Tobacco smoking

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Introduction

Tobacco smoking is the main preventable cause of morbidity and mortality from lung cancer, chronic obstructive pulmonary disease (COPD) and coronary artery disease, and it remains the most important health hazard in Europe. Today we have cost-effective tools to help smokers to quit and, thanks to political action, we have effective but still improvable legislation that helps to reduce the prevalence of smoking. The greatest effect on reducing morbidity and mortality in the next 10–20 years will come from cessation by current smokers, while intervention aimed at primary prevention – stopping people from taking up the habit at all – will mainly reduce smoking-induced disorders 20-plus years from now. However, the two interventions are complementary.

Key points

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- Smoking is habit-forming and physically addictive, and causes premature illness and death due to lung cancer, COPD, cardiovascular disease and a host of other ailments, as well as reducing lung function and complicating other diseases such as asthma and tuberculosis.
- Although there has been a decline in smoking prevalence in Europe, tobacco remains a huge problem, with at least one in four adults across Europe smoking and a rate in some countries exceeding 40%.
- Smoking cessation interventions, whether pharmaceutical or through advice and counselling, are highly cost-effective health measures among existing smokers.
- Smoking prevention policies such as advertising and marketing bans and high taxation play an invaluable role in preventing young people from taking up smoking: society will reap the benefits of these policies in future decades.

Epidemiology

Long-term trends in the prevalence of daily smoking in European countries where such data are available are illustrated in chapter 1. Overall, smoking is still a massive problem in Europe and there are large regional differences in smoking prevalence.

Figure 1 shows national smoking rates in Europe in 2010, based on data from the World Health Organization (WHO). It should be noted that the definition of smoking prevalence varies between countries: for many countries, the data are based on 'daily smoking of any tobacco product', while in others the definition 'current smoking of any tobacco product' is used. Subject to these caveats, average prevalence of daily or any current smoking in the 28 countries of the European Union (EU) in 2010 was 27.8% in females and 41.4% in males, while overall in the WHO European region, the averages were 24.1% in females and 47.3% in males.
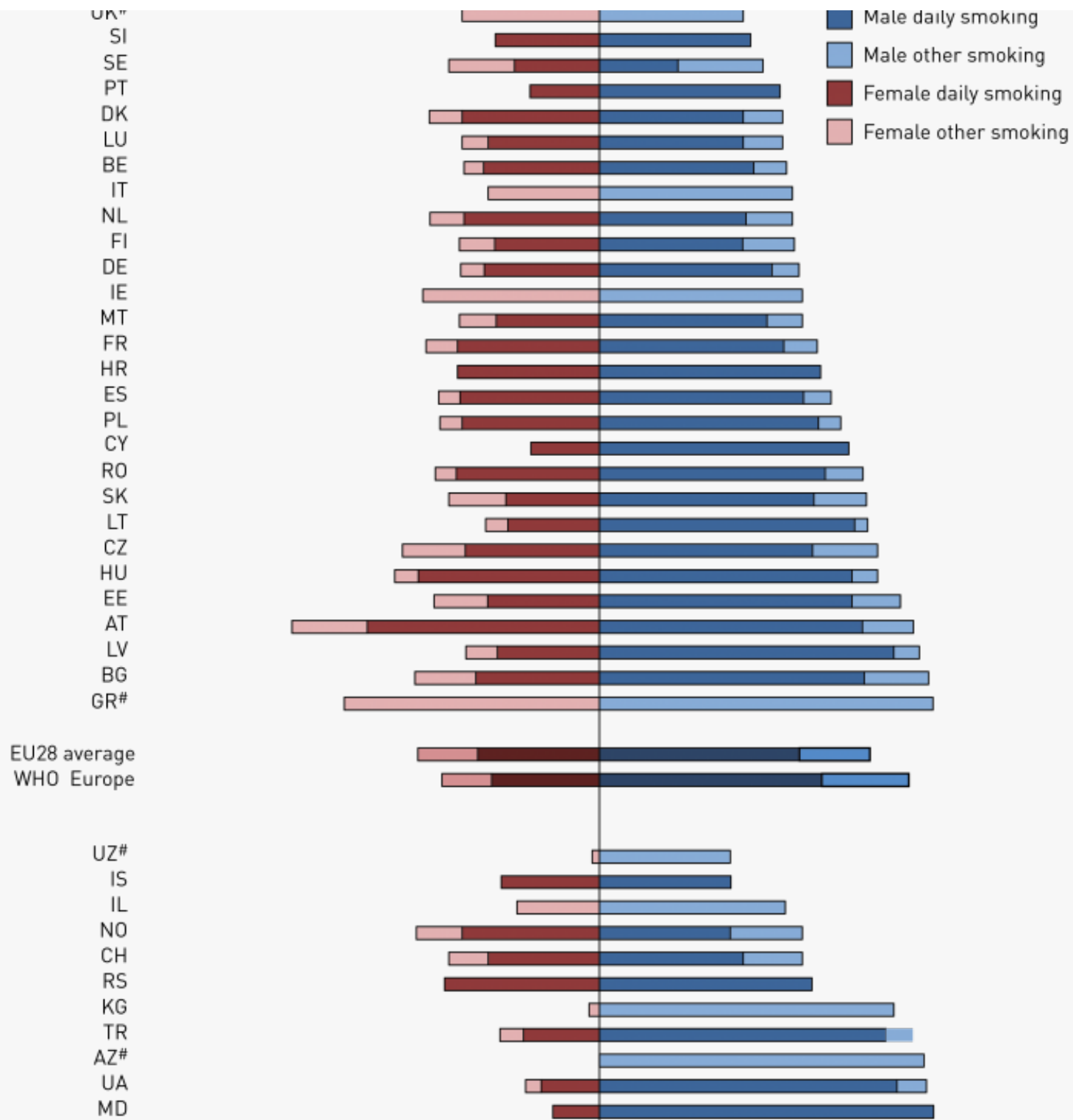
The most recent data on smoking prevalence come from the European Commission's (EC's) Eurobarometer survey, and are based on 26 751 interviews carried out in 2012 in 27 EU countries. Overall smoking prevalence was 28% (32% in males and 24% in females) and varied considerably with age (29% among 15–24-year-olds; 37% among 25–39-year-olds; 34% among 40–54-year-olds, and 17% among those aged 55 years or over.

