18

The effectiveness and cost-effectiveness of price increases and other tobacco-control policies

Kent Ranson, Prabhat Jha, Frank J. Chaloupka, and Son Nguyen

This chapter provides conservative estimates of the effectiveness and cost-effectiveness of tobacco-control policies. Using a model of the cohort of smokers alive in 1995, we find that tax increases that would raise the real price of cigarettes by 10% worldwide would cause about 42 million of these smokers to quit. This price increase would prevent a minimum of 10 million tobacco-related deaths. A combined set of non-price measures (such as comprehensive bans on advertising and promotion, bans on smoking in public places, prominent warning labels, and mass information) would cause some 23 million smokers alive in 1995 to quit and would prevent 5 million deaths. The non-price measures are assumed to have an effectiveness of 2%—a conservative assumption. Increased use of nicotine-replacement therapies (NRTs), with an assumed effectiveness of 0.5%, would enable some 6 million smokers alive in 1995 to quit and would avert 1 million deaths.

The cost-effectiveness of these interventions in low-income and middle-income countries has also been estimated. By weighing the public-sector costs of implementing and running tobacco-control programs against the years of healthy life saved, measured in disability-adjusted life years, or DALYs, we find that price increases on tobacco would be cost-effective in many circumstances. Depending on various assumptions, price increases could cost between US $4 and $34 per DALY in low-income and middle-income countries. Non-price measures are also cost-effective, ranging from $34 to $685 per DALY in low-income and middle-income countries. NRTs with public provision are also cost-effective in low-income and middle-income countries, ranging from $276 to $851 per DALY. Given that, in practice, there is substantial local variation in the likely effectiveness and costs of these interventions, local assessments are required to guide policy.

18.1 Introduction

Governments considering intervention in the tobacco market need to weigh the costs versus the benefits. In previous chapters, we have discussed the economic costs of control policies (Chapter 7, Chapter 10 and Chapter 13). We now ask whether tobacco control is cost-effective relative to other health interventions. For governments considering intervention, such information may be a further important factor in deciding how to proceed.

The cost-effectiveness of different health interventions can be evaluated by estimating the expected gain in years of healthy life that each will achieve in return for the requisite public costs needed to implement that intervention. According to the World Bank's World Development Report, *Investing in Health* (1993), interventions are considered to be cost-effective if they save a year of healthy life for less than the average gross domestic product per capita of the country. That same report found tobacco-control policies to be cost-effective and worthy of inclusion in a minimal package of healthcare. Existing studies (summarized in Jha *et al.* (1998)) suggest that policy-based programs cost about US$20 to $80 per discounted year of healthy life saved. (For a full explanation of the disability-adjusted life year, or DALY, the reader is referred to Murray and Lopez (1996).)

The purpose of this analysis is to estimate the effectiveness and cost-effectiveness of tobacco-control policies. We examine price increases, nicotine-replacement therapy (NRT), and non-price interventions other than NRT, separately. Effectiveness is measured in terms of the decrease in the number of smokers and decrease in tobacco-attributable deaths. The estimated costs of these interventions are entered into the model so as to generate broad estimates of cost-effectiveness. As with many cost-effectiveness analyses, this analysis is subject to considerable measurement error (Over 1991). Thus, we have ensured that assumptions err on the conservative side, so that the potential impact of the proposed package of interventions is, if anything, underestimated.

18.2 Methods

We have created a simple static model of the impact of tobacco-control policies using the 1995 baseline cohort of *current* smokers. This analysis is restricted to current smokers and is not a dynamic forecast model that includes cohorts of *future* smokers. There are several reasons for our choice of model. First, restricting analyses to current smokers provides results that are conservative, given that future smokers (mostly children) would be expected to be even more responsive to control policies than current smokers (see, for example, Chapter 10, for a discussion of how children are more price-responsive than adults). Second, most of the tobacco-attributable deaths that will occur over the next 50 years will be among current smokers (see Figure 19.1 in Chapter 19). Avoidance of death among this group is, therefore, the most pressing public policy question in tobacco control. Third, a model that incorporates future cohorts of non-smokers becoming smokers and then some of these smokers going on to death is more complex. Changes in future life expectancy, competing mortality, types of tobacco products used in the future, and variation in delay between exposure and disease are some of the factors that might affect whether a non-smoker takes up smoking and whether he or she eventually dies from it. It would be expected that our model would be sensitive to variation in age-specific responsiveness to control policies (Mendez *et al.* 1998). In response, we use conservative values wherever possible. We also limit the total variation in responsiveness to control policies to a certain value, even if age-specific variation is considerable. For example, the total price-elasticity for any region is the age-weighted average of the age-specific elasticities, and does not exceed –0.4 for high-income countries and –0.8 for low-income and middle-income countries. Finally, we present analyses of impact for mortality only, since the addition of disability results introduces further complexities, such as variation in disability weights across regions. However, in order to compare cost-effectiveness results with other studies, we convert these mortality estimates into DALYs, so that the cost in US dollars per healthy year of life saved can be seen.

We used smoking prevalence data for 89 countries from the World Health Organization (WHO 1997) and from the literature to derive estimates by age, region, and gender of smoking prevalence and the number of cigarettes smoked per day (see details in Chapter 2). From these numbers we took the following steps to estimate the global impact of price and non-price interventions.

18.2.1 Baseline numbers of smoking-attributable deaths by region, gender, and age

Using the total number of smokers alive in 1995 we made conservative assumptions about the numbers of deaths among these smokers. Recent studies in high-income countries, and in China and India (Chapter 1; Peto *et al.* 1994), suggest that at least one in two regular smokers who begin smoking during adolescence will eventually be killed by tobacco. The vast majority of smokers live in developing countries, where the prevalence of smoking has been rising in recent decades. Compared to populations in developed countries, these populations have higher death rates associated with causes other than tobacco, and fewer smokers have been smoking since early adult life. Thus, for a conservative analysis, the assumption of a mortality risk of one in two may be too high. The US Centers for Disease Control and Prevention (CDC) estimated how many children and adolescents aged 0–17 would become regular smokers as adults, and, recognizing that not all of them would stay as regular smokers, estimated that 32% of this smoking population would die prematurely from smoking-related diseases (CDC 1996). However, the applicability of these findings worldwide is uncertain. Quitting is rare in low-income and middle-income countries, where most smokers live, and thus the 1995 cohort of smokers probably represents long-term regular smokers (Chapter 2). Therefore, a one-in-three mortality risk may be too low. To be conservative, however, we assumed that 'only' one-third of current smokers would ultimately die of a smoking-attributable cause in all regions. The one-third risk is assumed to be true for males and females and for smokers of all ages. Further we assume that *bidis*, a type of hand-rolled cigarette common in South Asia, confer the same risk of premature death as cigarettes, based on epidemiological studies from India (Gajalakshmi and Peto 1997; Gupta and Mehta, in press). As noted below, we assume that men and women respond equally to interventions. Thus, the differences in results reflect underlying differences in smoking prevalence and age structure in 1995.

