthma is the same for women and men. One study concluded that independent of age, women with a BMI greater than or equal to 30 kg/m<sup>2</sup> were about twice as likely to develop asthma as women of a normal weight.<sup>51</sup>

Type 2 diabetes mellitus is often associated with obesity. Excessive food intake stimulates hyperinsulinemia. Through a negative-feedback mechanism, excessive insulin levels decrease the number of insulin receptor sites on adipose cells. The decrease in insulin receptor sites decreases the amount of glucose that can enter the cells. This promotes high blood levels of glucose. The excess glucose is stored as glycogen in the liver or as triglycerides in adipose cells, thereby enhancing hypertrophy and hyperplasia of fat cells in the already obese person. Weight reduction does reverse this process.

Obesity also is associated with significant functional deficits or problems that lead to functional impairments. Shortness of breath; fatigue; ADL limitations<sup>11</sup>; increased risk for falls<sup>53</sup>; and an increased incidence of hip, knee, and back pain in those who are obese<sup>11</sup> are potential problems.

Given a strong association between obesity and osteoarthritis (OA) of the knee, the risk for dysfunction in functional activities, such as walking and stair climbing, has been investigated.<sup>55,111</sup> Weight loss has been shown both to reduce the risk of OA, as well as to improve function in the face of this condition.<sup>111</sup>

Both perceptions and observed measures of functional limitations have been tested and found to be associated with difficulty of accomplishing daily tasks related to housework and self-care.<sup>149,150</sup> Thus the clinical manifestations of obesity have broad implications for numerous body systems and health dimensions.

### MEDICAL MANAGEMENT

**PREVENTION.** Preventing obesity from occurring or worsening is an important part of achieving a healthier population. Prevention includes maintenance of healthy weight, maintenance of weight loss, and prevention of weight gain. Identifying risk factors that can lead to obesity or cause related health problems and learning strategies toward achieving a healthy weight are the keys to successful prevention.<sup>6</sup> See also previous discussions of physical activity and nutrition in this chapter.

**DIAGNOSIS.** Physical examination should be directed at determining the presence of and distribution of body fat

by measuring height, weight, body circumference (extremity and waist), and nutritional status. In addition, the presence of associated causes of obesity should be investigated.

Abdominal (visceral) fat is metabolically active. Measurement of circumference is needed to identify the distribution of body fat and to determine the risks associated with increased waist circumference. Waist circumferences that are above 40 inches for men and above 35 inches for women increase the risk for premature death and disability as a consequence of overweight or obesity. Waist circumference is the best predictor of visceral (intraabdominal) fat and total fat. The most clinically telling physical sign of serious underlying disease is increased waist circumference, which is linked to insulin resistance, hypertension, dyslipidemia, type 2 diabetes, coronary heart disease, sleep apnea, and gallbladder disease.<sup>108</sup>

Waist circumference measurements have a high correlation with BMI.<sup>129</sup> Measurement of extremity circumference may also be useful in the adult population for the physician to rule out lipedema, a symmetrical "swelling" of both legs, extending from the hips to the ankles, caused by deposits of subcutaneous adipose tissue.

Although BMI and waist circumference measurements are the most clinically feasible methods to identify clients who are overweight or obese, additional methods may be used to measure subcutaneous fat or body composition.<sup>10</sup> Methods that are known for accuracy but often only used in research settings include hydrostatic weighing and dual-energy x-ray absorptiometry (DEXA).<sup>39,144</sup>

Additional methods that require less expensive equipment include the use of skinfold measurement calipers and the measurement of bioelectrical impedance. Skinfold measurements using calipers (the pinch test) are performed in several locations on the body (e.g., midbiceps, midtriceps, and subscapular areas). Measurements greater than 1 inch are thought to indicate excessive body fat. Skinfold measurement has been questioned in relationship to accuracy because interobserver variability may be high.<sup>139</sup> Skinfold measurement should be taken into consideration along with body type and height.

Bioelectrical impedance analysis (BIA) measures the impedance or resistance to an electrical signal that is circulated through the body. A person who has more fat mass will have larger impedance because there will be more resistance to the electrical signal traveling through the body since fat mass contains less water. BIA measures have been shown to be reliable and valid; however, variability among individuals can be high, and inaccuracy can occur in situations of altered hydration status and extreme obesity in those being measured.<sup>24,122</sup> Additionally, BIA has not been shown superior to BMI as a predictor of overall adiposity in a general population.<sup>263</sup>

All of these examples of measures can provide a baseline measurement for relative fat mass and can be used to monitor progress of body composition as people advance through a weight loss program.

**TREATMENT.** Both physical activity and nutrition are important in addressing obesity. Physical activity and nutrition are modifiable factors that respond similarly to the same interventions. To maintain a healthy weight, it

is important to keep energy expenditure at or above energy intake. This can be accomplished by decreasing caloric intake, increasing exercise energy expenditure, or both.

Weight loss is regarded as a major aspect of treatment for the person who is obese. Although the amount of weight loss necessary is arguable, 10% loss in body weight is regarded as a standard that improves health.

The National Weight Control Registry ([www.nwcr.ws/](http://www.nwcr.ws/)) reports that weight loss and maintenance of the weight loss are best accomplished if individuals participate in regular intensive exercise, attend support groups, restrict the amount and kinds of food eaten, and weigh themselves often.

A multidisciplinary approach with emphasis on weight loss maintenance should be directed toward anyone with a BMI of 30 and above and for those people with a BMI in the 25 to 29 range who have associated health problems. Such a treatment program includes moderate calorie intake, behavior modification, exercise, and social support.

Medications for obesity are widely available over the counter and by prescription. The use of pharmacologic agents to inhibit appetite, reduce fat absorption, and increase metabolic rate is highly controversial and provides at best only a short-term benefit. Drug therapy is thought to work best when it is part of an overall program aimed at lifestyle change involving dietary changes, exercise, and behavior modification.<sup>255,260</sup> To be effective, drug treatment for obesity should be continued indefinitely much like treatment for any chronic condition.<sup>5,14,260</sup> Researchers continue to look for drugs that can prevent or alter the physiology of obesity.

Surgical treatment, referred to as *bariatric surgery*, may be considered for some obese people if serious attempts to lose weight have failed, if BMI is greater than 40 kg/m<sup>2</sup> with or without comorbidities, or if there is a BMI of 35 kg/m<sup>2</sup> with significant health-related comorbidities<sup>5,34,194,239,260</sup> and complications of obesity that are life-threatening. Surgical approaches rely on reconfiguring or redirecting the gastrointestinal system through gastric restriction called vertical gastric banding (VCB) or gastric bypass procedures (e.g., Roux-En-Y gastric bypass [RYC.B]). Bariatric surgery has been shown to provide the greatest degree of sustained weight loss in people with morbid obesity.<sup>15</sup> Other benefits and complications of bariatric surgery are listed in Table 2-4.

Laparoscopic RYGB has been referred to as the "gold standard" operation for surgical control of obesity. It is effective in achieving weight loss, improving comorbidities and quality of life, and reducing recovery time and perioperative complications.<sup>224</sup> This procedure is safe, effective, and decreases overall costs.<sup>194</sup>

Evidence supports this shift in surgical approach for individuals having laparoscopic surgery based on studies demonstrating improved SF-36 scores,<sup>93,193,194,239</sup> decreased recovery times,<sup>193,224</sup> earlier return to work,<sup>193</sup> less postoperative pain,<sup>193,224</sup> and comparable amounts of weight loss.<sup>61,193</sup>

The relationship(s) between biologic and behavioral factors influencing obesity is not yet completely understood. However, regardless of the medical and surgical

**Table 2-4** Potential Benefits and Complications of Bariatric Surgery

Potential Benefits	Potential Complications
Weight loss	Nephrolithiasis
Improved serum lipids	Hepatic failure
Decreased blood pressure	Cholelithiasis
Improved or resolved diabetes mellitus	Malnutrition
Improved or resolved sleep apnea	Reflux
Reduced venous stasis	Small bowel obstruction (SBO)
Decreased joint pain	Hemorrhage
Improved quality of life	Iron deficiency anemia
Overall improved function	Vitamin B12 malabsorption
	Gastric prolapse

Courtesy Tamara L. Burlis, PT, DPT, CCS, Washington University Program in Physical Therapy, St Louis, MO. Used with permission, 2006. Data compiled from a variety of published studies.

treatments available to treat obesity, behavioral change in the frequency and type of eating and exercise habits remains the foundation of both prevention and intervention.<sup>256</sup>

Behavior in both prevention and treatment is influenced by what options are available (e.g., vending machines, safe parks in which to walk), how and to whom health information is portrayed (e.g., media versus health practitioner), and what type of support is given to individuals who seek and/or need to make a change.<sup>135</sup>

Practitioners require knowledge of what motivates change, how behavioral change occurs, what resources are needed to make change, and strategies useful for promoting change. Across the theoretic foundations guiding this knowledge, the combined merits of providing accurate information, understanding barriers preventing change, anticipating personal readiness for change, and providing structure and support over extended periods to enable sustained new behaviors have been recognized as helpful.<sup>20</sup>

Although lifestyle programs have been shown to be the most successful in creating durable change, regulation of body weight (to either prevent gain or maintain loss) is still affected by a myriad of intrapersonal and environmental factors that interact to make obesity control difficult. Tailoring all interventions to the "personal environment" of each individual is critical in overcoming the intrinsic and extrinsic pressures in the American culture that affect the current epidemic of obesity.<sup>161</sup>

**PROGNOSIS.** The management of obesity continues to be challenging, particularly because its effect on the whole person is so broad and the causes/influences are so numerous that prognosis relies on significant and sustained lifestyle changes that must last a lifetime. When therapy is confined to dietary measures alone, treatment of obesity is less likely to be successful. Because the risk of mortality and morbidity from obesity rises in proportion to the degree of obesity and the presence of complications, treatment is essential. For example, among the cardiovascular problems associated with obesity, hypertension in combination with obesity increases the risk for

development of cerebrovascular disease, specifically cerebral thrombosis.

