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*Recommendations and Reports*

*Inside:* Continuing Education Examination

# CDC Recommendations Regarding Selected Conditions Affecting Women's Health

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES**
Centers for Disease Control and Prevention (CDC)
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# Foreword

As the nation's prevention agency, CDC strives to accomplish its vision of "Healthy People in a Healthy World...Through Prevention." For women, this involves working to better understand the health issues that have an adverse impact on women, disproportionately affect women, occur only in women, or have an impact on infant outcomes as a direct result of a pregnancy-related event. Women's health once focused primarily on puberty, pregnancy, and menopause. Now, women's health is recognized as being broad in focus and warranting additional attention and study and involves not only chronic conditions but individual lifestyle choices and environmental and organizational factors.

This publication focuses on some of the specific issues affecting women's health: falls and resulting hip fractures, sports injuries, breast and cervical cancer, and congenital toxoplasmosis. For each report, prevention recommendations and specific research recommendations are provided. Much still needs to be done. The publication addresses diverse and seemingly unconnected women's health issues; however, these issues are very much connected, and several themes run throughout each of the reports. For example:

- Prevention — whether primary or secondary — continues to reduce or prevent injury, disease, death, and disability. Prevention is an essential component to maintaining health.
- Science continues to strengthen and support public health action on the individual, local, and national level.
- Although much progress has been made in the area of women's health to reduce morbidity and mortality, more prevention research needs to be done.
- Public health affects every phase of our lives: how we live, work, and play.

Whether the topic is falls in the home, injuries associated with leisure or work-related activities, screening for toxoplasmosis, or implementation of an early detection program, prevention plays a vital role. Our partners in prevention (e.g., other health agencies, business, education, communities, and individuals) also play a vital role by developing and implementing prevention strategies and policies and by promoting healthy behaviors and environments.

After reviewing each of these reports, examine current practices that have an impact on women's health where you live, work, and play. Are there opportunities for improvement? As costs related to disease, disability, and injury continue to increase, the role of prevention to maintain health becomes more critical. Prevention is about staying healthy and living well—and prevention works for women.

Yvonne Green
Associate Director
Office on Women's Health

# Contents

# Reducing Falls and Resulting Hip Fractures Among Older Women

**The material in this report was prepared for publication by:**

**National Center for Injury Prevention and Control ..... Stephen B. Thacker, M.D., M.Sc.**
***Acting Director***

**Division of Unintentional Injuries Prevention ..... Christine Branche, Ph.D.**
***Director***

# Reducing Falls and Resulting Hip Fractures Among Older Women

Judy A. Stevens, Ph.D.
Sarah Olson, M.S.
*National Center for Injury Prevention and Control*
*Division of Unintentional Injury Prevention*

***Abstract***

**Scope of the Problem**: Fall-related injuries are the leading cause of injury deaths and disabilities among older adults (i.e., persons aged ≥65 years). The most serious fall injury is hip fracture; one half of all older adults hospitalized for hip fracture never regain their former level of function. In 1996, a total of 340,000 hospitalizations for hip fracture occurred among persons aged ≥65 years, and 80% of these admissions occurred among women. From 1988 to 1996, hip fracture hospitalization rates for women aged ≥65 years increased 23%.

**Etiologic or Risk Factors**: Risk factors for falls include increasing age, muscle weakness, functional limitations, environmental hazards, use of psychoactive medications, and a history of falls. Age is also a risk factor for hip fracture. Women aged ≥85 years are nearly eight times more likely than women aged 65–74 years to be hospitalized for hip fracture. White women aged ≥65 years are at higher risk for hip fracture than black women. Other risk factors for hip fracture include lack of physical activity, osteoporosis, low body mass index, and a previous hip fracture.

**Recommendations for Prevention**: Because approximately 95% of hip fractures result from falls, minimizing fall risk is a practical approach to reducing these serious injuries. Research demonstrates that effective fall prevention strategies require a multifaceted approach with both behavioral and environmental components. Important elements include education and skill building to increase knowledge about fall risk factors, exercise to improve strength and balance, home modifications to reduce fall hazards, and medication assessment to minimize side effects (e.g., dizziness and grogginess).

**Program and Research Needs**: Coordination needs to be improved among the diverse Federal, state, and local organizations that conduct fall prevention activities. The effectiveness of existing fall prevention programs among specific groups of women (e.g., those aged ≥85 years or living with functional limitations) needs careful evaluation. New primary fall prevention approaches are needed (e.g., characterizing footwear that promotes stability), as well as secondary prevention strategies (e.g., protective hip pads) that can prevent injuries when falls occur. Finally, efforts are needed to increase collaboration among national experts from various disciplines, to reach consensus regarding priority research areas and program issues, and to work toward long-term strategies for reducing falls and fall-related injuries among older adults.

**Conclusion**: Persons aged ≥65 years constitute the fastest-growing segment of the U.S. population. Without effective intervention strategies, the number of hip fractures will increase as the U.S. population ages. Fall prevention programs have reduced falls and fall-related injuries among high-risk populations using multifaceted approaches that

include education, exercise, environmental modifications, and medication review. These programs need to be evaluated among older adults aged ≥65 years who are living independently in the community. In addition, secondary prevention strategies are needed to prevent hip fractures when falls occur. Effective public health strategies need to be implemented to promote behavioral changes, improve current interventions, and develop new fall prevention strategies to reduce future morbidity and mortality associated with hip fractures among older adults.

## BACKGROUND

Older adults (i.e., persons aged ≥65 years) are the fastest-growing segment of the U.S. population. In 1990, 13% of the population was aged ≥65 years; by 2050, this proportion will nearly double to 23% (*1*). The number of persons aged ≥65 years is projected to increase from 31.0 million in 1990 to 68.1 million by 2040; for persons aged ≥85 years, the relative growth is even faster (*1*). This report summarizes current knowledge about falls and hip fracture among women aged ≥65 years and describes both primary and secondary strategies for preventing fall-related injuries. When discussing research results, the term "significant" refers to a documented p-value of $p \leq 0.05$.

## SCOPE OF THE PROBLEM

Falls are the leading cause of injury deaths and disabilities among persons aged ≥65 years. In the United States, one of every three older adults falls each year (*2,3*). In 1997, nearly 9,000 persons aged ≥65 years died from falls (*4*). Of those who fall, 20%–30% sustain moderate to severe injuries that reduce mobility and independence and increase the risk for premature death (*5*). Older adults are hospitalized for fall-related injuries five times more often than they are for injuries from other causes (*5*), and women are nearly three times more likely than men to be hospitalized for a fall-related injury (*5*).

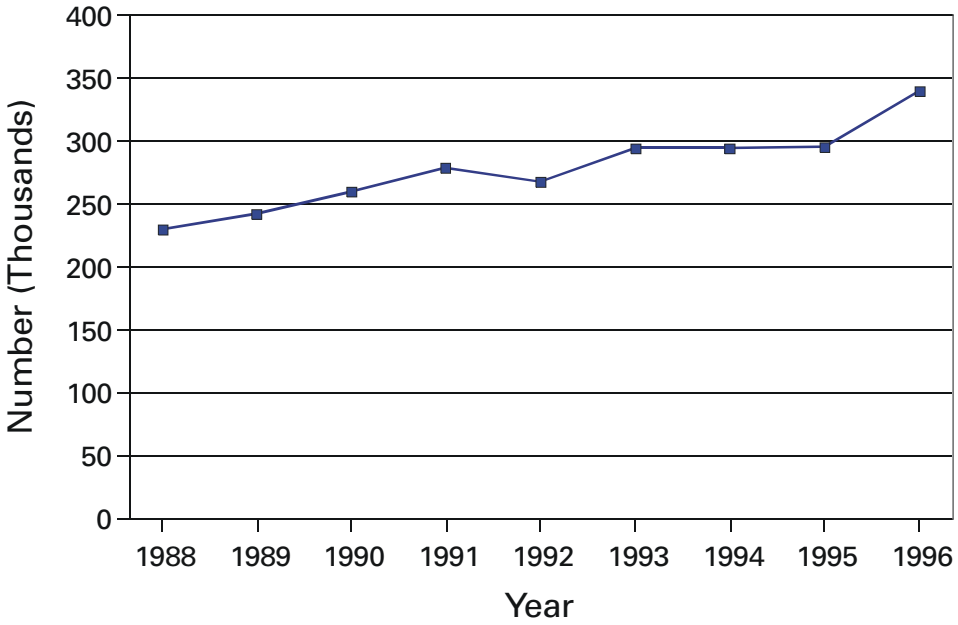
The most prevalent fall-related injuries among older adults are fractures of the hip; spine; upper arm; forearm; and bones of the pelvis, hand, and ankle (*6*). Of these, the most serious injury is hip fracture, a leading cause of morbidity and excess mortality among older adults (*7*). During 1988–1996, the estimated number of hospital admissions for hip fracture increased from 230,000 to 340,000 (Figure 1). In 1996, 80% of the admissions for hip fracture occurred among women (*8*).

The rate of hospitalization for hip fracture differs by sex. The hip fracture hospitalization rate for persons aged ≥65 years is significantly higher for women than men (*9*). During 1988–1996, the rates for women increased significantly, from 972 per 100,000 to 1,356; for men, rates remained stable (*9*). A *Healthy People 2010* objective is to reduce the hip fracture hospitalization rate among women aged ≥65 years to no more than 879 per 100,000 (objective 15-28a).

Hip fracture hospitalization rates are substantially higher for white women than black women. In 1996, the hospitalization rate for white women aged ≥65 years was 1,174 per 100,000, five times the rate for black women (*9*). A *Healthy People 2010* objective is to reduce hip fracture hospitalization rates among white women aged ≥65 years to no more than 932 per 100,000 (objective 15-28a).

The overall increase in hip fracture hospitalization rates can be explained in part by the increasing U.S. population of very old adults (i.e., persons aged ≥85 years). Today, a

**FIGURE 1. Estimated number of hospital admissions for hip fracture among persons aged ≥65 years — United States, 1988–1996**




**Source**: CDC's National Hospital Discharge Survey.

larger proportion of the population is living to age ≥85 years than in the past because of reduced mortality from cardiovascular and other chronic diseases. Since 1987, death rates from coronary heart disease, stroke, and cancer have declined, and the proportion of adults aged ≥70 years living with some functional limitation* has increased (*10*). Frail older adults are twice as likely to fall as healthier persons (*11*).

Hip fractures are expensive. A recent study documented that the cost of a hip fracture (including direct medical care, formal nonmedical care, and informal care provided by family and friends) was $16,300–$18,700 during the first year following the injury (*12*). In 1991, hip fracture accounted for an estimated $2.9 billion in Medicare costs (*13*). On the basis of the annual cost of hip fracture in 1984, an assumption that the average cost will remain constant, an inflation rate of 3%–5%, and the increasing number of hip fractures, the estimated total annual cost of hip fracture in the United States could reach $82–$240 billion by the year 2040 (*14*).

An even more important factor than the monetary cost of hip fracture is the injury's impact on a person's life in the form of loss of independence and decreased quality of life. Nationwide, only 50% of older adults hospitalized for hip fracture are able to return home or live independently after the injury (*15,16*).

## ETIOLOGIC OR RISK FACTORS

Approximately 95% of hip fractures are caused by falls (*17*). Other causes include being knocked over and being injured in a motor-vehicle crash; <2% of hip fractures occur spontaneously (e.g., as the result of a metabolic bone disease) (*17*). Not all falls are

*Defined as having difficulty with two or more activities of daily living.

equally likely to cause hip fracture. Biomechanical studies have demonstrated that, although both bone strength and the force of the impact are important factors, the point of impact must be on or near the hip for a fall to cause a hip fracture (*18*).

Many factors contribute to falls and subsequent fall injury. Fall risk increases rapidly with advancing age for persons aged ≥65 years (*19*). Other fall risk factors include lack of current or previous physical activity (*20,21*), muscle weakness or balance problems that can contribute both to the risk for falling and the inability to break the impact of a fall (*2,22,23*), functional limitations (e.g., difficulty with activities of daily living such as dressing or bathing) (*22,24*), cognitive impairment or dementia (*2*), use of psychoactive medications (e.g., tranquilizers or antidepressants), some combinations of medications (*2,25*), environmental factors (e.g., tripping hazards) (*26*), having fallen previously (*27*), having more than one chronic disease (*28*), having had a stroke (*28*), Parkinson disease (*29*) or a neuromuscular disease (*30*), urinary incontinence (*31*), and visual difficulties (*32,33*). Less clear is the fall risk associated with wearing shoes with thick, soft soles (e.g., jogging shoes) that can affect balance and proprioception or become a tripping hazard by catching in carpeting (*34*).

Similar to fall risk, hip fracture risk increases sharply with advancing age (*19*). Women aged ≥85 years are nearly eight times more likely than women aged 65–74 years to be hospitalized for hip fracture (*9*). White women aged ≥65 years are at higher risk for hip fracture (*19*) than black women, in part because the prevalence and severity of osteoporosis—a condition that predisposes to bone fragility—is greatest among white women. Other risk factors include low body mass index (weight in kilograms divided by height in meters squared [weight [kg]/height squared [$m^2$]) (*7,35,36*), previous history of osteoporosis (*27*), and having sustained a previous hip fracture (*27*).

Falls are caused by personal (intrinsic) and environmental (extrinsic) factors. Personal risk factors include problems with gait and balance, functional impairments or limitations in activities of daily living, visual problems, and behavioral risk factors (e.g., lack of physical activity and taking certain psychoactive medications such as tranquillizers or antidepressants). Environmental factors include home hazards (e.g., clutter; no stair railings; loose rugs or other tripping hazards; no grab bars in the bathroom; and poor lighting, especially on stairs). Frequently, a fall is the result of an interaction between personal and environmental factors.

## RECOMMENDATIONS FOR PREVENTION

Because approximately 95% of hip fractures result from falls (*17*), minimizing fall risk is a practical approach to reducing these serious injuries. Primary prevention of fall-related injuries involves reducing the occurrence of falls; secondary prevention of fall-related injuries involves preventing injuries when falls occur.

### Primary Prevention

Primary prevention of fall-related injuries among older adults can be targeted to persons living independently in the community or residents of nursing homes. Research has established that effective fall intervention programs employ a multifaceted approach and incorporate both behavioral and environmental elements: exercises to improve strength and balance, environmental modifications, education about fall prevention, medication review and assessment to minimize side effects, and risk factor reduction (*36–39*).

### *Community Intervention*

Approximately 90% of adults aged ≥65 years live in the community and many fall prevention programs target these persons; however, few of these programs have been evaluated for effectiveness. During 1990–1992, a prospective, multifaceted, fall-prevention study was conducted among 301 community-dwelling men and women who were aged ≥70 years and had at least one fall risk factor (e.g., sedative use or some limitation in arm or leg strength) (*36*). A total of 153 persons participated in an intervention that consisted of behavioral instructions and training to reduce specific risk factors (e.g., persons with gait or balance impairments received specialized training in these areas), exercise programs to increase strength, and medication adjustments. After 1 year, the group that received the intervention had 30% fewer falls than the control group. Further research is needed to evaluate the effectiveness of such a program among all persons aged ≥65 years living independently in the community.

**Physical Activity.** Increasing physical activity can be an effective component of fall prevention programs. Activities that improve strength, balance, and coordination can reduce the risk for falls and fall-related injuries among healthy (*40,41*) and frail persons (*42*). Studies have demonstrated a 40%–60% reduction in hip fracture risk with increasing levels of physical activity (*36,43*). Although fall prevention programs have focused on several techniques to improve strength, balance, coordination, mobility, and flexibility, Tai Chi is probably the most frequently studied type of exercise (*40*). Effective programs have been employed with persons of different ages and with varied physical abilities; however, persons with functional limitations might require more individualized physical activity programs (*44*).

**Environmental Modifications.** Because approximately 50%–60% of all falls among older adults occur at home, fall prevention programs should address home hazards that can contribute to falls (*45*). Home-visiting programs (e.g., those using visiting nurses) provide opportunities to identify potential fall hazards and take corrective action. These programs can increase awareness of fall risks among informal caregivers, (e.g., family and friends who frequently visit the homes of older adults) and the older adults themselves.

**Health Education.** Fall prevention programs frequently include health education and health promotion materials about reducing fall hazards that are distributed at central locations (e.g., senior centers or health fairs). However, educational materials alone might not promote behavioral changes. Many programs employ home-hazard checklists that can be used by the caregiver or health agency personnel (e.g., a visiting nurse or home health aide) to help persons identify fall hazards and to suggest corrective action (e.g., eliminating potential tripping hazards such as clutter and throw rugs, adding stair railings, improving lighting, adding nonslip floor surfaces, and installing grab bars in bathrooms). Checklists are also given to residents to help them assess personal and environmental risks and take preventive action, including behavioral changes (*45*). Research is needed to evaluate and assess the effectiveness of educational materials and home-hazard checklists to promote fall-risk reduction activities and behaviors.

**Risk Factor Reduction.** Approaches that address specific risk factors can supplement fall prevention program efforts. Medical approaches might include reducing fall risk factors (e.g., maximizing control of concomitant chronic diseases) and reducing hip fracture risk factors (e.g., counseling women aged ≥65 years against inappropriate weight loss).

### *Nursing-Home Intervention*

Nursing-home residents, who constitute approximately 5% of the population aged ≥65 years, are at particularly high risk for fall-related injuries. Approximately one half of the estimated 1.7 million nursing-home residents in the United States fall at least once each year, and 11% sustain a serious fall-related injury (*46*). A randomized trial of seven pairs of nursing homes that included 500 residents evaluated an intensive, multifaceted intervention of extensive environmental modifications (e.g., obtaining wheel locks for beds, changing lighting, modifying floor plans, and purchasing raised toilet seats), medication review, and increased attention to individual resident needs (*39*). Repeat falls declined 19% among nursing-home residents who had fallen at least once during the previous year. However, approximately one third of the safety recommendations implemented in the study group were discontinued within 3 months of the completion of the study. Strategies are needed to institutionalize fall prevention interventions in the nursing-home setting, and additional programs designed for high-risk nursing-home residents need to be implemented and evaluated.

## Secondary Prevention

Secondary prevention strategies are being developed to reduce the incidence of hip fracture among older women (*47*). Most hip fractures are caused by falling directly on the hip, and biomechanical studies have demonstrated that a pad that shunts the energy away from the point of impact is highly effective in reducing the force of a fall on the proximal femur (*48*). A 1993 clinical study in a Copenhagen nursing home demonstrated that hip protectors reduced the risk for hip fracture by approximately 50% (*47*). During 1994–1996, researchers in Finland conducted a study to determine whether nursing-home residents would wear an undergarment with energy-shunting hip pads. The findings indicated that 63% of the residents wore the pads (*49*). U.S. manufacturers have considered producing and marketing an undergarment with energy-absorbing hip pads, but how acceptable and effective this garment might be among community-dwelling older adults is unknown.

A promising technologic innovation for preventing fall-related injuries is a recently developed safety floor (*50*). Under laboratory conditions, this flooring material provides a firm walking surface and, if a fall occurs, reduces the force of impact through the use of special energy-absorbing flooring material. Field trials are under way in nursing homes to evaluate the effectiveness of this material in preventing fall-related hip fractures among nursing-home residents.

# PROGRAM AND RESEARCH AGENDA

Many professional and community-level organizations within the public health community, federal agencies, nongovernmental organizations, and state and local health departments are involved in efforts to reduce falls and fall-related injuries among older adults. However, coordination among these entities has been limited. CDC's National Center for Injury Prevention and Control has funded the National Resource Center on Aging and Injury at San Diego State University to collect, organize, and evaluate information and to increase awareness about preventing unintentional injuries among older adults. Information will be available through fact sheets, formal publications, and the Internet (at <http://www.olderadultinjury.org>) and will be provided to health-care

professionals, caretakers, and other persons concerned about reducing injuries among older adults.

Researchers do not know all the factors that contribute to falls and fall-related injuries or how personal and environmental factors interact to cause a fall. These factors have been difficult to identify because persons frequently cannot explain the causes or circumstances surrounding fall events. In one prospective study, one fourth to one third of the participants did not remember a fall that occurred 3–6 months earlier (*51*). Older adults might either blame themselves for falling or consider falls to be an inevitable consequence of the aging process. Longitudinal prospective studies are needed to accurately assess the associations between fall risk factors (e.g., interactions between intrinsic and extrinsic factors), the occurrence of falls, and fall outcomes (e.g., frequency of falls, whether an injury results, and level of injury severity).