Tobacco use is not high everywhere: according to 2011 data from the Organisation for Economic Co-operation and Development (OECD), Iceland has a notably low smoking prevalence of 14% in both sexes. Further afield, in California, comprehensive community legislation against smoking has contributed to a prevalence of less than 10% and to considerable savings in healthcare expenditure – an illustration of what can be achieved with the right political will.

The fight against tobacco use is making progress. The 2011 OECD data, from 26 European countries, show that between 1979 and 2010 the prevalence of smoking declined by an average of 36% in females and 32% in males, but with wide variation between countries from 0% to 71% (see chapter 1, figure 10). Among men, the overall tendency in European countries is for a gradual decline in smoking prevalence, which has levelled off in the past decade. Among women there has also been an overall decline, but in a minority of countries smoking prevalence has remained stubbornly constant for the past 30–40 years.

Reducing the health burden of tobacco smoking involves both treatment and prevention. In order to affect morbidity and mortality due to smoking during the next 20 years, the most powerful intervention is to persuade today's smokers to quit. Because it takes 20 years or more for most smoking-related disease to develop, the most effective means of reducing morbidity and mortality beyond that time is legislation now to reduce uptake of smoking among young people. In practice, we need to focus on both cessation and prevention.

Figure 1

	■	Male daily smoking	
	■	Male other smoking	
	■	Female daily smoking	
	■	Female other smoking	

UK#
SI
SE
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EU28 average
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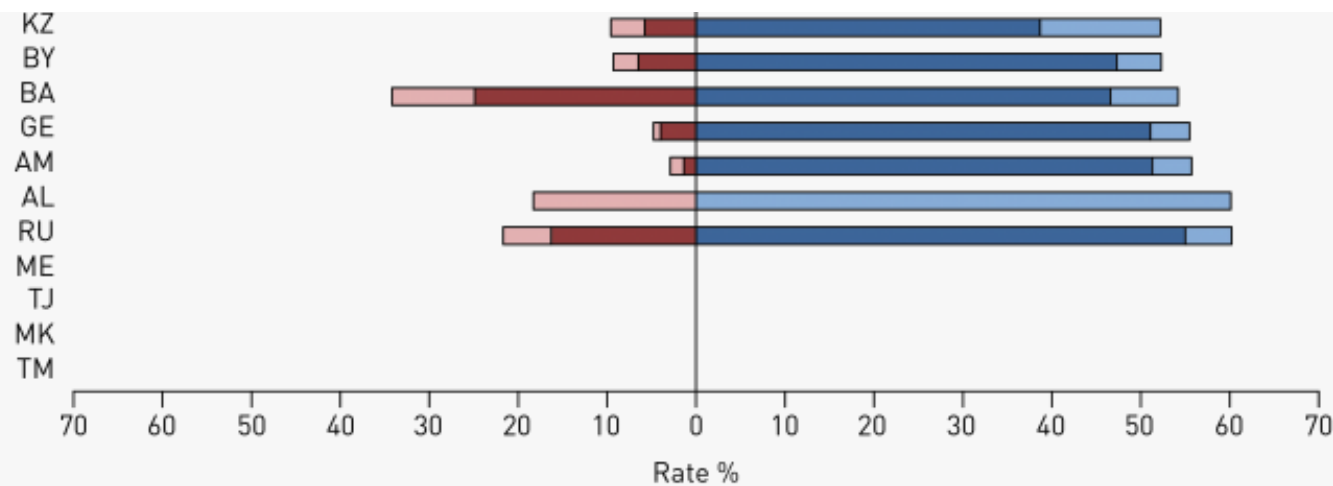
UZ#
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AZ#
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MD