Weight loss alters conditions associated with obesity and even moderate weight loss in an obese person (i.e., 10 to 20 lbs) provides substantial changes in risk factors. Following weight loss in the obese, a decrease in blood pressure usually occurs with a regression of left ventricular hypertrophy, total and HDL cholesterol are favorably changed, and glucose tolerance improves in those people with type 2 diabetes mellitus.

The addition of exercise to a comprehensive program of caloric reduction and behavior modification can improve results. Regular exercise can maximize body composition change and increase the probability of maintaining weight loss.

Patterns of fat distribution are important in determining the risks associated with obesity. Visceral fat within the abdominal cavity is more hazardous to health than subcutaneous fat around the abdomen. Upper body obesity around the waist and flank is a greater health hazard than lower body obesity marked by fat in the thighs and buttocks.

People who are obese with high waist-to-hip ratios (greater than 10 in men and 0.8 in women) have a significantly greater risk of diabetes mellitus, stroke, coronary heart disease, and early death than equally obese people with lower ratios. Waist circumference alone has also been designated as an independent predictor of health risks and may replace the waist-to-hip measurement as a predictor of increased risk. For women, weight-related health risks increase when the waist measurement is 35 inches or more; for men, this figure is 40 inches or more.

Although the connection between obesity (BMI greater than 30) and coronary heart disease is well established, it remains unknown whether a similar link exists for those who are mildly overweight. Research has shown that people whose BMI at midlife (30 to 55 years of age) was between 23 and 24.9 had a 50% higher risk of heart attack compared with those whose BMI was under 20. Women whose BMI was greater than 29 had a 3.6 times greater risk of heart attack compared with the leanest group.<sup>264</sup> Moderately higher adiposity at younger ages (18 years) is associated with increased premature death in younger and middle-aged women.<sup>252</sup>

## SPECIAL IMPLICATIONS FOR THE THERAPIST

2-3

### Obesity

#### PREFERRED PRACTICE PATTERNS

**Integument:** 7A, 7B, and 7C: Primary Prevention/Risk Factor Reduction of Integumentary Disorders; Impaired Integument Secondary to Superficial or Partial-Thickness Skin Involvement (pressure ulcer prevention)

Various musculoskeletal patterns may be observed depending on clinical presentation

**Cardiopulmonary:** 6A and 6B: Primary Prevention/Risk Factor Reduction for Cardiopulmonary Disorders; Impaired Aerobic Capacity and Endurance Secondary to Deconditioning

*Continued.*

Obesity has negative effects on overall health; emerging evidence indicates that obesity has effects on physical function, beyond those outcomes of chronic disease. Obesity has negative effects on overall physical function,<sup>66</sup> although the contributions of obesity to overall musculoskeletal function are not well understood.

Problems associated with obesity commonly seen in a therapy program include back pain; arthritis; biomechanical dysfunction affecting the hips, knees, and ankle/foot; skin breakdown; and cardiopulmonary compromise. Obesity is a known risk factor in the development of type 2 diabetes mellitus often accompanied by diabetic neuropathy, foot ulcerations, and neuropathic fractures (see discussion on Diabetes Mellitus in Chapter 11).

For the therapist, working with the obese person poses a definite risk to good health. Using proper body mechanics, careful planning for transfers, and obtaining adequate help are essential during any lifting, transfers, and hands-on therapy.

#### Obesity and Back Pain

A relationship between obesity and low back pain has not been definitively established. Studies show mixed results, with only severe obesity (BMI greater than 40) being consistently linked with back pain.<sup>92,204</sup> The link between obesity and the incidence of symptomatic lumbar disease manifested by low back pain is a weak one at best. Whereas some studies demonstrate a high incidence, others report no correlation between the conditions.<sup>177,204</sup>

#### Obesity and Joint Pain

Obesity contributes to increases in musculoskeletal pain, demonstrated by increased odd-ratios of 1.7 to 9.9 of work-restricting pain in obese subjects as compared to the general population.<sup>20</sup> There is an association between obesity and knee OA but not hip OA or general OA.<sup>218</sup>

There is also some relationship between BMI and the frequency of hip and knee replacement surgery<sup>261</sup> and poorer outcomes after total knee arthroplasty (TKA),<sup>25</sup> but no association is demonstrated between BMI and needing total hip or knee revision surgery.

Obese individuals should have greater joint loading forces; however, at least one study demonstrated that obese individuals appear to have gait loading forces in the knee that are less than normal weight individuals, adjusting gait by adopting a slower self-preferred speed.<sup>63</sup> In adolescents, this slower speed was also associated with difficulty increasing cadence, affecting the ability to adjust walking speeds to environmental conditions.<sup>118</sup>

#### Obesity and Physical Activity

Obesity might have a negative effect on performance of activities that require muscular strength or power, in that the muscle would have to apply a greater force to move a larger mass. This was demonstrated in one study of children where obesity limited the ability to perform lower extremity activities such as vertical jump and standing long jump.<sup>117</sup>

Another activity of daily living that requires significant lower extremity strength is rising from a chair. One study demonstrated that in 8- and 9-year-old obese children, 69% needed assistance in rising from a chair.<sup>117</sup> This difficulty may accelerate the cycle of obesity and encourage sedentary behavior as a result of the difficulty in getting up to perform physical activity.

#### Obesity and Operative Complications

There are technical challenges in preparing and operating on an obese individual. Imaging equipment may not be large enough to accommodate the very obese individual and the quality of the image may be poor. Motion studies using flexion and extension radiographs may not assess range of motion adequately. Additional considerations include maintaining an open airway and accessing venous or arterial blood vessels because of adipose tissue getting in the way.<sup>204</sup>

There is no strong correlation between obesity and perioperative complications,<sup>136,182</sup> but there are many reports of operative complications in obese individuals after many different kinds of procedures (e.g., gynecologic, orthopedic, cardiovascular, transplantation, urologic). There are reports of positional neuropathies after surgery in morbidly obese individuals (BMI greater than 40). Positional palsies are attributed to increased weight causing traction or compression on peripheral neurovascular bundles, especially when the individual is placed in the prone position without adequate support and padding.<sup>204</sup>

#### Prevention

Prevention and screening programs for adults and children are advocated by Healthy People 2010 toward the goal of promoting health and reducing chronic disease associated with diet and weight. The physical therapist's role in prevention and wellness, including screening programs and health promotion, is discussed in Chapter 1 and presented in detail in the APTA *Guide to Physical Therapist Practice*.

Therapists can be involved in hypertension and obesity screening as suggested by the Surgeon General because regular exercise is an important component toward physical and mental well-being and prevention of the comorbidities associated with obesity. Since obesity is often associated with an increased prevalence of cardiovascular risk factors, graded exercise testing may be indicated before prescribing an exercise program. Even morbidly obese people can be evaluated on the treadmill with some modification in the testing protocol such as beginning with slow walking without treadmill elevation, followed by gradual increases in speed to achieve maximal exertion. Submaximal exercise testing overcomes many of the limitations of maximal exercise testing and may be applicable to this population.<sup>3,68</sup>

#### Exercise

Prescribing exercise for obese people follows the principles used with healthy people (see Box 2-3), including modifications for mechanical limitations, awareness of potential hazards during exercise (Box 2-6), and awareness of the greater heat intolerance of the obese.

Some equipment modifications may be necessary if the client is too large to use a stationary bicycle or exceeds the manufacturer's recommended weight capacity. For example, the client can pedal some stationary bikes while seated in a chair behind the bike.

A higher incidence of exercise-related injury exists among the obese that requires extra caution in the first few weeks. Recommendations include adequate warm-up and stretching and progressive increases in intensity, frequency, and duration. Severe obesity contributes to back pain and back injury and affects foot mechanics, which can lead to foot and ankle problems. Selection of appropriate footwear with possible orthotic devices that provide heel support or compensatory foot pronation is recommended to make exercise safer and more comfortable.

Aerobic exercise with a frequency of four times a week to produce significant weight loss is recommended because it provides the greatest caloric expenditure per minute of training. However, the frequency required is the reason most exercise programs fail for obese people, so compliance and caloric expenditure are the early goals toward achieving a habit of regular exercise rather than an immediate increase in aerobic endurance.

Developing an exercise program the person likes and can complete over time is the initial focus. Finding the right match may take some time and several unsuccessful attempts. Moreover, studies indicate that improved fitness through regular physical activity reduces cardiovascular morbidity and mortality for overweight individuals even if they remain overweight. The ultimate goal for the exercising obese person is to make a life-long commitment to achieving reasonable energy expenditure through routine physical activity.<sup>228</sup> The American College of Sports Medicine (ACSM)<sup>3,4</sup> presents the benefits of low-intensity, short-duration regular exercise.