To decrease the incidence and severity of fall-related injuries, injury-prevention programs for older adults need to integrate research findings into multifaceted, community-level programs that include both implementation and evaluation components. A model program would employ a prospective design to accurately record fall occurrences and establish whether a fall resulted in an injury. Such a program should incorporate four critical elements: a) education and skill-building activities to increase knowledge about fall risk factors, b) exercise to increase strength and improve balance, c) home safety modifications and repairs to reduce fall hazards, and d) medication review to maximize control of comorbid conditions while reducing adverse side effects. Because persons must take an active role to reduce their risk for falling, a model fall prevention program should also include effective strategies to promote behavioral changes.

Because of the increasing number of persons aged ≥65 years in the United States, the need is increasing to develop an effective national plan to address the problem of falls and fall-related injuries within the constraints of limited health-care resources. To accomplish this goal, efforts are needed to increase collaboration among national experts from various disciplines (e.g., gerontologists, health educators, behavioral epidemiologists, home designers, and ergonomic experts), to reach consensus regarding the priority research areas and program issues, and to work toward long-term strategies for reducing falls and fall-related injuries among older adults.

Some subgroups of older adults (e.g., women aged ≥85 years and older adults with functional limitations) might have different fall-injury risks than most community-dwelling older adults (*44*). Efforts are needed to adapt existing fall prevention programs or develop new interventions to reduce falls in these groups. Finally, in addition to existing behavioral and environmental interventions, new fall prevention approaches (e.g., characterizing footwear that promotes stability and developing more effective home lighting) need to be developed.

## CONCLUSION

Persons aged ≥65 years constitute the fastest-growing segment of the U.S. population. The average life expectancy for both men and women is increasing, in part because of healthier life styles and better control and treatment of chronic conditions (e.g., cardiovascular disease). Without effective intervention strategies, the number of hip fractures will increase as the U.S. population ages.

Fall prevention programs have effectively reduced falls in select populations by 30%–50%, using multifaceted approaches that include various combinations of education, exercise, medication assessment, risk factor reduction, and environmental modifications. Such programs need to be expanded to include multiple intervention components tailored for diverse populations of older adults and evaluated for effectiveness. In addition, secondary prevention strategies (e.g., reducing the amount of energy transferred to the hip) are needed to prevent hip fracture when falls occur.

The problem of fall-related hip fractures will continue to increase unless effective intervention strategies are developed and implemented to improve fall prevention interventions and expand existing programs. Older adults must take an active role in reducing their risk for falling. Because most older adults live independently, fall prevention programs must include effective strategies to promote behavioral changes. Innovative and effective fall prevention strategies are needed to reduce future morbidity and mortality associated with hip fractures, increase independence, and improve quality of life for the growing number of older adults.

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# Exercise-Related Injuries Among Women: Strategies for Prevention from Civilian and Military Studies

**The material in this report was prepared for publication by:**

**National Center for Injury Prevention and Control ..... Stephen B. Thacker, M.D., M.Sc.**
***Acting Director***

**Division of Unintentional Injuries Prevention ..... Christine Branche, Ph.D.**
***Director***

# Exercise-Related Injuries Among Women: Strategies for Prevention from Civilian and Military Studies

Julie Gilchrist, M.D.
Bruce H. Jones, M.D., M.P.H.
David A. Sleet, Ph.D.
*Division of Unintentional Injury Prevention*
*National Center for Injury Prevention and Control*

C. Dexter Kimsey, Ph.D., M.S.E.H.
*Division of Physical Activity and Nutrition*
*National Center for Chronic Disease Prevention and Health Promotion*

***Abstract***

**Scope of the Problem**: The numerous health benefits of physical activity have been well documented, resulting in public health support of regular physical activity and exercise. Although beneficial, exercise also has corresponding risks, including musculoskeletal injuries. The incidence and risk factors for exercise-related injury have been poorly assessed in women. Many civilian exercise activities (e.g., jogging, walking, and aerobics) have corollaries in military physical training; injury incidence and risk factors associated with military physical training have been more thoroughly studied.

**Etiologic Factors**: Injury risks increase as the amount of training increases (increased exposure). The same exercise parameters that can be modified to enhance physical fitness (i.e., frequency, duration, and intensity) also influence the risk for injury in a dose-response manner. Higher levels of current physical fitness (aerobic fitness) protect the participant against future injury. A history of previous injury is a risk factor for future injury. Smoking cigarettes has been associated with increased risk for exercise-related injury. Studies conducted in military populations suggest that the most important risk factor for injuries among persons engaged in vigorous weight-bearing aerobic physical activity might be low aerobic fitness rather than female sex.

**Recommendations for Prevention**: Because of the limited scientific research regarding women engaging in exercise, general recommendations are provided. Women starting exercise programs should be realistic about their goals and start slowly at frequency, duration, and intensity levels commensurate with their current physical fitness condition. Women should be informed about the early indicators of potential injury. Women who have sustained an injury should take precautions to prevent reinjury (e.g., ensuring appropriate recovery and rehabilitation).

**Research Agenda**: In general, a combination of factors affects the risk for exercise-related injury in women. How these factors act singly and in combination to influence injury risk is not well understood. Additional research regarding exercise-related injury in women is needed to answer many of the remaining epidemiologic questions and to help develop exercise programs that improve health while reducing the risk for injury.

**Conclusion**: Exercise is an important component in improving and maintaining health; however, injury is also an accompanying risk. A review of key military and civilian research studies regarding exercise-related injuries provides some clues to reducing these injuries in women. Greater adherence to exercise guidelines can help decrease these risks.

## BACKGROUND

In 1996, the U.S. Surgeon General's report on physical activity brought together for the first time current knowledge regarding the health benefits of regular physical activity (*1*). The report concluded that persons who are inactive can improve their current and future health by becoming moderately active on a regular basis. In addition, the report indicated that activity does not need to be strenuous to achieve some health benefits, but that greater health benefits can be achieved by increasing the amount (frequency, duration, or intensity) of physical activity. Although many studies have documented the hazards of inactivity, few have assessed the adverse effects of increased physical activity (e.g., injury). Increased physical activity increases the risk for injury. Although opportunities for women to participate in sports and organized fitness activities have increased substantially during the preceding century, little is known about the risks for injuries associated with increased physical activity and exercise for women. This report reviews key military and civilian research studies regarding musculoskeletal injury associated with common weight-bearing exercise (e.g., running, walking, and aerobics) and provides general recommendations for preventing exercise-related injuries among women.

Recent public health reports have reviewed the scientific evidence supporting the association between physical activity and several health benefits (*1,2*). Documented health benefits of regular physical activity include reducing the risk for coronary heart disease, noninsulin-dependent diabetes, hypertension, colon cancer, osteoporosis, and other disorders (*1*). Physical activity decreases the symptoms and might reduce episodes of anxiety and depression (*1*). In addition, regular physical activity improves physical fitness (e.g., cardiorespiratory endurance and muscle strength); reduces body fat; and builds and maintains healthy bones, joints, and muscles (*1*). Physical activity enhances strength, balance, and coordination (*1*). These benefits might be particularly important in preventing falls and maintaining independence in older adults. As a consequence of these health benefits, regular physical activity is highly recommended for women and men of all ages (*1*).

The U.S. Surgeon General's report indicated that approximately 60% of adult women in the United States did not engage in the recommended amount of physical activity, and 25% did not participate in physical activity during their leisure time (*1*). Physical inactivity is more common in women than men (*1,3*). To help increase the proportion of persons engaged in regular physical activity, two of the *Healthy People 2010* objectives are to a) reduce to ≤20% the proportion of persons aged ≥18 years who engage in no leisure-time physical activity (objective 22-1) and b) increase to ≥30% the proportion of persons aged ≥18 years who engage in regular, preferably daily, moderate physical activity for at least 30 minutes per day (objective 22-2). Because regular physical activity is considered essential to health, it has been included as one of the leading health indicators for health promotion and disease prevention in the United States (*4*).

Although physical activity has many health benefits, exercise has corresponding injury risks. Participants are at risk for exercise-related traumatic or overuse injuries. Some of the consequences of these injuries can be long-term (e.g., osteoarthritis and adverse health effects resulting from inactivity because of an injury). Injury causes many persons to stop participating in exercise (*2,5*). Efforts to increase physical activity and exercise in women must also be balanced with efforts to prevent injury.

Because lifestyles have become more sedentary and work has become less physically demanding, planned physical activity intended to improve physical fitness has become more important. Consequently, many adults choose to participate in exercise programs or sports. Health-related exercise programs and sports are excellent ways for women to increase their physical activity.

Opportunities for young women to participate in sports have substantially increased in recent decades. Since passage of the 1972 Title IX legislation that prevented sex discrimination in educational settings, the number of young women who participate in high school athletics has increased from approximately 300,000 during the early 1970s to nearly 2.7 million (one in three high school women) in the 1998–99 school year (*6,7*). This increased participation in high school athletics has fostered increased participation in college and elite athletics as well. Women now comprise approximately one third of all college athletes and 37% of U.S. Olympic athletes (*7*).

Many adult women participate in recreational aerobic activities. The National Sporting Goods Association reported that an estimated 37.4 million women participate more than twice a week in common aerobic activities (i.e., aerobic dance, cycling, exercise walking, exercising with equipment, calisthenics, swimming, and running) (*8*). Walking is the most prevalent physical activity among adults in the United States (*1,9*). If trends of increased participation in women's sports expand to include increased participation in recreational and other physical activities, the number of exercise-related injuries can also be expected to increase.

Injuries occur in association with physical activity, exercise, and sports (*10–13*), but the incidence and underlying causes of such injuries are not well understood. At the peak of the fitness boom in the 1980s, researchers knew little about exercise-related injuries and injury rates, even for common activities (e.g., walking and running) (*12*). During that period, researchers were only beginning to study the epidemiology of and risk factors for exercise-related injuries (*12,14*). Today, injury risk factors for physically active men remain poorly defined, and the specific risks for women who exercise are even less understood. Studies of runners have provided the most thorough examination of injury incidence and some related risk factors in civilian populations (*5,12,14–17*).

Studies of military populations provide sex-specific information on injury risks associated with physical training and exercise; activities are controlled, and complete and detailed health records, physical examinations, and physical fitness assessments are available (*18,19*). Studies of basic combat training, which occurs in all branches of the military and involves running, marching, and other weight-bearing aerobic activities, can often provide information relevant to civilian populations. Uniformity of training within military units provides unique control for the variability observed in exercise routines in the civilian population. Examination of military studies provides some data on exposure risks (*18,20*) and intrinsic risk factors (e.g., sex, previous injuries, health behaviors, sports participation, physical fitness, and anatomic factors) (*19–24*).

This report describes civilian and military research related to weight-bearing aerobic exercise and injuries. Aerobic exercises (e.g., running, walking, and aerobic dance) are highlighted in this report because they are popular and commonly prescribed activities. Military studies of training-related injuries are presented to identify shared and sex-specific intrinsic risk factors. Risks for men will be discussed briefly for comparative purposes. This report focuses on modifiable risk factors, which underlie the recommendations for prevention and future research.

## Definitions

In this report, distinctions between the terms "physical activity," "exercise," and "physical training" are important. Physical activity has been defined as movement created by skeletal muscle contractions, resulting in energy expenditure. Exercise is a type of physical activity that is planned, repetitive, and designed to improve or maintain at least one of the health-related components of physical fitness (*25*). Physical training (as used in the military) is organized exercise intended to enhance fitness. The terms exercise and physical training are used interchangeably. Physical fitness can be categorized into five health-related components: a) cardiorespiratory endurance (aerobic fitness), b) muscle endurance, c) strength, d) flexibility, and e) body composition (*1,25*). The focus of this report is on exercise for women aimed at enhancing cardiorespiratory endurance (aerobic fitness). When discussing research results from cited literature, the terms "significant" and "not significant" refer to a documented p-value of $<0.05$ or $>0.05$, respectively, unless otherwise stated.

Musculoskeletal injuries related to exercise can be classified as either traumatic (acute) injuries (e.g., sprains and fractures) or overuse injuries (e.g., tendinitis, bursitis, and stress fractures). A distinction is also made between extrinsic and intrinsic risk factors for musculoskeletal injury. Extrinsic risk factors refer to the parameters of training (e.g., frequency, duration, and intensity) and the conditions associated with the environment in which the exercise takes place. Intrinsic risk factors refer to the personal and internal characteristics of the participant (Table 1).

# SCOPE OF THE PROBLEM

## Findings from Civilian Studies

The incidence of exercise-related injury among women in the civilian population is not well documented. Civilian studies of male and female exercise participants provide some indication of the frequency of such injuries. Surveys demonstrate that the incidence of self-reported running-related injury is high. Annually, approximately 25%–65% of male and female runners report being injured to the extent that they reduced or stopped training (*5,13,15–18,26*). In addition, 14%–50% of these injured runners seek medical care for their injuries (*5,13,15–18*), representing substantial health-care costs for treatment and rehabilitation. Prospective studies that incorporated follow-up of injury among runners and other persons involved in vigorous physical activities suggest that the incidence of injuries might be even higher (*11,27–29*).

In an 18-month study of runners training for a marathon, 85% experienced $\geq$1 injury, and 174 injuries were reported among the 73 participants (159 injuries per 100 runners

**TABLE 1. Extrinsic and intrinsic risk factors for musculoskeletal injuries associated with weight-bearing exercise and activity***

| |
|---|
| **Extrinsic factors** |
| Training parameters (excessive or rapid increase) |
| Duration |
| Frequency |
| Intensity |
| Environmental conditions (extremes or irregular) |
| Terrain |
| Surfacing |
| Weather |
| Equipment (e.g., footwear) |
| **Intrinsic factors** |
| Sex |
| Age (extremes) |
| Previous injury |
| Behavioral factors |
| Smoking |
| Alcohol use |
| Previous physical activity/lifestyle (sedentary) |
| Physical fitness |
| Aerobic endurance (low) |
| Muscle endurance (low) |
| Strength (low or imbalanced) |
| Flexibility (extremes or imbalanced) |
| Body composition (extremes) |
| Anatomic abnormalities |
| High arches |
| Bowed legs |
| Leg-length discrepancies |
| Musculoskeletal disease |
| Osteoporosis |
| Arthritis |

*__Source:__ Jones BH, Reynolds KL, Rock PB, Moore MP. Exercise-related musculoskeletal injuries: risks, prevention, and care. In: Durstine JL, King AC, Painter PL, Roitman JL, Zwiren LD, Kenny WL, eds. Resource manual for guidelines for exercise testing and prescription. 2nd ed. Philadelphia, PA: Lea & Febiger, 1993:378–93.

per year) (*27*). In a 12-week study of aerobic dancers, 200 (49%) of 411 participants reported complaints associated with aerobics, and approximately 25% had to modify or stop participation because of an injury (*28*). In a study of participants engaged in several recreational sporting activities, 475 injuries occurred among 986 participants during a 12-week period (192 injuries per 100 participants per year) (*11*). In a 6-month study of walkers who averaged 14 miles per week, 21% stopped walking for ≥1 week because of injury (*29*). Although injuries during fitness activities are common, few studies of women or men who participate in recreational fitness activities are available to quantify risk or identify modifiable risk factors.

## Findings from Military Studies

Many civilian fitness activities (e.g., walking and jogging) have corollaries in military physical training (e.g., marching and running). The incidence of injury and related intrinsic risk factors for these activities have been more thoroughly studied in military populations than in civilians. Because physical fitness is required for military readiness, recruits undergo a vigorous basic training (BT) course, and substantial research has been devoted to methods of enhancing fitness and understanding the causes of training-related injuries. Studies from the U.S. Army 8-week BT have documented cumulative injury rates from 42% to 67% among women during the course of training (*19,20,30*). Of women in the U.S. Air Force, 33% incurred an injury during the 6-week BT (*20*). Similarly, 22% of women in the U.S. Navy sustained an injury during the 9-week BT, and 49% of women in the U.S. Marine Corps were injured during the 11-week BT (*20*). The range of injury incidence (22%–67%) among women in the different services and over time might be explained by differences in the duration and intensity of BT.

Most of the injuries to both women and men engaged in military BT are overuse injuries (e.g., achilles tendinitis, patellar-femoral syndrome, plantar fasciitis, and stress fractures). Most injuries occur to the lower extremities. Studies during Army BT indicate that 60%–80% of BT injuries are related to overuse, and 80%–90% occur to the lower extremities (*21,22,30*).

Injuries in the military have substantial effects on training and combat readiness because they require greater rehabilitation and recovery time than illnesses. Approximately 50% of health-care visits in these young, vigorously active military populations are injury-related (*20*). The rate ratios of injury-to-illness sick call visits for women in the Army, Marine Corps, and Air Force are 1.0, 1.0, and 0.8, respectively. Furthermore, the rates of limited duty days (i.e., days when a trainee cannot fully function on duty) are often substantially higher from an injury than from illness (*20,24*). In one Army study, women were assigned 129 injury-related limited duty days per 100 female trainees per month compared with 6 illness-related limited duty days per 100 trainees per month. The rate ratio between injury and illness limited-duty days was 22, even though 50% of sick-call visits were for illnesses (*20*). Among men, the rates of limited duty for injury were five times higher than the rates of limited duty for illness. In the physically active and generally healthy military populations, injury can be expected to account for a substantial proportion of morbidity, health-care costs, and rehabilitation time in comparison with illnesses. The burden of injuries among physically active civilian populations might reflect a similar pattern.

## Risk Factors for Exercise-Related Injuries

Risk factors for exercise-related injuries can be either extrinsic or intrinsic to the participant (Table 1). This report focuses on extrinsic training factors, perhaps the most important factors in determining injury risks, and addresses selected intrinsic factors. The association between training parameters and injury risks in civilian and military populations will be examined first because they are potentially the most important.

### *Extrinsic Training Factors*

The same training parameters that are modified to achieve a training effect (i.e., frequency, duration, and intensity of exercise) are also the most important factors re-

lated to injury. Several surveys of distance runners indicate a relation between a higher number of miles run per week and a higher incidence of injury in both women and men (*5,10,13,15,26*). Several studies have demonstrated that the relative risk (RR) of injury among civilian women and men is a function of the miles run per week (Table 2) (*5,15,26*). One classic study indicated that as the average weekly training mileage increased in 10-mile increments from <10 miles per week to >50 miles per week, the incidence of injury for women increased from 29% to 57%. The incidence of injury for men increased in a similar manner (*5*). Two additional studies reported similar sex-specific trends (*15,26*). The annual incidence of injury among female and male runners was approximately the same, and the RRs of injury for both sexes increased with increasing miles run. These and other studies suggest that, for weight-bearing exercise (e.g., running), injury rates increase as the amount of training increases in a dose-response manner.

In a study that examined the benefits of aerobic fitness and injury risks associated with increased duration or frequency of training among men, injury rates increased with duration of exercise (when frequency and intensity remained constant). Participants received limited additional aerobic fitness benefits when they exercised 45 minutes compared with 30 minutes. As duration of running increased from 15 minutes to 30 minutes to 45 minutes per workout, injury rates increased from 22% to 24% to 54%, respectively, whereas aerobic fitness (measured by maximal oxygen uptake) improved only 9%, 16%, and 17%, respectively. Although a plateau in fitness occurred, more exercise increased the incidence of injury. This study also demonstrated that frequency of exercise (number of training sessions per week), although positively related to aerobic fitness, was also positively related to injury (*31*).

A similar study of male walkers and joggers demonstrated that injury rates were more related to total mileage walked and jogged than to the intensity of exercise. This study controlled the total amount of activity in two groups of participants during a 6-month period. Both groups exercised the same duration per day (30 minutes); however, the walkers exercised more frequently (more days per week) than the joggers to accumulate approximately the same mileage. The walkers averaged 120 minutes of exercise per week, and the joggers averaged 90 minutes per week; however, the total distance accumulated by both groups was approximately the same (13.7 km per week and 14.7 km per week, respectively). At the end of the 6-month study period, the two groups had similar injury rates: 21% of the walkers and 25% of the joggers had sustained injuries sufficiently severe to require terminating their activity for ≥1 week (*29*). Studies such as these indicate that the total amount of training is an important determinant of injury risk. These studies were conducted with men, and similar studies of women are needed.