18.2.2 The potential impact of price increases

Step 1: Price-elasticity for low- and medium-income, and high-income regions

We assume a price-elasticity of –0.8 in low-income countries and –0.4 in high-income countries, based on an overall review of all available price-elasticity studies (Chapter 10). We reached similar values when we used alternative methods, such as relying on the most recent studies or averaging results across countries. To be conservative, we used short-run elasticities because they indicate a smaller response to a price increase than do long-term estimates. The price-elasticity of *bidis* in South Asia is assumed to be equal to the price-elasticity of cigarettes in low-income and middle-income regions. We base this assumption on the data from Finland (Pekurinen 1989) suggesting that price-responsiveness for hand-rolled cigarettes is approximately equal to that for cigarettes. It is assumed that price-elasticity is the same for males and females; while one study found that women were more responsive to price than men, other studies have suggested the opposite (Chaloupka and Warner, in press).

Step 2: Price-elasticity by age category

Most recent studies in high-income countries that have used nationally representative surveys have found that youth are more responsive to price changes than adults. This finding is consistent with economic theory. Based on several reviews (Warner 1986; Chaloupka 1998), we assume in this analysis that price-elasticity is three times higher amongst 15–19-year-olds, and 1.5 times higher amongst 20–29-year-olds, than amongst those 30 years of age and older. The total price-elasticity for any region is the age-weighted average of the age-specific elasticities, and does not exceed –0.4 for high-income countries and –0.8 for low- and middle-income countries.

Step 3: Impact of a price increase on the number of smokers and the number of smoking-attributable deaths

Price-elasticity expresses the *net* impact of a price change on the quantity demanded for cigarettes (or *bidis*). A price change can either impact on the *fact* of smoking (or prevalence) or the *rate* of smoking (conditional demand) by continuing smokers (CDC 1998). The relative impact of price on prevalence and on conditional demand varies across studies in OECD countries. For these analyses, we used a value of 50% for impact on prevalence. These come from various studies suggesting that slightly more than half of the price effect is on prevalence and just less than half is on average consumption by continuing smokers. Farrelly, for example, found that price-elasticity in the United States was –0.25, with a prevalence elasticity of –0.15 and conditional demand of –0.10 (CDC 1998). Chaloupka and Grossman (1996) and Chaloupka and Wechsler (1997) found that the effect on prevalence for youth and young adults, respectively, is about half of the overall effect. The effect of price on the prevalence of smoking may vary by age group, but for simplicity we assume constant effects on prevalence across age groups.

Calculations are performed for price increases of 10% and 100%. The results of the

100% price increase are more uncertain. Thus, we present these largely as illustrative, and focus the discussion on the smaller price increase. Change in the number of smokers is the product of:

(1) percentage change in the price of cigarettes;
(2) price-elasticity;
(3) impact of 50% on prevalence (see above); and
(4) total number of smokers.

Change in the number of smoking-attributable deaths is the product of:

(1) percentage change in the price of cigarettes;
(2) price-elasticity;
(3) prevalence impact of 50%;
(4) number of tobacco-attributable deaths prior to the price increase; and
(5) a 'mortality adjustment factor'.

Mortality adjustment is intended to account for the fact that not all smokers will be able to avoid a premature, tobacco-related death by quitting. As of yet, there are few large epidemiological studies that provide reliable studies of the age- and sex-specific benefits of cessation. The likelihood of avoiding such a death depends on several factors, including the number of years of smoking, the number of cigarettes smoked per day, and the presence or absence of disease at the time of quitting. Several studies suggest that the reduction in risk with cessation is not linear with age. The results of the American Cancer Society's Cancer Prevention Study II show that although the benefits of cessation extend to quitting at older ages, the relative reduction in risk of dying is greatest for younger quitters (USDHHS 1990). Doll *et al.* (1994) found that doctors in the United Kingdom who quit before age 35 returned to life-table estimates of mortality very close to those of people who had never smoked. Smokers who quit at ages 35–44, 45–54, 55–64, and 65 or older, were also found to have reduced risks of tobacco-related death, but these risks appeared not have a linear relationship with the age of quitting. Earlier work by Peto (1986) suggests that, at least for lung cancers, a three-fold increase in the duration of exposure would increase lung-cancer risk by 100-fold, whereas a three-fold increase in the number of cigarettes smoked daily would increase the risk by only three-fold. Based on data from these studies, we make the following conservative assumptions: 95% of quitters aged 15–29 years will avoid tobacco-related death, while only 75% of quitters aged 30–39, 70% of quitters aged 40–49, 50% of quitters aged 50–59, and 10% of quitters aged 60 or older will avoid tobacco-related death. In keeping with the conservative nature of this analysis, we assume that a decrease in the rate of smoking by those who continue smoking has no impact on mortality.

18.2.3 The potential impact of NRT

The aim of NRT is to provide smokers with modest doses of nicotine in an attempt to suppress the craving for cigarettes. NRT in its various forms (chewing gum, transdermal patches, nasal spray, and inhalers) has repeatedly been shown to increase smokers' chances of quitting (Chapter 12; Raw *et al.* 1998; Silagy *et al.* 1998). A recent meta-analysis found that rates of cessation after at least 6 months are 1.73 times higher with NRT than in controls (Silagy *et al.* 1998). A previous meta-analysis by the same authors found that the pooled abstinence rates (at the longest duration of follow-up available) were 19% among those allocated to NRT and 11% among controls (Silagy *et al.* 1994). Despite this evidence for the efficacy of NRT (most of it from high-income countries), it is difficult to estimate the effectiveness of NRT in real-world settings. Even if NRT could be made widely available at low cost (or even for free), it is difficult to know how many people would choose to access it and use it as indicated.

We estimate that NRTs have an overall effectiveness of 0.5–2.5%. This effectiveness range was derived from reviews of NRT use in the United States (Shiffman *et al.* 1997, 1998), which found that about 40–50% of smokers want to quit and that, of these, between 5% and 35% would wish to use NRTs. We assume that adults of ages 30–59 years will be more willing and able to use this intervention than individuals of ages 15–29 years, and 60 years and older, given they have more disposable income, and are more likely to be aware of the risks of smoking and the benefits of cessation (USDHHS 1990). Hence, NRT is assumed to be 1.5 times as effective among adults aged 30–59 as among other adults.