The influence of body weight on exertion and lower-extremity trauma may support an initial program of stationary cycling. Aquatic exercise programs can be an important part of reducing strain on joints by providing non-weight-bearing exercise for the obese person. Resistive exercises and weightlifting can be structured to produce aerobic gains by using a circuit style with low resistance, multiple repetitions, and short rests between sets. For most individuals, caloric expenditure with traditional strength-training techniques is not as great as with circuit lifting or aerobic conditioning, but strength training does use calories and can increase lean body mass.

Behavior modification focusing on routine daily activities that require no special equipment and involve only simple lifestyle changes may be the only type of physical activity that is continued for any length of time. For example, less reliance on vehicular transportation, parking a distance from the destination, avoiding elevators and using stairs, delivering messages within the work structure rather than telephoning, and walking 10 minutes during lunch are useful and easily accommodated suggestions for increasing energy expenditure.

**Box 2-6****POTENTIAL COMPLICATIONS OF OBESITY DURING EXERCISE**

- Precipitation of angina pectoris or myocardial infarction
- Excessive rise in blood pressure
- Aggravation of degenerative arthritis and other joint problems
- Ligamentous injuries
- Injury from falling
- Excessive sweating
- Skin disorders, chafing
- Hypohydration and reduced circulating blood volume
- Heat stroke or heat exhaustion

From Skinner JS: *Exercise testing and exercise prescription for special cases: theoretical basis and clinical application*, ed 2, Philadelphia, 1993, Lea & Febiger.

**Smoking and Tobacco Use**

Smoking and the use of tobacco products are associated with a number of chronic diseases, including chronic pulmonary diseases and cardiovascular conditions, as well as many types of cancers. Smoking also decreases the health of individuals who smoke. Some of the significant links between smoking and disease are reported in the Surgeon General's report.<sup>229</sup>

Beside the obvious health risks associated with tobacco use as a lifestyle choice, it can become a psychologic problem because of the addictive qualities of this substance. For this reason, we have chosen to include tobacco use as part of a discussion of Substance Abuse in Chapter 3.

**Alcohol and Other Drugs**

Whether to consider substance use/abuse a behavioral condition or a psychologic problem remains uncertain. Many psychologists and addiction counselors say it is a condition, illness, or problem with multiple factors, including physical, psychologic, social, economic, and spiritual. Others place it on a continuum from behavior to disorder, depending on the individual's relationship to the substance(s) and how that individual's friends, family, colleagues, or coworkers are affected. Substance use is considered by some a "choice," whereas addictions may be diagnosed as a disorder and then categorized as a pathologic psychologic disorder.

Addiction specialists and drug educators want to make it clear that alcohol is a drug. The commonly used phrase today when discussing substance use and abuse is "alcohol and other drugs."

Culturally and socially, we live in a world that advertises and encourages the use of alcohol and other drugs as part of the American lifestyle. Addictions may be considered unique disorders that have their start in personal or lifestyle behaviors and choices but later become addictions with diagnosable pathology. Someone who drinks or uses drugs recreationally may not be an alcoholic or addicted, but when the use of substances has consequences in other areas of their life, then a problem is identified. There can be a fine line between lifestyle choices and behaviors and addictions and psychologic

disorders. For now, we have chosen to place alcohol and other drug use in Chapter 3 but mention it here as a possible lifestyle, behavior, or choice that can impact the health of the individual and/or family members.

## Domestic Violence

Domestic violence (DV) can be classified under categories of child abuse, intimate partner violence (IPV), and elder abuse. Because of the wide variety of practice settings in which they work, physical therapists are likely to encounter individuals of all ages who have been victims or survivors of DV.

DV is the physical, emotional/psychological, or sexual abuse; financial exploitation; neglect; or stalking of an individual by a person with whom they have a marital, familial, social, or dependency relationship. DV occurs in all socioeconomic and racial/ethnic groups. In all forms of DV, the incidence of abuse of individuals with disabilities is greater than in the nondisabled population.<sup>211,240,251,279</sup>

*Physical abuse* involves nonaccidental physical injury, which can range from superficial bruises and welts to broken bones, burns, serious internal injuries, and death. *Emotional and psychologic abuse* can result from acts or omissions that cause or could cause serious behavioral, cognitive, emotional, or mental disorders as a result of actions such as confinement or the constant use of verbally abusive language and criticism.

*Sexual abuse* ranges from nontouching offenses, such as exhibitionism, to fondling, rape, molestation, or the forced use of a child or an adult in the production of pornographic materials.

*Neglect* can involve the withholding of or failure to provide adequate food, shelter, clothing, hygiene, medical care, and/or supervision needed for optimal health and well-being. Neglect also includes refusal or delay in seeking health care, abandonment, inadequate supervision, and expulsion from home. Emotional neglect in children includes allowing a child to witness chronic or extreme spousal abuse or permitting truancy or drug/alcohol use. *Stalking*, another form of DV, is defined by the National Criminal Justice Association as "a course of conduct directed at a specific person that involves repeated visual or physical proximity, nonconsensual communication, or verbal, written or implied threats, or a combination thereof, that would cause a reasonable person fear."<sup>2189</sup>

## Child Abuse

Child abuse involves the physical or emotional abuse or neglect or sexual abuse of a child under the age of 18 years, unless a state's protection law specifies a different age limit. It is estimated that 12 out of every 1000 children in the United States are victims of physical or sexual abuse or neglect and that many more cases are never reported.<sup>251</sup> Almost 1500 children die each year as the result of abuse; the majority of these children are less than 3 years of age.<sup>251</sup>

Because children are prone to accidents, it is important for clinicians to distinguish between the signs of accidental versus inflicted injuries and to determine if there is a

reasonable suspicion of child abuse or neglect. The clinical manifestations often associated with child abuse are listed in Table 2-5.

Generally, accidental bruising, fractures, and burns are rarely found in infants who are not yet crawling or walking. In older children, accidental injuries, such as those occurring from falls, usually result in contusions over bony prominences. Bruises on the buttocks or other areas of the body are suspicious for abuse.

Sexual abuse should be suspected if bruising is found on the inner thighs. Contusions around the mouth of infants and young children often are the result of force-feeding. Other indicators of abuse include marks resembling finger imprints, which may occur when a child is forcibly held, shaken, or slapped. Injuries that resemble straps, cords, bites, or utensils should be reported to appropriate child abuse agencies.

Many types of burns are associated with child abuse, and these injuries account for 10% of child abuse cases.<sup>206</sup> Most occur in children under 10 years of age, with the majority of inflicted burns occurring in children less than 2 years old.<sup>206</sup>

*Immersion* burns can be identified by sharply delineated water lines. These are often seen as glove or stocking distribution patterns that result from holding the hands or feet in very hot water. A doughnut pattern may result if a child is held in a tub of scalding water. This pattern occurs when the buttocks are spared from burns because they make contact with the bottom of the tub instead of the hot water that burns the legs and lower trunk. "Sparing" may also occur in the creases of the body and palms of the hands when, as a defensive mechanism, a child will flex the body or hands when held in very hot water.

*Contact* burns resulting from having hot liquid thrown at a child differ from those resulting when young children pull pots of hot liquid off a stove. In the latter case, the first point of contact occurs on the face, chin, neck, and axilla (because they look up as they reach for the handle) and the flow pattern lessens along the torso. When hot liquids are thrown at a child, the burns are usually not present on the neck and axillary area.

Contact burns that are *accidental* burns often can be distinguished from *intentional* burns. Accidental burns tend to be superficial because of the tendency to pull away when something hot is encountered. Brushing against a hot object, such as a cigarette, causes a burn pattern that is shallow and irregular, not the symmetric and deep pattern that occurs when a cigarette is used to intentionally burn a child. These burns are often found inside the palm of the hand or on the back or buttocks. Irons and curling irons may be used to intentionally inflict injury; the therapist must judge whether the explanation of the injury is reasonable and accounts for the child's age, height, and motor abilities.

*Shaken baby syndrome* (SBS) generally occurs when a frustrated caregiver shakes an infant vigorously, usually in an attempt to stop crying or other unwanted behaviors. In most cases, there is an unawareness of the dangers of shaking. Shaken baby syndrome usually occurs in infants under 3 years of age and can result in serious, sometimes fatal, injury and disability.