Figure 1 – Prevalence of daily and other current tobacco smoking in adults, 2010. [#]: current cigarette smoking. Source: World Health Organization Global Health Observatory.

Toxic effects of tobacco smoke

Tobacco smoke contains more than 4000 constituents, including carcinogens such as N-nitrosoamines and aromatic hydrocarbons, as well as toxic substances including ammonia, nitrogen oxides, hydrogen cyanide, carbon monoxide and nicotine. The carcinogens are the main cause of smoking-induced cancers – lung cancer, laryngeal cancer and urinary bladder cancer – and carbon monoxide has an important role in the aetiology of cardiovascular disease. However, it is not known precisely which constituents of smoke are responsible for the development of COPD. Nicotine plays no role in cancer or COPD and only a minor role in atherosclerosis. The constituents of smoke implicated in causing non-malignant disease are summarised in table 1 and the toxic effects of smoke are reviewed in more detail in chapter 8.

Disorders induced by tobacco smoking

Smoking is the main cause of many respiratory diseases and is one of the most important risk factors for cardiovascular diseases, cancers of several organs and many other pathological conditions. Estimates suggest that overall, approximately one-third of all cancers are caused by tobacco use. Of these, lung cancer is the prime example: in most societies, 80–90% of all lung cancers are attributable to tobacco. Lung cancer kills more people in the EU than any other cancer, accounting for about 20% of all cancer deaths. Tobacco smoking also plays a causal role in cancers of the mouth, larynx, pharynx, nose and sinuses, oesophagus, stomach, liver, pancreas, kidney, bladder, cervix and

bowel, as well as one type of ovarian cancer and some types of leukaemia. Smoking is the main cause of COPD, particularly in Europe. (In some other parts of the world exposure to biomass fuels is relatively more important.) Smoking reduces the rate of growth of respiratory function during adolescence, resulting in a lower maximum forced expiratory volume in 1 s (FEV_1) (a key measure of lung function) at maturity. Smoking then accelerates the decline of FEV_1 in later adulthood and in old age. Figure 2 shows schematically the effect of smoking on FEV_1 in healthy nonsmokers and susceptible smokers, as well as the effect of quitting smoking.

Non-cancer effects	Smoke constituent	NCRI
Respiratory effects	**Acrolein**	172
	Acetaldehyde	3.78
	Formaldehyde	0.83
	Cadmium	0.52
	Chromium (hexavalent)	0.26
	Acrylonitrile	0.22
	Nickel	0.011
	Ammonia	0.006
Cardiovascular effects	**Hydrogen cyanide**	1.97
	Arsenic	1.17
	m-+p-Cresol	0.18
	O–Cresol	0.071
	Carbon monoxide	0.068
	Benzene	0.039
	Phenol	0.0022

Table 1 – Non-cancer risk indices (NCRI) for individual chemical constituents of mainstream cigarette smoke based on a single cigarette per day. Reference exposure levels (REL) are a guide to protect sensitive individuals against chronic effects over a long period of continuous exposure. The NCRI is equal to reported concentration as a fraction of the REL, assuming a total volume of 20 m_3 of air breathed daily. Bold numbers indicate an NCRI greater than 1.0, w hich signals that the threshold for adverse effects could be reached for some people by smoking a single cigarette per day. Reproduced from Fow les *et al*., 2003, w ith permission from the publisher.

Smoking is also a cause of childhood asthma and a risk factor for the development of asthma in adults and is associated with increased risk of mortality, asthma attacks and exacerbations, greater severity and more difficulty in controlling asthma. Smoking predisposes to infection and is a serious complicating factor for tuberculosis.