18.2.4 Potential impact of non-price interventions other than NRT

Non-price interventions other than NRT include the following: complete bans on advertising and promotion of all tobacco products, related logos or trademarks; dissemination of information on the health consequences of smoking (including new research findings); and restrictions on smoking in public places and work places. Complete bans on advertising and promotion may have a modest impact on prevalence (see Chapter 9). As discussed in detail by Kenkel and Chen (Chapter 8), information 'shocks' and new research in the United States in the 1960s are judged to have been responsible for reducing the prevalence of smoking by 5–10% (USDHHS 1989). Workplace bans on smoking in the United States are judged to have reduced total smoking prevalence by approximately 4–10% (Chapter 11). Specific attempts to quantify the aggregate impact of non-price interventions have not yet been made. Thus, in this analysis, it is assumed that a package including all of the non-price interventions would reduce prevalence by between 2% and 10%. Given research that youths are more sensitive to advertising and promotion, at least in the United States (DiFranza *et al.* 1991), we assume that a complete ban on advertising and promotion would more likely effect adolescents. On the other hand, clean-air laws and mass information are more likely to reduce adult smoking. Low-income and middle-income countries can more easily enforce advertising and promotion bans than they can clean-air laws (see Table 11.1 in Chapter 11). For these reasons, we assume constant effectiveness of a package of these interventions across age groups.

18.2.5 Cost-effectiveness of anti-smoking interventions

Many tobacco-control policies cost very little. Tax increases can often be done by legislation alone, if a strong tax-collection system is in place. To be conservative, we estimate that interventions, such as research dissemination and mass counter-advertising campaigns, incur administrative costs, and that tax increases incur enforcement costs to collect taxes. We further assume that one-time costs for NRTs would be required to help some of the 1995 cohort of smokers to quit. We use the same annual, public-sector costs for both price increases and the set of non-price interventions other than NRT. Based on costing estimates in the World Bank Review of Disease Control Priorities (Barnum and Greenberg 1993), and an unpublished review of costs for mass information campaigns in World Bank projects, we assume that the annual costs of *each* are 0.005–0.02% of current Gross National Product (GNP). The low end of this range approximates actual levels of spending on tobacco control in North America. For example, expenditure on tobacco research and education in Canada totalled 0.009% of GNP in 1996 and 0.002% in 1997. In the United States, an average of 0.003% of GNP was spent on tobacco research and education from 1994 to 1996 (Pechman *et al.* 1998). The US Centers for Disease Control and Prevention (CDC 1999) recommends that American states spend 0.026–0.036% of GNP on tobacco research and education. This level slightly exceeds the high end of the range used in this analysis. World Bank estimates of GNP for each of the regions are used (in 1997 US dollars). The assumed cost of the NRT intervention can be broken down into two components. The first is the 'non-drug' costs of the intervention (e.g. administrative and education costs). These costs are assumed to be the same as the cost of a price increase and the cost of non-price interventions other than NRT (i.e. 0.005–0.02% of GNP per person per year). The second component is the cost of the drugs themselves (i.e. the cost of nicotine gum, patches, etc.). Based on industrial marketing data (IMS 1998) we assume that each individual who attempts to quit in low-income or middle-income countries will spend $50 for short-term use of NRT. In high-income countries we assume that the amount spent will be $100. Further, based on data from Silagy *et al.* (1998), we calculate NRT costs to include the fact that for every person who is successful at quitting, ten others will use NRT unsuccessfully. The costs of a price increase and of NRT are assumed to occur only for the year of implementation. Non-price interventions, in contrast, comprise ongoing costs for counter-advertising and research, so these costs are assumed to recur each year for a period of 30 years. Costs of interventions are discounted by between 3% and 10% per annum.

The effectiveness of the interventions is measured by the numbers of deaths averted, calculated as described above. Future deaths among the cohort of smokers alive in 1995 are converted into DALYs using the region-specific ratios of tobacco-attributable deaths from a study by Murray and Lopez (1996; WHO 1996). Murray and Lopez estimate that DALYs lost will be at a steady rate over the next 30 years. The exact trend in deaths or DALYs is uncertain. A linear trend seems reasonable, given projections from China (Liu *et al.* 1998). Like costs, DALYs lost in the future are discounted by between 3% and 10%.

18.3 Results

18.3.1 Baseline estimates of smoking-attributable deaths

Of the estimated 1.1 billion smokers in 1995, it is estimated that one-third, or about 377 million, will ultimately die of a smoking-related illness (Table 18.1). Low-income

Table 18.1 Estimated number of smokers alive in 1995 who will ultimately die of smoking-attributable causes, by region

Region	Smoking-attributable deaths	
	Number (millions)	Percentage of total
East Asia and Pacific	136	36
Europe and Central Asia	48	13
Latin America and Caribbean	31	8
Middle East and North Africa	13	4
South Asia (cigarettes)	29	8
South Asia (bidis)	33	9
Sub-Saharan Africa	19	5
Low-income and middle-income	310	82
High-income	68	18
World	377	100

Source: authors' calculations. Note: numbers have been rounded.

and middle-income countries account for 82% (or 310 million) smoking-attributable deaths, and an equivalent percentage of the world's population aged 15 years and older. East Asia and the Pacific, which includes China, accounts for 36% (136 million) of smoking-attributable deaths, but only 32% of the population aged 15 years and over.

18.3.2 Potential impact of price increases

With a price increase of 10%, it is predicted that more than 40 million people will quit smoking worldwide (4% of all smokers in 1995, Table 18.2). This same price increase will result in 10 million smoking-attributable deaths being averted (3% of all smoking-attributable deaths expected amongst those who smoke in 1995). A price increase of 100% results in proportional increases in these outcome variables. Low-income and middle-income countries account for about 90% of quitters and averted deaths. East Asia and the Pacific alone account for roughly 40% of quitters and averted deaths.

Of the tobacco-related deaths that would be averted by a price increase, 80% would be male, reflecting the higher overall prevalence of smoking in men (Table 18.3). The greatest relative impact of a price increase on deaths averted is among younger age-cohorts. With a price increase of 100%, more than 80% of smoking-attributable deaths amongst smokers who are 15–19 years of age in 1995 would be averted, and about 40% of deaths amongst smokers aged 20–29 in 1995 would be averted. A significant portion

Table 18.2 Change in number of smokers and smoking-attributable deaths with price increases of 10% and 100%, by World Bank region, for smokers alive in 1995