**Table 2-5** Clinical Manifestations of Domestic Violence

All Populations	Child Abuse	Intimate Partner Violence	Elder Abuse
<b>Physical Manifestations</b>			
Cuts, lacerations, puncture wounds, fractures	Explanation of injuries incompatible with child's age, size, and developmental skills	Head, neck, and facial injuries; temporomandibular joint pain	Soiled clothing or bed, fecal or urine smell, health or safety hazards in living environment
Bruise, welt, and wound patterns that resemble utensils, bite marks, cords, etc.	History of frequent illness affecting the ears, throat, lungs, chest, and GI tract	Injuries in a central pattern that involves the breasts/ chest, abdomen, and genital areas	Absence of hair and/or hemorrhaging below scalp
Any injury incompatible with history	Shaken baby syndrome: retinal hemorrhage, signs of traumatic brain injury	Traumatic brain injury, mild traumatic brain injury, postconcussive syndrome	Dehydration and/or malnourishment/ weight loss without illness-related cause
Untreated injuries, delay in obtaining medical care	Subdural hematoma, skull fracture in infants	Back, neck, and chest pain; abdominal and pelvic pain	Poor skin condition, poor skin hygiene, rashes, decubitus ulcers
Burns from cigarettes or acids, friction from ropes or chains	Upper lip and frenulum injuries from forced feedings	Vague symptoms of pain, chronic pain	Marks around mouth indicating that the person has been gagged
Defensive pattern of injuries when the hands and arms are used to protect the face or head		Posttraumatic distress symptoms	Rope burns or abrasions on the wrists, ankles, torso, and neck from restraints
Injuries in various stages of healing		Frequent headaches, migraine headaches	Inadequate clothing, heat, and food
Injuries to genitals and inner thighs from sexual abuse		Pregnancy complications	
<b>Behavioral Manifestations</b>			
Mood and appetite disturbances, eating disorders	Neglect may result in head banging and rocking	Increased use of alcohol and other drugs	Increased use of alcohol and other drugs
Depression/suicidal tendencies	Failure to thrive, developmental delays	Partner answers all questions, partner always present	Caregiver answers all questions, caregiver always present
Sleep disturbances	Speech delays	Fatigue	
Use of emergency departments for health care	Aversion to touch		
Frequently missed/cancelled therapy/medical appointments			

Courtesy Claudia B. Fenderson, PT, EdD, PCS, Mercy College, Dobbs Ferry, New York, 2007.

CL Gastrointestinal.

Because of the weakness of an infant's neck muscles and the size of the head, shaking results in multiple forces of the fragile brain against the skull. This impact can result in direct trauma to the brain, swelling, subdural hematoma, and subarachnoid hemorrhaging. This in turn can lead to traumatic brain injury, seizures, cerebral palsy, brain damage, and death. SBS is the most common cause of mortality in infants,<sup>213</sup> and one of four infants dies as the result of being shaken.<sup>209</sup>

Other sequelae of SBS include retinal hemorrhage, blindness, spinal paralysis, mental retardation, and learning disabilities. Symptoms of SBS include irritability, seizures, vomiting, diminished eating, decreased responsiveness, and changes in breathing. Fractures of the ribs and long bones often accompany SBS. These symptoms of SBS warrant emergency attention. The inju-

ries associated with SBS are not attributable to accidental falls.

The medical history of children should be carefully reviewed since many medical disorders can mimic signs of child abuse. Osteogenesis imperfecta is a collagen defect in which fractures can occur with minimal or even no apparent force. Hemophilia, a clotting factor disorder, often causes persistent bleeding with little or no injury. Illness and medical treatment involving platelet irregularities can also result in excessive bleeding/bruising. Allergies can result in "allergic shiners" that resemble the contusions associated with a "black eye."

Mongolian spots are darkly pigmented areas caused by entrapment of melanocytes; they are often found on the sacrum or lower back of many African-American and Hispanic infants (Fig. 2-2). Although these spots resem-



**Figure 2-2**

Mongolian spots (congenital dermal melanocytosis). The therapist must be aware of Mongolian spots, which can be mistaken for bruising from child abuse in certain population groups (e.g., Asian, East Indian, Native American, Inuit, African, and Latino or Hispanic heritage). They are also present in about 1 in 10 fair-skinned infants. Mongolian spots are bluish gray to deep brown to black skin markings that often appear on the base of the spine, on the buttocks and back, and even sometimes on the shoulders, ankles, or wrists. Mongolian spots may cover a large area of the back. When the melanocytes are close to the surface, they look deep brown. The deeper they are in the skin, the more bluish they look, often mistaken for signs of child abuse. These spots "fade" with age as the child grows and usually disappear by age 5. (From Goodman CC, Snyder TE: *Differential diagnosis for the physical therapist: screening for referral*, ed 4, Philadelphia, 2007, WB Saunders. Courtesy Dr. Dubin Pavel.)

ble bruises, they do not change in size and fade over a period of years. Another cultural consideration is that contusions may be difficult to perceive in darkly pigmented children. On autopsy, significant bleeding may be found when external injury was not detected.

### Intimate Partner Violence

Although often used synonymously with DV, IPV occurs between current or former partners in both heterosexual and homosexual relationships. Individuals involved may, or may not be, cohabiting or involved in sexual activity. IPV is usually considered to be a recurrent pattern of abuse that often worsens with time. It is responsible for a wide range of injuries and accounts for approximately 33% of homicides of women in the United States.<sup>214</sup> Although approximately 9.2% to 9.5% of IPV victims are women, men are also victims of abuse.<sup>49</sup>

Two of the most vulnerable groups at risk for IPV include individuals with disabilities and pregnant women. Women with disabilities have indicated that their primary health concern is abuse,<sup>109</sup> which is not surprising when considering that they are twice as likely to be abused as nondisabled women.<sup>211</sup>

Pregnancy and the postpartum period represent a time of significantly higher risk for IPV. The reported incidence of abuse of pregnant women varies from 0.9% to 2.4%.<sup>94,96,131</sup> These rates indicate that violence during pregnancy is more common than placenta previa, preeclampsia, or gestational diabetes.<sup>94</sup> Ferris<sup>79</sup> reported that

previous abuse is the strongest indicator that abuse will occur during pregnancy. Additionally, if abuse occurs during the first trimester, it will most likely continue in the postpartum period. Often the abuse and injuries worsen throughout the course of the pregnancy.

Physical injury may occur to any area of the body, although there are three frequently occurring patterns associated with IPV. Head, neck, and facial injuries are commonly seen, and this pattern is suggestive of battering. Perciaccante<sup>208</sup> found that women involved in IPV were 7.5 times more likely to have sustained head, neck, and facial injuries than women with other forms of trauma. Second, injuries resulting from IPV occur in a central pattern, involving the breasts/chest, abdomen, and genital areas. A third common pattern of injury is suggestive of a defensive posture in which there are bruises, cuts, and/or fractures to the hands or arms, consistent with raising them to protect the head and face. The pattern of injuries resulting from IPV differs from those associated with household and sports-related accidents.

Medical problems frequently encountered as the result of IPV include chronic neck, back, and pelvic pain; headaches; temporomandibular joint dysfunction; and a history of bone fractures and musculoskeletal pain. IPV survivors also have a higher rate of central nervous system symptoms; individuals with traumatic brain injury, mild traumatic brain injury, and postconcussive syndrome should be screened for IPV.

### Elder Abuse

Elder abuse is any intentional or negligent act by a caregiver or other person that causes harm, or a serious risk of harm, to an older person. Legislation regarding elder abuse varies widely from state to state and in some states only involves elderly individuals living in their own residence; other states also include those living in long-term care facilities. Generally, elder abuse is defined as occurring in anyone over 60 or 65 years of age.

It is estimated that more than 1.8 million seniors in the United States are victims of abuse.<sup>205</sup> The true incidence is difficult to ascertain because many cases of abuse are never reported. The definitions of types of abuse of older adults are similar to those of IPV, although there are some indicators of abuse that are specific to the older adult population.

Physical abuse is more likely to involve the use of physical restraints and over-medication. Emotional/psychologic abuse can involve isolating the elderly from acquaintances and threatening abandonment and placement in a long-term care facility. Financial exploitation, the illegal or improper use of funds or assets, is more common in this age group. Self-neglect occurs when an older person fails to provide for his or her own welfare and medical care. Passive neglect is the nonwillful failure to provide care and often occurs when an elderly person is unable to take care of his or her spouse.

Indicators of elder abuse include being fearful, withdrawn, or hesitant to talk and/or demonstrating signs of depression and extreme changes in mood. Issues in detecting abuse are hampered by the victim's shame, reluctance to report abuse because of reliance on the perpetrator for financial support, fear that the abuse will

worsen, and concern about victimization of other family members or pets. Detection of abuse of older adults is also difficult because so many live in isolation and see few outsiders. Perpetrators of elder abuse may attribute an older person's complaints of abuse to dementia.

Whenever possible, therapists should attempt to interview seniors in private. Therapists should be alert for explanations that are not compatible with the nature of the injury and delays in seeking prompt medical attention. In the aging adult, additional signs of abuse may include dehydration or malnourishment in the absence of illness, poor skin condition and hygiene, and the presence of sores and pressure ulcers.

## SPECIAL IMPLICATIONS FOR THE THERAPIST 2-4

### Domestic Violence

Therapists are in a position to recognize abusive situations for several reasons. They generally see clients for multiple visits and have an opportunity to develop trusting relationships in which they are able to discuss causes of injuries. Therapists may view parts of the person's body that are usually covered and accordingly may observe contusions, welts, burns, and other injuries. Over the course of several visits, they might observe frequent injuries in different stages of healing. Such injuries should be documented, preferably on a body map. A detailed description should include the size, shape, color, and anatomic location of injuries, as well as the type of wound. If written permission can be obtained, photographs should be taken of bruises and injuries, with care to include the person's face in some of the pictures in case they are needed for evidence at criminal trials.

Documentation should also include any agencies that are contacted. Reports of abuse should include the client's own description of how the injuries occurred. If a person fears for his or her immediate safety, local law enforcement should be contacted and the therapist should stay with the victim until they arrive. One of the most important services therapists can provide to victims of DV is appropriate referral for medical care and counseling. Most states have free materials on child abuse, IPV, and elder abuse, and these resources should be readily available to share with clients.

