

## 4. Impact of Tobacco Use on Women's Health

### Introduction

Cigarette smoking was initially adopted by men in industrialized countries and was later taken up by women in those countries and men in developing countries. With the recent decline in smoking in industrialized countries, the multinational tobacco companies have moved aggressively into the developing nations. Consequently, there is a risk of an epidemic of tobacco-related diseases in the developing world, where tobacco use is increasingly becoming a major health issue for women as well as men.<sup>1</sup> The high percentage of non-smoking women in those countries makes them an attractive target for the industry.

The health effects of smoking in a population become fully pronounced only about a half-century after the habit is adopted by a sizeable percentage of young adults. Thus, most of what is known about the health effects of tobacco use among women comes from studies in industrialized countries, where women began smoking cigarettes decades ago and there has been adequate time to monitor the consequences. Despite the relative paucity of epidemiological data on women in developing countries, there is no reason to think that female smokers there will be spared the serious health effects of smoking. In those countries where female smoking is increasing, it may be several decades before the full health impact is felt, but devastating health consequences are inevitable unless action is taken today. Data from industrialized countries show that mortality of women who smoke is elevated by 90% or more compared with mortality among those who do not smoke,<sup>2–4</sup> with evidence that risk increases as the number of cigarettes smoked and the duration of smoking increase. Thus, the risk of premature death for tens of millions of women worldwide is nearly doubled by a single factor—tobacco use—that is entirely preventable.

It is well established that lung cancer is generally rare in populations where smoking prevalence is low and that its occurrence tends to increase following increases in smoking prevalence. Given this relationship, lung cancer mortality rates—which are available for most countries of the world, even though accuracy and completeness of reporting vary

considerably—can serve as an indicator of the “maturity” of the tobacco epidemic across populations. Although this review focuses much more on lung cancer than on other smoking-related diseases, lung cancer is only one of myriad adverse health consequences of smoking for women. Lung cancer accounted for approximately 13% of all smoking-attributable deaths among women in high-income countries in 2004;<sup>5</sup> the remaining 87% of tobacco's toll on women in high-income countries was due to other diseases. Moreover, lung cancer rates are a reflection of smoking patterns two to three decades earlier, so they inadequately reflect the more immediate health effects of women's smoking, such as adverse reproductive outcomes.

Most of what is known about the health effects of tobacco is based on the smoking of manufactured cigarettes, although in some areas of the world, other forms of tobacco use among women are common (e.g. smoking of traditional hand-rolled flavoured cigarettes (bidis), use of water pipes to smoke tobacco, use of snuff and other types of smokeless tobacco, and reverse cigarette smoking). Further studies of the health effects of these forms of tobacco use are needed, although no form can be considered safe.<sup>6</sup> Moreover, many women throughout the world are involved in tobacco agriculture and factory work. Although the literature contains descriptions of some of the toxic effects of handling tobacco,<sup>7,8</sup> there has been little study of the health effects of employment in tobacco production on women; for example, effects of such employment on pregnancy outcomes should be investigated. However, this chapter focuses on the health consequences of active smoking. The effects of exposure to second-hand smoke (SHS) are reviewed elsewhere in this monograph.

### Effects of Smoking on Women's Health

#### *Effects of Smoking on the Health of Infants and Children*

The infants of mothers who smoke during pregnancy have birth weights approximately 200 g to 250 g lower, on average, than those of infants born to non-smoking women,<sup>9–11</sup> and they are more likely to be small for gestational age.<sup>12–15</sup> Risks of stillbirth,<sup>16–19</sup> neonatal death,<sup>16,17,20</sup> and sudden infant death syndrome (SIDS)<sup>21–24</sup> are also

greater among the offspring of women who smoke. In addition, it appears that breastfeeding is less common or of shorter duration among women who smoke than among non-smokers and that smokers who breastfeed may produce less breast milk than non-smokers do.<sup>25–29</sup>