Region	Change in number of smokers in millions (and % of all smokers) with price increases of			Change in number of deaths in millions (and % of all smoking deaths expected) with price increases of		
	10%	100%	% Total	10%	100%	% Total
East Asia and Pacific	–16.5 –(4.0)	–165.2 –(40.0)	39.7	–4.3 –(3.1)	–42.8 –(31.4)	41.3
Europe and Central Asia	–5.8 –(4.0)	–57.9 –(40.0)	13.9	–1.4 –(3.0)	–14.2 –(29.8)	13.8
Latin America and Caribbean	–3.8 –(4.0)	–38.1 –(40.0)	9.1	–1.0 –(3.3)	–10.4 –(33.3)	10.1
Middle East and North Africa	–1.6 –(4.0)	–16.1 –(40.0)	3.9	–0.4 –(3.0)	–4.0 –(29.9)	3.8
South Asia (cigarettes)	–3.5 –(4.0)	–35.3 –(40.0)	8.5	–0.7 –(2.5)	–7.3 –(25.0)	7.0
South Asia (bidis)	–4.0 –(4.0)	–39.5 –(40.0)	9.5	–0.8 –(2.5)	–8.1 –(24.8)	7.8
Sub-Saharan Africa	–2.4 –(4.0)	–23.6 –(40.0)	5.7	–0.7 –(3.4)	–6.6 –(33.8)	6.3
Low-income and middle-income	–37.6 –(4.0)	–375.7 –(40.0)	90.2	–9.3 –(3.0)	–93.4 –(30.1)	90.2
High-income	–4.1 –(2.0)	–40.9 –(20.0)	9.8	–1.0 –(1.5)	–10.1 –(15.0)	9.8
World	–41.7 –(3.6)	–416.6 –(36.4)	100.0	–10.3 –(2.7)	–103.5 –(27.4)	100.0

Source: authors' calculations.

(40%) of deaths averted will occur among smokers who are aged 30 years and older at the time of cessation.

18.3.3 Potential impact of NRT

Provision of NRTs with an effectiveness of 0.5% is predicted to result in about 6 million people giving up smoking and 1 million smoking-attributable deaths being averted (Table 18.4). NRT of 2.5% effectiveness is predicted to have five times the impact. Low-income and middle-income countries account for roughly 80% of quitters and averted deaths, and more than 70% of the global decrease in tobacco consumption.

Table 18.3 Worldwide change in number of smoking-attributable deaths, with a price increase of 100%, by age and gender, for smokers alive in 1995

Age categories	Males		Females		Males and Females	
	Number in millions (and % of all male smoking deaths in each category)	% of all averted male smoking deaths	Number in millions (and % of all female smoking deaths in each category)	% of all averted female smoking deaths	Number in millions (and % of all smoking deaths in each category)	% of all averted smoking deaths
15–19	–23.2 –(81.8)	27.0	–3.1 –(75.9)	17.6	–26.3 –(81.1)	25.4
20–29	–27.7 –(39.5)	32.2	–6.7 –(37.0)	38.2	–34.4 –(39.0)	33.2
30–39	–16.8 –(21.6)	19.5	–3.8 –(19.7)	21.6	–20.6 –(21.2)	19.9
40–49	–12.1 –(20.1)	14.1	–2.6 –(18.4)	15.2	–14.7 –(19.8)	14.2
50–59	–5.2 –(14.7)	6.1	–1.0 –(13.9)	5.9	–6.3 –(14.5)	6.1
60+	–1.0 –(2.9)	1.1	–0.3 –(3.0)	1.6	–1.3 –(3.0)	1.2
TOTAL	–86.0 –(28.2)	100.0	–17.4 –(24.2)	100.0	–103.5 –(27.4)	100.0
% Total	83.1		16.9		100.0	

Source: authors' calculations.

Males account for about 80% of tobacco-attributable deaths averted as a result of NRT (Table 18.5). The relative impact of NRT on deaths averted is 1.4–2.2% amongst individuals aged 15–59 years, and lower amongst those 60 years and older. The cohort aged 30–59 in 1995 will account for 65% of deaths averted.

18.3.4 Potential impact of non-price interventions other than NRT

A package of non-price interventions, other than NRT, that decreases the prevalence of smoking by 2% is predicted to cause about 23 million people to quit smoking worldwide (2% of all smokers in 1995, Table 18.6). This same package of interventions would result in about 5 million smoking-attributable deaths being averted (1% of all smoking-attributable deaths amongst those who smoke in 1995). A package of interventions that decreases the prevalence of smoking by 10% would have an impact five times greater. As with NRT, low-income and middle-income countries account for approximately three-quarters of quitters and averted deaths.

Of all tobacco-attributable deaths averted as a result of non-price interventions, 80% would be male (Table 18.7). The greatest relative impact of non-price interventions on deaths averted would be among younger age cohorts. A package that results in a 10%

Table 18.4 Change in number of smokers and smoking-attributable deaths with NRT of 0.5% and 2.5% effectiveness, by World Bank region, for smokers alive in 1995

Region	Change in number of smokers in millions (and % of all smokers) with effectiveness of			Change in number of deaths in millions (and % of all smoking deaths expected) with effectiveness of		
	0.5%	2.5%	% Total	0.5%	2.5%	% Total
East Asia and Pacific	–2.1 –(0.5)	–10.3 –(2.5)	36	–0.5 –(0.4)	–2.4 –(1.8)	37
Europe and Central Asia	–0.7 –(0.5)	–3.6 –(2.5)	13	–0.2 –(0.3)	–0.8 –(1.7)	13
Latin America and Caribbean	–0.5 –(0.5)	–2.4 –(2.5)	8	–0.1 –(0.4)	–0.6 –(1.9)	9
Middle East and North Africa	–0.2 –(0.5)	–1.0 –(2.5)	4	–0.05 –(0.3)	–0.2 –(1.7)	3
South Asia (cigarettes)	–0.4 –(0.5)	–2.2 –(2.5)	8	–0.1 –(0.3)	–0.4 –(1.5)	7
South Asia (bidis)	–0.5 –(0.5)	–2.5 –(2.5)	9	–0.1 –(0.3)	–0.5 –(1.5)	7
Sub-Saharan Africa	–0.3 –(0.5)	–1.5 –(2.5)	5	–0.1 –(0.4)	–0.4 –(1.9)	6
Low-income and middle-income	–4.7 –(0.5)	–23.5 –(2.5)	82	–1.1 –(0.3)	–5.4 –(1.7)	82
High-income	–1.0 –(0.5)	–5.1 –(2.5)	18	–0.2 –(0.3)	–1.2 –(1.7)	18
World	–5.7 –(0.5)	–28.6 –(2.5)	100	–1.3 –(0.3)	–6.6 –(1.7)	100

Source: authors' calculations.

decrease in smoking prevalence would avert roughly 10% of smoking deaths amongst smokers aged 15–29 in 1995, and 5–9% of deaths amongst smokers aged 30–59 in 1995. The cohort aged 20–29 in 1995 will account for the greatest percentage (about 32%) of deaths averted.