There are several reasons why therapists do not inquire about domestic violence. These include lack of knowledge, feelings of helplessness about the situation, fear of offending others, and holding the false belief that the victims can readily remove themselves from the situation. However, the APTA, as well as many other health care organizations, advocates screening of all clients for domestic violence. Evidence demonstrates that most women in abusive relationships favor being asked about abuse<sup>44</sup> and would discuss the abuse if health care workers raise the issue.<sup>45</sup>

The APTA recommends that all therapists routinely ask their clients about abuse. It is suggested that asking direct, nonjudgmental questions about abuse will open the door, allowing clients to disclose abuse and possibly seek help. To avoid offending clients, therapists should explain that they routinely ask all clients

about domestic violence because it is so common. By doing so, they demonstrate that the problem is not uncommon and that the therapist is knowledgeable about the situation.

Health care professionals should recognize that both perpetrators and victims of abuse come from all racial/ethnic, socioeconomic, sexual orientation, educational, religious, and occupational groups. Suspicion of abuse should not be based on a belief that a person is "too nice" or "too respectable" to be either abused or an abuser.

### Child Abuse

All states have legislation regarding the reporting of child abuse. It is essential that therapists are knowledgeable about the reporting regulations of states in which they work. Health care professionals do not have to have evidence of abuse but instead are legally obligated to report "suspected" child abuse, since this will prompt an investigation of the matter.

In addition to the ethical reasons that abuse must be reported, there are legal implications for health care professionals who do not report child abuse. Therapists may be charged with a Class A misdemeanor and be subject to criminal penalties. They also risk suspension or revocation of their license to practice and can be sued in civil court for monetary damages for any injuries that occur that are attributed to the failure to report the abuse. All states have a 24-hour child abuse hotline. The National Child Abuse Hotline (1-800-4-A-CHILD or 1-800-635-1522) provides information and services for parents and professionals in 140 languages.

Health care professionals should be alert to indicators of abuse involving parent-child interaction. Examples of such indicators include parents who do not respond to a child's distress or who believe that a child does things, such as soiling themselves, to annoy the parents. Such information should be documented. Therapists are in an excellent position to model appropriate interactions with children and to teach about age-appropriate expectations, such as an infant's need for attention, and the importance of positive reinforcement.

### Intimate Partner Violence

The U.S. Department of Justice estimates that each year there are more than 8.5 million physical assault and rape victimizations by intimate partners. They also estimate victims of physical assault and rape account for more than 2.3 million visits to physical therapy annually.<sup>44,45</sup> This demonstrates the abundance of opportunities that therapists have to raise the question of abuse.

Reporting suspected IPV is controversial, since it may put the victim in more danger, especially if they are not willing to press charges. Additionally, victims of IPV have multiple issues that may prevent them from leaving an abusive situation, including lack of housing options and financial resources and children and their educational needs, as well as religious and

*Continued.*

cultural beliefs. If an issue of safety exists, therapists should call 911. Resources should be provided for clients and should include the National Domestic Violence Hotline at 1-800-99-SAFE (7233).

#### Elder Abuse

Whenever possible, therapists should attempt to interview their elderly clients in private. In some states, health care workers are not obligated to report cases of IPV and elder abuse, whereas in other states, failure to report elder abuse can result in misdemeanor charges. Regardless of legal implications, therapists have an ethical responsibility to inquire and offer assistance if abuse is suspected in these populations. All states have hotlines and established systems for reporting abuse. This is generally done through Adult Protective Service agencies that receive and investigate reports of suspected elder abuse. Information about state agencies can be obtained through Eldercare Locator, a public service of the U.S. Administration on Aging at 1-800-677-1116. If the safety and welfare of an elderly person are at risk, 911 should be called.

It is recommended that all settings in which therapists work have established protocols and policies regarding DV. These should include ongoing training about the recognition of abuse (including abuse or violence in the work place), state reporting laws, and referrals to local and state agencies, as well as routine screening for DV. Appropriate handling of DV situations can protect clients and save lives.

## BEHAVIORAL INFLUENCES ON HEALTH

Individual behaviors as they relate to lifestyle significantly influence health, including morbidity/disability and mortality. Specific individual behaviors that are important in health and disease include coping with stressful situations. Because of the importance of lifestyle choices in health and wellness, it is also important to understand the process by which individuals are effective at changing behaviors. These models, broadly described as health behavior models, assist health professionals in developing effective strategies to improve lifestyle choices and thus to improve health. In the following section, we will be discussing how stress, coping, and self-efficacy affect health and then describe models of behavior change.

### Stress, Coping, and Self-Efficacy

People react to a stressful event using coping mechanisms, also called *relief behaviors*. Behavioral or cognitive coping mechanisms are used to resolve, reduce, or replace the level of stress, depression, and anxiety. When the stress is resolved, accepted, or changed, adaptation occurs, implying that a sense of equilibrium is restored to the person disordered by stress.

The body also has physiologic coping mechanisms, referred to as the *generalized adaptation response*, to stressors with multiple physiologic events (see Fig. 2-4). The

human stress response has been characterized, both physiologically and behaviorally, as the "fight, flight, or freeze" response. The autonomic nervous system activates the body's involuntary responses such as hormone secretions, metabolism, and fluid regulation.

Once the body recognizes a continued threat, physiologic forces are mobilized to maintain an increased resistance to stressors and return to a state of homeostasis. Chronic resistance eventually causes damage to the involved systems as the body enters a stage of exhaustion, possibly resulting in diseases of adaptation or stress-related responses or conditions.

A landmark UCLA study suggests that women may physiologically respond to stress with a cascade of chemicals that causes them to make and maintain friendships with other women. This response is referred to as "tend-and-befriend." When the hormone oxytocin is released as part of the stress response in a woman, it buffers the fight-or-flight response. She is more likely to tend to children and gather with other women instead.<sup>244</sup> When the woman engages in tending or befriending, more oxytocin is released along with endogenous opioids, which further counters stress and produces a calming effect. This calming response does not occur in men because testosterone, which is produced in high levels when the male is under stress, reduces the effects of oxytocin.<sup>181</sup>

The fact that women respond differently to stress than men has significant implications for their health. It may take time for new studies to reveal all the ways oxytocin helps women manage stress physiologically.<sup>244</sup> The concept of tend-and-befriend may also help explain sex-based differences in behavioral manifestations of some psychiatric illnesses.<sup>139</sup>

The idea that stress can cause premature aging and death is not new. For example, chronic depression has been linked with heart disease and immune system dysfunction. Heightened levels of stress hormones (i.e., glucocorticoids) and the increased activity of the sympathetic nervous system also increase the rate of oxidative damage, formation of free radicals, and shortening of telomeres. The end-result is acceleration in the aging of leukocytes.<sup>12</sup>

Life stressors do not necessarily cause shortened chromosomes. Some research suggests it could be the other way around: people with intact telomeres are better able to resist psychologic and emotional stress.<sup>222</sup> Researchers are now focused on individual genetic differences in the vulnerability of telomeres to stress.

The process of coping with chronic pain, trauma, or illness is ongoing. Each change in the downward course of the illness requires new and painful acceptance of the disease and its limitations. Behavioral or cognitive coping may be adaptive (e.g., talking or reading about the problem, prayer, or seeking God) or maladaptive (e.g., denial and distancing or the use of alcohol or other drugs). When a person is unable to mobilize the necessary resources to manage stress, death from disease may result or suicide may be the final step to conflict resolution.

#### Stress

**Definition and Overview.** Alterations in an individual's personal health or social situation can create significant

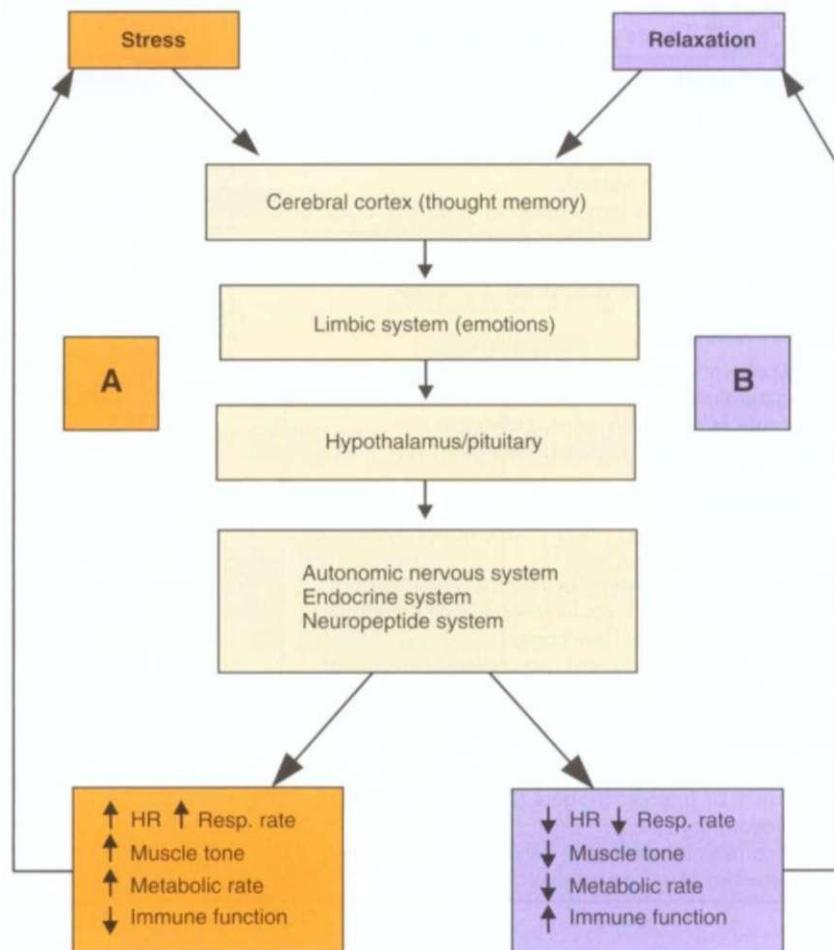


Figure 2-3

A simplified model of the cyclic mind-body and body-mind influences of stress (A) and relaxation (B) on health. As our body experiences the physical responses to stress or relaxation, the central nervous system remembers each event, causing a continuation of the cycle and resulting in long-term positive or negative physiologic responses and consequences. (Modified from Rakel D: *Integrative medicine*, ed 2, Philadelphia, 2007, WB Saunders.)