Studies of military populations have also examined the relation between training frequency and duration, gains in cardiorespiratory fitness, and injury risk. As mileage during physical training increases, both aerobic fitness and the risk of injury increases. Similar to the findings in civilian populations (*31*), military studies have documented thresholds in physical training, above which increased training does not improve fitness levels but continues to increase the likelihood of injury (*18–20*). These studies of military populations examined the association between training parameters and injury risk among men only. Additional studies among women are needed.

**TABLE 2. Relative risk for injury among civilian distance runners as a function of miles run per week, by study and sex — United States**

| Name of study | Sex/No. in study | Annual incidence (% Injured) | Measure of Injury | Miles per week <10 | Miles per week 10–19 | Miles per week 20–29 | Miles per week 30–39 | Miles per week 40–49 | Miles per week ≥50 | p-value for trend |
|---|---|---|---|---|---|---|---|---|---|---|
| **Koplan*** | Male | | (% Injured) | 21% | 29% | 36% | 41% | 52% | 71% | |
| | 688 | 37% | Risk ratio | 1.0 | 1.4 | 1.7 | 2.0 | 2.5 | 3.4 | <0.0000 |
| | Female | | (% Injured) | 29% | 32% | 41% | 53% | 36% | 57% | |
| | 725 | 38% | Risk ratio | 1.0 | 1.1 | 1.4 | 1.8 | 1.2 | 2.0 | <0.0003 |
| **Macera†** | Male | | Odds ratio | 1.0 | 1.8 | 2.0 | 2.7 | 5.0 | NA§ | NA |
| | 485 | 52% | (95% CI¶) | Reference | (0.9–3.3) | (1.1–3.8) | (1.4–5.7) | (2.4–10.6) | NA | |
| | Female | | Odds ratio | 1.0 | 0.8 | 1.4 | 5.9 | 2.1 | NA | NA |
| | 98 | 49% | (95% CI) | Reference | (0.2–2.7) | (0.4–5.2) | (1.1–30.1) | (0.5–9.5) | NA | |
| **Walter**** | Male | | Relative risk | 1.0 | 0.9 | 1.4 | 1.3 | 2.2 | NA | NA |
| | 985 | 49% | (95% CI) | Reference | (0.4–1.6) | (0.8–2.4) | (0.7–2.3) | (1.3–3.7) | NA | |
| | Female | | Relative risk | 1.0 | 1.0 | 1.4 | 2.0 | 3.4 | NA | NA |
| | 303 | 46% | (95% CI) | Reference | (0.4–2.2) | (0.6–3.2) | (0.8–4.8) | (1.4–7.9) | NA | |

* **Sources:** Koplan JP, Powell KE, Sikes RK, Shirley RW, Campbell CC. An epidemiologic study of the benefits and risks of running. JAMA 1982;248:3118–21.
† Macera CA, Pate RR, Powell KE, Jackson KL, Kendrick JS, Craven TE. Predicting lower extremity injuries among habitual runners. Arch Intern Med 1989;149: 2565–8.
§ Not applicable. No persons participated at the ≥50-mile-per-week level.
¶ Confidence interval.
** **Source**: Walter SD, Hart LE, McIntosh JM, Sutton JR. The Ontario Cohort Study of Running-Related Injuries. Arch Intern Med 1989;149:2561–4.

### *Intrinsic Training Factors*

Military BT provides a unique opportunity to study some intrinsic risk factors for exercise-related injuries. Unlike civilian fitness participants, regimentation in military training requires that trainees do the same type and amount of training. Researchers studying military populations have systematically examined several intrinsic factors and their relation to musculoskeletal injury risk. The most consistently identified intrinsic risk factors have been a) sex, b) age, c) history of previous injury, d) adverse health behaviors (e.g., smoking tobacco), e) previous physical activity (e.g., sedentary lifestyle), and f) current level of physical fitness.

**Sex.** Sex has consistently been identified as a risk factor for injury in military BT. In studies from the 1980s to 1997 that examined women and men at the same training site who performed essentially the same physical training, incidences of injuries for women were 1.7–2.2 times higher than those for men (*19,20,21,30,32,33*) (Table 3).

In addition, rates of some specific injuries during military training (e.g., stress fractures) are higher for women than men (*20,24,30,33,34*). In Army training, RR for stress fractures is 2–10 times higher for women than men engaged in the same training regimen (*20,21,30,34–36*). In the Marine Corps recruit training, the risk for stress fractures is 3.7 times higher for women than men (*20*).

Some specific injuries (e.g., anterior cruciate ligament tears in the knee) occur more frequently in female athletes (*37*). However, in studies comparing civilian runners (the most extensively studied civilian recreational fitness activity), the overall rates of exercise-related injury are similar among women and men. Researchers suggest that female civilian runners have the same injury rates as men because they can modulate their training frequency, duration, and intensity (unlike military trainees) to accommodate their fitness levels and the minor overuse injuries that might occur (*10*). Injury studies among military populations suggest that without controlling for physical fitness, at any fixed level of activity, women will be at greater risk for injury than men (Table 3).

**TABLE 3. Cumulative incidence of injury during basic training among women and men, by U.S. military branch and risk ratio for ≥1 injury — United States***

| Year | Branch of U.S. military | Duration of basic training (weeks) | Women | | Men | | Risk ratio (≥1 injury) |
|---|---|---|---|---|---|---|---|
| | | | No. | (% Injured) | No. | (% Injured) | |
| 1980 | Army | 8 | 347 | (54) | 770 | (26) | 2.1 |
| 1982 | Army | 8 | 767 | (42) | 3,437 | (23) | 1.8 |
| 1984 | Army | 8 | 186 | (50) | 124 | (28) | 1.8 |
| 1988 | Army | 8 | 352 | (62) | 509 | (29) | 2.1 |
| 1993 | Army | 8 | 174 | (67) | 0 | NA† | NA |
| 1997 | Army | 8 | 388 | (63) | 685 | (37) | 1.7 |
| 1995 | Navy | 9 | 4,415 | (22) | 9,500 | (11) | 2.0 |
| 1995 | Marine Corps | 11 | 1,498 | (49) | 396 | (29) | 1.7 |
| 1995 | Air Force | 6 | 5,250 | (33) | 8,656 | (15) | 2.2 |

* **Sources**: Jones BH, Shaffer RA, Snedecor MR, eds. Atlas of injuries in the U.S. Armed Forces. Mil Med 1999;164(suppl): 6-1–6-89.
Knapik JJ, Sharp MA, Canham ML, et. al. Injury incidence and injury risk factors among U.S. Army basic trainees (including fitness training unit personnel, discharges, and newstarts), Ft. Jackson, SC, 1998. Ft. Jackson, SC: Epidemiological Consultation Report, 1999; report no. 29-HE-8370-98.
† Not applicable.

**Age.** Results of military studies regarding the effects of age on training and injuries have been inconsistent. Some studies have revealed that during BT, female (*38*) and male trainees aged >23 years are at greater risk for injury (*22,38,39*). Other military studies have indicated no statistically significant difference in injury risk by age (*20,36,40*). Studies of civilian runners have also had inconsistent results. Some studies have demonstrated that age is not an important risk factor, whereas others have demonstrated that rates of injury decrease with age (*10,13,15,16,26*). Among civilian women, older age was not associated with elevated risk (*10*). Unlike military trainees, older participants in civilian studies might have been able to decrease their risk by modulating the frequency, duration, or intensity of their personal training regimens (*10*). Alternatively, a "survivor effect" might exist, whereby persons who have sustained injury change activities or cease participation and thus are unavailable for inclusion in studies (*10*). Data from military and civilian studies suggest that among adults aged <45 years, age alone is not a strong predictor of injury in exercise.

**History of Previous Injury.** A history of previous musculoskeletal injury has also been reported as a risk factor for injury in both civilian and military studies. In a systematic review of the literature regarding the prevention of ankle sprains in sports, the most commonly identified risk factor for an ankle sprain was a previous ankle sprain (*41*). Overuse injuries occurred twice as frequently in trainees with a previous history of ankle sprain (*19*). A previous ankle sprain is also a risk factor for injuries among male trainees in Army BT (*22*). In addition, data from the Marine Corps suggest that previous injuries pose a risk for future injury (*20,40*). These findings are consistent with civilian studies of female and male distance runners, in which RR for an injury in a person who has had an injury during the preceding year was 1.8–2.4 for women and 1.7–2.7 for men (*15,26*).

**Health-Related Behaviors**. Health behaviors engaged in before entry into military service (e.g., smoking tobacco and participating in regular physical activity) can influence a woman's injury risk during BT.

*Smoking.* Both female and male smokers who participate in Army or Marine Corps BT are at a significantly higher risk for injury than nonsmokers (*20*). Women who were smokers on entry into the Army were 25% more likely to be injured in BT; injury rates were 77% for smokers and 62% for nonsmokers (*20*). Similarly, the risk for injury among women in the Marine Corps who smoked before beginning BT was 1.7 times higher than for those who were nonsmokers (*20*). Male smokers in Army and Marine Corps BT were 1.9 times and 2.3 times more likely to have an injury, respectively, than their nonsmoking male counterparts (*20,22*). Studies have not indicated whether civilian athletes or exercise participants who smoke tobacco are at greater risk for injury. However, in a literature review of the potential association between smoking and injuries, researchers estimated that smokers were two times more likely than nonsmokers to sustain unintentional injuries in the workplace, although some of these injuries might not be related to physical activity (*42*). Data from these studies suggest that women who smoke are at a higher risk for training-related injuries than women who do not smoke.

*Previous Physical Activity.* Although some health behaviors (e.g., smoking) might increase injury risk, previous regular physical activity might be protective against injury. This protective effect has been documented in men in the Army and Marine Corps (*20–22,32,39*). Among male trainees in the Army, running before entry into the service might be protective. For military women, the association between previous regular physi-

cal activity and injury risk has not been documented (*20,32,36*). Researchers documented that, for men, more years of participating in running was protective against injury; however, for women, more years of participating in running might be associated with higher risk for injury (*15*). These results are difficult to interpret because of possible survivor effects (e.g., injured runners cease to run). Because no comparable data in civilian populations of women exist, no conclusions can be drawn regarding the influence of previous regular physical activity as a protective factor against injury among women. Further research is needed regarding the influence of previous physical activities and exercise-related injury risk among women and men in both military and civilian populations.

**Current Level of Physical Fitness.** A person's current level of physical fitness has been one of the most important predictors of injury in military studies (*19–21,24,32,33,40*). Of the five health-related components, low levels of aerobic fitness and, to a lesser extent, low muscular endurance have consistently been associated with injury risk during BT. Other factors (e.g., body composition and strength) demonstrated weaker and less consistent associations with injury risk.

Aerobic fitness, as measured by timed performance of 1- to 2-mile runs during Army or Marine Corps physical fitness entry tests, has been the single most consistently and strongly associated intrinsic risk factor for subsequent training-related injury. During Army BT, women who scored in the slowest quartile on the initial entry physical fitness test experienced 1.5–1.7 times greater injury risk than women in the fastest quartile (*21,36*) (Table 4). Findings were similar for women in Marine Corps BT: women in the slowest quartile experienced 2.4 times greater risk for injury than women in the fastest quartile. Women and men with the slowest run times (i.e., least aerobically fit) were consistently at greater risk for injury than those with the fastest run times (i.e., most aerobically fit). Comparable trends were documented among female Army cadets at West Point Academy, New York (*24*). Among men, the inverse relation of aerobic fitness and injury risk is similar to that of women. Male trainees with slower run times were at greater risk for injury than those who ran the fastest (*20,36*).

In addition to being at greater risk for injury, women who had the slowest run times experienced 2.5 times the risk of stress fractures and stress reactions compared with women who had faster run times (*20,32*). Similar findings were documented among women in Marine Corps BT (*20,40*). Researchers demonstrated that the least aerobically fit and least physically active trainees were 3.5 times more likely than persons who were the most fit and most active to sustain a stress fracture (*23*).

A prospective study of Army trainees in BT demonstrated an association between maximal oxygen consumption (ml $O_2$ per kg body weight per minute), which is a measure of aerobic fitness, and subsequent risk for injury. Maximal oxygen consumption ($VO_2$ max) was measured in trainees running on a treadmill before the start of BT. For women in successive tertiles of $VO_2$ max, risk for injury increased from 39% in the highest tertile to 50% in the middle tertile, to 55% in the lowest. Similarly, men with the lowest $VO_2$ max were at greatest risk for injury (36). Prospective studies among civilians examining the association between aerobic fitness and injury are not available. Military research suggests that higher levels of baseline physical fitness is protective, at least at the start of a training program. Further research is needed to determine the degree and duration of this protection.

**TABLE 4. Injury risk during U.S. military basic training, by level of aerobic fitness measured by run times of initial physical fitness tests, and by U.S. military branch — Ft. Jackson, South Carolina, 1984 and 1998, and Parris Island, South Carolina, 1993**

| Sex/No. in study | Branch of U.S. military | Location and year of study | Measure of injury | Quartile 1 (fastest) | Quartile 2 | Quartile 3 | Quartile 4 (slowest) | p-value for trend |
|---|---|---|---|---|---|---|---|---|
| Women | Army | Ft. Jackson | Injury risk | 36% | 33% | 57% | 61% | 0.03 |
| 79 | | 1984* | Risk ratio | 1.0 | 0.9 | 1.6 | 1.7 | |
| Men | Army | Ft. Jackson | Injury risk | 14% | 10% | 26% | 42% | 0.02 |
| 140 | | 1984* | Risk ratio | 1.0 | 1.4 | 1.9 | 3.0 | |
| Women | Army | Ft. Jackson | Injury risk | 39% | 55% | 59% | 60% | 0.02 |
| 680 | | 1998† | Risk ratio | 1.0 | 1.4 | 1.5 | 1.5 | |
| Men | Army | Ft. Jackson | Injury risk | 21% | 23% | 32% | 30% | 0.01 |
| 488 | | 1998† | Risk ratio | 1.0 | 1.1 | 1.5 | 1.4 | |
| Women | Marine | Parris Island | Odds ratio¶ | 1.0 | 2.2 | 2.2 | 2.4 | NA** |
| 265 | Corps | 1993§ | (95% CI) | Reference | (1.1–4.4) | (1.1–4.5) | (1.2–5.1) | |
| Men | Marine | Parris Island | Odds ratio¶ | 1.0 | 2.1 | 1.3 | 2.1 | NA |
| 369 | Corps | 1993§ | (95% CI) | Reference | (1.1–4.2) | (0.6–2.6) | (1.1–4.3) | |

* **Sources**: Jones BH, Bovee MW, Knapik JJ. Associations among body composition, physical fitness, and injury in men and women Army trainees. In: Marriott BM, Gumstrup-Scott J, eds. Body composition and physical performance. Washington DC: National Academy Press, 1992:141–72.

† Knapik JJ, Sharp MA, Canham ML, et. al. Injury incidence and injury risk factors among U.S. Army basic trainees (including fitness training unit personnel, discharges, and newstarts), Ft. Jackson, SC, 1998. Epidemiological Consultation Report, 1999; report no. 29-HE-8370-98.

§ Jones BH, Shaffer RA, Snedecor MR, eds. Atlas of injuries in the U.S. Armed Forces. Mil Med 1999;164(suppl): 6-1–6-89. Kimsey Jr CD. The epidemiology of lower extremity injuries in United States Marine Corps recruits [Dissertation]. Columbia, SC: University of South Carolina, 1993.

¶ Derived from logistic regression.

** Not applicable.

Higher levels of muscular endurance and strength can also be protective against injury in military BT. For both women and men, greater muscular endurance (measured by the number of push-ups completed in 2 minutes) was associated with fewer training-related injuries (*20*). When categorized into quartiles, risk for injury decreased for women who could do more push-ups. The cumulative incidence of injury was 57% for women who completed the least number of push-ups in 2 minutes and 38% for women who did the most push-ups. Similarly, Army women who could not lift >34 kg had RR for injury of 1.4 compared with women who could lift >46 kg (*20*).

The relation of body composition to exercise-related injury risk is complex. Some studies indicate no association between body composition and exercise-related injury risk (*20,36*). When an association between measures of body fat and injury incidence for women in Army BT has been identified, the relation has been bimodal (U-shaped). Women with the least and the most body fat were at greater risk for injury (*21,32,40*). Among women in Army BT, the risk for injury varies by body mass index (BMI). To obtain BMI, weight in kilograms is divided by height in meters squared (weight [kg]/[height squared [$m^2$]). The cumulative incidence of injuries in successive quartiles of increasing BMI were 56% (lowest quartile), 46%, 38%, and 63% (highest quartile). The corresponding RRs were 1.5, 1.2, 1.0, and 1.6, respectively. BMI for women ranged from 18 kg/$m^2$ to 27 kg/$m^2$ (*32*). A study of civilian male distance runners demonstrated a statistically significant bimodal relation between BMI and injury (*16*). A study of civilian female runners indicated a statistically not significant but also bimodal relation between BMI and injury (*15*). Additional research is needed to better determine the relation

between body fat, BMI, and incidence of injury; these studies should control for physical fitness and previous physical activity.

## The Relation Between Sex and Level of Physical Fitness

The observation that low levels of physical fitness on entry into BT is related to injuries during BT is particularly relevant to the issue of injuries among women. The incidence of injuries among women in Army BT is consistently 1.6–2.1 times higher than the incidence for men in Army BT. However, several studies also document that on entry into the Army, women are less physically fit than men (*20,21,32,35,43*). On average, women have slower run times, perform fewer push-ups, and have a higher percentage of body fat than men.

What would be the effect of controlling for level of fitness when making comparisons between men and women? In several studies, injury risks were stratified by quartiles or quintiles of run times to enable comparison of groups of women and men who performed similarly on the initial-entry physical training test (*20,32,35,43*). In these studies, initial RRs of injury for women were higher than for men, with RRs ranging from 1.6 to 2.1. However, when stratified by aerobic fitness (run times), the stratum-specific risk ratios all approached 1.0, and the summary risk ratios declined (range = 0.9–1.2). In a logistic regression model that controlled for physical fitness (i.e., run times, numbers of push-ups and sit-ups, and strength), age, and race, the odds ratio for women versus men was 1.1 (*20,43*). Slower run times were the only component of fitness associated with increased odds of injury. Odds of injury progressively increased for successive quintiles of run time from fastest to slowest: 1.0, 1.4, 1.5, 2.5, and 3.2, respectively. In another logistic regression model, female sex was initially a risk factor, with an odds ratio of 2.5 for women compared with men, until run time was entered into the model. When corrected for run times, the odds ratio for females declined to 1.0; however, run time remained a significant predictor (*32*). These findings suggest that the most important underlying risk factor for injuries among military trainees engaged in vigorous aerobic weight-bearing activities (e.g., running and marching) is aerobic fitness level and not female sex (*33,43*). Studies that compare injury risks between men and women with similar fitness levels have not been conducted in civilian populations.

Because the findings in this report are derived from studies of special populations (e.g., runners and military trainees), they might not be generalizable to other U.S. populations. A review of the studies in these special populations provides guidance toward establishing general principles that will be valuable in preventing injuries and guiding research in the general population.

# RECOMMENDATIONS FOR PREVENTION

Scientific research regarding injuries related to physical training and exercise has focused on men rather than women, on military trainees rather than physically active civilians, and on competitive rather than recreational athletes. In addition, the studies of military populations generally involve a young, healthy population. Studies of recreational athletes in the civilian population are difficult to conduct and might not be able to completely control for the frequency, duration, and intensity of activity, as is possible in studies of military populations. In addition, measures of current physical fitness might be difficult to obtain.