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Exposure to SHS has numerous effects on the health of children, particularly relating to respiratory illnesses and ear infections, lung function, and asthma; these are reviewed elsewhere in this monograph in the chapter on SHS, women, and children. Older children and adolescents who are active smokers have increased risks of respiratory illness, cough, and phlegm production; slower rates of lung growth; reduced lung function; and poorer lipid profiles than their non-smoking counterparts.<sup>30</sup>

### *Effects of Smoking on Reproduction and Menstrual Function*

Women who smoke are more likely than non-smokers to experience primary and secondary infertility<sup>31,32</sup> and delays in conceiving.<sup>33–36</sup> Women smokers who become pregnant are also at increased risk of premature rupture of membranes, abruptio placentae (premature separation of the implanted placenta from the uterine wall), placenta previa (partial or total obstruction by the placenta of the cervical os), and pre-term delivery.<sup>18,37–53</sup> As noted above, their infants have lower average birth weights, are more likely to be small for gestational age, and are at increased risk of stillbirth and perinatal mortality than are the infants of non-smoking women. The proportion of pregnant women who smoke exceeds 30% in some populations, such as the poor and the less educated,<sup>54–64</sup> and in light of the serious health consequences and the strong motivation of pregnant women to ensure the health of their newborns, efforts to help pregnant women quit smoking (and to prevent postpartum relapse) should be a high priority in public health programmes focusing on women and children.

Additional studies of the effects of smoking on menstrual function, including menstrual regularity, are needed. From the evidence to date, it appears that women who smoke are more likely to experience dysmenorrhoea (painful menstruation)<sup>65–68</sup> and more severe and more frequent menopausal symptoms.<sup>68</sup> Early menopause is also more common among women who smoke. On average, women who are current smokers go through menopause about one to two years earlier than non-smoking women.<sup>68–72</sup>

### *Effects of Smoking on Cardiovascular Disease*

In both industrialized and developing countries, cardiovascular diseases are the major causes of death among women, as well as among men.<sup>73,74</sup> Women who smoke have an increased risk of cardiovascular disease, including coronary heart disease (CHD), ischaemic stroke, and subarachnoid haemorrhage. Numerous prospective and case-control studies document the finding that smoking is one of the major causes of CHD in women.<sup>2,75–81</sup> Relative risks of CHD associated with smoking are greater for younger women than for older women. Data from the American Cancer Society's Cancer Prevention Study II (CPS II) for 1982–1986 indicate that age-adjusted relative risks of CHD were 3.0 (95% confidence interval (CI) = 2.5, 3.6) in women 35 to 64 years of age and 1.6 (95% CI = 1.4, 1.8) in women 65 years of age or older.<sup>82</sup> In the 1980s, evidence suggested that smoking may account for a majority of cases of CHD among women in the United States under the age of 50.<sup>83</sup> Risk of CHD increases with the number of cigarettes smoked daily and with the duration of smoking.<sup>77,78</sup> In the Nurses' Health Study, current smokers who began to smoke before the age of 15 years had an estimated relative risk of 9.3 (95% CI = 5.3, 16.2) in comparison with non-smokers.<sup>78</sup>

Women who use oral contraceptives and also smoke have a particularly elevated risk of CHD.<sup>83,84</sup> Earlier studies found that use of oral contraceptives alone was associated with a moderate increase in CHD risk and that the risk was 20- to 40-fold greater among oral contraceptive users who also smoked heavily, compared with women who neither used oral contraceptives nor smoked.<sup>85,86</sup> Recent studies based on lower-dose formulations show the overall risk of CHD associated with oral contraceptive use to be less than was observed with the first-generation formulations; however, the relative risk among smokers—

especially heavy smokers—who use oral contraceptives is still markedly higher than that among non-smokers who do not use them.<sup>87–89</sup> It is important that all women who wish to use oral contraceptives be informed of these risks and encouraged not to smoke.