stress for that individual. The term *stress* can be used to describe many social (e.g., change in job, residence, or marital status); psychologic (e.g., anxiety, fear of the unknown); and physiologic (e.g., blood loss, anesthesia, pain, immobility, infection) factors that cause neurochemical changes within the body.

Stress and other emotional responses are components of complex interactions of genetic, physiologic, behavioral, and environmental factors that affect the body's ability to remain or become healthy or to resist or overcome disease. Regulated by nervous, endocrine, and immune systems, stress exerts a powerful influence on other bodily systems with important implications for the initiation or progression of cancer, cardiovascular disease, HIV, autoimmune diseases, and other illnesses.<sup>23</sup>

Holmes and Rahe<sup>24</sup> first developed the notion that personal or work-related life changes as a source of stress can eventually lead to disease. Their findings rank-ordered major life change events, giving each event an assigned number to represent units of stress that could be totaled and scored.

At that time, it was thought that a direct link could be established between stress events and illness or between personality type and illness. It was not uncommon to hear professionals speak of a colitis-, ulcer-, or stroke-personality. Research supports a strong correlation between chronic stress response and the manifestation of

various disorders, but a direct link has not been established; only personality (angry, hostile type A behavior) has been directly linked with heart disease.

Type A behavior pattern associated with the development of coronary heart disease is characterized by excessive competitiveness and aggression and a fast-paced lifestyle. Persons exhibiting type A behavior are constantly struggling to accomplish ill-defined or broadly encompassing goals in the shortest time possible. This type of behavior has been shown to be as significant as other risk factors in the development of coronary artery disease and myocardial infarction when accompanied by hostility associated with anger.<sup>25</sup> The opposite type of behavior, exhibited by people who are relaxed, unhurried, and less aggressive, is sometimes called type B.

The body's response to any stress, whether caused by events perceived as positive or negative, is to mobilize its defenses to maintain homeostasis (Fig. 2-3 and Table 2-6). The success of the stress response in maintaining homeostatic balance is determined by biobehavioral factors such as a person's age, gender, physical condition, coping mechanisms, health-enhancing or -impairing behaviors (e.g., diet, exercise, tobacco use, exposure to sunlight), and the duration of the stress.<sup>26</sup>

Research suggests a possible role of early life factors (e.g., adverse or traumatic life events) in altering the stress response. Stressful experiences that occur very early in life

**Table 2-6** Stress and Stress-Related Components

Stress Factors	Stress Response	Symptoms of Stress
<b>Situational</b>		
Poor social support (e.g., family, friends, coworkers) Exposure to safety hazards Recent life changes (e.g., death of a parent, child, or partner; family separation; pregnancy or birth; change in job or housing; retirement or being fired; heavy debt; sexual difficulties)	Increased heart rate and blood pressure Changes in respiratory system Release of glucose, adrenaline Redirection of blood supply (brain, muscles) Decrease in blood clotting time Dilation of pupils Contraction of the spleen Increased sweat production Decreased peristalsis and gut function Decreased immune response (chronic stress)	Hypertension Chest pain Headache Myalgia, arthralgia, fibromyalgia Allergic responses Gastrointestinal symptoms Depression, anxiety, panic attacks Discouragement, boredom Eating disorder Prolonged fatigue (chronic fatigue syndrome) Poor work or school performance; errors in judgment Sleep disturbance
<b>Environmental</b>		
Physical work environment; noise, lighting, temperature Exposure to chemicals, dust, pathogens Rotating shift work (regularly changing work hours)		
<b>Psychologic</b>		
Personality traits (e.g., aggressive, hostile Type A behavior) Lack of faith, spirituality, or religious practices Relationship or work conflict, work-family conflict, high job demands/low control History of abuse (physical, psychologic, emotional, sexual)		
<b>Physical</b>		
Sleep disturbances and/or sleep deprivation Chemical or biologic triggers (e.g., foods, poor nutrition, caffeine) Medical events, change in personal health, injury No exercise or excessive exercise		

can alter the responsiveness of the nervous and immune systems.<sup>97</sup> Individuals may become more vulnerable to future adverse events after early stressors have affected cortisol secretion, diurnal rhythm, and HPA axis function.<sup>232</sup> Combined together, psychologic stress and aging can impact the immune system and the effects are interactive. Psychologic stress can mimic and exacerbate the effects of aging. Older adults often show greater immunologic impairment to stress than younger adults.<sup>97</sup>

**Risk Factors.** A growing consensus among stress researchers is to understand the relationship between stress and illness outcomes, so the factors that modify or mediate the relationship must be identified. Although stressors may produce temporary physiologic and psychologic changes, most stressors are not followed by long-term illness.

A stressor may produce an extreme reaction in one person but no reaction in another, or the same stressor may produce variable reactions in the same individual at different times. This suggests that factors exist that alter the responses to stressors. Age has been mentioned as one risk factor. Another factor that can alter a stress response is the environment, such as social support, which tends to buffer individuals from the potentially negative effects of stressors. Those people with strong social supports live longer and have a lower incidence of physical illness.

Several large studies have established that women feel stress more than men do at comparable life stages and in

similar circumstances. Women's catecholamines and blood pressures tend to remain elevated long after the end of the workday, whereas men's blood pressures start to decline as soon as they leave work.<sup>86,106</sup> Other potential factors are listed in Table 2-6.

In addition to early stressful life events, negative life events in adults, especially work-related, are associated with adverse physiologic responses. Depressed mood and mental strain have been reported as a result of chronic stress. Depressed mood and mental strain are also directly linked with increased tobacco consumption in labor workers and increased alcohol consumption in professional workers.<sup>216</sup> Although many factors causing stress have been studied, the ability to predict a stress response in any given individual remains poor.

Even transient physical and psychologic stressors can cause immune dysregulation and delay healing. For example, acute pain, academic examinations, and other anxiety and perceived stress have been reported as risk factors for health problems.<sup>97</sup>

**Pathogenesis.** Over the past century, many theories to describe the biologic response of the body to acute and chronic stress have been proposed. Today there is evidence that stress is a neurophysiologic, hormonal, and behavioral event. The body's response to stress is a complex combination of biologic and behavioral mechanisms that are regulated by the neurohormonal axis. According to Selye, who introduced the theory of the general adaptation syndrome (GAS) (Fig. 2-4), the three

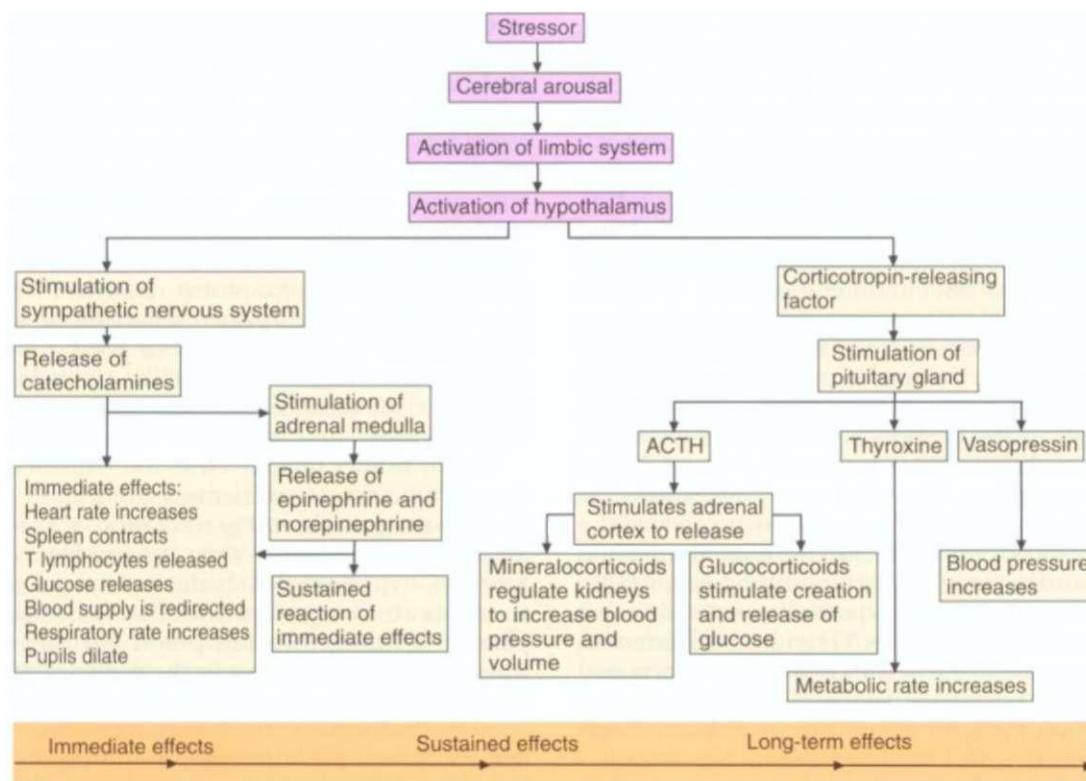


Figure 2-4

The general adaption syndrome. See text discussion. (From Ignatavicius DD, Workman M, Mishler MA: *Medical-surgical nursing*, ed 2, Philadelphia, 1995, WB Saunders.)

phases that occur in response to prolonged stress are alarm, resistance, and exhaustion.