Based on the limited scientific research regarding physical activity, exercise, and injuries among women and generally agreed on "best practices," the following recommendations are made to reduce the risk of exercise-related injury among women:

- Although most healthy women do not need to visit their physician before starting a moderate-intensity exercise program, women aged >50 years or women who have either a chronic disease or risk factors for a chronic disease should consult their physician to ensure that their exercise program is safe and appropriate.
- The choice of an exercise program should be tailored to a woman's current physical fitness level. Resources that include examples of activities categorized by exercise intensity levels are available and can aid women in choosing activities based on their respective physical fitness levels.
- Decisions regarding the frequency, duration, and intensity of exercise should be individualized, based on the woman's current level of physical fitness, history of physical activity, and history of injury.
- Women, particularly those with lower fitness levels, should begin participating in exercise at a lower level of training (frequency, duration, and intensity) and progress slowly. Women who are sedentary and start a new exercise program or activity might need to begin with intervals of activity as short as 5–10 minutes of light-intensity activity and gradually increase to the desired intensity and/or duration of participation.
- Participants should be aware of early signs of potential injury (i.e., increasing muscle soreness, bone and joint pain, excessive fatigue, and performance decrements). Coaches, personal trainers, and instructors should be alert to these signs among the women they are supervising.
- When a participant senses any of the warning signs (i.e., increasing muscle soreness, bone and joint pain, excessive fatigue, performance decrements, or current injury), she should incrementally decrease training (i.e., reduce frequency, duration, or intensity) until symptoms diminish or cease participation temporarily, depending on the severity of injury.
- Women who sustain a musculoskeletal injury should allow sufficient recovery and rehabilitation time and take precautions to prevent reinjury.
- Women who smoke should be informed that smoking might increase their risk for exercise-related injury. They should make every effort to stop smoking, not only to reduce their risk for injury, but also to enhance their long-term overall health.
- Women should be realistic in setting their exercise goals by balancing the desire for measurable weight reduction, increases in endurance or strength, or other health-related fitness benefits with the risk for injury.

# RESEARCH AGENDA

## Research Needs

This report provides an overview of the relation between extrinsic training factors, selected intrinsic factors, and musculoskeletal injury risks during exercise. Some research exists regarding exercise-related injury risk factors among military or elite athletic populations; however, little research has been conducted among other physically active populations. Even less research specifically addresses the particular risks to women who exercise. These gaps in current knowledge limit the specificity with which recommendations can be made. Future research is needed to identify methods of promoting physical activity while preventing or reducing the risk for injury. As researchers continue to define the benefits of regular exercise, the following suggestions might help develop complementary research regarding injury risks:

Surveillance systems need to be developed to monitor physical fitness, health, injury, and other medical outcomes of physical activity and exercise. Questions regarding exercise-related injuries need to be incorporated into existing surveillance instruments that monitor physical activity participation levels. Measures of exposure in physical activity (i.e., frequency, duration, and intensity) by sex, age, and activity should be incorporated into data-gathering systems to better characterize population-based injury risks.

Research regarding the etiology of exercise-related injuries is needed to determine the incidence of and risk factors for injuries in common exercise activities (e.g., walking, hiking, bicycling, and aerobic dance) and active sports (e.g., tennis, racquetball, basketball, and soccer) for women. Identification of the amount (i.e., frequency, duration, and intensity), type (e.g., jogging, walking, biking, and dancing), and progression of exercise that is appropriate for women of differing physical fitness levels and body composition is needed to maximize fitness while minimizing injury risk. To prevent overuse injuries among women, the appropriate amounts and balance of training and recovery for different types of exercise and activity need to be determined. In addition, sex-specific exercise-related injury risks need to be determined to guide the choices women make regarding exercise. These risks include but are not limited to a) anterior cruciate ligament rupture, b) stress fractures, c) pregnancy and postpartum injury risks, and d) risks (and benefits) of exercise in older women and women with osteoporosis.

Conducting longitudinal intervention trials to monitor injury occurrences while measuring changes in fitness is essential for developing and evaluating injury reduction measures. Determination of the long-term effects of exercise-related injuries on health outcomes (e.g., osteoarthritis, late or chronic sequelae, and disability) and future exercise participation is needed because a decrease in physical activity might increase the risk for chronic diseases. Finally, to document the impact of exercise-related injury and the importance of further research, the economic and social costs of exercise-related injury and any resultant nonadherence to exercise regimens need to be determined.

## CONCLUSION

Persons who participate in vigorous exercise might incur a higher number of musculoskeletal injuries than more sedentary persons. However, several intrinsic and extrinsic factors interact to modify the risk for incurring an exercise-related injury. For activities other than running and military training, little data are available regarding the incidence or risk factors for such injuries. The data suggest that a combination of factors (e.g., sex, current level of fitness, previous exercise experience, smoking, previous injury, and body composition) might affect the risk for exercise-related injury in women. However, how these factors act singly and in combination to influence injury risk is not well understood. The following conclusions might help in the development of further research regarding the relation between exercise and the risk for injury:

- The most important risk factors for exercise- or training-related injuries are the frequency, duration, and intensity of the physical training activity. The total amount of exercise (e.g., the frequency, duration, and intensity) is the most consistently identified predictor for injury risk.
- Physical fitness is inversely related to injury risk; as physical fitness level increases, risk for injury decreases. Men and women who participate in the same activities and have the same physical fitness levels generally have similar incidences of injury. Thus, physical fitness rather than female sex is the underlying risk factor.
- A dose-response relation exists between the amount of weight-bearing exercise performed and the risk of injury for both women and men.
- A training threshold exists, above which increased training does not appreciably increase fitness but will substantially increase risk for injury. This threshold might be different for each person.
- Although higher current amounts of exercise or physical activity are risk factors for injury because of increased exposure, at any fixed amount of activity, men with a history of higher amounts of physical activity are at lower risk for injury. For women, the relation is unclear.
- At any given amount of aerobic weight-bearing activity, women and men who have the highest aerobic fitness levels can be expected to have lower subsequent injury rates.
- The combined findings of research regarding the association of training, previous physical activity, and current physical fitness levels suggest that tailoring exercise to accommodate a person's current level of fitness and previous physical activity reduces injury rates. Changes in frequency, duration, or intensity of exercise can have cumulative effects on injury risk. These findings are particularly important for persons who are the least fit or most sedentary because they are at the greatest risk for injury when initiating physical activity.
- The protective effect against injury of higher levels of aerobic fitness provides an incentive to become more physically active. It suggests that incremental

increases in fitness are beneficial in terms of increasing health benefits and decreasing injury risks.

- The relation between previous injuries and higher risk for subsequent exercise-related injuries provides some indication of the importance of a) recovery and rehabilitation and b) consideration of the history of previous injuries when planning exercise programs.
- The association between smoking tobacco and higher exercise-related injury risks suggests another possible reason to discourage smoking, both for injury reduction in the short-term and increased overall health benefits in the long-term.
- Although the association of body composition with exercise-related injury risks is not completely clear, the bimodal relation that exists suggests that proper maintenance of body weight in the normal range (i.e., BMI 18.5 kg/m$^2$–24.9 kg/m$^2$) is important not only for health and appearance but also to reduce risks for injury.

Further research is needed to answer many of the remaining epidemiologic questions and to help develop exercise programs for women that improve health while reducing the risk for injury.

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# Implementing Recommendations for the Early Detection of Breast and Cervical Cancer Among Low-Income Women

**The material in this report was prepared for publication by:**

**National Center for Chronic Disease Prevention and Health Promotion** ..... **James S. Marks, M.D.**
***Director***

**Division of Cancer Prevention and Control** ..... **Nancy C. Lee, M.D.**
***Director***

# Implementing Recommendations for the Early Detection of Breast and Cervical Cancer Among Low-Income Women

Herschel W. Lawson, M.D.
Rosemarie Henson, M.S.S.W., M.P.H.
Janet Kay Bobo, Ph.D., M.S.W.
Mary K. Kaeser, M.Ed.
*Division of Cancer Prevention and Control*
*National Center for Chronic Disease Prevention and Health Promotion*

***Abstract***

**Scope of the Problem**: Among U.S. women, breast cancer is the most commonly diagnosed cancer and remains second only to lung cancer as a cause of cancer-related mortality. The American Cancer Society (ACS) estimates that 182,800 new cases of female breast cancer and 41,200 deaths from breast cancer will occur in 2000. Since the 1950s, the incidence of invasive cervical cancer and mortality from this disease have decreased substantially; much of the decline is attributed to widespread use of the Papanicolaou (Pap) test. ACS estimates that 12,800 new cases of invasive cervical cancer will be diagnosed, and 4,600 deaths from this disease will occur in the United States in 2000.

**Etiologic Factors**: The risk for breast cancer increases with advancing age; other risk factors include personal or family history of breast cancer, certain benign breast diseases, early age at menarche, late age at menopause, white race, nulliparity, and higher socioeconomic status. Risk factors for cervical cancer include certain human papilloma virus infections, early age at first intercourse, multiple male sex partners, a history of sexually transmitted diseases, and low socioeconomic status. Black, Hispanic, or American Indian racial/ethnic background is considered a risk factor because cervical cancer detection and death rates are higher among these women.

**Recommendations for Prevention**: Because studies of the etiology of breast cancer have failed to identify feasible primary prevention strategies suitable for use in the general population, reducing mortality from breast cancer through early detection has become a high priority. The potential for reducing death rates from breast cancer is contingent on increasing mammography screening rates and subsequently detecting the disease at an early stage — when more treatment options are available and survival rates are higher. Effective control of cervical cancer depends primarily on early detection of precancerous lesions through use of the Papanicolaou test, followed by timely evaluation and treatment. Thus, the intended outcome of cervical cancer screening differs from that of breast cancer screening. In 1991, the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) was implemented to increase breast and cervical cancer screening among uninsured, low-income women.

**Research Agenda**: To support recommended priority activities for NBCCEDP, CDC has developed a research agenda comprising six priorities. These six priorities are a) determining effective strategies to communicate changes in NBCCEDP policy to cancer screening providers and women enrolled in the program; b) identifying effective

strategies to increase the proportion of enrolled women who complete routine breast and cervical cancer rescreening according to NBCCEDP policy; c) identifying effective strategies to increase NBCCEDP enrollment among eligible women who have never received breast or cervical cancer screening; d) evaluating variations in clinical practice patterns among providers of NBCCEDP screening services; e) determining optimal models for providing case-management services to women in NBCCEDP who have an abnormal screening result, precancerous breast or cervical lesion, or a diagnosis of cancer; and f) conducting economic analyses to determine costs of providing screening services in NBCCEDP.

**Conclusion**: The NBCCEDP, through federal, state, territorial, and tribal governments, in collaboration with national and community-based organizations, has increased access to breast and cervical cancer screening among low-income and uninsured women. This initiative enabled the United States to make substantial progress toward achieving the *Healthy People 2000* objectives for breast and cervical cancer control among racial/ethnic minorities and persons who are medically underserved. A continuing challenge for the future is to increase national commitment to providing screening services for all eligible uninsured women to ultimately reduce morbidity and mortality from breast and cervical cancer.

## INTRODUCTION

Although the causes and natural histories of breast and cervical cancer are different, the public health responses to these diseases have been similar. Early detection of breast cancer and primary prevention of cervical cancer are possible through community-based screening programs; however, early detection of both breast and cervical cancer is less common among low-income* women (*1*). This report presents morbidity and mortality data regarding breast and cervical cancer, screening recommendations, an update on the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), and recommended priority activities for NBCCEDP. NBCCEDP is a major public health effort to increase breast and cervical cancer screening among uninsured, low-income women.

## SCOPE OF THE PROBLEM

### Breast Cancer

Among women in the United States, breast cancer is the most commonly diagnosed cancer and remains second only to lung cancer as a cause of cancer-related death. The American Cancer Society (ACS) estimates that 182,800 new cases of female breast cancer and 41,200 deaths from breast cancer will occur in 2000 (*2*). In 1996, data from the National Cancer Institute's (NCI) Surveillance, Epidemiology, and End Results (SEER) Program† indicated that the incidence of breast cancer increased 25.3% during

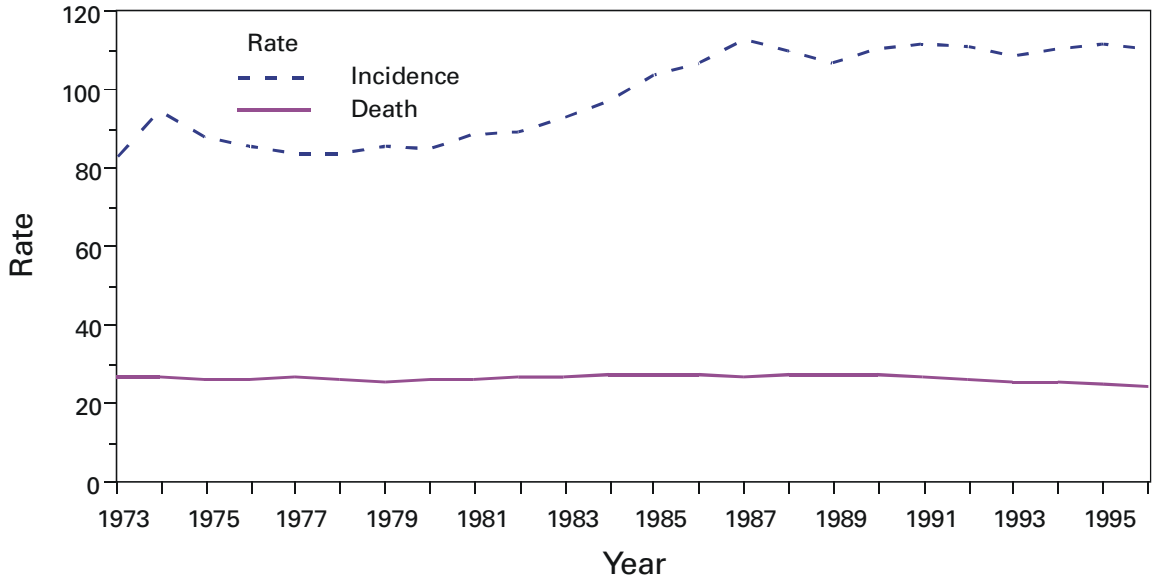
*Defined as up to 250% of poverty level depending, on family size.

†In 1996, the SEER program comprised cases from 11 population-based cancer registries throughout the United States that represent an estimated 13.9% of the U.S. population. The SEER program also publishes death rates based on a public-use data tape from CDC's National Center for Health Statistics. During 1988–1996, the 11 locations were Connecticut; Hawaii; Iowa; New Mexico; Utah; and Atlanta, Detroit, San Francisco/Oakland, San Jose/Monterey, Los Angeles, and Seattle/Puget Sound.

1973–1996 (Figure 1). Most of the increase occurred during 1973–1991; incidence rates remained stable during 1992–1996. In 1996, the incidence rate for breast cancer was 110.7 cases per 100,000 women, a 29.6% increase since 1980. In addition, in 1996, the case-fatality rate for breast cancer was 24.3 per 100,000 women, a 4.5% decrease since 1992, representing the first sustained decline in breast cancer-related mortality since 1973 (when SEER surveillance for breast cancer began). Although the percentage increases in incidence during 1973–1996 were similar among black and white women, the percentage decrease in mortality during 1992–1996 was substantially greater among white women than black women (*3,4*).

Overall during 1992–1996, breast cancer incidence rates were higher among white women (113.1 per 100,000) than black women (100.3), but breast cancer death rates were lower among white women (25.1) than black women (32.0). Furthermore, these race-specific differences in rates varied by age. Among women aged <50 years, the incidence rate for black women (32.7) was higher than that for white women (31.1). Among women aged ≥50 years, the rate was higher for white women (365.8) than for black women (308.7). The death rate among women aged <65 years was higher for black women (20.4) than for white women (14.3). Although the death rate among women aged ≥65 years was higher for white women than for black women before 1987, recent data indicate that the death rate among this age group is higher for black women (130.9) than for white women (124.0) (*4,5*). On the basis of SEER data for 1988–1992 (most recent data available), incidence rates were highest for white (145.7), Hawaiian (105.6), and black women (95.4) and lowest for Korean (28.5), American Indian (31.6), and Vietnamese (37.5) women. Incidence rates among white, non-Hispanic women were four times higher than among Korean women (*3*).

**FIGURE 1. Incidence rate* and death rate† of invasive breast cancer, by year — United States, 1973–1996**



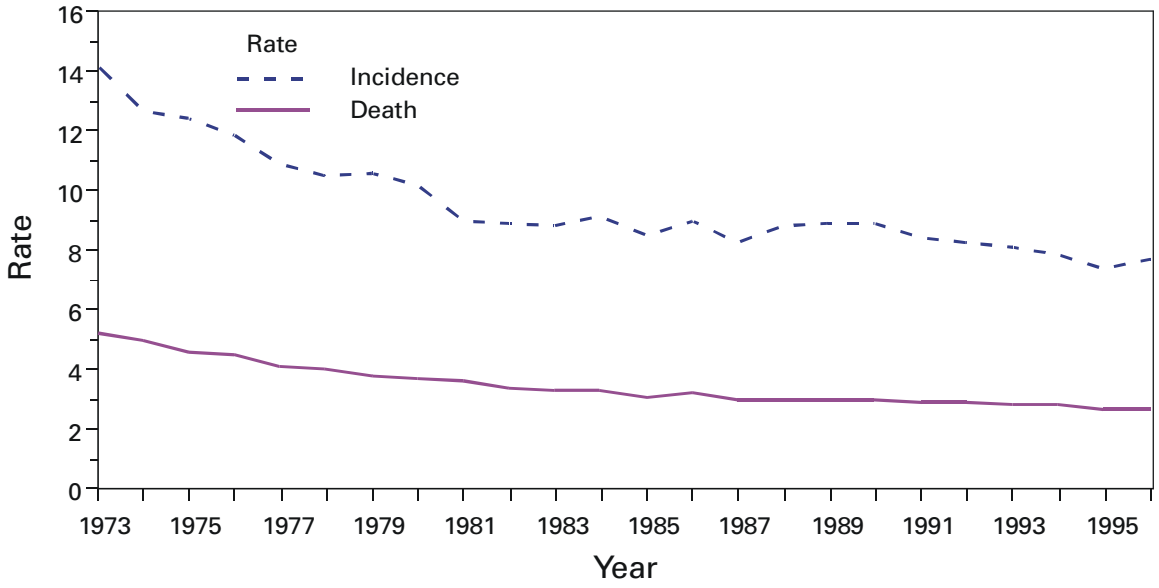

*Per 100,000 women; age-adjusted to 1970 U.S. population. Calculated using Surveillance, Epidemiology, and End Results (SEER) data.
†Per 100,000 women; age-adjusted to 1970 U.S. population. Calculated using national mortality data from CDC's National Center for Health Statistics.
**Source**: SEER Cancer Statistics Review, 1973–1996.

Stage-specific survival rates among women with breast cancer have increased slightly since the 1970s (*6*). The overall 5-year survival rates for women during 1989–95 were 86% for white women and 71% for black women (*4*). Survival was greatest at the earliest stage of disease. Age-specific survival rates were similar for white and black women. One explanation for the disparity in race-specific survival rates is that white women, on average, seek medical care for tumors at an earlier stage of disease than black women. However, the interim between symptom recognition and medical consultation does not appear to account for these race-specific differences in survival rates or stage at diagnosis of breast cancer (*6*). Limited data are available regarding survival for other ethnic groups in the United States. In a study of stage at diagnosis and tumor histology among white and Asian women, the 5-year survival rate at all stages was higher among Asian women than among white women (*7*). In addition, based on data from another study, the survival rate among Hispanic women is similar to the rate among white women in the United States (*8*).

## Cervical Cancer

Since the 1950s, the incidence of invasive cervical cancer and mortality from this disease have decreased substantially. In large part, the decline has been attributed to widespread use of the Papanicolaou (Pap) test — a highly effective preventive measure. However, the rate of decline in invasive cervical cancer has slowed since the early 1980s and appears to have stabilized in recent years (Figure 2). ACS projects that approximately 12,800 cases of invasive cervical cancer will be diagnosed and that approxi-

**FIGURE 2. Incidence rate* and death rate† of invasive cervical cancer, by year — United States, 1973–1996**




*Per 100,000 women; age-adjusted to 1970 U.S. population. Calculated using Surveillance, Epidemiology, and End Results (SEER) data.
† Per 100,000 women; age-adjusted to 1970 U.S. population. Calculated using national mortality data from CDC's National Center for Health Statistics.
**Source**: SEER Cancer Statistics Review, 1973–1996.

mately 4,600 cervical cancer deaths will occur in the United States in 2000 (*2*). During 1992–1996, the incidence rate at SEER sites was 7.9 cases per 100,000 women, and the death rate for cervical cancer was 2.8 per 100,000 women (*4*).