18.3.5 Cost-effectiveness of anti-smoking interventions

Price increases are found to be the most cost-effective anti-smoking intervention. These could be achieved for a cost of US$18–151 per DALY saved globally. Wider access to NRT could be achieved for between $353 and $1869 per DALY saved, depending on a wide range of conditions. Non-price interventions other than NRT

Table 18.5 Worldwide change in number of smoking-attributable deaths, with NRT of 2.5% effectiveness, by age and gender, for smokers alive in 1995

Age categories	Males		Females		Males and Females	
	Number in millions (and % of all male smoking deaths in each category)	% of all averted male smoking deaths	Number in millions (and % of all female smoking deaths in each category)	% of all averted female smoking deaths	Number in millions (and % of all smoking deaths in each category)	% of all averted smoking deaths
15–19	–0.5 –(1.9)	9.9	–0.1 –(1.9)	6.0	–0.6 –(1.9)	9.2
20–29	–1.3 –(1.9)	24.5	–0.3 –(1.9)	26.8	–1.6 –(1.9)	24.9
30–39	–1.7 –(2.2)	31.9	–0.4 –(2.2)	33.6	–2.1 –(2.2)	32.2
40–49	–1.2 –(2.0)	22.9	–0.3 –(2.0)	23.5	–1.5 –(2.0)	23.0
50–59	–0.5 –(1.4)	9.7	–0.1 –(1.5)	8.7	–0.6 –(1.5)	9.5
60+	–0.1 –(0.2)	1.2	0.0 –(0.2)	1.5	–0.1 –(0.2)	1.3
TOTAL	–5.3 –(1.8)	100.0	–1.2 –(1.7)	100.0	–6.6 –(1.7)	100.0
% Total	81.1		18.9		100.0	

Source: authors' calculations.

could be implemented for between $140 and $2805 per DALY saved, again, with a wide range of conditions (Table 18.8). Thus, NRT and other non-price measures are slightly less cost-effective than price increases, but remain cost-effective in many settings.

For a given set of assumptions, the variation in the cost-effectiveness of each intervention between low-income and middle-income regions is relatively small. All three interventions are most cost-effective in South Asia and Sub-Saharan Africa, and least cost-effective in Latin America and the Caribbean. The difference between low-income and middle-income countries, and high-income countries is more pronounced. For NRT, the cost per year of healthy life gained is three to eight times higher in high-income countries than elsewhere. For non-price interventions other than NRT, the cost in high-income countries is 20 times higher; and for price increases, almost 40 times higher.

The estimates of cost-effectiveness are subject to wide ranges. For price increases, the high-end estimates are roughly eight times the low-end estimates, and this difference is consistent among the regions. For NRT, the high-end estimates are 2.5–10 times the low-end estimates, varying among the regions. Finally, for non-price interventions

Table 18.6 Change in number of smokers and smoking-attributable deaths, with non-price interventions (other than NRT) of 2% and 10% effectiveness, by World Bank region, for smokers alive in 1995

Region	Change in number of smokers in millions (and % of all smokers) with effectiveness of			Change in number of deaths in millions (and % of all smoking deaths expected) with effectiveness of		
	2%	10%	% Total	2%	10%	% Total
East Asia and Pacific	–8.3 –(2.0)	–41.3 –(10.0)	36.1	–2.0 –(1.4)	–9.9 –(7.2)	37.2
Europe and Central Asia	–2.8 –(2.0)	–14.5 –(10.0)	12.7	–0.7 –(1.4)	–3.3 –(7.0)	12.6
Latin America and Caribbean	–1.8 –(1.9)	–9.5 –(10.0)	8.3	–0.5 –(1.6)	–2.5 –(7.9)	9.3
Middle East and North Africa	–0.8 –(2.0)	–4.0 –(10.0)	3.5	–0.2 –(1.4)	–0.9 –(6.9)	3.5
South Asia (cigarettes)	–1.8 –(2.0)	–8.8 –(10.0)	7.7	–0.3 –(1.2)	–1.7 –(5.9)	6.5
South Asia (bidis)	–2.0 –(2.0)	–9.9 –(10.0)	8.6	–0.4 –(1.2)	–1.9 –(5.9)	7.2
Sub-Saharan Africa	–1.1 –(1.9)	–5.9 –(10.0)	5.1	–0.3 –(1.6)	–1.5 –(7.9)	5.8
Low-income and middle-income	–18.6 –(2.0)	–93.9 –(10.0)	82.1	–4.4 –(1.4)	–21.8 –(7.0)	82.1
High-income	–4.0 –(2.0)	–20.5 –(10.0)	17.9	–0.9 –(1.4)	–4.7 –(7.0)	17.9
World	–22.6 –(2.0)	–114.4 –(10.0)	100.0	–5.3 –(1.4)	–26.5 –(7.0)	100.0

Source: authors' calculations.

other than NRT, the high-end estimates are 20 times the low-end estimates, and this difference is consistent among the regions.

18.4 Discussion

Our analyses suggest that price increases of 10% would be the most effective and cost-effective of the three interventions examined. Accepting that the results in this study represent very conservative estimates, the reductions in mortality are still quite impressive. Price increases as low as 10%, NRT use that enables 0.5% of smokers to quit, and

Table 18.7 Worldwide change in number of smoking-attributable deaths, with non-price interventions (other than NRT) of 10% effectiveness, by age and gender, for smokers alive in 1995

Age categories	Males		Females		Males and Females	
	Number in millions (and % of all male smoking deaths in each category)	% of all averted male smoking deaths	Number in millions (and % of all female smoking deaths in each category)	% of all averted female smoking deaths	Number in millions (and % of all smoking deaths in each category)	% of all averted smoking deaths
15–19	–2.7 –(9.5)	13	–0.4 –(9.5)	8	–3.1 –(9.5)	12
20–29	–6.7 –(9.5)	31	–1.7 –(9.5)	34	–8.4 –(9.5)	32
30–39	–5.8 –(7.5)	27	–1.4 –(7.5)	29	–7.3 –(7.5)	27
40–49	–4.2 –(7.0)	20	–1.0 –(7.0)	20	–5.2 –(7.0)	20
50–59	–1.8 –(5.0)	8	–0.4 –(5.0)	7	–2.2 –(5.0)	8
60+	–0.3 –(1.0)	2	–0.1 –(1.0)	2	–0.4 –(1.0)	2
TOTAL	–21.5 –(7.0)	100	–5.0 –(6.9)	100	–26.5 –(7.0)	100
% Total	81.1		18.9		100.0	

Source: authors' caculations.

non-price interventions that reduce smoking prevalence by 2%, could save many lives if applied to large populations. Table 18.9 summarizes these results.