Beyond the respiratory system, cigarette smoking is a risk factor for osteoporosis, reproductive disorders, adverse post-

operative events and delayed wound healing, duodenal and gastric ulcers, periodontal disease and diabetes. It is a major modifiable risk factor for cardiovascular disease, including coronary artery disease, stroke, peripheral vascular disease and congestive heart failure. Studies of the relationship between cigarette smoking and cardiovascular disease show that cigarette smoking is associated with higher serum levels of cholesterol, coronary vasomotor reactivity, platelet aggregation and a pro-thrombotic state.
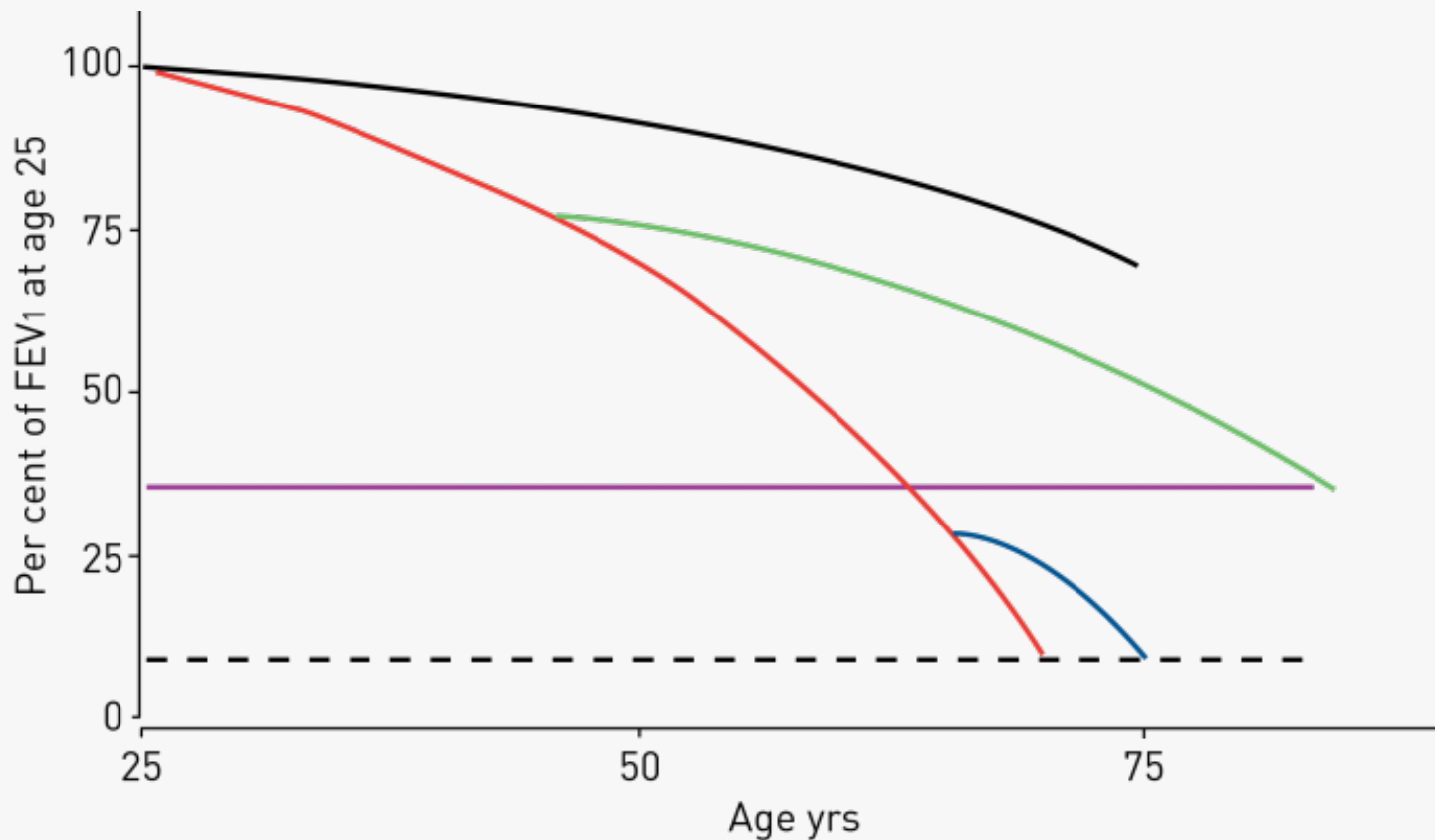
Figure 2

Figure 2 – Schematic diagram of the decline in lung function with age in nonsmokers, smokers and those who quit. Black: never-smoker or not susceptible to smoke; red: regular smoker and susceptible to smoke; green: quitter at age 45 years; blue: quitter at age 65 years. FEV1: forced expiratory volume in 1 s. The horizontal pink line indicates the level at which symptoms are likely to be disabling and the broken black line the level at which death is likely. Note that stopping smoking slows the rate of decline of lung function.