On the basis of SEER data, both incidence and death rates for cervical cancer vary among racial/ethnic groups. The incidence rate for cervical cancer is highest among Vietnamese women (43.0), and the death rate for cervical cancer is highest among black women (6.7) (*3*). The incidence rate among black women (11.2 per 100,000) is approximately 50% higher than among white women (7.3) (*3,4*). Death rates among black women (5.9) are approximately twice as high as those among white women (2.4). Although the disparities in rates between blacks and whites have declined since 1990, differences in rates persist. This persistent disparity has been attributed to several factors, including differences in the prevalence of risk factors for cervical cancer; differences in screening, diagnostic evaluation, and treatment; and differences in the stage of disease at diagnosis (*9*).

Race-specific differences in incidence and death rates for cervical cancer also varied by age (*4*). During 1992–1996, among women aged <35 years, the rate of invasive cervical cancer among black women was lower than the rate among white women. However, in older age groups, incidence rates among white women fluctuated between 13 and 15 per 100,000 women, whereas rates among black women tended to increase with age to approximately 32 per 100,000 for those aged ≥75 years. Among both black and white women, death rates for cervical cancer increased with advancing age; however, rates were substantially higher for black women aged >40 years than for white women the same age. Regardless of race, most cervical cancer deaths occur among women aged ≥50 years (*4*).

For women in whom invasive but localized (i.e., Stage I) cervical cancer has been diagnosed, the 5-year relative survival rate is approximately 90% (*4*). In contrast, for women with advanced invasive cervical cancer (beyond the cervix and pelvis [i.e., Stage III and IV, respectively]), the 5-year relative survival rate is approximately 12%. As with breast cancer, diagnosis of invasive cervical cancer in black women usually occurs at a later stage of disease compared with white women. Moreover, 5-year relative survival rates for local and regional stages are lower for blacks than for whites.

# ETIOLOGIC FACTORS

## Breast Cancer

The risk for breast cancer increases with advancing age. Other risk factors include personal or family history of breast cancer, history of certain benign breast diseases, early age at menarche, late age at menopause, exposure to ionizing radiation, obesity, white race, nulliparity, late age at first birth, nodular densities on mammogram, higher socioeconomic status, and residence in urban areas of the northern United States (*6,10*). Less clearly established risk factors include the duration between menstrual periods, use of oral contraceptives, use of replacement hormones (estrogen), height, alcohol consumption, and not breast-feeding.

Studies of immigrants to the United States suggest that environmental factors rather than genetic factors are responsible for variations in breast cancer rates among countries. For example, the rate of breast cancer among first-generation Japanese-American

women is only slightly higher than the rate among their mothers, but the rate among their daughters is considerably higher (*6*).

No primary prevention measures suitable for use in the general population have been established for breast cancer. Preliminary results from clinical trials among high-risk women regarding the use of the drug tamoxifen indicate a 45% decline in incidence from its use (*11*). Although side effects and potential development of other neoplasms are associated with tamoxifen use, other medications in its class might offer even greater benefits in breast cancer treatment. The Study of Tamoxifen and Raloxifene (STAR) trial is under way to evaluate tamoxifen versus raloxifene and the potential for reducing the incidence of breast cancer in high-risk postmenopausal women.

## Cervical Cancer

The risk for cancer of the cervix has been associated with several factors, including infection with certain types of human papilloma virus (HPV), early age at first intercourse, multiple male sex partners, a history of sexually transmitted diseases, smoking, certain nutritional deficiencies, and low socioeconomic status (*12*). HPV is widely accepted as the cause of most squamous cell cervical cancers, and the sexual practices listed are well-established risk factors for the disease; however, the role of other demographic and behavioral factors is less clear. Black, Hispanic, or American Indian race/ethnicity is considered a risk factor for cervical cancer because rates of detection and death from cervical cancer are higher among these women (*13*). However, some of the racial/ethnic differences in cervical cancer rates can be explained by the strong inverse association between socioeconomic indicators and the risk for invasive cervical cancer (*13*). This increased risk could be associated with differences in access to care and cultural behavior.

# RECOMMENDATIONS FOR PREVENTION

## Breast Cancer

Studies of the etiology of breast cancer have failed to identify feasible primary prevention strategies suitable for use in the general population. Many established risk factors for the disease are neither environmental nor behavioral and, therefore, are not amenable to prevention. Most of the hypothesized behavioral factors are not fully accepted as risk factors and are typically difficult to alter at the individual level. For these reasons, reducing mortality from breast cancer through early detection has become a high priority. The potential for reducing death rates from breast cancer is contingent on increasing initial and repeat mammography screening rates and subsequently detecting the disease at an early stage — when more treatment options are available, and survival rates are higher.

Mammography is the most effective method of detecting breast cancer in its earliest and most treatable stage (*14*). Mammography is a low-dose X-ray procedure that visualizes the internal structure of the breast to detect cancers too small to be palpated during a clinical breast examination (CBE) performed by a health-care provider. Mammography detects cancer before the woman can palpate the lump herself. Cancers

detected at a small size are more likely to be localized (i.e., not spread to regional lymph nodes or distant body sites).

The sensitivity of mammography (75%–94%) is higher than comparable values for CBE alone or breast self-examination (*14,15*). The specificity of mammography (i.e., the likelihood that a mammogram will correctly indicate that breast cancer is not present) is also high (83%–98%) (*14,15*). Widespread use of this procedure, alone or with a CBE performed by a trained health-care provider, can reduce overall mortality from breast cancer (*14,16*). Since the 1970s, scientific studies have demonstrated that regular screening mammograms among women aged 50–69 years can reduce mortality from breast cancer by 30% (*14,17–19*). However, evidence is not as conclusive for women aged 40–49 years and ≥70 years (*14*).

The ability of mammography to identify breast cancer at an early stage improves the opportunity for effective treatment and survival. Women in whom localized/Stage I disease has been diagnosed have a 5-year relative survival rate of 94% (*4*). In comparison, women with disease spread beyond regional lymph nodes have a 5-year relative survival rate of only 18.2%. Treatment at this late stage is substantially less effective, as well as more debilitating.

### *Breast Cancer Screening Guidelines Recommended by Various Groups*

Annual breast cancer screening for women aged ≥50 years is widely recommended. In addition, screening is recommended for women aged 40–49 years; however, consensus has not been reached regarding the effectiveness of screening or the optimal interval for screening in this age group (*20*). Several review groups have reached different conclusions about the efficacy of mammography among younger women because of the limitations of studies conducted among women in this age group. These limitations include small sample sizes and limited duration of follow-up after entry into the screening programs (*21*).

In 1996, the U.S. Preventive Services Task Force (USPSTF) recommended that women aged 50–69 years receive routine breast cancer screening every 1–2 years using mammography alone or mammography combined with annual CBE (*14*). USPSTF noted that insufficient evidence exists to recommend or not recommend routine mammography or CBE for women aged 40–49 years and ≥70 years. Moreover, insufficient evidence exists to recommend CBE alone or teaching breast self-examination. In addition, USPSTF noted that recommendations for mammography among high-risk women aged 40–49 years and among healthy women aged ≥70 years might be made on other grounds.

In 1997, a National Institutes of Health Consensus Development Conference panel reviewed new data not previously available to USPSTF, which documented mortality benefit from mammography among women aged 40–49 years (*22*). However, the panel concluded that these data did not warrant a universal recommendation for mammography for women aged 40–49 years. As a result, the panel encourages these women to determine for themselves whether to receive mammography on the basis of objective analysis of scientific evidence, individual health history, and perceived risks and benefits (*20*).

Because mortality can be reduced among women aged 40–49 years, in 1997 the National Cancer Institute (NCI) accepted new guidelines for mammography screening recommended by the presidentially appointed National Cancer Advisory Board. These

guidelines recommend that all women aged ≥40 years receive mammography every 1–2 years to achieve the best possible outcome if breast cancer is detected (*22*).

### *Prevalence of Breast Cancer Screening*

Data collected through CDC's 1997 Behavioral Risk Factor Surveillance System (BRFSS) indicate that 85% of all interviewed women aged ≥40 years had ever received a mammogram (*23*). The percentage of low-income women and women without health insurance who had ever received a mammogram was comparable (77% and 69%, respectively). The percentage of all interviewed women aged ≥40 years who had received a mammogram within the preceding 2 years was 71%. Rates for low-income women and women without health insurance were substantially lower (58% and 50%, respectively).

A *Healthy People 2000* objective is to increase to at least 80% the proportion of women aged ≥40 years who have ever received a CBE and a mammogram, and to at least 60% those aged ≥50 years who have received them within the preceding 1–2 years (objective 16.11) (*24*). Although 1997 BRFSS data indicate the goal has been attained for all women interviewed aged ≥40 years who had ever received a mammogram, progress is still needed to attain the goal for low-income women and women without health insurance.

## Cervical Cancer

Effective control of cervical cancer depends primarily on early detection of precancerous lesions through use of the Pap test, followed by timely evaluation and treatment. The Pap test is probably the most successful screening test ever developed to detect a cancer. Although the efficacy of cervical cancer screening using the Pap test has not been evaluated in clinical trials, at least two factors support the positive impact of this screening test: a) evidence from many observational studies and b) the marked decline in cervical cancer incidence and death rates in the United States and other countries since the introduction of the Pap test >40 years ago (*14,25*).

In the United States, approximately 50 million Pap tests are performed annually (*26*). Approximately 10% of these tests indicate an abnormality requiring further testing. Detection and treatment of precancerous cervical intraepithelial neoplasia (CIN) lesions identified by the Pap test can prevent cervical cancer. Thus, the intended outcome of cervical cancer screening differs from breast cancer screening. The primary goal of cervical cancer screening is to detect and treat CIN to prevent the occurrence of invasive cancer. For women in whom CIN lesions have been detected, the likelihood of survival is nearly 100% with appropriate evaluation, treatment, and follow-up.

### *Cervical Cancer Screening Guidelines Recommended by Various Groups*

The American College of Obstetricians and Gynecologists (ACOG) and ACS recommend that women have a Pap test and pelvic examination when they become sexually active or at age 18 years, whichever occurs first (*13*). Annual Pap tests are recommended until three consecutive Pap tests are interpreted as being normal. Following this, the two groups recommend that Pap tests can be performed less frequently at the discretion of the provider (*13*).

In 1996, USPSTF recommended routine screening for women who are or who have been sexually active and who have a uterine cervix (*14*). The task force recommends Pap tests with the onset of sexual activity and repeated screening every 3 years. A

reduced interval between screenings can be recommended by the physician on the basis of a woman's risk factors for cervical cancer. In addition, USPSTF recommends that, on the basis of existing evidence, Pap screening might not be necessary for women after age 65 years. Moreover, USPSTF recommended not performing Pap tests on women who have undergone total hysterectomies for diseases unrelated to cervical cancer or its precursors (*14*).

In recent years, several studies have been conducted to determine the value of expanding HPV testing from testing only women with abnormal Pap test results to routinely testing all women to detect those women at greatest risk for developing CIN or invasive cervical cancer. Evidence from these studies does not support routine HPV testing to screen for cervical cancer (*26*). Although new cervical cancer screening technologies have been approved for primary screening, professional organizations have not endorsed their widespread use because of concerns about cost effectiveness.

An increasing concern is that rescreening the same women annually will not result in further reductions in cervical cancer mortality (*27*). Increased effort is needed to target groups with large proportions of unscreened or rarely screened women, including women residing in rural areas; minorities; and recent immigrants who have different attitudes, knowledge, and behaviors regarding disease prevention and health promotion. Screening for cervical cancer among these women could further reduce the burden of disease from cervical cancer.

### *Prevalence of Cervical Cancer Screening*

The 1997 BRFSS documented that 93% of women aged ≥18 years with a uterine cervix reported ever having received a Pap test (*23*). Corresponding values for low-income and uninsured women were 89% and 85%, respectively. Among all women with a uterine cervix, 80% had obtained a Pap test within the preceding 2 years. For low-income women and uninsured women, the proportion who had obtained a Pap test was substantially lower (69% and 65%, respectively).

A *Healthy People 2000* objective is to increase to at least 95% the proportion of women aged ≥18 years with a uterine cervix who have ever received a Pap test, and to at least 85% those who have received a Pap test within the preceding 1–3 years (objective 16.12) (*24*). Although 1997 BRFSS data indicate the goal for women aged ≥18 years with a uterine cervix who reported ever having received a Pap test is near attainment, progress is still needed, as with breast cancer screening, to attain the goal for low-income women and women without health insurance.

Low income and lack of health insurance are barriers to both cervical and breast cancer screening. These factors increase the likelihood that these diseases will be diagnosed at a later stage, when survival rates are lower (*1*).

## Implementation of the National Breast and Cervical Cancer Early Detection Program

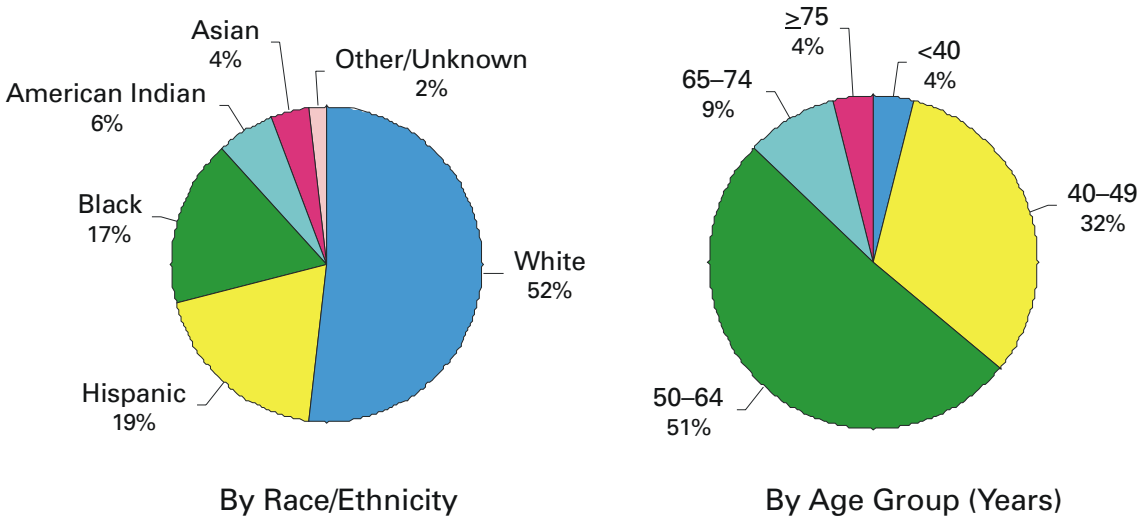
In August 1990, Congress enacted the Breast and Cervical Cancer Mortality Prevention Act, thereby authorizing CDC to establish a national public health infrastructure to increase breast and cervical cancer screening among low-income women who are uninsured (*28*). Consequently, CDC established the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), a comprehensive women's health initiative imple-

mented through cooperative agreements with qualifying health agencies (including state and territorial health departments and American Indian/Alaska Native tribes and tribal organizations). In addition to providing breast and cervical cancer screening, participating programs provide diagnostic testing, surveillance and follow-up, case management, public education and outreach, professional education and training, quality assurance of screening tests, coalition and partnership development, and program evaluation. NBCCEDP-sponsored programs have initiated outreach efforts to serve women in high priority groups (e.g., women with increased risk for breast or cervical cancer and women who do not or rarely access breast and cervical cancer screening), including older women, racial/ethnic minorities, foreign-born women, women with disabilities, lesbians, and women residing in rural or other hard-to-reach areas.

Fiscal year (FY) 2000 marked the 10th year of the NBCCEDP, with Congressional appropriations of $167 million. CDC provides funds to all 50 states, six U.S. territories, the District of Columbia, and 15 American Indian/Alaska Native tribes and tribal organizations to implement comprehensive screening programs for breast and cervical cancer (*29*).

During the reporting period July 1991–March 1999, approximately 2.2 million screenings for breast and cervical cancer were provided to uninsured women. The program supported 1,049,752 mammograms: 64% of the mammograms were provided to women aged ≥50 years; 48% were provided to racial/ethnic minorities (Figure 3). Breast cancer was diagnosed in 6,265 women aged ≥40 years. Although the rate of abnormalities detected by a mammogram was highest for younger women, the rate of breast cancers detected per 100,000 mammograms increased directly with advancing age (Figure 4). A total of 1,192,346 Pap tests were performed: 72% of the tests were provided to women

**FIGURE 3. Percentage distribution of program participants* who received screening mammograms, by race/ethnicity† and age group — United States, National Breast and Cervical Cancer Early Detection Program, July 1991–March 1999**




*n = 676,474.

†Persons of Hispanic origin can be of any race.

aged ≥40 years; 47% were provided to racial/ethnic minorities (Figure 5). Cervical intraepithelial neoplasia was detected in 34,046 women. Invasive cervical cancer was diagnosed in 561 women. The rate of abnormal Pap tests varied inversely with age.

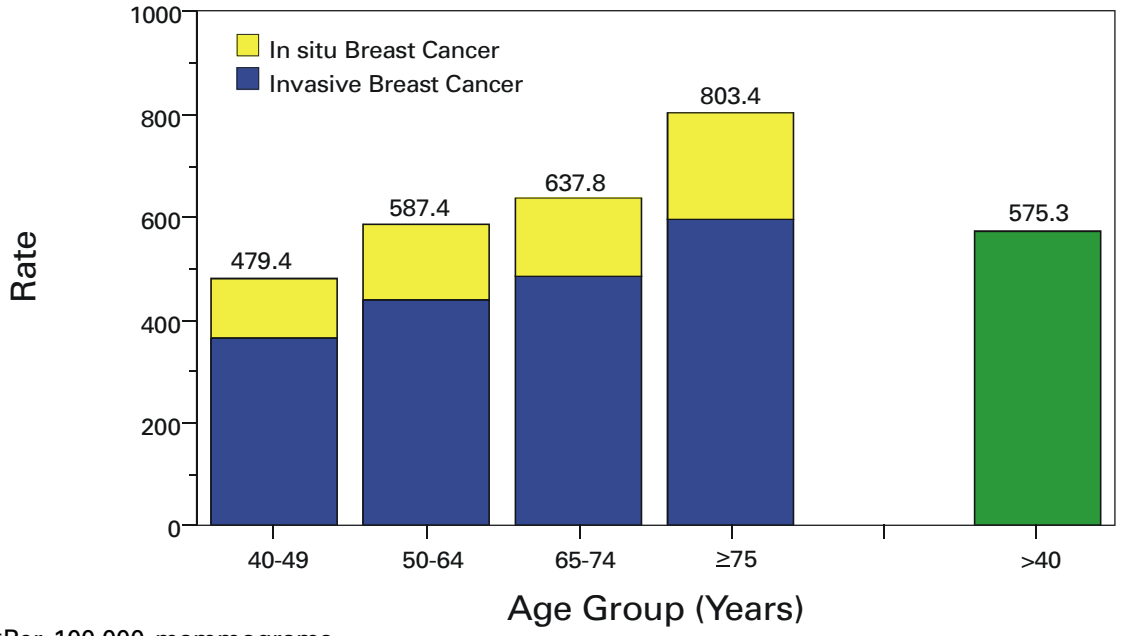
### *Policy of NBCCEDP*

As NBCCEDP has evolved, the program has addressed many challenges, especially regarding screening recommendations and treatment resources for women in whom precancerous cervical lesions or cancer of the breast or cervix has been diagnosed through NBCCEDP. FY 2000 Congressional appropriations will enable NBCCEDP to screen approximately 12%–15% of the eligible uninsured women aged 50–64 years in the United States (*30* ). The remaining unmet need and the absence of funding to cover treatment expenses for women who have received a diagnosis of precancerous cervical lesions or breast or cervical cancer have been persistent challenges to the program. A key public health priority of NBCCEDP is to direct program resources to eligible women who have rarely or have never received breast or cervical cancer screening. To address this priority and maximize efficient use of limited resources, the program has developed cancer-control policies on the basis of programmatic data, current scientific research, and availability of screening services through other government-supported programs (e.g., Medicare and Title X Family Planning programs).

### *Breast Cancer Screening Policies*

Following implementation of NBCCEDP in 1991, CDC encouraged NBCCEDP-sponsored programs to place a high priority on screening women aged ≥50 years.