Women who smoke also have elevated risks of ischaemic stroke and subarachnoid haemorrhage.<sup>2,76,90–93</sup> In a meta-analysis published in 1989 that was based on 31 studies, risk of stroke among female smokers was 1.72 (95% CI = 1.59, 1.86) times that of women who had never smoked.<sup>94</sup> More recent studies have reported a twofold to threefold excess risk for ischaemic stroke and subarachnoid haemorrhage among women who smoked over that for women who never smoked.<sup>29</sup> In CPS II, 55% (95% CI = 45, 65) of cerebrovascular deaths among women younger than 65 years of age were attributed to smoking.<sup>82</sup> Women who smoke also have significantly increased risks of carotid atherosclerosis,<sup>95–97</sup> peripheral vascular atherosclerosis,<sup>98,99</sup> and death from ruptured abdominal aortic aneurysm.<sup>80,100–102</sup>

### *Effects of Smoking on Chronic Obstructive Pulmonary Disease*

Women who smoke have markedly increased risks of developing and dying of chronic obstructive pulmonary disease (COPD), which includes chronic bronchitis and emphysema with airflow obstruction.<sup>103,104</sup> In CPS II, the relative risk of COPD was 12.8 (95% CI = 10.4, 15.9) in current smokers, compared with non-smokers.<sup>105</sup> Risk increases with the number of cigarettes smoked per day.<sup>2</sup> At the population level, increases in smoking prevalence rates have been followed by steep increases in COPD mortality in countries around the world. In industrialized countries, prevalence of COPD is now almost the same in women and men.<sup>106</sup> Approximately 90% of COPD among women in CPS II was attributed to smoking.<sup>105</sup> Consistent with these findings, longitudinal studies have shown that lung function (as measured by forced expiratory volume in 1 sec (FEV1)) declines more steeply with age in women who smoke than it does in non-smokers.<sup>107–110</sup>

### *Effects of Smoking on Cancer*

An estimated one fifth of all cancer deaths worldwide are attributable to smoking.<sup>5</sup> Women who smoke have

higher risks for many cancers, including cancers of the lung, mouth, pharynx, oesophagus, larynx, bladder, pancreas, kidney, cervix, and possibly other sites, along with acute myelogenous leukaemia. In 2004, approximately 6% of new cases of cancer among women in low- and middle-income countries and 11% of new cases among women in high-income countries were attributable to tobacco.<sup>5</sup>

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**Lung cancer.** Lung cancer was a rare disease among both men and women in the early decades of the 20th century. By the 1950s, however, it had become the leading cause of cancer death among men in many industrialized countries. By the 1970s and 1980s, lung cancer mortality rates were increasing among men in developing countries, as well as among women in many industrialized regions where female cigarette smoking was already well established (e.g. in North America, Northern Europe, and Australia/New Zealand). In 1950, lung cancer accounted for only about 3% of all cancer deaths of women in the United States, but today it accounts for 25%.<sup>111</sup> In 1955–1959, the lung cancer death rate among women aged 35 to 64 years in the 15 countries of the European Union combined was 7.7 per 100 000;<sup>112</sup> in 2006, the estimated age-standardized rate for all women was 18.4 per 100 000 in the 25 countries of the European Union.<sup>113</sup>

Age-adjusted lung cancer mortality rates among women in the United States have increased approximately 800% since 1950 (see Figure 4.1); by 1987, lung cancer had surpassed breast cancer to become the leading cause of cancer death among women in that country. However, mortality rates for female lung cancer appear to have recently levelled off for the first time, after increasing for several decades.<sup>111</sup> In countries where smoking among