8.4.1 Comparison with existing estimates

We can compare our results against existing studies only for high-income countries, given the lack of studies in low-income countries. Moore (1996) has conducted the only direct study of the deaths avoided by tax increases on tobacco. Using data from the United States on tobacco-related death rates for the period from 1954 through 1988, he estimated the impact of an increase of 10% in the cigarette tax. Assuming that taxes are 25% of price, a 10% tax increase results in a price increase of 2.5%. The higher price resulted in a 1.5% decrease in the annual number of deaths from respiratory cancers and a 0.5% decrease in the annual number of deaths from cardiovascular disease. Based on mortality data from Peto *et al.* (1994), this represents a short-run decrease in tobacco-related deaths of more than 1.5%. Other studies using an indirect methodology similar to ours have generally found greater reductions in smoking or smoking-attributable mortality with smaller price increases (Harris 1983; Warner 1986;

Table 18.8 Range of cost-effectiveness values for price, NRT and non-price interventions (US dollars/DALY saved), by region

Region	Price increase of 10%		NRT effectiveness of 0.5–2.5%		Non-price other than NRT effectiveness of 2–10%	
	Low-end Estimate[1]	High-end Estimate[2]	Low-end Estimate[3]	High-end Estimate[4]	Low-end Estimate[5]	High-end Estimate[6]
East Asia and Pacific	3	26	335	911	26	527
Europe and Central Asia	4	33	227	739	33	658
Latin America and Caribbean	10	87	241	1213	86	1726
Middle East and North Africa	7	58	223	944	60	1192
South Asia	2	16	289	722	15	309
Sub-Saharan Africa	2	19	196	566	19	386
Low-income and middle-income	4	34	276	851	34	685
High-income	165	1370	749	7142	689	13775
World	18	151	353	1869	140	2805

[1] Calculations based on: intevention cost of 0.005% of GNP, benefits (DALYs saved) distributed over 30 years, and discounted at 3%.
[2] Calculations based on: intervention cost of 0.02% of GNP, benefits distributed over 30 years and discounted at 10%.
[3] Calculations based on: effectiveness of 2.5%, intervention cost of 0.005% of GNP (plus drug costs), benefits distributed over 30 years, and discounted at 3%.
[4] Calculations based on: effectiveness of 0.5%, intervention cost of 0.02% of GNP (plus drug costs), benefits distributed over 30 years, and discounted at 10%.
[5] Calculations based on: effectiveness of 10%, intervention cost of 0.005% of GNP and repeated annually over 30 years, and discounted at 3%, benefits distributed over 30 years and discounted at 3%.
[6] Calculations based on: effectiveness of 2%, intervention cost of 0.02% of GNP and repeated annually over 30 years, and discounted at 10%, benefits distributed over 30 years and discounted at 10%.

Source: authors' calculations.

Chaloupka 1998). For example, Warner (1986) estimated that an increase of 8% in cigarette prices in the United States would avoid about 450 000 deaths, or about 3% of the tobacco-attributable deaths. In contrast, we find that in high-income countries, a 10% price increase would decrease tobacco-attributable premature deaths by 1.5%. This suggests our analyses are conservative.

Our cost-effectiveness results for high-income countries appear to be conservative compared with those of other studies in high-income countries. A 1997 study from the United Kingdom found that the cost per life-year gained using community-wide interventions varied from £107 to £3622 (approximately US$171–5800). Brief advice from a physician was found to cost £469 ($750) per life-year saved, while the addition of nicotine gum cost £2370 ($3800) per life-year saved (Buck *et al.* 1997). In general,

Table 18.9 Summary of effectiveness of tobacco-control policies, by region

Region	Change in the number of smokers (million)			Change in the number of deaths (million)		
	10% price increase	NRT that enables 0.5% of smokers to quit	Non-price measures that reduce smoking prevalence by 2%	10% price increase	NRT that enables 0.5% of smokers to quit	Non-price measures that reduce smoking prevalence by 2%
Low-income and middle income	–37.6	–4.7	–18.6	–9.3	–1.1	–4.4
High-income	–4.1	–1.0	–4.0	–1.0	–0.2	–0.9
World	–41.7	–5.7	–22.6	–10.3	–1.3	–5.3

Source: authors' calculations.

these results fall within the lower half of our range of estimates of cost-effectiveness for high-income countries. A separate study of nicotine gum found that, as an adjunct to counseling, it would cost between $4113 and $6465 per year of life saved for males, and between $6880 and $9473 per year of life saved for females (Oster *et al.* 1986). Another study found the cost-effectiveness of nicotine patch therapy matched with brief physical counselling to range from $4390 for 35–39-year-old males to $10 943 for 65–69-year-old males (Fiscella and Franks 1996). These values overlap with the higher end of the range of estimates of cost-effectiveness of NRT for high-income countries calculated above. An evaluation of a proposed mass television campaign for the United Kingdom suggested that one year of life could be saved for US$10–20 (Reid 1996). This value falls far below the range of cost-effectiveness values for non-price interventions other than NRT calculated in the present analysis. Reid assumed lower costs (US$18 million per year, or 0.0015% of GNP), and a quit rate of 2.5%.

8.4.2 Comparing cost-effectiveness to other health interventions

Our findings suggest that these interventions are also cost-effective relative to other health interventions (Table 18.8). The cost-effectiveness of tax increases compares favorably with many health interventions. Depending on the assumptions made about the administrative costs of raising and monitoring higher tobacco taxes, the cost of implementing a price increase of 10% ranges from $4 to $34 per DALY in low-income and middle-income countries Table 18.10 summarizes these results.

Countries that implement these interventions may experience much wider ranges (see Table 18.8, where for the low-income and middle-income countries, the values for price increases of 10% range from 2 to 87). Overall, tax increases represent cost-effectiveness values comparable to many health interventions financed by governments, such as child immunization (cost per DALY of about $25; World Bank 1993). Non-price measures may also be highly cost-effective for low-income and middle-

Table 18.10 Summary of cost-effectiveness of tobacco control policies, by region, in US$ per DALY

Region	Price increases of 10%	Non-price measures with effectiveness of 2–10%	NRTs with effectiveness of 0.5–2.5%
Low-income and middle income	4–34	276–851	34–685
High-income	165–1370	749–7142	689–13775
World	18–151	353–1869	140–2805

Source: authors' calculations.

income countries. Depending on the assumptions on which the estimates are based, a package could be delivered for as little as $34 per DALY. This level of cost-effectiveness compares reasonably with several established interventions in public health, such as the package for the integrated management of the sick child, which has been estimated to cost between $30 and $50 per DALY in low-income countries and between $50 and $100 in middle-income countries (WHO 1996). NRT and other non-price interventions are also likely to be good investments, but the extent to which they should be utilized should be determined with country-specific cost-effectiveness analyses.

8.4.3 Effectiveness by region and with combined interventions

In this analysis, the effectiveness of non-price interventions is assumed to be the same in all regions. It may be possible, however, that effectiveness of these interventions differs between countries. For example, information campaigns may be much more effective in developing countries, given the relative novelty of the information (Chapter 8), and thus their impact might be similar to the impact of the health reports of the 1960s in the United States and the United Kingdom. One could similarly argue that advertising and promotion bans would also be relatively more effective in these countries. In contrast, clean-air laws are less likely to have an effect in low-income countries (Chapter 11).