In the alarm phase, the body releases adrenaline and a variety of other chemicals to combat the stress and to stay in control. This is called the *fight, flight, or freeze* response. The muscles tense, the heart beats faster, breathing and perspiration increase, and the eyes dilate. All of these autonomic nervous system responses are protective in nature and critical to survival. Once the cause of the stress is removed, the body will return to a state of homeostasis.

If the stressor is not removed, GAS goes to its second stage called *resistance* or *adaptation*. The body is responding now to the need for long-term protection. It secretes further hormones that increase blood sugar levels to sustain energy and raise blood pressure. The adrenal cortex produces corticosteroids for this resistance reaction.

Overuse by the body's defense mechanism in this phase can lead to disease. If this adaptation phase continues for a prolonged period of time without relaxation or rest to counterbalance the stress response, sufferers become prone to fatigue, concentration lapses, irritability, and lethargy as the effort to sustain arousal slides into negative stress.

The third stage of GAS is called *exhaustion*. In this stage, the body has run out of its reserves of body energy and immunity. Mental, physical, and emotional resources are depleted. The body experiences "adrenal exhaustion." The blood sugar levels decrease, leading to decreased stress tolerance, progressive mental and physical exhaust-

tion, illness, and possible collapse. Immune, metabolic, and neuronal responses so necessary in the early defenses to abnormal stress now lead to specific organ damage.

How stress produces disease is frequently debated, and the exact pathophysiologic mechanism remains unknown. The stress response has been associated with a variety of physiologic changes that may be postulated as mediators in the development of disease. The HPA axis, the autonomic nervous system, and the catecholamine response are often cited as stress-sensitive systems. These and other neurologic and endocrine systems may be important factors in the chain of events leading to cardiovascular, gastrointestinal, endocrine, and other stress-related disorders.

Recently, significant amounts of information have become available on how the stress response systems interact in combination with a proposed neuroendocrine-neuroimmune stress response to affect autoimmunity. Findings that link immune and neuroendocrine function may provide explanations of how the emotional state or response to stress can modify a person's capacity to cope with infection, inflammation, or cancer and influence the course of autoimmune disease. For example, in response to a stress impulse, the amygdala in the brain signals the hypothalamus to release adrenocorticotrophic hormone-releasing factor (ACTH-RF). This stimulating hormone causes ACTH (corticotropin) to be released from the pituitary gland.

ACTH is the major hormone regulator of the body's adaptive response to stress and the physiologic stimulus

for the release of stress hormones (e.g., adrenaline, noradrenaline, Cortisol) from the adrenal glands (target organ). These powerful hormones and glucocorticoids (Cortisol) create within the body the fight, flight, or freeze response. This cascade of events can lead to hypercortisolism and inappropriately elevated catecholamines, resulting in immunosuppression (i.e., decreased numbers of lymphocytes [white blood cells]) and antibodies and thus increasing vulnerability to infectious diseases, including viral-induced cancers and other diseases.

Studies of the HPA axis as a potential psychobiologic mediator of these effects are underway.<sup>22</sup> Understanding the biochemical mechanisms underlying stress may permit the development of more effective strategies to treat chronic stress and possibly prevent the development of stress-related disorders.

In 1995, researchers identified a peptide known as *prepro-TRH 178-199* that had been shown to reduce the secretion of corticotropin, or ACTH, by 50%. Administration of this corticotropin release-inhibiting factor (CRIF) in animal studies before exposure to stress revealed significantly reduced levels of ACTH and other hormones elevated in response to stress. This peptide also decreased fear and anxiety-related behaviors.<sup>23</sup> Ongoing studies continue to look for ways to use this peptide for therapeutic purposes.

Another theory holds that certain kinds of stress are consistently likely to produce given physiologic responses and consequently, specific pathologic states. The impact of stress on cells directly or indirectly causes protein denaturation and elicits a stress response. A cell with normal antistress mechanisms may be able to withstand stress if the intensity is not beyond that which will cause irreversible protein damage. Age-related degenerative disorders with protein deposits in various tissues may be an example of the physiologic result of this type of stress.<sup>24</sup>

Still another viewpoint is that stress is nonspecific and that personal factors, such as conditioning and heredity, determine which organ system if any will be affected by a variety of stressors. A given individual may have a specific susceptible organ that will be the target of a variety of stresses; thus some people are gastrointestinal reactors and others are cardiac or muscle-tension reactors.

Familial patterns may account for the hereditary factor determining which organ system is affected. Low back pain, abdominal pain, and migraine headaches affecting adults often also occurred in the parents. Finally, stress may be viewed as a nonspecific force that exacerbates existing disease states.

Stress can play a key role in psychogenic pain (i.e., pain believed to be caused by emotional factors rather than the result of physiologic dysfunction). Although psychogenic pain begins without a physical basis, repeated severe stress most likely alters the complex physiology of pain transmission, modulation, and perception.

The psychogenic effect of stress, anxiety, fear, and anger that produces painful alterations in physiology is referred to as *psychophysiological* pain. For example, stress can produce chronic excessive muscle contraction with resultant ischemia and pain with eventual functional impairment.

**Clinical Manifestations.** Therapists often treat people with neuromusculoskeletal dysfunction, especially head, neck, and back pain, without an identified point of injury or cause. Stress, reaction to stress, and posttraumatic stress disorder are common causes of physical manifestations treated by the therapist. Muscle tension and pain, restlessness, irritability, fatigue, increased startle reaction, breath holding, hyperventilation, tachycardia, palpitations, and sleep disturbances are some of the more common symptoms reported to the therapist (see Table 2-6). Clients often self-medicate using chemical (alcohol, nicotine, drugs) or food substances; the alert therapist may help assist the client by facilitating treatment intervention for this aspect of the person's stress response.

Recent studies provide clear and convincing evidence that chronic psychosocial stress contributes significantly to the pathogenesis and exacerbation of coronary artery atherosclerosis, whereas acute stress induces ovarian dysfunction, hypercortisolism, and accelerated atherosclerosis. Acute stress triggers myocardial ischemia, stimulates platelet function, increases blood viscosity, and causes coronary vasoconstriction in the presence of underlying atherosclerosis (coronary heart disease).<sup>21,22</sup>

Some individuals also experience exaggerated heart rate and blood pressure responses to psychologic stress. Emotionally responsive individuals report less satisfaction with social support and higher levels of perceived daily stress, anxiety, and depressive symptoms. Psychosocial traits that have been linked to cardiovascular disease may be associated with more marked cardiovascular activation occurring in response to negative emotions experienced throughout the day.<sup>23</sup>

Researchers hypothesize the exaggerated systemic vascular resistance responses during stress may be caused by endothelial dysfunction. This association may help explain the growing evidence of a relationship between stress hemodynamics and cardiovascular disease risk. It is postulated that the interplay between the sympathetic nervous system and the endothelium accounts for the regulation or dysfunction of vascular tone.<sup>22,23</sup>

### Coping and Self-Efficacy

Coping strategies refer to the tools individuals use to manage, tolerate, or control stressful events. Whether an individual has effective or maladaptive coping strategies can significantly influence both physical health and the level of disability associated with a particular medical condition. It is important for physical therapists to support effective coping strategies. Generally, there are two main ways of coping: an active problem-solving strategy and an emotion-based strategy.<sup>25</sup> Active coping strategies appear to be more effective in dealing with stressful events.<sup>22,26</sup> For example, cognitive restructuring guides the client to focus on active coping behaviors and improving function instead of focusing on physical symptoms and pain. Reinforcing positive active behaviors and ignoring pain-related behaviors is called *operant conditioning* (see Box 3-15).

**Measuring Coping.** Several tools are frequently used to measure coping strategies. The Ways of Coping tool developed by Folkman and Lazarus<sup>24</sup> identifies specific

strategies such as seeking social support, planned problem solving, self-control, distancing, or escape/avoidance. The COPE measure asks participants to identify specific traits that typify their response to stressful events. These trait scales include topics that are similar to the ways of coping, such as active coping, planning, seeking social support, religion, or acceptance.<sup>43</sup>

Using the Ways of Coping and COPE measures, it appears that active coping strategies have a positive influence on physical health. Active coping was better than avoidance for improving immune status of HIV-positive men.<sup>45</sup> Active coping was associated with fewer recurrences of melanoma.<sup>46</sup> Physical therapists may want to familiarize themselves with these coping tools or work with team psychologists to support active coping strategies for their clients.