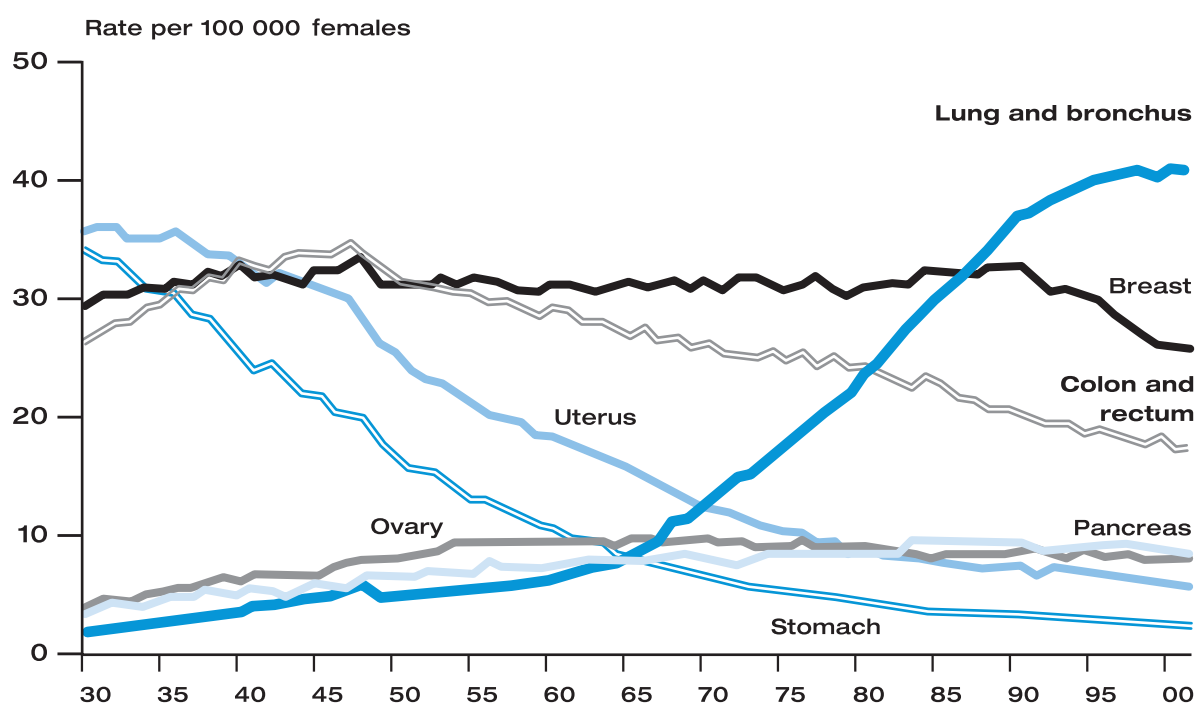
women became common relatively early in the 20th century, the vast majority of lung cancer deaths (about 90% in the United States<sup>2</sup>) are caused by smoking.<sup>114,115</sup> Worldwide, an estimated 53% of lung cancer in women is attributable to smoking.<sup>5</sup>

Current lung cancer rates among women vary dramatically between countries (Figure 4.2), reflecting historical differences in cigarette smoking across populations. Thus, lung cancer rates are intermediate or remain low in populations of women in which smoking was adopted later or is still relatively uncommon. Even within countries, there can be dramatic differences in subgroups of the population. For example, in the United States, the lung cancer death rate in the state of Utah is less than half the national average (13.9 per 100 000 vs 33.2 per 100 000);<sup>117</sup> the prevalence of smoking is low in Utah because of the predominance there of the Mormon religion, which proscribes smoking. In California, Asian women have much lower lung cancer death rates (24.9 per 100 000 in 1992–1996) than Caucasian women (48.9 per 100 000),<sup>118</sup> reflecting historical differences in smoking prevalence in the two racial groups.