Societal costs of smoking

The burden of smoking-related diseases on society is enormous. It has been estimated that about 100 million people worldwide were killed by tobacco in the 20th century, and that the number will increase to 1 billion in the 21st century. It is estimated that in 2000, about 4.83 million deaths worldwide were attributable to tobacco smoking (12% of the estimated total global mortality among adults aged 30 years or older), with about 2.43 million of these in industrialised countries (19% of total adult mortality). The leading causes of death from tobacco smoking were cardiovascular diseases (1.69 million deaths), COPD (0.97 million) and lung cancer (0.85 million). In Europe, smoking leads to more than 650 000 premature deaths every year. Only 15% of the world's population live in Europe, but nearly a third of the burden of tobacco-related diseases occurs in Europe.

Smoking places a tremendous economic burden on society worldwide. The WHO estimates that the drain on the world economy is so large that it exceeds the total annual expenditure on health in all low- and middle-income countries. The total economic costs of tobacco reduce national wealth in terms of gross domestic product (GDP) by as much as 3.6%. In Europe, the burden from smoking, according to a report submitted to the EC in 2012, cost the economy €544 billion in 2009 – equivalent to about 4.6% of the EU's GDP.

According to the WHO, the economic burden of tobacco is particularly high in the developing world and by 2030 four out of five tobacco-related deaths will occur in less developed countries. The poor are disproportionately affected, because buying tobacco diverts expenditure from necessities, including food, shelter, education and healthcare.

The economic costs of smoking extend beyond the direct costs of smoking-related illness and death and can be attributed to four elements:

1. Healthcare expenditures attributable to the treatment of smoking-related diseases in active smokers and those affected by second-hand smoke.
2. Loss of earnings, employee absence and reduced workplace productivity.
3. The monetised value of premature mortality and disability as assessed by disability-adjusted life-years lost.
4. Other indirect costs such as fire damage related to smoking and costs related to cleaning up after smoke. Smoking is the biggest cause of discarded litter in many cities. Tobacco growing results in widespread environmental harm from deforestation as well as pesticide and fertiliser contamination.
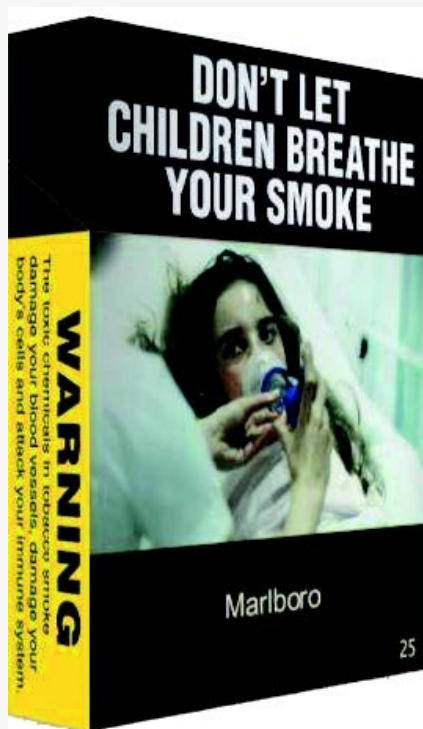
Dependence on tobacco

Cigarette smoking is a chronic relapsing disease. It is defined as a disorder or disease in the WHO International Statistical Classification of Diseases and Related Health Problems (ICD-10). One of the most important reasons for long-term smoking is physical dependence on nicotine although psychological components, habituation and genetic influences also are involved. Specific nicotine receptors have been identified in the brain and nicotine-dependent rats in which these receptors have been destroyed cease their intake of nicotine. When nicotine binds to these receptors, the

neurotransmitter dopamine is released.