Although coping is a mechanism used by individuals to manage stressful events, greater improvements in health can be observed if certain lifestyle behaviors are changed. Changing individual behaviors is a complex and dynamic process affected by many factors. Several models of health behavior have been examined to assist health professionals in understanding the process of behavior change and developing effective strategies to improve lifestyle choices and thus to improve health.

**Changing Health Behaviors.** Helping people change behavior has become more important in the plan of care for all individuals in the health care setting. Addressing lifestyle modification for disease prevention, long-term disease management, addictions, chronic pain, and many other areas of health care is increasing in importance and a necessary component of whole-person care.<sup>280</sup> Understanding readiness to make changes, recognizing barriers to change, and helping clients anticipate relapse can improve patient/client satisfaction, and lower frustration on the part of the provider during the change process.

Much has been written about the success and failure in helping people change behaviors. People clearly understand the need to change and often make efforts to make lifestyle modifications, but consistent, life-long behavior changes are difficult and relapse is common. Repeated suggestions, record-keeping, a "just do it" attitude, and other behavior modification approaches do not always work. Individuals are often labeled as "noncompliant" or "unmotivated" when behavior change does not take place.<sup>280</sup>

The behavioral change approach to disease prevention and health promotion focuses on the modification of individual health-related behaviors. Research into smoking cessation and alcohol abuse has advanced our understanding of the change process, including what works and what is not effective. Clearly, there is not a "one-size-fits-all" approach.<sup>280</sup> Four models and theories often cited in the literature using a health behavior change approach are presented here.

**Models of Health Behavior Change.** The *Health Belief Model* (HBM) was initially developed in the 1950s by the U.S. Public Health Service in order to help explain why there was limited success of early screening programs such as free mobile x-ray screening for tuberculosis.<sup>132</sup> Its foundation was based on the social psychology literature

of the time, which included the confluence of two learning theories: Stimulus Response Theory and Cognitive Theory.

The HBM is a value-expectancy model in which the desire to avoid illness or get well is considered the value and the belief that a certain action will prevent or limit illness is the expectation. This model embraces the cognitive theorists' and behaviorists' understanding of learning versus the traditional stimulus response or operant conditioning theories popular at the time. The HBM proposes that in order for persons to change their behaviors they must first believe they are susceptible to a particular condition and that the severity of that condition is serious.<sup>132</sup> Changes in behavior are based on six key components: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy.

The HBM model assumes individuals act on the basis of their rational appraisal of a given situation. The model is not designed to account for social pressures that might persuade the individual to partake in the unhealthy behavior.<sup>53,91</sup> This is a limiting factor when one considers that a problem like obesity often has stigma and social pressure attached to it; therefore the intervention must acknowledge this.

Rating the severity, susceptibility, benefits, barriers, and self-efficacy associated with a health behavior is just the first of many steps to understanding why (or why not) individuals adopt a specific health behavior. Prospective studies performed on the HBM in the early 1980s provided support of earlier research, demonstrating that perceived barriers were the most powerful predictor of the HBM concepts.<sup>132</sup> Any attempt to change behavior, such as eating habits or physical activity, must address the perceived barriers, which are often at the family or community level rather than the individual level.

The *Theory of Reasoned Action* (TRA) and the *Theory of Planned Behavior* (TPB) are also based on a value-expectancy theory similar to the HBM,<sup>175</sup> which was originally designed in order to understand the relationship between attitudes and behavior.<sup>80</sup> A key aspect is the difference between the attitudes toward the object of health (in this case breast cancer) versus the attitude toward the behavior of health with respect to that object (specifically a mammogram).<sup>81</sup>

The TRA assumes that the most important determinant of behavior is the individual's intent to change behavior. The person's attitude toward the behavior is determined by his or her belief about the outcomes of performing the behavior. If a positive outcome is the expected result, then there will be a positive attitude toward that behavior. These intentions are measured on a bipolar scale, such as agree/disagree or likely/unlikely, although the behavior itself is not usually measured. One limitation to the TRA is that individuals usually have only incomplete volitional control of behavioral choices.

The TPB builds on the TRA to help predict behaviors over which people have incomplete volitional control.<sup>1</sup> The TPB includes some understanding of environmental factors that may prevent the individual with high motivation from performing that behavior. This has been the case in fighting obesity since the individual may not have

access to facilities to perform physical activity or the availability to obtain healthy food choices.

Perceived behavioral control indirectly measured by control beliefs and perceived power were components added to the TPB. By including normative belief and norms, which impact intentions, this model shows that the individual can be affected by external influences that can mix with the social environment.

The *Transtheoretical Model* (TTM), also known as the *Stages of Change Model*, utilizes a stage construct to represent change over time. The stages of change were used to attempt to systematically integrate various theories of intervention, hence the TTM.<sup>212</sup> Six stages are used to demonstrate that behavior change is a process rather than a finite event or single activity. The stages include pre-contemplation (uninterested, unaware, or unwilling to change), contemplation (considering a change), preparation (getting ready to change), action (taking actual steps to effect change), maintenance, and termination.

This model looks beyond the intention aspect of a decision and includes an observable action of behavior change. It takes into account the fact that most people will relapse or even fail, but they can reengage with the stages and may even do so several times before a change becomes genuinely established.<sup>213</sup> This is essential with physical activity in that the individual must demonstrate the behavior and then even continue into the maintenance stage with less temptation to relapse into the previous behavior pattern. As self-efficacy improves in this model, an individual is able to move into maintenance and eventually into termination, although very few people (<20%) attain this final stage.<sup>212</sup>

Changing an overt behavior for more than 6 months constitutes the maintenance stage. Success using the TTM involves the delivery of "tailored" interventions versus targeted or one-size-fits-all programs. This would seem to match the clinical model in which an individually tailored program can be designed, providing the provider is willing and capable of recognizing the stage the person is in and then developing a tailored intervention. These stage-matched interventions take additional time and effort, and more research is needed using modern tools of communication, such as the Internet, that would improve the efficiency and ability to reach more diverse populations.<sup>212</sup>

*Social Cognitive Theory* (SCT) is a health behavior model that is more dynamic in nature than the HBM. Bandura initially felt that children can learn through observational learning and therefore the behavior is modeled and the reward is gained through vicarious reinforcement versus direct reward.<sup>21</sup> These became two important constructs of the SCT.

The SCT is similar to ecologic models in the sense that it shares the perspective that environmental factors can be influential in shaping health-promoting behaviors.<sup>18</sup> SCT not only incorporates factors associated with the environment but also personal and behavior-specific factors. These three components are constantly influencing each other and became the concept known as *reciprocal determinism*.<sup>29</sup>

Behavior under SCT is not focused independently on factors external to the individual or the environment. The

situation is the person's perception of that environment. The combination of these two constructs provides an ecologic framework for the understanding of the behavior.

This model also includes a significant acknowledgment of the sociologic concept of agency and that personal efficacy constitutes a key factor of human agency. Human agency operates within the structure of these three determinants and acts reciprocally at various strengths, times, and circumstances.<sup>17,19</sup>

Finally, outcome expectations are also constructs within the overall theory. Self-efficacy (the ability or confidence of a person to implement an effective behavior) is considered the most important construct and necessary prerequisite for behavior change.<sup>18</sup> Self-efficacy is based on the combination of the attitudes, cognition, and expectations of an individual and can be improved through successful attainment of tasks, skills, or behaviors. Self-efficacy has been used in previous studies of healthy eating behaviors and food choices among third and fourth grade students. It was the primary predictor of the intention to engage in these healthy food choices.

Although SCT encompasses the environment more so than other behavioral models or theories, there is still limited ability to measure long-term sustainability and in some cases even action beyond the person's stated intention. Other limitations of SCT include the criticism that the theory is too comprehensive with too many constructs that allow researchers to explain almost any phenomena observed.<sup>21</sup>

Winters and colleagues<sup>266</sup> used the SCT to explain the variance in predictor variables for moderate and vigorous exercise in high school students. They determined that although educational methods can be effective, the specific psychosocial variables relating to self-regulation, self-efficacy perception, and outcome expectation within the SCT should be the focus.

These theories have been utilized in other large studies and programs, such as the Multiple Risk Factor Intervention Trials and the Minnesota Heart Health Program, in an attempt to reduce cardiovascular disease, although the modest impact of these interventions demonstrates a limitation in focusing on the individual behavior change models for health promotion.<sup>274</sup>

## SPECIAL IMPLICATIONS FOR THE THERAPIST

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### Stress, Coping, and Self-Efficacy

#### PREFERRED PRACTICE PATTERNS

Other patterns associated with additional variables (e.g., substance use/abuse, posttraumatic stress disorder, side effects of medications) may be observed.

**Musculoskeletal 4B:** Impaired posture; **4C:** Impaired muscle performance

#### Health Behavior Change

It is not easy for people to make necessary changes (or they would have done so long ago), and denial often obscures the picture. The therapist has a key role in