Epidemiological studies consistently demonstrate that smoking is strongly associated with an increased risk of lung cancer in women and that risk increases with duration and amount of smoking and decreases with time since smoking cessation.<sup>119–121</sup> For example, in CPS II, which included more than 676 000 women 30 years of age or older, during follow-up from 1982 through 1988, those who were current smokers at the time of enrolment were approximately 12 times more likely than non-smokers to die of lung cancer.<sup>2</sup> The relative risk increased from 3.9 for women who smoked from one to nine cigarettes per day to 19.3 for women who smoked 40 cigarettes per day.<sup>2</sup>

Among women in industrialized countries, lung cancer ranks third (after cancers of the breast and colon/rectum) among all cancers in the number of new cases, and second (after cancer of the breast) among all cancers in the number of deaths. Among women in developing countries, lung cancer ranks fourth among cancers, after cancers of the cervix, breast, and stomach, in both number of new cases and deaths.<sup>122</sup> An estimated 379 000 women worldwide died from lung cancer in 2004 (compared with 940 000 men), accounting for 12% of all female cancer

**Figure 4.1. Annual Age-Adjusted Death Rates from Selected Cancer Types Among Females in the United States, 1930–2001 (age-adjusted to the US standard population)**



Source: Ref. 111.



deaths (compared with 23% for men).<sup>5</sup> These numbers are expected to increase dramatically in the future, paralleling increases in female smoking prevalence in most countries of the world.

Not only is active smoking a well-established cause of lung cancer in women, many studies now document causal association of exposure to SHS with lung cancer in non-smoking women.

**Other cancers.** Women who smoke have markedly increased risk of cancers of the mouth and pharynx (oral cancers), oesophagus, larynx, bladder, pancreas, and kidney.<sup>119,123–136</sup> Risk of cervical cancer also has been shown in many studies to be higher in smokers than in non-smokers. While human papilloma virus (HPV) is now considered to be a cause of cervical cancer, the rate of development of cervical cancer is increased in HPV-infected women who smoke. The 2004 report of the US Surgeon General concluded that smoking should be considered a cause of cervical cancer.<sup>137</sup> Although the extent to which this relationship is independent of HPV infection is uncertain,<sup>138</sup> at least two prospective cohort studies have found smoking to be significantly associated with cervical cancer neoplasia in HPV-infected women.<sup>139,140</sup> An accumulating body of evidence indicates a possible link between active smoking and breast cancer, particularly premenopausal breast cancer.<sup>141–146</sup> Available data also show increased risks of acute myeloid leukaemia<sup>147,148</sup> in women who smoke, compared with non-smokers. Both the International Agency for Research on Cancer (IARC) and the Surgeon General of the United States have found that smoking is a cause of acute myeloid leukaemia.<sup>149</sup> In the United States, the majority of deaths due to several cancers in addition to lung cancer, including cancers of the larynx, pharynx, and oesophagus, among both men and women are attributable to smoking.<sup>150</sup>

### *Effects of Smoking on Bone Density and Fractures*

Although smoking has not been consistently shown to have an effect on bone density in premenopausal or perimenopausal women, many studies have found that postmenopausal women who smoke have lower bone densities than non-smokers have.<sup>29,151–156</sup> Three recent meta-analyses examined the risk of hip fracture associated with

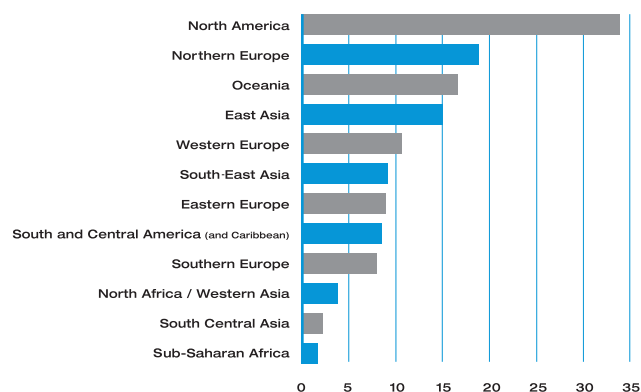
smoking and found reported increases in risk ranging from 31% to 84% among predominantly female study samples. The relative risk of hip fracture in smokers, compared with non-smokers, appears to be strongly associated with age. There is also evidence of an association between smoking and risk of fractures at other sites, but the highest observed risk is for fractures of the hip.<sup>157</sup>

### *Other Health Effects of Smoking*

Cigarette smoking and depression are strongly associated, although it is difficult to determine whether the association reflects an effect of smoking on the etiology of depression, results from the use of smoking for self-medication by depressed individuals, or is due to common genetic or other factors that predispose people to both smoking and depression.<sup>158–165</sup> Because depression is a major cause of morbidity worldwide and is more prevalent in women than in men, the association between smoking and depression is important for women's health and needs further study.