Since nicotine dependence plays such an important role in continued smoking, it is not easy to quit and among those attempting to do so, a 1-year quit rate of 10–35% is the rule. Two simple questions can assess whether a smoker is dependent: whether he/she 1) smokes more than 8–10 cigarettes per day and 2) smokes the first cigarette within 30 minutes of waking. It is important to realise that smoking is not simply a lifestyle choice, but a disorder, and that quitting is not just a question of willpower, although motivation is an important factor for success.
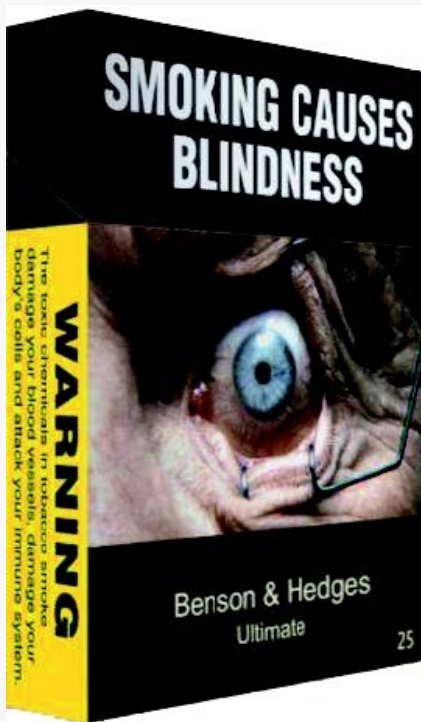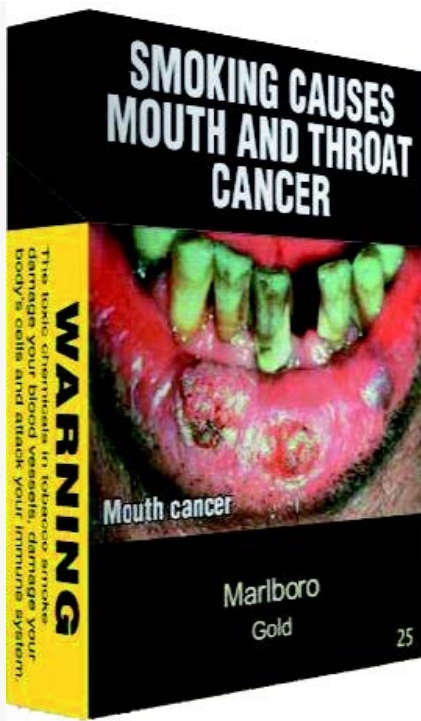
Legislation and prevention of smoking

The 2005 WHO Framework Convention for Tobacco Control was the first international treaty negotiated by WHO and offers a blueprint for tobacco control. All EU countries are among the 176 nations that have signed it, but effective enforcement of the FCTC requires firm political commitment to achieve the WHO goal of a 40% reduction in global smoking prevalence between 2010 and 2025.

Taxation as a tool to prevent tobacco use

Price is probably the most powerful tool for reducing tobacco use. The relationship between price and reduction of demand for smoking is described by the price elasticity. Overall, there is a 3–4% fall in consumption for every 10% increase in price. A recent examination of this relationship in 11 EU countries carried out by the Pricing Policy and Control of Tobacco (PPACTE) project found it to be robust overall, but noted several further important aspects. For instance, lower socioeconomic groups and young people are most sensitive to price increases, while increases in income reduce price elasticity.

The tobacco industry usually opposes tax rises and often successfully persuades finance ministers that a price increase will lead to a loss of revenue through an increase in smuggling. There is evidence from many studies, including PPACTE, that this does not happen. Price is not the only – or even the main – cause of increases in smuggling. Smuggling depends on other factors such as the existence of established distribution networks, high levels of

corruption, criminal involvement, low penalties for smuggling, and low probability of detection with poor implementation of controls. In the EU, these are compounded by nearness to land borders with countries where a high volume of cheap cigarettes is available.

Restriction of access to tobacco by minors

It is often argued that the sale of tobacco should be banned entirely. Some countries, such as Finland, foresee that they may be able to ban its use in 2040 but no country in Europe is ready to ban tobacco outright today. There are much better data on the feasibility and usefulness of banning sale of tobacco to minors and properly applied restrictions do reduce teenage smoking. The importance of such measures is driven home by the fact that some 85% of smokers take up the habit in their teens.

The EU Tobacco Product Directive

The banning of advertising, sponsorship and promotion is obviously an important aspect of tobacco control, and such bans are widespread in the EU, backed by an EC directive on advertising. This directive is not universally adhered to and is of course not applicable outside the EU. In developing economies, tobacco advertising is still widespread.

In the EU, the battleground has shifted to tobacco packaging. Currently, Directive 2001/37/EC (the Tobacco Products Directive) is being revised with a view to further strengthening of the regulations. The use of health warnings and, more recently, graphic images of diseases caused by tobacco has become common on cigarette packages in many countries. Cancer images, usually showing advanced disease, are among the most often used. These images are thought to be effective in changing attitudes to smoking. Australia has led the world in introducing what is known as 'plain packaging', where the iconic logos of the tobacco industry are replaced by a simple description of the brand, and health warnings and images are used to discourage tobacco use. In Australia a law has been passed to end the general availability of cigarettes in 2035, after which they will only be available on prescription to buy in pharmacies. Similar proposals have been made in other countries. The European Respiratory Society (ERS) has been very active in the field of smoking prevention, with its Tobacco Control Committee focusing on the preventive and legislative aspects of tobacco control and lobbying the EU in this area.