No attempt has been made in this analysis to examine the impact of combining the various packages of interventions (e.g. price increases with NRT, or NRT and other non-price interventions). Although a number of studies have compared the impact of price and non-price interventions, few empirical attempts have been made to assess how these interventions might interact (CDC 1996b). It might be expected that the marginal impact of one policy could be lower or higher in the presence of another. For example, if price increases and NRT both facilitate cessation amongst the small population that is 'least addicted', then the impact of these two interventions combined might be less than the sum of their impacts if implemented independently. Alternatively, if these interventions act on different segments of the smoking population, then it is possible that the two interventions would interact in an additive fashion. It is also quite possible that interventions interact synergistically. For example, a massmedia campaign might potentiate the impact of NRT by making more people aware of the availability and benefits of this intervention.

8.4.4 Conservative assumptions on effectiveness and cost-effectiveness

Several features of our analyses suggest that our results are appropriately conservative. First, we use only the 1995 cohort of smokers, and ignore effects on future cohorts. Second, we estimate that 'only' one in three of current smokers are killed by their addiction. Third, we estimate that the reduced rate of smoking has no impact on mortality. Fourth, in estimating effectiveness, we do not calculate the additional benefits expected from reductions in morbidity over and above the benefits of preventing deaths (USDHHS 1990). Finally, our analysis is also conservative in estimating the public-sector costs of intervening. Some of the interventions, such as raising taxes or banning advertising and promotion, have zero or minimal costs, as these are 'stroke-of-the pen' interventions. To be conservative, we have assigned substantial implementation and administrative costs, along with drug costs for NRT.

Our assumptions on price elasticities merit further elaboration. We use short-run price-elasticities. In high-income countries, it appears that long-run elasticities may be two-fold higher. The long-run elasticity in low-income and middle-income countries may not be double the short-run elasticities in these countries, however. This is partly because the reasons that lower-income countries are more price-sensitive will have some impact on the ratio of short- to long-run elasticities, but would still be expected to be greater (Chapter 10). As such, our estimated reductions in mortality are likely to be smaller than the real number. In addition, we assume that price responsiveness for younger age groups is high and similar across regions. Economic theory would suggest that part of the greater price sensitivity in lower-income countries is for the same reasons as the greater price sensitivity of youth (Chapter 10). Thus, we might have over-estimated the impact of price changes on the prevalence of smoking in young people. Of course, for these same reasons, we might have under-estimated the impact on adult smoking in low-income countries, given that the overall price-responsiveness was fixed in our model not to exceed –0.8 for all age groups in those countries. Finally, we use a constant price-elasticity. An alternative is to assume linear demand, implying that elasticity rises as price rises, and that larger price increases produce disproportionately larger reductions in smoking. There is no reliable evidence population-based studies to verify a linear demand curve. However, some behavioral economics studies suggest that elasticity does rise with price (Bickel and Madden 1999).

It is important to point out that the costs assessed in our cost-effectiveness analyses do not include those borne by individuals. The omission of these costs from similar earlier analyses has led some experts to criticize them (Warner 1997). For example, it is difficult to describe the personal (or individual) costs of being prevented from smoking in certain places. As discussed in earlier chapters (e.g. Chapter 7), the biggest costs of tax increases are likely to be those borne by individuals. The welfare impact is difficult to estimate, given that welfare losses would differ for current smokers versus future smokers, and because of information and addiction issues. Moreover, the inclusion of such costs would force us to enter the more complex area of cost–benefit analyses, which require the analyst to impose a dollar value on a year or human life, which many are unwilling to do, and also to include non-health burdens, such as lost income from disease. For the purposes of the health sector, cost-effectiveness analyses are assumed to be a better choice. Private costs are, as a rule, not included in cost-effectiveness analyses of health interventions (Over 1991; Jamison 1993) and many health interventions do impose such costs. For example, child immunization imposes costs of parents taking time off work, travel to the clinic etc. Tobacco-control interventions are not, in principle, different from these other interventions.

18.5 Conclusions

Existing instruments of tax increases, a set of non-price information measures, and NRT policies, are all highly effective, and make small but quite worthwhile reductions in mortality. Several millions of premature deaths could be avoided with a combination of these interventions.

Tobacco control is cost-effective relative to other health interventions. Our analyses suggest that tax increases would be cost-effective. Non-price measures are also cost-effective in many settings. Measures to liberalize access to NRT, e.g. by changing the conditions for its sale, are likely to be cost-effective in most settings. However, individual countries would need to make careful assessments before deciding to provide subsidies for NRT and other cessation interventions for poor smokers. As with all cost-effectiveness analyses, our estimates are subject to considerable variation in actual settings, notably in costs. Thus, local cost-effectiveness studies are required to guide local policy.

References

Barnum, H. and Greenberg, R. E. (1993). Cancers. In *Disease Control Priorities in Developing Countries* (ed. D. T. Jamison, H. W Mosley, A. R. Measham, and J. L. Bobadilla), pp. 529–60. Oxford Medical Publications, New York.

Bickel, W. K. and Madden, G. J. (1997). *The Behavioral Economics of Smoking*. Presented at the National Bureau of Economic Research Conference on The Economic Analysis of Substance Use and Abuse: An Integration of Econometric and Behavioral Economic Research, Boston.

Buck, D., Godfrey, C., Parrott, S., and Raw, M. (1997). *Cost-effectiveness of Smoking Cessation Interventions*. Centre for Health Economics, University of York and Health Education Authority, York.

Centers for Disease Control and Prevention (1996a). Cigarette smoking before and after an excise tax increase and an antismoking campaign—Massachusetts, 1990–1996. *Morbidity and Mortality Weekly Report*, **45**(44), 996–70.

Centers for Disease Control and Prevention (1996b). Projected smoking-related deaths among youth—United States. *Morbidity and Mortality Weekly Report*, **45**(44), 966–70.

Centers for Disease Control and Prevention (1998). Response to increases in cigarette prices by race/ethnicity, income, and age groups—United States, 1976–1993. *Morbidity and Mortality Weekly Report*, **47**(29), 605–9.

Centers for Disease Control and Prevention (1999). *Best practices for Comprehensive Tobacco Control Programs–August 1999*. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and health, Atlanta GA.

Chaloupka, F. J. (1998). *The Impact of Proposed Cigarette Price Increases*. Policy Analysis No. 9, Health Science Analysis Project, Advocacy Institute, Washington D.C.

Chaloupka, F. J. and Grossman, M. (1996). *Price, Tobacco-control policies and Youth Tobacco Use*. National Bureau of Economic Research Working Paper number 5740.