Risk of a number of other conditions is higher among women who smoke than among non-smokers. These conditions include, but are not limited to, periodontal disease,<sup>137,166</sup> gall bladder disease,<sup>167–171</sup> peptic ulcer,<sup>29,137,170–172</sup> some forms of cataract,<sup>137,173,174</sup> and facial wrinkling.<sup>100,175,176</sup> While not necessarily life-threatening, these conditions can have considerable impact on the quality of women's lives.

**Figure 4.2. Age-Standardized Lung Cancer Incidence Rates per 100 000 Women, by World Region, 2000 (standardized to the world population)**



Source: Ref. 116.

## Effects of Smoking on Total Mortality Worldwide: Narrowing of the Gender Gap

Peto et al.<sup>114</sup> estimated mortality from smoking during 1955–1995 for the major populations of the world that are classified by the United Nations as “developed”. The proportion of all deaths attributed to smoking in these populations increased over time among persons of both sexes. In 1955, the proportion of all deaths resulting from smoking by persons 35 to 69 years of age in industrialized countries was 2% among women and 20% among men.<sup>114</sup> A more recent WHO report estimated global mortality caused by smoking in 2004.<sup>5</sup> In the 30-to-69-year age group, the proportion of all deaths due to smoking in industrialized countries was 12% among women and 33% among men. While these figures of estimated mortality from smoking are drawn from different studies with some of the changes attributable to methodological changes, nevertheless they demonstrate the narrowing of the gender gap in deaths due to smoking, as the increase was relatively greater among women. According to Peto,<sup>114</sup> each smoker in this age group who died (men and women combined) lost an average of 22 years of life expectancy.

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Most of the deaths attributable to smoking worldwide have occurred in industrialized countries, but the situation is changing dramatically as the impact of the rising prevalence of smoking among women in the developing world is felt. It has been estimated that during the 1990s, about 2 million smoking-attributable deaths among men and women combined occurred annually in industrialized countries, and 1 million occurred in developing countries.<sup>114</sup> In 2004, the estimated numbers of smoking-attributable deaths in industrialized and developing countries were approximately equal: 2.43 million in industrialized countries and 2.41 million in developing countries.<sup>5</sup> However, by 2025, there will be

an estimated 0.6 million such deaths among women every year in industrialized countries, compared with 1.98 million among women in developing countries.

In 2004, 3.8 million deaths among men worldwide were attributable to smoking (2.0 million in developing countries and 1.8 million in industrialized countries), and 1.0 million among women were attributable to smoking (0.4 million in developing countries and 0.6 million in industrialized countries).<sup>5</sup> However, women will account for an increasing proportion of all smoking-attributable deaths in the future. Recent estimates and projections from a WHO report<sup>5</sup> indicate that mortality from tobacco use at the global level will increase by 80% among women between 2004 and 2030; the increase in men will be 60% over the same time period. The gender gap is closing as smoking prevalence in women approximates that of men.