Variation within Europe

Despite the universal ratification of the Framework Convention of Tobacco Control within the EU, tobacco control legislation varies widely across the continent. In 2011, the Association of European Cancer Leagues published a report into tobacco control activity in 31 countries, grading them on a 100-point scale according to their rules on pricing, smoke-free environments, tobacco advertising and promotion and packaging, as well as the provision of public information campaigns and smoking cessation services. Only five countries scored more than 60 points (figure 3), with the UK taking the top spot. Eight countries scored 40 points or fewer, with Austria and Greece having the least effective control measures in place.

Figure 3

Score	2010 rank	2007 rank	Countries
77	1	1	UK
69	2	2	IE
62	3	4	NO
61	4	-	TR
61	4	2	IS
55	6	7	FR
52	7	8	FI
52	7	5	MT
51	9	6	SE
50	10	8	BE
48	11	18	CH
47	12	10	IT
46	13	12	ES
46	13	20	DK
46	13	14	NL
45	16	14	RO
44	17	25	SL
44	17	24	LA
43	19	23	PT
43	19	11	EE
43	19	14	PL
41	22	17	SI
41	22	21	LT
40	24	19	CY
40	24	13	BG
37	26	27	DE
34	27	22	HU
34	27	25	CZ
33	29	28	LU
32	30	30	AT
32	30	28	GR

Pharmacotherapy for smoking cessation

Several high-quality meta-analyses have investigated pharmaceutical interventions for smoking cessation, and guidelines have been published by several organisations. First-line pharmacological drugs for smoking cessation are nicotine replacement products (patch, gum, inhaler, nasal spray, lozenge/tablets, and oral spray), varenicline and bupropion, with scientifically well-documented efficacy when used for 2–3 months, mostly mild side-effects and at least a doubling of the 1-year quit rate compared with placebo (table 2). However, a 100% cure rate is not achievable and a typical finding in most studies of smoking cessation is a 1-year quit rate of about 25–35%, similar to the quit rates in other dependencies such as alchohol and opiates. To stop smoking is to break a complex habit and addiction and, to achieve reasonable quit rates, it is necessary to provide psychological support combined with pharmacological drugs.

Counselling for smoking cessation

With the most minimal intervention – provision of self-help materials for smoking cessation – the effect is only small. Telephone counselling is effective and can be used as well as, or instead of, face-to-face contact as an adjunct to self-help interventions.

Brief advice (less than 3 minutes) given by a general practitioner or nurse results in a small but significant increase in quit rates, of 2–3%. However there is a dose–response effect with person-to-person counselling in relation to the time taken in each session, as well as to the number of sessions. Group therapy seems to be as effective as individual counselling.

Benefits of quitting smoking

Compared to never-smokers, long-term daily cigarette smokers suffer higher early mortality from smoking-induced diseases. Ex-smokers have a longer average survival than continuing smokers. Particularly convincing evidence comes from a longitudinal study of UK male doctors. It was found that the mortality of the smokers was almost double that of never-smokers and that COPD was 13 times more prevalent and lung cancer 15 times more prevalent among smokers compared with never-smokers. After a 50-year observation period it was concluded that smokers die about 10 years younger than nonsmokers. Cessation at ages 60, 50, 40 or 30 years results in gains of about 3, 6, 9 or 10 years of life expectancy, respectively. The effect of smoking cessation on the rate of decline of FEV1 is illustrated schematically in figure 2 .

	OR (95% CI)	1-year quit rate %
Placebo	1.0	13.6
Monotherapies		
Varenicline	3.1 (2.5–3.8)	33.2
High-dose nicotine patch	2.3 (1.7–3.0)	26.5
Nicotine gum (more than 14 weeks)	2.2 (1.5–3.2)	26.1
BupropionSR	2.0 (1.8–2.2)	24.2
Combination therapies		
Patch + ad libitem nicotine replacement therapy	3.6 (2.5–5.2)	36.5
Patch + BupropionSR	2.5 (1.9–3.4)	28.9
Patch + inhaler	2.2 (1.3–3.6)	25.8

Table 2 – Efficacy of first-line drugs for smoking cessation. Meta-analysis of data from placebo-controlled trials in smoking cessation reporting 1-year quit rates with the above drugs for smoking cessation used for 3 months in combination with counselling. The comparator is the placebo arm without drug but with counselling. The results are shown as odds ratios (OR) with 95% confidence intervals (CI) and as % of subjects who have stopped smoking at 1 year; OR is the proportional increase in quit rate compared to placebo (for example, with varencicline the average quit rate was 3.1 times that with placebo). Modified from Fiore *et al*., 2008.