Chaloupka, F. J. and Warner, K. E. The economics of smoking. In *The Handbook of Health Economics* (ed. J. Newhouse and A. Culyer). New York: North-Holland. (In press.)

Chaloupka, F. J. and Wechsler, H. (1997). Price, tobacco-control policies and smoking among young adults. *Journal of Health Economics*, **16**(3), 359–73.

DiFranza, J. R., Richards, J. W., Paulman, P. M., Wolf-Gillespie, N., Fletcher, C., Jaffe, R. D. *et al.* (1991). RJR Nabisco's cartoon camel promotes camel cigarettes to children. *JAMA*, **266**(22), 3149–53.

Doll, R., Peto, R., Wheatley, K., Gray, R., and Sutherland, I. (1994). Mortality in relation to smoking: 40 years' observations on male British doctors. *BMJ*, **309**, 901–11.

Fiscella, K. and Franks, P. (1996). Cost-effectiveness of the transdermal nicotine patch as an adjunct to physicians' smoking cessation counselling. *Journal of the American Medical Association*, **275**(16), 1247–51.

Gajalakshmi, C. K. and Peto, R. (1997). *Studies on Tobacco in Chennai, India*. Presented at the 10th World Conference on Tobacco or Health, Chinese Medical Association, Beijing.

Gupta, P. C. and Mehta, H. C. A cohort study of all-cause mortality among tobacco users in Mumbai, India. *The International Journal of Public Health.* (In press.)

Harris, J. E. (1987). The 1983 increase in the federal cigarette excise tax. In*Tax Policy and the Economy*, vol. 1 (ed. : L. H. Summers), pp. 87–111. MIT Press, Cambridge (MA).

IMS Global Services (1998). *Medical Information Database (MIDAS).* Plymouth Meeting, PA, USA.

Jamison, D. T. (1993). Disease control priorities in developing countries: an overview. In *Disease Control Priorities in Developing Countries* (ed. D. T. Jamison, H. W. Mosley, A. R. Measham, and J. L. Bobadilla), pp. 3–34. Oxford Medical Publications, New York.

Jha, P., Novotny, T. E., and Feachem, R. (1998). The role of governments in global tobacco control. In *The Economics of Tobacco Control: Towards an Optimal Policy Mix* (ed. I. Abedian, R. van der Merwe, N. Wilkins, and P. Jha), pp. 38–56. Applied Fiscal Research Centre, University of Cape Town, South Africa.

Leu, R. E. and Schaub, T. (1983). Does smoking increase medical expenditures? *Social Science & Medicine*, **17**(23), 1907–14.

Liu, B. Q., Peto, R., Chen, Z. M., Boreham, J., Wu, Y. P., Li, J. Y. *et al.* (1998). Emerging tobacco hazards in China. I. Retrospective proportional mortality study of one million deaths. *BMJ*, **317**(7170), 1411–22.

Mendez, D., Warner, K. E., and Courant, P. N. (1998). Has smoking cessation ceased? Expected trends in the prevalence of smoking in the United States. *Am. J. Epidemiol.*, **148**(3), 249–58.

Moore, M. J. (1996). Death and tobacco taxes. *RAND Journal of Economics*, **27**(2), 415–28.

Murray, C. J. and Lopez, A. D. (ed.) (1996). *The Global Burden of Disease.* Harvard University Press, Boston.

Oster, G., Huse, D. M., Delea, T. E., and Colditz, G. A. (1986). Cost-effectiveness of nicotine gum as an adjunct to physician's advice against cigarette smoking. *JAMA*, **256**, 1315–18.

Over, M. (1991). *Economics for Health Sector Analyses: Concepts and Cases.* Economic Development Institute. Technical Materials. Washington. DC World Bank.

Pechman, C., Dixon, P., and Layne, N. (1998). An assessment of US and Canadian smoking reduction objectives for the year 2000. *Am. J. Public Health*, **88**(9), 1362–7.

Pekurinen, M. (1989). The demand for tobacco products in Finland. *British Journal of Addiction*, **84**, 1183–92.

Peto, R. (1986). Influence of dose and duration of smoking on lung cancer rates. In *Tobacco: a Major International Health Hazard* (ed. R. Peto and D. Zaridze), pp. 23–34. International Agency for Research on Cancer, Lyon. IARC Scientific Publications, no.74.

Peto, R., Lopez, A. D., Boreham, J., Thun, M., and Clark Jr, H. (1994). *Mortality from Smoking In Developing Countries 1950–2000*. New York: Oxford University Press.

Raw, M., McNeill, A., and West, R. (1998). Smoking cessation guidelines for health professionals. A guide to effective smoking cessation interventions for the health care system. Health Education Authority. *Thorax*, **53**(Supplement 5)(1), S1–19.

Reid, D. (1996). Tobacco control: overview. *British Medical Bulletin*, **52**(1), 108–20.

Shiffman, S., Gitchell, J., Pinney, J. M., Burton, S. L., Kemper, K. E., and Lara, E. A. (1997). The public health benefit of over-the-counter nicotine medications. *Tobacco Control*, **6**, 306–10.

Shiffman, S., Mason,, M. K., and Henningfield, J. E. (1998). Tobacco dependence treatments: review and prospectus. *Annual Review of Public Health*, **19**, 335–58.

Silagy, C., Mant, D., Fowler, G., and Lodge, M. (1994). Meta-analysis on efficacy of nicotine replacement therapies in smoking cessation. *The Lancet*, **343**, 139–142.

Silagy, C., Mant, D., Fowler, G., and Lancaster. T. (1998). Nicotine replacement therapy for smoking cessation (Cochrane Review). In *The Cochrane Library, Issue 4*. Oxford: Update Software.

US Department of Health and Human Services (1989). *Reducing the Health Consequences of Smoking: 25 Years of Progress. A Report of the Surgeon General*. Rockville, Maryland: US Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. DHHS Publication No. (CDC)89–8411.

US Department of Health and Human Services. (1990). *The health benefits of smoking cessation.* US Department of health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. DHHS Publication No. (CDC) 90–8416, 1990.

Warner, K. E. (1986). Smoking and health implications of a change in the federal cigarette excise tax. *JAMA*, **255**(8), 1028–32.

Warner, K. E. (1997). Cost-effectiveness of smoking cessation therapies: interpretation of the evidence and implications for coverage. *Pharmaco.Economics,* **11**, 538–49.

World Bank (1993). *World Development Report 1993: Investing in Health.* New York: Oxford University Press.

World Health Organization (WHO) (1996). *Investing in Health Research and Development.* Report of the Ad Hoc Committee on Health Research Relating to Future Intervention Options (Document TDR/Gen/96.1.), Geneva, Switzerland.

World Health Organization (WHO) (1997). *Tobacco or Health: a Global Status Report*. Geneva: World Health Organisation.