It is instructive to compare the experience of the United States, where smoking among women became common in the 1930s and 1940s and peaked (at about 33%) in the 1960s, with that of Japan, where female smoking prevalence has been low. The estimated proportion of deaths attributable to smoking among women in the United States 35 to 69 years of age increased from 0.6% in 1955 to 15% in 1975 to 31% in 1995; the increase in Japanese women was much less: from 0% in 1955 to 3% in 1975 to 4% in 1995.<sup>114,115</sup>

Reports from CPS II (conducted during 1982–1988) suggest that perhaps as many as half (47.9%) of the deaths among women who were smokers at the time of enrolment in the study were attributable to smoking.<sup>105</sup> In other words, about half of the persistent smokers in that study were eventually killed by their smoking. This proportion was higher than that for female smokers in the American Cancer Society's earlier CPS I study (1959–1965) (18.7%), reflecting the fact that female smokers in CPS I had started smoking later in life and had smoked fewer cigarettes per day than women in CPS II had.<sup>105</sup>

Based on a recent analysis of data from three large Danish population-based studies, it is estimated that among female smokers who inhaled, those who smoked 15 or more cigarettes per day lost 9.4 years of life expectancy, and lighter smokers lost 7.4 years, compared with women who had never smoked.<sup>177</sup>

## The Benefits of Smoking Cessation

Women who quit smoking experience marked reductions in disease risks. Some of the most extensively documented effects are discussed here, but the benefits are not limited to these examples.

Many studies suggest that the infants of women who stop smoking by the first trimester of pregnancy have weight and body measurements similar to those of infants born to non-smoking women.<sup>11,13,51,178–186</sup>

Risk of CHD is markedly reduced (by 25% to 50%) within one to two years of smoking cessation. There is a continued but more gradual reduction to the level of risk of non-smokers by approximately 10 to 15 years following cessation.<sup>78,182–185</sup> Stroke risk among smokers also decreases with smoking cessation; the estimated amount of time needed for risks to approximate those of individuals who have never smoked ranges from less than five years of abstinence to 15 or more years of abstinence.<sup>90,100,183,186</sup>

Individuals who quit smoking experience a slowing in the decline of pulmonary function,<sup>100</sup> a benefit that is considerably greater when cessation occurs at younger ages,<sup>109,187</sup> presumably because the cumulative adverse effects of smoking are less in young people than they are in older smokers who quit. A small improvement in lung function decline occurs during the first year following cessation, and the rate of decline slows in comparison with that of continuing smokers.<sup>188</sup> A number of years after quitting, former smokers have lower relative risks of COPD than continuing smokers, but in most studies their risks are still elevated, compared with those of non-smokers.<sup>103</sup> An analysis based on a large cohort of women in the United States suggests that former smokers' risk of developing chronic bronchitis approached that of individuals who had never smoked approximately 5 years after quitting.<sup>104</sup>

Risk of lung cancer and other cancers also declines with duration of smoking cessation. In CPS II, female former smokers who smoked up to 19 cigarettes per day had a relative risk of lung cancer of 9.1 (compared with women who had never smoked) after 1 to 2 years of not smoking. The risk declined to 2.9 after only 3 to 5 years of not smoking. Among former smokers of 20 or more cigarettes per day, the relative risk was 9.1 for women who had quit 6 to 10 years previously (compared with women

who had never smoked) and declined to 2.6 with 16 or more years of smoking abstinence.<sup>100</sup> Although risk of lung cancer in former smokers declines dramatically, compared with that of continuing smokers, it may never reach the low risk level of individuals who never smoked. Benefits of reduced tobacco consumption are now becoming apparent at the national level in some areas. Among adult women in the United States, smoking prevalence has declined since the mid-1970s, and lung cancer incidence is now declining in all age groups under 60 years of age; in fact, overall age-adjusted lung cancer incidence rates appear to have peaked in the 1990s.