**FIGURE 4. Rate* of breast cancer, by age group, and overall rate† — United States, National Breast and Cervical Cancer Early Detection Program, July 1991–March 1999**



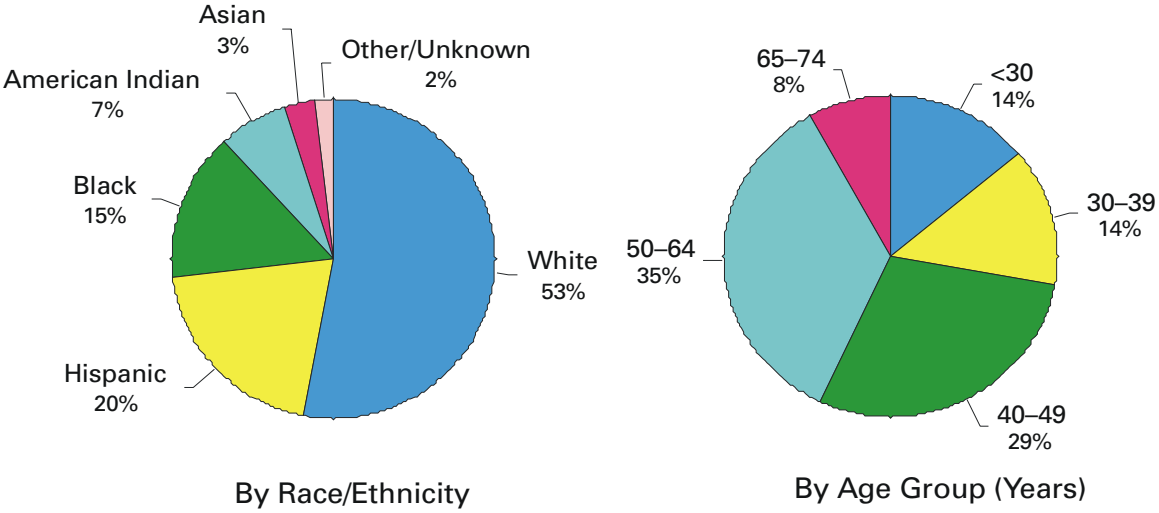

*Per 100,000 mammograms.

†Per 100,000 mammograms; age-adjusted to the 1970 U.S. population.

NBCCEDP data indicated that only 57% of their mammograms were provided to women aged ≥50 years. In October 1994, CDC established the first age-specific targets for the breast cancer screening component of NBCCEDP. For 1995, 75% of the mammograms were to be provided to women aged ≥50 years. The percentage was gradually increased to 90% by October 1998. A review of NBCCEDP mammography screening data in 12-month intervals indicated that, since 1994, programs had screened increasing numbers of women aged ≥50 years for breast cancer; however, the age-specific percentage goals had not been attained. For example, the percentage of initial mammograms provided to women aged ≥50 years for the reporting period October 1996–September 1997 was 74%.

In 1998, NBCCEDP mammogram screening policy was revised in response to new scientific research, recent changes in recommendations by NCI and ACS, changes in Medicare preventive services coverage, and the need to establish a more realistic national target based on historical programmatic screening data. The new NBCCEDP policy is to provide at least 75% of mammograms to women aged ≥50 years who are not eligible to receive Medicare Part B benefits or are unable to pay the premium to enroll in Medicare Part B. Correspondingly, no more than 25% of mammograms should be provided to women aged <50 years. As a result of this new policy, some participating health agencies have developed strategies to cover breast cancer screening for women aged 40–49 years. Several programs have obtained breast cancer screening resources for these women from state appropriations or tobacco tax revenues and through collaborative efforts with foundations (e.g., the Susan G. Komen Breast Cancer Foundation). During October 1997–September 1998, 75% of NBCCEDP-sponsored mammograms were provided to women aged ≥50 years.

**FIGURE 5. Percentage distribution of program participants* who received Papanicolaou tests, by race/ethnicity† and age group — United States, National Breast and Cervical Cancer Early Detection Program, July 1991–March 1999**




*n = 761,822.

†Persons of Hispanic origin can be of any race.

### *Cervical Cancer Screening Policies*

The primary purpose of the cervical cancer component of NBCCEDP is to identify and treat precancerous cervical lesions and to detect and treat invasive cervical cancer at an early stage. When the program was established in 1991, CDC implemented program guidelines for cervical cancer screening that were consistent with ACS guidelines. Women enrolled in NBCCEDP who were aged ≥18 years, with an intact uterine cervix, were eligible for an annual Pap test and pelvic examination. After a woman has had three consecutive annual examinations with normal findings, Pap tests could be performed less frequently at the discretion of the woman and her health-care provider.

In 1999, CDC, in consultation with an external work group comprising clinical experts, epidemiologists, and public health practitioners, reexamined NBCCEDP's cervical cancer screening policy and other emerging issues related to Pap testing. One of the key issues addressed by this work group was recommendations for Pap screening intervals.

ACOG's and ACS's recommendations regarding the frequency of screening are similar and advise that after a woman has had three consecutive annual examinations with normal findings, the Pap test can be performed less frequently at the discretion of the woman's provider. Scientific data suggest that once a woman has demonstrated no signs of CIN, as evidenced by three consecutive annual Pap tests with normal findings, her chance of developing CIN II or worse within a 3-year period is extremely low, regardless of other risk factors (*31*). Preliminary analysis of NBCCEDP data supports these findings (CDC, unpublished data, 2000).

Beginning in March 2000, NBCCEDP-sponsored programs will be required to direct more cervical cancer screening resources to women who have never had a Pap test or who have not had a Pap test for at least 5 years. Among all women screened, at least 20% should be women who have either never been screened or have rarely been screened (i.e., not screened for ≥5 years). Programs are also being required to reduce over-screening among program-enrolled women. Beginning in October 2001, programs will be required to document that at least 75% of women with three consecutive annual Pap tests with normal findings did not receive a fourth annual Pap test. Their screening interval will be changed to every 3 years. To successfully implement this policy change, CDC will assist NBCCEDP-sponsored programs in assessing current program provider practices, modifying patient recall systems, and developing professional and public education strategies.

### *Breast and Cervical Cancer Follow-Up and Treatment Policy*

The policy issue that has caused the greatest controversy in NBCCEDP concerns the availability of funds to pay for treatment of cancerous or precancerous lesions diagnosed in enrolled women (*28*). A crucial component of NBCCEDP is to ensure that all women with abnormal screening results, precancerous breast or cervical lesions, or a diagnosis of cancer receive timely and appropriate follow-up care. Program providers receive reimbursement for most diagnostic procedures, including diagnostic mammography, breast ultrasound, fine-needle aspiration of the breast, breast and cervical biopsies, and colposcopy of the cervix. However, the Breast and Cervical Cancer Mortality Prevention Act of 1990 prohibits use of federal program funds for any component of breast or cervical cancer treatment primarily because of a concern that such payment would rapidly deplete resources available for screening services. NBCCEDP-sponsored programs are required to identify and secure resources for treatment from other sources.

In 1996, CDC conducted in-depth case studies of seven state programs to determine how early detection programs identified and obtained resources for treatment. The results indicated that state health agencies and their partners had developed a wide range of strategies for procuring treatment services in the absence of program resources. However, the study respondents considered the strategies used to obtain these services as short-term solutions that were labor intensive and that diverted resources away from screening activities (*32* ).

NBCCEDP surveillance data for October 1991–September 1998 indicate that 92% of the clients in whom breast cancer had been diagnosed and 93% of the clients in whom invasive cervical cancer had been diagnosed initiated treatment. The remainder either refused treatment, were lost to follow-up, or had an outcome pending. In FY 1999, CDC received increased Congressional appropriations to expand case-management activities to assist women in overcoming financial, logistical, and other barriers to obtaining these services.

## *Recommended Priority Activities for CDC*

The Breast and Cervical Cancer Mortality Prevention Act of 1990 has played an important role in focusing public health efforts on cancer control in the United States. Since 1991, CDC has collaborated with a diverse group of public and private partners to build the public health infrastructure, implement screening services, and conduct research activities. CDC will continue to foster these relationships to achieve goals set in the following four priority areas of screening initiatives, case-management services, professional education and training, and partnerships:

### *Screening Initiatives*

- Collaborate with NBCCEDP-sponsored programs to increase public education and outreach strategies to reach women who have rarely or have never received breast or cervical cancer screening.
- Collaborate with NBCCEDP-sponsored programs to implement strategies among health-care providers to address missed opportunities for enrolling women into screening.
- Collaborate with NBCCEDP-sponsored programs to implement strategies through professional groups and public education to modify screening intervals for all program-enrolled women who have had three consecutive annual Pap tests with normal findings.
- Continue to promote the need for routine rescreening for breast and cervical cancer at regular intervals to improve rescreening rates for women enrolled in NBCCEDP.

### *Case-Management Services*

- Expand case-management activities to ensure that women enrolled in NBCCEDP receive timely and appropriate rescreening and diagnostic services and treatment services, if indicated.
- Increase case-management activities to sustain networks and partnerships to maximize access to and availability of diagnostic, treatment, and essential support services for women enrolled in NBCCEDP.

### *Professional Education and Training*

- Increase collaboration with professional groups that provide continuing education for their constituents to address breast and cervical cancer control issues in standardized curricula and training.
- Continue to advocate for incorporation of breast and cervical cancer education in curricula for health professionals to facilitate a long-term effect on provider practice.

### *Partnerships*

- Continue to build partnerships with public health departments, tribes and tribal organizations, national and voluntary organizations, academic centers, and health-care purchasers through the following activities: implementing strategies communitywide to promote awareness and screening practices among all women; replicating and disseminating programmatic approaches that are proven effective in providing screening to priority populations (e.g., racial/ethnic minorities and women residing in rural or other hard-to-reach areas); cosponsoring conferences, workshops, and training related to breast and cervical cancer issues; and advocating for breast and cervical cancer control priorities (e.g., policies and standards) to ensure the quality of mammography and Pap screening delivered by all providers.

## RESEARCH AGENDA

To support the recommended priority activities for NBCCEDP, CDC has developed a research agenda comprising six priorities. This research will assist in improving cancer screening services provided to women enrolled in NBCCEDP and in developing new methods to recruit eligible women who have rarely or have never received breast or cervical cancer screening.

- ***Priority: Determine effective strategies to communicate changes in NBCCEDP policy to cancer screening providers and women enrolled in the program.*** Emerging developments in cancer prevention and control occasionally require substantial changes in program policy (e.g., changing from annual to triennial cervical cancer screening among women with three previous normal Pap tests). Changes in program policy might require adapting the practice patterns of providers and modifying the expectations and behaviors of enrolled women. Research is needed to develop and evaluate effective public and provider education and materials for dissemination that will help translate policy changes into practice as rapidly as possible.
- ***Priority: Identify effective strategies to increase the proportion of enrolled women who complete routine breast and cervical cancer rescreening according to NBCCEDP policy.*** Available data submitted twice a year to CDC by participating programs suggest that many women enrolled in NBCCEDP, regardless of their race/ethnicity, do not complete routine rescreening on schedule. Some research is under way in this area, but more is needed. A multiethnic, multicultural focus group study of the barriers to mammography rescreening among NBCCEDP

enrollees in Texas (*33*) resulted in development of an ongoing retrospective cohort investigation among 2,500 randomly selected enrollees in Maryland, New York, Ohio, and Texas. Findings from this research that identify risk factors for failure to rescreen on schedule will be used to develop and test new interventions to increase routine rescreening; however, additional research is needed in this area.

- ***Priority: Identify effective strategies to increase NBCCEDP enrollment among eligible women who have never received breast or cervical cancer screening.*** Data from the 1997 BRFSS suggest that substantial numbers of age-eligible, low-income women have never received mammography or Pap smear screening (*23*). To develop effective outreach and enrollment strategies for women who have rarely or have never received cancer screening, participatory research methods that involve unscreened women and members of their communities in all phases of the research process might be particularly valuable. In addition, quantitative research designs might be necessary to test proposed interventions. Research initiatives related to this priority topic must address both missed screening opportunities in diverse provider settings and various cultural, language, and institutional barriers that might influence a woman's willingness to accept free or low-cost cancer screening when offered.

- ***Priority: Evaluate variations in clinical practice patterns among providers of NBCCEDP screening services.*** Analyses of data submitted every 6 months to CDC by participating programs have identified several practice patterns that differ markedly across these programs. These variations raise concern regarding quality assessment. For example, an analysis of mammography results for 1991–1996 reported through the Breast Imaging Reporting and Data System (BI-RADS®) lexicon developed by the American College of Radiology (*34*) documented that the proportion of mammograms coded "probably benign, short-term follow-up recommended" varied substantially across the state, territorial, and tribal programs (*35*). To understand the reasons for such variations and to develop appropriate provider education materials, where necessary, case studies and record linkage investigations within collaborating programs might be necessary. Such studies must be conducted within participating programs because data submitted to CDC cannot be linked with medical records, pathology laboratory reports, or cancer registries.

- ***Priority: Determine optimal models for providing case-management services to women in NBCCEDP who have an abnormal screening result or a diagnosis of cancer.*** Without effective case management, some low-income women who need additional cancer testing or treatment will not receive the necessary care or will not receive it as rapidly as possible. Diverse case-management models have been developed for other public health concerns including tuberculosis control, adolescent prenatal care, and human immunodeficiency virus infection/acquired immunodeficiency syndrome. Research is needed to evaluate the applicability of these and other models to low-income, medically uninsured women who need additional cancer testing and treatment. Critical issues include determining how women will be selected for case management, how extensive case-management

efforts should be, and what proportion of screening resources should be allocated to case-management activities.

- ***Priority: Conduct economic analyses to determine costs of providing screening services in NBCCEDP.*** Because the funds appropriated by Congress to NBCCEDP are not adequate to screen all eligible women who need breast and cervical cancer screening, economic analyses are necessary to enhance efficient use of the available resources. Important issues include the potential cost advantages of high-volume versus low-volume laboratories and mammography facilities, the sustainability of facilities that are providing program-funded screenings below their current cost levels, and the costs and benefits of mammography vans compared with standard facilities.

## CONCLUSION

Breast and cervical cancer continue to be major health problems in the United States. Preventive measures are available to reduce morbidity and mortality associated with these diseases. The NBCCEDP, through federal, state, territorial, and tribal governments, in collaboration with national and community-based organizations, has increased access to breast and cervical cancer screening among low-income and uninsured women. In addition, NBCCEDP-sponsored programs have increased the staff working in cancer control and the expertise of these persons, implemented professional education programs for health-care providers, and developed innovative public education and outreach strategies to encourage medically underserved women to seek screening services. This national effort enabled the United States to make substantial progress toward achieving the *Healthy People 2000* objectives for breast and cervical cancer control, particularly among racial/ethnic minorities and the medically underserved. However, NBCCEDP still reaches only 12%–15% of uninsured women aged 50–64 years who are eligible for screening services. A continuing challenge for the future is to increase national commitment to providing screening services for all eligible uninsured women to ultimately reduce morbidity and mortality from breast and cervical cancer.

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# Preventing Congenital Toxoplasmosis

**The material in this report was prepared for publication by:**

**National Center for Infectious Diseases** ..... **James M. Hughes, M.D.**
***Director***

**Division of Parasitic Diseases** ..... **Daniel G. Colley, Ph.D.**
***Director***

# Preventing Congenital Toxoplasmosis

Adriana Lopez, M.H.S.
Vance J. Dietz, M.D.
Marianna Wilson, M.S.
Thomas R. Navin, M.D.
Jeffrey L. Jones, M.D., M.P.H.
*Division of Parasitic Diseases*
*National Center for Infectious Diseases*

***Abstract***

**Scope of the Problem**: Toxoplasmosis is caused by infection with the protozoan parasite *Toxoplasma gondii*. Acute infections in pregnant women can be transmitted to the fetus and cause severe illness (e.g., mental retardation, blindness, and epilepsy). An estimated 400–4,000 cases of congenital toxoplasmosis occur each year in the United States. Of the 750 deaths attributed to toxoplasmosis each year, 375 (50%) are believed to be caused by eating contaminated meat, making toxoplasmosis the third leading cause of foodborne deaths in this country.

**Etiologic Factors**: *Toxoplasma* can be transmitted to humans by three principal routes: a) ingestion of raw or inadequately cooked infected meat; b) ingestion of oocysts, an environmentally resistant form of the organism that cats pass in their feces, with exposure of humans occurring through exposure to cat litter or soil (e.g., from gardening or unwashed fruits or vegetables); and c) a newly infected pregnant woman passing the infection to her unborn fetus.

**Recommendations for Prevention**: *Toxoplasma* infection can be prevented in large part by a) cooking meat to a safe temperature (i.e., one sufficient to kill *Toxoplasma*); b) peeling or thoroughly washing fruits and vegetables before eating; c) cleaning cooking surfaces and utensils after they have contacted raw meat, poultry, seafood, or unwashed fruits or vegetables; d) pregnant women avoiding changing cat litter or, if no one else is available to change the cat litter, using gloves, then washing hands thoroughly; and e) not feeding raw or undercooked meat to cats and keeping cats inside to prevent acquisition of *Toxoplasma* by eating infected prey.

**Research Agenda**: Priorities for research were discussed at a national workshop sponsored by CDC in September 1998 and include a) improving estimates of the burden of toxoplasmosis, b) improving diagnostic tests to determine when a person becomes infected with *Toxoplasma*, and c) determining the applicability of national screening programs.

**Conclusion**: Many cases of congenital toxoplasmosis can be prevented. Specific measures can be taken by women and their health-care providers to decrease the risk for infection during pregnancy and prevent severe illness in newborn infants.

# INTRODUCTION

Toxoplasmosis is caused by infection with the protozoan parasite *Toxoplasma gondii*. In the United States, an estimated 23% of adolescents and adults have laboratory evidence of infection with *T. gondii* (*1*; CDC, unpublished data, 1994). Although these infections are usually either asymptomatic or associated with self-limited symptoms (e.g., fever, malaise, and lymphadenopathy), infection in immunosuppressed persons (e.g., persons with acquired immunodeficiency syndrome [AIDS]) can be severe. In addition, infections in pregnant women can cause serious health problems in the fetus if the parasites are transmitted (i.e., congenital toxoplasmosis) and cause severe sequelae in the infant (e.g., mental retardation, blindness, and epilepsy). Although congenital toxoplasmosis is not a nationally reportable disease and no national data are available regarding its occurrence, extrapolation from regional studies indicates that an estimated 400–4,000 cases occur in the United States each year. In addition, of the 750 deaths attributed to toxoplasmosis each year, 375 (50%) are believed to be foodborne, making toxoplasmosis the third leading cause of foodborne deaths in this country (*2*).

In 1997, the U.S. Department of Health and Human Services, the U.S. Department of Agriculture (USDA), and the U.S. Environmental Protection Agency (EPA) collaborated to develop the National Food Safety Initiative (*3*). The project aims to reduce the incidence of foodborne illness by enhancing surveillance, improving risk assessment, developing new research methods, and furthering food-safety education. Because congenital toxoplasmosis poses a substantial public health problem, CDC has developed prevention recommendations to reduce the risk for congenital infections.

In September 1998, CDC convened the National Workshop on Toxoplasmosis: Preventing Congenital Toxoplasmosis (NWTPCT) in Atlanta, Georgia, to discuss research priorities for preventing the disease. Approximately 30 international and national experts in toxoplasmosis participated, representing universities, practitioner associations, research institutions, health-care centers, and other federal agencies. Specific objectives of NWTPCT included defining approaches for reducing the prevalence of congenital toxoplasmosis, determining the data needed to evaluate and implement these strategies, and identifying critical research and prevention efforts for the future. This report summarizes the recommendations from this workshop and the activities that have been undertaken by CDC in response to these recommendations.*

# SCOPE OF THE PROBLEM

## Burden of Toxoplasmosis in the United States

Toxoplasmosis is not a nationally reportable disease in the United States, and no reliable data are available at the national level about the number of cases diagnosed each year. The most reliable information about the burden of toxoplasmosis in the general population is derived from serosurveys, which determine the percentage of persons with elevated levels of *Toxoplasma*-specific IgG antibodies.

*A separate effort at CDC deals with the prevention of opportunistic infections. Toxoplasmosis can be a serious opportunistic infection in persons with AIDS, and specific recommendations regarding how to prevent it have been published (*4*). Therefore, toxoplasmosis in persons with AIDS is not the primary focus of this report.