To prove a causal relationship between smoking cessation and health benefits, an intervention study is necessary where smokers quit and outcome is observed. One of the best studies is the US Lung Health Study, a large randomised controlled trial in 5587 patients with mild COPD, which showed that repeated smoking cessation during 5 years resulted in a quit rate of 37%, and after 14.5 years the quitters had appreciably better lung function and a higher survival rate compared with those who continued to smoke. In another study, the quality of life of patients with moderate or severe COPD 1 year after quitting was significantly better than that of continuing smokers.

Cost-effectiveness of smoking cessation

Smoking cessation with counselling and drugs is one of the most cost-effective interventions in medicine for reducing ill health and prolonging life. More than 200 scientific studies have shown this, and the data also show that the more intensive the intervention, the more cost-effective it is. A directory of healthcare programmes which ranked the cost-effectiveness of interventions in relation to quality-adjusted life years (QALYs) gained showed that giving up smoking following the advice of a general practitioner was ranked third in a list of 21 medical and surgical interventions aimed at preventing or treating diseases.

The UK National Institute for Health and Clinical Excellence (NICE) has reported that smoking cessation interventions are highly cost-effective, at €1120–2800 per QALY gained. A recent meta-analysis from the Netherlands of studies in patients with COPD found that the cost per QALY gained was only €2400 for intensive counselling combined with pharmacotherapy.

Research from the USA has shown that insurance coverage of treatment for smoking cessation results in more frequent evidence-based counselling and drug provision and a higher overall cessation rate among the populations covered by this insurance.

Since 2000, the UK National Health Service has offered free counselling and smoking cessation drugs, and the issue of reimbursement is a matter of debate in most other European countries. Reimbursement for counselling and medicine for smoking cessation seems to increase adherence to clinical guidelines and results in more smokers becoming involved in cessation attempts.

ERS guidelines on smoking cessation

In 2007, the ERS published guidelines on smoking cessation in patients with respiratory disorders. The most important conclusions were:

1. Patients with respiratory disease have a greater and more urgent need to stop smoking than the average smoker.
2. Smoking cessation treatment should be integrated into the management of the patient's respiratory condition.
3. Therapies should include pharmacological treatment (nicotine replacement therapy, bupropion or varenicline) combined with behavioural support.
4. Respiratory physicians should receive training to ensure that they have the knowledge, attitudes and skills necessary to deliver these interventions or to refer to an appropriate specialist.

According to a report by 'Europe Quitting: Progress and Pathways', more than 78 million smokers in Europe want to quit, but half of those surveyed who have tried to quit rate smoking cessation services as inadequate, poor or unacceptable. Education and training in cessation of tobacco use should be included in the curricula of all health professionals and medical students.

Future developments

Better primary prevention should be prioritised. It is also important to make smoking cessation interventions available to all patients with respiratory disorders who smoke. We have cost-effective interventions, but these are underused. Hospital administrators as well as national respiratory societies have a role to try to improve the quality of care in this area. The ERS, too, needs to continue to be a leader in this implementation process.

Conclusions

1. To prevent uptake of smoking amongst young people it is important to develop more smoke-free areas in public and to increase the price of cigarettes, in that way reducing morbidity and mortality from smoking 20 years hence and beyond.
2. Comprehensive community, country and EU interventions against smoking should be further strengthened, including plain packaging and the phasing-out of cigarettes.
3. To reduce the burden of tobacco-induced respiratory disorders – of which the most important are lung cancer and COPD – it is important to encourage all current smokers to quit in order to reduce morbidity and mortality from smoking over the next two decades.
4. Smoking cessation treatment (counselling in combination with drugs) is one of the most cost-effective interventions in medicine; it should be used more widely and its cost should be reimbursed completely. Education and training in cessation of tobacco use should be included in the curricula of all health professionals and medical students.
5. The UK model, with public smoking cessation clinics for every 150 000 of the population and reimbursement of smoking cessation therapy, could be a model for other European countries.
6. The proposals in the WHO Framework Convention of Tobacco Control should be further implemented across Europe.

Further reading

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Chapter 8	Passive smoking

Chapter 10	Indoor environment

Chapter 13	Chronic obstructive pulmonary disease

Chapter 19	Lung cancer

Chapter 41	Recommendations and policy

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Tel: +44 114 267 28 60 Fax: + 44 114 266 50 64 info@ersj.org.uk

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