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## China: Hope for Women

Large-scale epidemiological studies of smoking in relation to all-cause and cause-specific mortality among Chinese adults confirm the significant increases in overall risk associated with smoking previously seen in North America and Europe,<sup>189–191</sup> although, at least in men, the principal causes of tobacco-related death are proportionately very different from those in Western countries. Approximately two thirds of Chinese males begin to smoke in early adulthood, and it appears that about half of them will eventually die prematurely as a result of their smoking. The proportion of deaths attributed to smoking has been estimated to increase from 12% in 1990 to 33% in 2030.<sup>192</sup> However, smoking prevalence among young Chinese women is low and may even be declining;<sup>193–195</sup> if the decline continues, the proportion of smoking-attributable deaths among Chinese women will drop from 3% in 1990 to 1% in 2030.<sup>194</sup> Preventing an epidemic of tobacco-related diseases among women in China and

other countries where female smoking prevalence is still low is a tremendous public health opportunity.

## ***Effects of Using Forms of Tobacco Other Than Cigarettes***

Few epidemiological studies have addressed the health effects in women of using forms of tobacco other than modern cigarettes. This is an area that definitely requires further study given that large numbers of women, especially in developing countries, use oral snuff, practise reverse smoking, smoke hand-rolled herbal or other traditional cigarettes, or use other forms of tobacco. Existing evidence suggests that the health effects of smoking tobacco with a water pipe—including higher risks of lung cancer, cardiovascular disease, and harm to the fetus in the case of pregnant women—are similar to those of smoking cigarettes.<sup>196,197</sup> There is some evidence that smokeless tobacco is associated with poor health outcomes at different stages of life; such outcomes include low birth weight of infants, modest cardiovascular disease risk, pancreatic cancer, and oral cancer.<sup>112,198–203</sup> Research in this area is continuing.

## ***Research Gaps***

Additional research on women and smoking is needed in several areas:

- A life-course approach is essential to fully comprehend the health of girls and women of all ages.<sup>204</sup> However, little is known concerning the implications of tobacco smoke exposure from childhood, through adolescence, during the reproductive years, and beyond to old age. More investigation is needed of the later consequences of early life exposures to tobacco smoke. Further research is also needed on how the age of starting to smoke regularly might affect children's growth, risks associated with pregnancy, and subsequent risk for diseases caused by smoking.
- Much better population-level data on smoking prevalence among women are needed, especially prevalence in the developing world. Data collection should occur at regular time intervals, and standardized measures should be used to define various aspects of active and passive smoking, so

that comparisons can be made over time and across populations. A step towards such data collection is being made with the launch of the Global Adult Tobacco Survey (GATS) in 15 high-burden countries.

- High-quality, population-based cancer-incidence data are needed to monitor changes in tobacco-related cancers and to enable compilation of data across countries for better estimation of the worldwide impact of tobacco use on women's health. Cause-specific mortality data would also be useful. The data should be sex- and age-disaggregated as appropriate.
- Studies of the possible modifying effects of lifestyle and environmental exposure on the disease risks associated with smoking are needed. This is especially true for women in the developing world whose dietary, occupational, and other exposures may differ from those of women in the industrialized world, on whom most of the research to date has been conducted.
- Studies are needed to determine whether there are sex differences in susceptibility to nicotine addiction and whether women and men with similar smoking patterns experience different disease risks.
- Studies are needed on girls' and women's understanding of the disease risks associated with tobacco use and on effective means of tobacco-use prevention and cessation among various subgroups of women and girls.
- Studies are needed on the health effects unique to women of using forms of tobacco other than cigarettes, such as smokeless tobacco and pipes.
- Studies are needed to determine whether women who work in tobacco production experience increased disease risks, including effects on the children of those who work in tobacco production while pregnant.

## **Conclusions**

Smoking by women is causally associated with an increased risk of developing and dying from myriad diseases, including many cancers, cardiovascular disease, and COPD, as well as increased risk of adverse reproductive



outcomes. During the latter half of the 20th century, tobacco-related diseases became epidemic among women in the industrialized world, following women's adoption of cigarette smoking earlier in the century. Tobacco-caused diseases will threaten women in developing countries in the 21st century unless sustained efforts are undertaken to curb tobacco use. Preventing an epidemic of tobacco-related diseases among women in the developing world presents one of the greatest public health opportunities of our time.

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