Since the 1960s, rates of infection with *Toxoplasma* in the United States appear to be declining. In the 1960s, a study of U.S. military recruits indicated that the overall seroprevalence of *Toxoplasma* was 14% (*5*). In 1989, a second study of military recruits indicated a seroprevalence of 9.6% (*6*). Similar downward trends have been observed in France and Sweden (*7,8*).

The most reliable estimate of *Toxoplasma* seroprevalence in the United States is derived from the third National Health and Nutrition Examination Survey (NHANES III) (*1*), which was conducted during 1988–1994. The survey design was a cluster sample of U.S. residents. Serum samples from 17,658 persons were tested at CDC for *Toxoplasma*-specific IgG antibodies; 23% were positive. Of 5,988 women of childbearing age (i.e., age 12–49 years), 14% were seropositive (CDC, unpublished data, 1994). No recent U.S. studies of a large population of pregnant women have been conducted to determine the incidence of new infections during pregnancy.

Although serosurveys of the general population help define temporal trends in *Toxoplasma* seropositivity rates and can be used to estimate the number of women of childbearing age who are at risk for acquiring *Toxoplasma* infections and potentially transmitting it to their fetuses, serosurveys are less helpful in estimating the number of cases of congenital toxoplasmosis. Three prospective studies provide useful information regarding the number of congenital toxoplasmosis cases in the United States.

Two prospective studies in the 1970s both reported rates of congenital toxoplasmosis of approximately 10 per 10,000 live births. In one study in the early 1970s, 7,500 consecutive live births at a hospital in Birmingham, Alabama, were screened for *Toxoplasma* infection; of these, 10 (13 per 10,000 live births) were seropositive (*9*). In a study of acute *Toxoplasma* infection in 4,048 pregnant women in New York during 1967–1969, six (0.2%) women seroconverted during their pregnancies, and 17 others (0.4%) had at least an eightfold rise in antibody titers during pregnancy (*10*). Of the 23 infants born to these 23 women, three had congenital toxoplasmosis, representing an infection rate of 7 per 10,000 live births in the study population.

More recent data regarding the rate of congenital toxoplasmosis are available from the New England Regional Newborn Screening Program (*11*). All infants born in the catchment area of this program are tested for evidence of congenital toxoplasmosis; infected infants undergo clinical evaluation and treatment for 1 year. During 1986–1992, of 635,000 infants who underwent serologic testing, 52 were infected, representing an infection rate of approximately 1 per 10,000 live births. Only two (4%) of these infants were recognized to have congenital toxoplasmosis before the screening results were known; however, follow-up examinations of 19 (40%) of the 48 infants evaluated revealed signs of disease (e.g., abnormal cerebrospinal fluid examinations, hydrocephalus, and retinal lesions).

Whether the rates of congenital infection in these three studies are representative of the entire U.S. population is unknown. However, if these rates (i.e., 1 per 10,000 and 10 per 10,000 ) were extrapolated to the approximately 4 million live births in the United States each year, an estimated 400–4,000 infants would be born each year with congenital toxoplasmosis.

Limited data are available to assist in estimating the portion of the disease burden of toxoplasmosis attributable to meat consumption. A recent study compared results from a cross-sectional seroprevalence study of Seventh Day Adventists, a religious group that follows a diet containing no meat, with serologic results from a control group of

volunteers who were not Seventh Day Adventists (*12*). Results from this study documented a significantly lower rate of *Toxoplasma* infection in Seventh Day Adventists than the control group (24% versus 50%, respectively; $p < 0.01$). Thus, approximately one half of *Toxoplasma* exposure might be caused by eating contaminated meat. Furthermore, a statistically significant decrease in risk for infection was observed among nonmeat eaters even after the data were adjusted for age and sex (odds ratio = 0.2; 95% confidence interval = 0.1–0.5). Because this study was originally designed to evaluate the possible association between eating shellfish and *Vibrio* and Norwalk virus infections, important questions regarding toxoplasmosis (i.e., amount of meat consumed, contact with or ownership of cats, or history of outdoor activity) were not asked in the interview.

A report conducted by USDA's Economic Research Service concluded that one half of the toxoplasmosis cases in the United States are caused by eating contaminated meat. The estimated economic burden of these infections is $7.7 billion each year, primarily from congenital toxoplasmosis (*13*).

Pork has been implicated by some authorities as the meat most commonly associated with foodborne toxoplasmosis (*14*). In some areas, market pigs from small producers have had higher rates of *Toxoplasma* infections than pigs from larger producers (*15*); however, overall rates appear to be declining over time (*16*). In 1992, a large survey in Illinois documented that 3.1% of market pigs had serologic evidence of *Toxoplasma* infection (*16*). *Toxoplasma* infection has also been identified in other meats, but their contribution to the burden of disease is believed to be small (*14*).

Although *Toxoplasma* infections are associated either with eating contaminated meat or with ingesting oocysts passed in the feces of cats, no laboratory test exists that can determine the origin of a *Toxoplasma* infection in a specific person and whether it was associated with foodborne, catborne, or soilborne transmission. Epidemiologic studies of the transmission of toxoplasmosis have been hindered by an inability to determine the origin of isolated infections.

## Diagnosis and Treatment

Acute toxoplasmosis is rarely diagnosed by detecting the parasite in body fluids, tissue, or secretions; the most common method of diagnosis is based on antibody detection. The presence of elevated levels of *Toxoplasma*-specific IgG antibodies indicates infection has occurred at some point but does not distinguish between an infection acquired recently and one acquired in the distant past. The presence of a high *Toxoplasma*-specific IgM antibody titer combined with a high IgG titer probably indicates an acute infection within the previous 3 months. A low-to-medium IgM titer and a high IgG titer might indicate an acute infection 3–6 months previously, but IgM antibodies have been detected as long as 18 months after initial infection (*17*). Determining when *Toxoplasma* infection occurred in a pregnant woman is particularly important because infection before conception poses no substantial risk for transmission of infection to the fetus; however, infection after conception does pose such risk.

In the United States, commercial test kits for *Toxoplasma*-specific IgG and IgM antibodies are readily available. Some commercial IgM tests have had problems with specificity, resulting in unacceptably high rates of false-positive test results. In 1996, FDA and CDC conducted extensive evaluations of the six most commonly used commercial IgM kits in the United States to determine the extent of the problem with the specificity of

these kits. Sensitivity and specificity rates for these six kits ranged from 93.3% to 100.0% and from 77.5% to 99.1%, respectively (*18*).

As a result of these findings, in 1997 FDA distributed an advisory to physicians in the United States highlighting these test limitations. The agency provided a guide for interpreting test results and issued a recommendation to laboratory personnel and physicians advising them to be aware of the problems associated with the test kits before making decisions about the clinical management of their patients. In addition, IgM-positive results should be confirmed by a *Toxoplasma* reference laboratory (*18*).

Treatment of toxoplasmosis in immunocompetent persons other than pregnant women is generally not indicated unless symptoms are severe or persistent (*19–21*). In immunocompromised persons, treatment usually consists of pyrimethamine and sulfadiazine. Depending on gestational age and whether the fetus is known to be infected, pregnant women have been treated with the antibiotic spiramycin or with sulfadiazine alone or the combination of pyrimethamine and sulfadiazine. Treatment of acute infection during pregnancy has been associated with an approximately 50% reduction in fetal infection (*22*).

## ETIOLOGIC FACTORS

*T. gondii* has a complex life cycle consisting of three stages: a) tachyzoite — during the acute stage of infection, this form of the parasite invades and replicates within cells; b) bradyzoite — during latent infections, this form of the parasite is present in tissue cysts; and c) sporozoite — this form of the parasite is found in oocysts, which are environmentally resistant. Members of the family Felidae (including domestic and feral cats) are the definitive hosts of *Toxoplasma*. During acute infections, cats excrete unsporulated (i.e., uninfectious) oocysts in their feces; after several days to several weeks, depending on environmental conditions, the oocysts sporulate and become infectious. Under favorable conditions (i.e., in warm, moist soil), oocysts can remain infectious for approximately 1 year. They do not survive in arid, cool climates and can be destroyed by heating (*17,19,20,23,24*).

Toxoplasmosis can be transmitted to humans by three principal routes. First, humans can eat raw or inadequately cooked infected meat or eat uncooked foods that have come in contact with contaminated meat. Second, humans can inadvertently ingest oocysts that cats have passed in their feces, either in a cat litter box or outdoors in soil (e.g., soil from gardening or unwashed fruits or vegetables). Third, a woman can transmit the infection to her unborn fetus.

Women infected with *Toxoplasma* before conception, with rare exceptions, do not transmit the infection to their fetuses. Women infected with *Toxoplasma* after conception (i.e., during pregnancy) can transmit the infection across the placenta to their fetuses. Maternal infections early in pregnancy are less likely to be transmitted to the fetus than infections later in pregnancy, but early fetal infections, when they do occur, are more likely than later infections to be severe (*25*). An estimated one half of untreated maternal infections are transmitted to the fetus.

The classic triad of signs suggestive of congenital toxoplasmosis include chorioretinitis, intracranial calcifications, and hydrocephalus. However, most infants infected in utero are born with no obvious signs of toxoplasmosis on routine examination, but many

develop learning and visual disabilities later in life (*26,27*). If untreated, congenital toxoplasmosis can be associated with severe and even fatal disease (*28*).

The severity of *Toxoplasma* infections is correlated with the immune status of the infected person. Toxoplasmosis in immunocompetent adolescents or adults is generally mild or unapparent. Mild infections can result in lymphadenopathy, fever, fatigue, and malaise, all of which usually resolve within weeks to months without specific treatment. However, infection in immunocompromised persons can be severe. Immunosuppression caused by AIDS or therapies for malignancies, transplants, or lymphoproliferative disorders can result in reactivation of preexisting latent *Toxoplasma* infections. Reactivation most often involves the central nervous system, and symptoms can include meningoencephalitis or symptoms of a mass lesion.

## RECOMMENDATIONS FOR PREVENTION

- To prevent toxoplasmosis and other foodborne illnesses, food should be cooked to safe temperatures. A food thermometer should be used to measure the internal temperature of cooked meat to ensure that meat is cooked all the way through. Beef, lamb, and veal roasts and steaks should be cooked to at least 145 F, and pork, ground meat, and wild game should be cooked to 160 F before eating. Whole poultry should be cooked to 180 F in the thigh to ensure doneness.
- Fruits and vegetables should be peeled or thoroughly washed before eating.
- Cutting boards, dishes, counters, utensils, and hands should always be washed with hot soapy water after they have contacted raw meat, poultry, seafood, or unwashed fruits or vegetables.
- Pregnant women should wear gloves when gardening and during any contact with soil or sand because cat waste might be in soil or sand. After gardening or contact with soil or sand, wash hands thoroughly.
- Pregnant women should avoid changing cat litter if possible. If no one else is available to change the cat litter, use gloves, then wash hands thoroughly. Change the litter box daily because *Toxoplasma* oocysts require several days to become infectious. Pregnant women should be encouraged to keep their cats inside and not adopt or handle stray cats. Cats should be fed only canned or dried commercial food or well-cooked table food, not raw or undercooked meats.
- Health education for women of childbearing age should include information about meat-related and soilborne toxoplasmosis prevention. Health-care providers should educate pregnant women at their first prenatal visit about food hygiene and prevention of exposure to cat feces.
- Health-care providers who care for pregnant women should be educated about two potential problems associated with *Toxoplasma* serology tests. First, no assay exists that can determine precisely when initial *Toxoplasma* infection occurred. Second, in populations with a low incidence of *Toxoplasma* infection, such as in the United States, a substantial proportion of the positive IgM test results will probably be false positive.

- The government and the meat industry should continue efforts to reduce *Toxoplasma* in meat.

# RESEARCH AGENDA

## NWTPCT Recommendations for Research

Experts who participated in NWTPCT considered several issues regarding prevention of this disease. These issues included the need to improve estimates of the burden of toxoplasmosis and immunodiagnostics for the disease and to determine the applicability of national toxoplasmosis screening for newborns. Participants discussed current knowledge about these issues, gaps in current knowledge, and needs for future research.

### *Improving Estimates of the Burden of Toxoplasmosis*

In their recommendations, NWTPCT participants emphasized the importance of obtaining more complete and accurate data regarding the incidence of new infections and the number of cases by mode of transmission. Participants recommended that CDC obtain population-based data regarding the incidence of and risk factors for toxoplasmosis. In addition, participants recommended the use of existing private data systems (e.g., those of health-maintenance organizations and managed-care systems) for surveillance and research, and development of techniques that would enable tracing the source of individual infections to foodborne, catborne, or soilborne transmission.

### *Improving Immunodiagnostics for Toxoplasma*

NWTPCT participants recommended that additional efforts were needed to develop more accurate screening diagnostic tests and improved confirmatory tests. NWTPCT participants also emphasized that resources should be identified to increase current capacity to provide reference diagnostic services in the United States.

### *Determining the Applicability of National Toxoplasmosis Screening for Newborns*

Research is under way to determine the need for national toxoplasmosis screening of newborn infants in the United States (See Exhibit). NWTPCT participants identified the need for cost-effectiveness studies to enable comparison of the benefits of expanded testing in the United States and the costs of such testing.

## CDC Priorities

The Food Safety Initiative has enabled CDC to increase support for activities related to prevention of toxoplasmosis, with a special emphasis on preventing congenital toxoplasmosis. The NWTPCT has helped CDC to identify high-priority activities and to form important partnerships with other groups with similar goals.

CDC is engaged in several activities to improve the ability to measure the burden of toxoplasmosis in the United States and to provide a baseline against which the impact of future prevention efforts can be measured. Epidemiologic staff are analyzing *Toxoplasma* IgG seroprevalence in samples collected in the nationally representative NHANES III (*1*) and preparing a document to disseminate the results. Plans are under way to conduct

serologic testing of samples obtained as part of NHANES 2000 to evaluate trends in the prevalence of *Toxoplasma* infection and to assess the occurrence of acute *Toxoplasma* infections. In addition, CDC staff will examine national hospital discharge data and national death certificate data to monitor the annual number of cases of and deaths caused by toxoplasmosis, the proportion of toxoplasmosis associated with congenital infection, and the proportion associated with HIV infection. Other possible activities include a) examination of surveillance data (obtained from both educational and medical records) for multiple developmental disabilities (e.g., mental retardation, cerebral palsy, and hearing and vision impairment) and evidence of positive *Toxoplasma* tests and b) the designation by state health departments of congenital toxoplasmosis as a reportable infection.

CDC is supporting a cost-effectiveness analysis of the New England Newborn Screening Program to provide background information for states considering newborn toxoplasmosis screening and reporting. One state has already received funding from CDC through the Emerging Infections Program and has begun toxoplasmosis-related activities. Minnesota is conducting active surveillance for toxoplasmosis using laboratories, ophthalmologists, infection-control practitioners, and other clinicians.

CDC is conducting research on the genetic variation of *Toxoplasma* to develop tools that would enable molecular epidemiologic studies (e.g., to determine whether different strains have different characteristics and are more infectious or pathogenic for humans). The results of this research might help investigators describe the source and spread of *Toxoplasma* in outbreaks and differentiate between foodborne and cat feces or soilborne *Toxoplasma* infections. In addition, through FoodNet, CDC is querying laboratories in eight states about their diagnostic practices for toxoplasmosis.

To help evaluate the accuracy of future commercial *Toxoplasma* antibody test kits, CDC created a *Toxoplasma* serum panel that contains known positive and negative sera. FDA now requires that any new commercial *Toxoplasma* test kit perform adequately based on results obtained using this panel. The panel is available for purchase through the CDC Technology Transfer Office.

The American College of Obstetricians and Gynecologists, with assistance from CDC, is conducting a national survey of obstetricians to assess their knowledge about congenital toxoplasmosis and interpretation of related laboratory tests. The results of the survey will be used to identify ways to educate health-care providers about diagnosis and clinical management of pregnant women with suspected *Toxoplasma* infections.

To help educate women about toxoplasmosis prevention, CDC has published a pamphlet entitled "Attention Pregnant Women: What You Can Do to Keep Germs from Harming You and Your Baby," which discusses, among other infections, toxoplasmosis and ways to minimize the risk for infection during pregnancy. The pamphlet is available by mail (CDC, National Center for Infectious Diseases, Division of Bacterial and Mycotic Diseases, Respiratory Diseases Branch, MS C-23, 1600 Clifton Rd. N.E., Atlanta, GA 30333), fax ([404] 639-3970), or on the Internet at <http:// www.cdc.gov/ncidod/diseases>.

## CONCLUSION

Many cases of congenital toxoplasmosis in the United States can be prevented. Specific measures can be taken by women and their health-care providers to decrease the risk for infection during pregnancy and, if primary prevention fails and congenital infection occurs, to reduce the severity of infection in newborns. CDC is involved in efforts to

improve measurement of the burden of toxoplasmosis in the United States, evaluate current prevention programs, train health-care providers, and educate women about toxoplasmosis. These efforts should allow CDC and state and local health departments to better monitor and reduce the impact of toxoplasmosis on pregnant women and their newborn infants.

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# Exhibit

Innovative and ambitious programs to prevent toxoplasmosis have been developed in the United States and in Europe, and the National Workshop on Toxoplasmosis: Preventing Congenital Toxoplasmosis (NWTPCT) provided a forum to compare current efforts. These programs involve three approaches: a) screening pregnant women (or all women of childbearing age) to detect as early as possible *Toxoplasma* infections (or susceptibility to such infections) that might indicate a risk for congenital infection, b) screening newborns to detect infections in infants as early as possible to enable early initiation of treatment, and c) educating women about preventing infection.

## Screening Programs for Pregnant Women

### *France*

In France, a screening program was implemented in 1976 to detect and treat *Toxoplasma* infection during pregnancy. The goal of this program is to institute preventive measures for seronegative women and to ensure early diagnosis and treatment of infection acquired during pregnancy. Since the beginning of the program, premarital and prenatal medical examinations for *Toxoplasma* antibodies have been performed. Premarital examinations are conducted to distinguish previously infected women from women who have not been previously infected. When a previously uninfected woman becomes pregnant, testing is conducted at her first prenatal examination during her first trimester and at six additional examinations conducted monthly during her second and third trimesters. In addition, women are educated about prevention methods during pregnancy (*29* ). If these screening tests detect evidence of acute infection during pregnancy, treatment for the woman is initiated with spiramycin. If infection in the fetus is confirmed through fetal blood sampling and amniocentesis, pyrimethamine and sulfadiazine or sulfadoxine is added to the regimen (*30–32* ).

Even though coverage of the French program has been incomplete, the program has been associated with a decline in the incidence of congenital infection, as well as a decline in severe disease detected at birth. The proportion of the decline specifically attributable to the program or to the general decline in Europe in rates of seropositivity is difficult to determine because no unscreened group of women exists for comparison.

### *Austria*

Austria implemented a toxoplasmosis screening program in 1975. Nearly all women who become pregnant are serologically screened early in pregnancy and, if found to be negative initially, are tested again during the second and third trimesters. Women with *Toxoplasma* infections are treated as soon as infection is detected. Although seropositivity rates among pregnant Austrian women have declined from approximately 50.0% during the late 1970s to 36.7% during the early 1990s, the incidence of congenital *Toxoplasma* infection has declined even more, from 50–70 cases per 10,000 births before the program to 1 per 10,000 births during the early 1990s (*33* ). As with the French program, the lack of an unscreened comparison group precludes determining the proportion of

the decline attributable to the screening program, and lack of cost figures precludes cost-effectiveness analyses.

### *European Research Network on Congenital Toxoplasmosis*

The European Research Network on Congenital Toxoplasmosis was established in 1993 and has sponsored several studies regarding public health interventions for congenital toxoplasmosis. Most recently, a multicenter study was conducted to evaluate the effectiveness of toxoplasmosis treatment administered during pregnancy in preventing transmission of maternal infection to the fetus. Pregnant women who visited one of five European university medical centers for prenatal care were screened for *Toxoplasma* antibodies at their first prenatal visit. Women who were seronegative were retested at least once every trimester in two centers and monthly in the other centers, until the birth of the infant. For women who seroconverted during pregnancy, prenatal antibiotic treatment was started, and their infants were followed for 1 year after birth. Treatment regimens consisted of spiramycin or a combination of pyrimethamine and sulfadiazine. If prenatal infection was confirmed with amniocentesis or cordocentesis, women were treated with pyrimethamine and sulfadiazine or sulfadoxine. Of women who screened positive and did not receive prenatal therapy, transmission from mother to infant occurred in 72% of the mother-infant pairs; of women who received prenatal therapy, transmission occurred in 39% of the mother-infant pairs. In addition, 20% of the untreated mothers gave birth to infants with severe sequelae, and 3.5% of the treated mothers gave birth to infants with severe sequelae. Furthermore, the earlier antibiotics were administered after infection, the less likely sequelae were detected in the infant (*34*).

### *Finland*

From January 1988 through June 1989, a cost-benefit analysis of *Toxoplasma* screening during pregnancy was conducted in a prospective study in Finland. The study compared costs of screening alternatives for primary infections during pregnancy with the costs of no screening. With screening, the annual costs of congenital toxoplasmosis were $95 US per pregnancy; without screening, annual costs were $128 US per pregnancy. Furthermore, screening along with health education was more beneficial than health education alone (*35*). The study findings suggest screening is beneficial in countries with low incidence of congenital toxoplasmosis, such as Finland. The findings of other studies suggest screening programs can also be beneficial in areas with high incidences of congenital toxoplasmosis (*30,36,37*).

### *NWTPCT's Assessment*

Although the findings of the European studies suggest *Toxoplasma* screening programs of women of childbearing age can prevent cases of congenital toxoplasmosis, several concerns could limit support for such programs in the United States. NWTPCT participants identified the need for cost-effectiveness studies to enable comparison of the benefits of expanded testing in the United States, the costs of such testing, and the unintended adverse consequences that might accompany such testing (e.g., inappropriately treating women with false-positive test results).

## Screening Programs for Newborns

### *Denmark*

During June 1992–August 1996, researchers in Denmark conducted a newborn screening study for toxoplasmosis. The primary goal of this study was to determine the feasibility of screening newborn infants for congenital toxoplasmosis in an area with low prevalence; in Denmark, the seroprevalence of antibodies to *Toxoplasma* among women during this study was 28% (*38,39*). Approximately 90,000 infants were screened for *Toxoplasma*-specific IgG antibodies 5–10 days after birth. Infants born to mothers who seroconverted during pregnancy were subsequently examined physically and serologically for 1 year; for those with confirmed congenital infections, treatment was initiated with courses of pyrimethamine and sulfadiazine, alternating with spiramycin (*38*). During 1996, serum levels of *Toxoplasma*-specific IgM antibodies were also determined. The IgM test conducted within 10 days of birth resulted in a false-positive rate of 0.2 per 1,000 with no false-negatives. Results from this study indicated that a newborn screening program using a *Toxoplasma*-specific IgM antibody test exclusively could identify approximately 75% of infections in infants born to untreated mothers. In addition, the low rates of false-positives and false-negatives suggested this method would be feasible in large-scale newborn screening programs in areas with low seroprevalence rates of toxoplasmosis.

### *United States*

In the United States, the New England Newborn Screening Program tests newborn "filter-paper" specimens from all infants born in Massachusetts and New Hampshire for congenital toxoplasmosis by using a *Toxoplasma*-specific IgM antibody assay. If IgM antibodies are detected, an extensive clinical evaluation is performed, and a 1-year treatment regimen is initiated with a combination therapy of pyrimethamine and sulfadiazine (*11*). During 1986–1992, a total of 52 of the 635,000 infants screened had confirmed congenital infections; 50 appeared normal on routine neonatal examination and had toxoplasmosis diagnosed through screening alone. After more intensive examination, 19 (40%) of the 48 evaluated infants who appeared normal on routine examination had evidence of retinal or central nervous system disease. Treatment was provided for these infants, and compliance with therapy was observed. After 1 year of treatment, only one (2.2%) of 46 children had a neurologic deficit, and four (10.3%) of 39 had eye lesions that could have developed after birth. The findings of this program demonstrated that screening newborns for congenital toxoplasmosis is feasible in the United States. The laboratory and personnel costs of screening approximately 100,000 infants per year for *Toxoplasma* infection and following those who were infected totaled $220,000 or approximately $30,000 per infant identified. Costs were relatively low because the system used by the program to collect and process specimens was the same one already used for screening newborns for eight other diseases. On the basis of these preliminary cost estimates, this screening program appears to be a favorable alternative, considering the financial and social costs associated with raising a visually or mentally impaired child (*40*).

### *NWTPCT's Assessment*

NWTPCT participants recognized the benefits of these newborn screening programs and discussed ways to evaluate the New England program to determine the benefit of using it as a model for developing additional programs in other areas of the United States. One specific recommendation was for CDC to support a detailed, cost-effectiveness evaluation of the program.

## Education Programs for Women

The third approach to preventing toxoplasmosis focuses on educating women of childbearing age about minimizing their risk for infection with *Toxoplasma*. Education interventions assume that increased knowledge results in awareness, which consequently results in changes in risky behavior and declines in infection rates. Messages emphasize the importance of avoiding eating raw or undercooked meat, handling raw meat safely, and washing hands after gardening or changing cat litter boxes (*37*).

### *Canada*

A study conducted as part of prenatal classes at Canadian public health agencies evaluated the effect of a 10-minute teaching session on three behaviors: practices associated with cleaning the cat litter box and limiting the cat's diet to cooked food; safe food-handling practices; and handwashing after exposure to cat feces, garden soil, or raw meats. Among women in the classes, behavior improved regarding practices associated with cats; however, behavior regarding food-handling practices remained unchanged. In addition, improvement occurred in handwashing practices but only among professional women (*41*).

### *Belgium*

During 1979–1986, a Belgium study assessed the effectiveness of educational sessions held in hospital settings. Baseline data were collected during 1979–1982, when no education measures were in effect. During 1983–1986, education sessions were provided to pregnant women. Although the intervention was associated with a 34% decrease in seroconversion rates, the decrease was not statistically significant (*42*).

### *NWTPCT's Assessment*

NWTPCT participants considered education programs to be a potentially powerful intervention because of their low cost and because pregnant women were highly motivated to protect the health of their babies. However, participants emphasized that the impact of educational programs was difficult to evaluate because of the limited number of comparative studies a) conducted with rigorous scientific methodology and b) of sufficient size to enable calculation of the effectiveness of the intervention compared with its cost.

# Participants in the National Workshop on Toxoplasmosis: Preventing Congenital Toxoplasmosis

Professor Horst Aspöck
Department of Medical Parasitology
Clinical Institute of Hygiene
Kinderspitalgasse 15
A-1095 Vienna, Austria

Sue Binder, M.D.
Division of Parasitic Diseases
National Center for Infectious Diseases
CDC, MS F-22
4770 Buford Highway
Atlanta, Georgia 30341

Kenneth Boyer, M.D.
Department of Pediatrics
Rush Presbyterian/St. Luke's Medical Center
1653 W. Congress Parkway
Chicago, Illinois 60612

Steve Crutchfield, Ph.D
U.S. Department of Agriculture
Room N 3077
1800 M Street N.W.
Washington, D.C. 20036-5831

Alfred DeMaria, Jr., M.D.
State Laboratory Institute
305 South Street
Jamaica Plain, Massachusetts 02130

Vance Dietz, M.D.
Division of Parasitic Diseases
National Center for Infectious Diseases
CDC, MS F-22
4770 Buford Highway
Atlanta, Georgia 30341

J.P. Dubey, Ph.D.
Zoonotic Diseases Laboratory
U.S. Department of Agriculture
Barc-East Bldg. 1040
Beltsville, Maryland 20705

Roger Eaton, Ph.D.
NE Newborn Screening Program
University of Massachusetts Medical School
305 South Street
Jamaica Plain, Massachusetts 02130

Ruth Etzel, M.D.
U.S. Department of Agriculture
Room 3718 Franklin Court
1400 Independence Avenue, S.W.
Washington, D.C. 20250-3700

Jack Frenkel, M.D.
1252 Vallecita Drive
Sante Fe, NM 87501-8803

Ronald Gibbs, M.D.
Department of Ob/Gyn
University of Colorado Health Sciences Center
4200 E. Ninth Avenue, Campus Box B-198
Denver, Colorado 80262

Ruth Gilbert, M.D.
Department of Epidemiology and Public Health
Institute of Child Health
30 Guilford Street
London WC1 N 1EH, United Kingdom

Carol Herman, M.S.
OSB, Center for Devices & Radiological Health
Food and Drug Administration, HFZ-510
1350 Piccard Drive
Rockville, Maryland 20850

Peter Hotez, M.D.
Yale University School of Medicine
507 LEPH; 60 College Street
New Haven, Connecticut 06520

Dennis Juranek, D.V.M.
Division of Parasitic Diseases
National Center for Infectious Diseases
CDC, MS F-22
4770 Buford Highway
Atlanta, Georgia 30341

Ruth Lynfield, M.D.
Acute Disease Epidemiology Section
Minnesota Department of Health
717 Delaware Street, S.E.
Minneapolis, Minnesota 55440-9441

James McAuley, M.D.
Westside Center for Disease Control
2160 W. Ogden Avenue
Chicago, Illinois 60612

Rima McLeod, M.D.
The University of Chicago
939 E. 57th Street (VSC, MC 2114)
Chicago, Illinois 60637

Martin Meltzer, Ph.D.
Office of the Director
National Center for Infectious Diseases
CDC, MS C-12
1600 Clifton Road, N.E.
Atlanta, Georgia 30333

Marilyn Mets, M.D.
Children's Memorial Hospital
Division of Ophthalmology
2300 Children's Plaza/Box 70
Chicago, Illinois 60614

Thomas Navin, M.D.
Division of Parasitic Diseases
National Center for Infectious Diseases
CDC, MS F-22
4770 Buford Highway
Atlanta, Georgia 30341

Eskild Petersen, M.D.
Laboratory of Parasitology
Statens Serum Institute
Artillerivej 5
DK-2300 Copenhagen S Denmark

Jack Remington, M.D.
Research Institute
Palo Alto Medical Foundation
860 Bryant Street
Palo Alto, California 94301

Rigoberto Roca, M.D.
Center for Drug Evaluation & Research
Food and Drug Administration, HFD-590
5600 Fishers Lane
Rockville, Maryland 20857

Peter Schantz, V.M.D.
Division of Parasitic Diseases
National Center for Infectious Diseases
CDC, MS F-22
4770 Buford Highway
Atlanta, Georgia 30341

Jack Schlater, D.V.M.
National Veterinary Services Laboratories
1800 Dayton Avenue
Ames, Iowa 50010

L. David Sibley, Ph.D.
Washington University School of Medicine
660 S. Euclid Avenue, Campus Box 8230
St. Louis, Missouri 63110-1093

Kirk Smith, D.V.M.
Acute Disease Epidemiology
MN Department of Health
717 Delaware Street, N.E.
Minneapolis, Minnesota 55414

Philippe Thulliez, M.D.
Laboratoire de la Toxoplasmose
Institut de Puériculture
26 Boulevard Brune
F-75014 Paris
France

Ralph Timperi, M.P.H.
State Laboratory Institute
Massachusetts Department of Health
305 South Street
Jamaica Plain, Massachusetts 02130-3597

Marianna Wilson, M.S.
Division of Parasitic Diseases
National Center for Infectious Diseases
CDC, MS F-13
4770 Buford Highway
Atlanta, Georgia 30341

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MMWR
MORBIDITY AND MORTALITY
WEEKLY REPORT

March 31, 2000 / Vol. 49 / No. RR-2

*Recommendations and Reports*

# Continuing Education Activity Sponsored by CDC

## CDC Recommendations Regarding Selected Conditions Affecting Women's Health

### EXPIRATION — MARCH 31, 2001

You must complete and return the response form electronically or by mail by **March 31, 2001**, to receive continuing education credit. If you answer all of the questions, you will receive an award letter for 2.5 hours Continuing Medical Education (CME) credit, 0.2 hour Continuing Education Units (CEUs), or 2.9 hours Continuing Nursing Education (CNE) credit. If you return the form electronically, you will receive educational credit immediately. If you mail the form, you will receive educational credit in approximately 30 days. No fees are charged for participating in this continuing education activity.

### INSTRUCTIONS

**By Internet**

1. Read this *MMWR* (Vol. 49, RR-2), which contains the correct answers to the questions beginning on the next page.
2. Go to the *MMWR* Continuing Education Internet site at <http://www2.cdc.gov/mmwr/cme/conted.html>.
3. Select which exam you want to take and select whether you want to register for CME, CEU, or CNE credit.
4. Fill out and submit the registration form.
5. Select exam questions. To receive continuing education credit, you must answer all of the questions. Questions with more than one correct answer will instruct you to "Indicate all that apply."
6. Submit your answers no later than **March 31, 2001**.
7. Immediately print your Certificate of Completion for your records.

**By Mail**

1. Read this *MMWR* (Vol. 49, RR-2), which contains the correct answers to the questions beginning on the next page.
2. Complete all registration information on the response form, including your name, mailing address, phone number, and e-mail address, if available.
3. Indicate whether you are registering for CME, CEU, or CNE credit.
4. Select your answers to the questions, and mark the corresponding letters on the response form. To receive continuing education credit, you must answer all of the questions. Questions with more than one correct answer will instruct you to "Indicate all that apply."
5. Sign and date the response form or a photocopy of the form and send no later than **March 31, 2001**, to
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**ACCREDITATION**

**Continuing Medical Education (CME).** CDC is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians. CDC designates this educational activity for a maximum of 2.5 hours in category 1 credit toward the AMA Physician's Recognition Award. Each physician should claim only those hours of credit that he/she actually spent in the educational activity.

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**Continuing Nursing Education (CNE).** This activity for 2.9 contact hours is provided by CDC, which is accredited as a provider of continuing education in nursing by the American Nurses Credentialing Center's Commission on Accreditation.

## GOALS AND OBJECTIVES

This *MMWR* provides recommendations and other information to help health professionals improve skills in protecting the health of women. The articles in this *MMWR* were developed by CDC staff. This *MMWR* is intended to provide information to guide public health policy development, program management, and clinical care related to women's health. Upon completion of this educational activity, the reader should be able to develop strategies to reduce the risk for hip fractures, develop strategies to reduce the risk for exercise-related trauma, identify disease risk factors and prevention interventions for breast and cervical cancer, and develop strategies to reduce the risk for toxoplasmosis during pregnancy.

***To receive continuing education credit, please answer all of the following questions.***

**1. Factors strongly associated with the risk for hip fracture among older adults include . . .**

A. sex.

B. race.

C. age.

D. current level of physical activity.

E. all of the above.

**2. Research has demonstrated that the most effective component of a fall-prevention program is . . .**

A. education about personal fall risk factors.

B. exercise to improve strength and balance.

C. checklists to help identify and correct home hazards.

D. teaching persons how to safely walk up and down stairs.

E. encouraging the use of sturdy shoes when walking outside.

**3. What is the most important risk factor for exercise-related injury among women?**

A. Smoking.

B. Age.

C. Intensity, frequency, and duration of training.

D. Previous injury.

**4. Men and women of the same physical fitness level, participating in the same activities, can be expected to have similar incidences of injury.**

A. True.

B. False.

**5. The greatest reduction in breast cancer mortality, following detection by mammography screening at regularly scheduled intervals, has been reported among . . .**

A. women aged 30–39 years.

B. women aged 40–49 years.

C. women aged >50 years.

D. women aged 50–69 years.

E. none of the above.

**6. What is the main purpose for receiving Pap tests at regularly scheduled intervals?**

A. To detect and treat vaginal and vulvar cancer.

B. To detect and treat invasive cervical cancer.

C. To identify and treat precancerous cervical lesions.

D. B and C.

E. None of the above.

**7. Which of the following should be recommended to pregnant women to prevent exposure to *T. gondii*?**

A. Do not eat raw or undercooked meat; wash hands and surfaces with warm soapy water after they have contacted raw meat, poultry, seafood, or unwashed fruits or vegetables.

B. If no one else is available to change cat litter, use gloves, then wash hands thoroughly after changing cat litter and change it daily.

C. Peel or thoroughly wash fruits and vegetables before eating.

D. Do not pet cats.

E. A, B, and C.

**8. Which of the following have contributed to the difficulties in diagnosing acute toxoplasmosis in pregnant women?**

A. Symptoms of the disease are mild or unapparent.

B. High false-positive rate of commercial IgM laboratory tests for diagnosing toxoplasmosis.

C. Patient's lack of knowledge regarding exposure to *T. gondii*.

D. All of the above.

**9. Indicate your work setting.**

A. State/local health department.

B. Other public health setting.

C. Hospital clinic/private practice.

D. Managed-care organization.

E. Academic institution.

F. Other.

**10. Which best describes your professional activities?**

A. Infectious diseases.

B. Obstetrics/gynecology.

C. Internal medicine.

D. Pediatrics.

E. Family practice.

F. Other.

**11. Each month, approximately how many women aged ≥65 years do you treat for fall-related injuries?**

A. None.

B. 1–5.

C. 6–20.

D. 21–50.

E. 51–100

F. >100

**12. Each month, approximately how many women do you treat for exercise-related injuries?**

A. None.

B. 1–5.

C. 6–20.

D. 21–50.

E. 51–100

F. >100

**13. Each month, approximately how many women do you treat for breast or cervical cancer?**

A. None.

B. 1–5.

C. 6–20.

D. 21–50.

E. 51–100

F. >100

**14. Each month, approximately how many women do you treat for toxoplasmosis?**

A. None.

B. 1–5.

C. 6–20.

D. 21–50.

E. 51–100

F. >100

**15. How much time did you spend reading this report and completing the exam?**

A. 1 to 1½ hours.

B. More than 1½ hours but fewer than 2 hours.

C. 2 to 2 ½ hours.

D. More than 2 ½ hours but fewer than 3 hours.

E. 3 hours or more.

**16. After reading this report, I am confident I can develop strategies to reduce the risk for hip fracture.**

A. Strongly agree.

B. Agree.

C. Neither agree nor disagree.

D. Disagree.

E. Strongly disagree.

**17. After reading this report, I am confident I can develop strategies to reduce the risk for exercise-related trauma.**

A. Strongly agree.

B. Agree.

C. Neither agree nor disagree.

D. Disagree.

E. Strongly disagree.

**18. After reading this report, I am confident I can identify disease risk factors and prevention interventions for breast and cervical cancer.**

A. Strongly agree.

B. Agree.

C. Neither agree nor disagree.

D. Disagree.

E. Strongly disagree.

**19. After reading this report, I am confident I can develop strategies to reduce the risk for toxoplasmosis during pregnancy.**

A. Strongly agree.

B. Agree.

C. Neither agree nor disagree.

D. Disagree.

E. Strongly disagree.

**20. Overall, the presentation of the report enhanced my ability to understand the material.**

A. Strongly agree.

B. Agree.

C. Neither agree nor disagree.

D. Disagree.

E. Strongly disagree.

**21. These recommendations will affect my practice.**

A. Strongly agree.

B. Agree.

C. Neither agree nor disagree.

D. Disagree.

E. Strongly disagree.

**[Correct answers for questions 1–8]**

[1. E; 2. B; 3. C; 4. A; 5. D; 6. D; 7. E; 8. D.]

# *MMWR* Response Form for Continuing Education Credit
# March 31, 2000/Vol. 49/No. RR-2

## CDC Recommendations Regarding Selected Conditions Affecting Women's Health

***To receive continuing education credit, you must***
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***3. answer <u>all</u> of the test questions;***
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7. [ ] A [ ] B [ ] C [ ] D [ ] E
8. [ ] A [ ] B [ ] C [ ] D
9. [ ] A [ ] B [ ] C [ ] D [ ] E [ ] F
10. [ ] A [ ] B [ ] C [ ] D [ ] E [ ] F
11. [ ] A [ ] B [ ] C [ ] D [ ] E [ ] F
12. [ ] A [ ] B [ ] C [ ] D [ ] E [ ] F
13. [ ] A [ ] B [ ] C [ ] D [ ] E [ ] F
14. [ ] A [ ] B [ ] C [ ] D [ ] E [ ] F
15. [ ] A [ ] B [ ] C [ ] D [ ] E
16. [ ] A [ ] B [ ] C [ ] D [ ] E
17. [ ] A [ ] B [ ] C [ ] D [ ] E
18. [ ] A [ ] B [ ] C [ ] D [ ] E
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**MMWR**

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