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# **The tobacco health toll**



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## **Introduction**

With the increasing realization of the devastating effects tobacco use has, and the heavy toll it exacts on the health of individuals, the health of the young, the well-being of families and societies, and the economies of countries, the need for a clear, comprehensive document covering the full range of the negative effects tobacco and its use has on human health was apparent. This publication sums up and simplifies the answers to the questions that the public, individuals and special groups have, and is intended to fill the wide but often underestimated gap in the public's knowledge concerning the vast spectrum of tobacco-related health hazards. It is expected therefore, that this publication will be of interest to people from all walks of life, including school and university students, physicians and nurses, as well as the public in general.

Tobacco and tobacco smoke contain thousands of chemicals. Many of these chemicals are well known to be toxic, carcinogenic, atherogenic, teratogenic and addictive; many have no known safe level of exposure. The chemicals found in tobacco and tobacco smoke include nicotine, tar, carbon monoxide, acetaldehyde, hydrogen cyanides, arsenic, chromium, DDT, formaldehyde, benzene, N-nitrosamines, cadmium, nickel, beryllium and vinyl chloride.

Globally, one person dies from tobacco use every 6.5 seconds; tobacco kills around 5 million smokers each year, or the equivalent of 13 699 people per day. This is in addition to the suffering caused through tobacco-related diseases and the burden of disease on individuals, families and society as a whole.

Studies have shown that people who start smoking in their teens (as more than 70% do), and continue to do so for two decades or more will die 20–25 years earlier than those who have never smoked, thus losing some of the most productive years of their lives. Lung cancer and heart disease are two of the most common health problems encountered by smokers, but the general public is largely unaware that there are a wide range of other diseases and ill-effects associated with tobacco use which are not as widely publicized. This publication lists the range of diseases and illnesses caused through smoking, and shows how the harmful effects of smoking can damage nearly every organ and system in the human body.

Women and smoking deserve special attention as a result of the negative and serious health impacts on smoking women and their offspring, in addition to particular health concerns related to the use of contraceptives and women's frequent involuntary exposure to environmental tobacco smoke.

Children, who represent the building blocks of the future, are a large and significant segment of the population who are involuntarily exposed to the harm that tobacco can cause. Society needs to acknowledge the harm that environmental tobacco smoke exposure causes to the health of children and exert efforts to protect them from

exposure to this smoke. The importance of cessation and reduced exposure to tobacco smoke cannot be overemphasized. Adults need to abstain from tobacco use, not only to protect themselves, but to protect the young and future generations from falling prey to deadly tobacco-related diseases. It is also important to raise public awareness of the fact that modifications made to the shape, intensity and flavour of tobacco products is just the tobacco industry's way of masking the truth about the deadly effects of tobacco use. The issue of environmental tobacco smoke has been an arena of intense struggle between health advocates and the tobacco industry as it affects smokers and non-smokers alike, but also because it addresses more directly the question of choice when faced with the health hazards caused through tobacco. This issue has the greatest potential to shape the outcome of tobacco control efforts.

**Important note.** For the sake of readability, the references to studies and evidence of the harm caused by tobacco use have been omitted from the printed version of this publication. Students, physicians and members of the general public who wish to read further on the subject may consult the on-line version and its list of references at [www.emro.who.int/tfi/InPrint.htm](http://www.emro.who.int/tfi/InPrint.htm).

## **Effects on the body**

### **Addiction and psychological effects**

Cigarettes and other forms of tobacco are addictive. Nicotine is the drug in tobacco that causes addiction; and it is also a psychoactive (mood altering) drug [1]. Nicotine is a euphoriant and its withdrawal symptoms can include irritability, difficulty in concentrating, cognitive impairment, anxiety and weight gain [2].

The pharmacological and behavioural processes that determine tobacco addiction are similar to those that determine addiction to other drugs, such as heroin and cocaine [1]. Environmental factors and social pressures are important in the initiation of tobacco use, patterns of its use, stopping smoking and resumption of its use after stopping [1].

The problem of addiction to tobacco and nicotine is extremely serious as the symptoms of tobacco dependence can develop rapidly, in some cases, within just a few days, in others within a few weeks, and with minimum consumption. The development of even a single symptom of dependence strongly predicts the continued use of tobacco [3].

In one study, nicotine was found to be more addictive than other drugs surveyed [4]. Experimentally, volunteer smokers who received intravenous nicotine reported effects similar to those produced by other drugs of abuse, such as morphine or cocaine [5]. Individuals with nicotine dependence had higher rates of depression and anxiety disorders when compared to individuals with dependencies on other substances [6].

The perception that smoking or nicotine alleviates stress is an erroneous perception, as nicotine, through its addictive and psychotropic effects, leads smokers to be in constant need for nicotine to feel 'normal', to reverse the tension and irritability that develop during nicotine depletion [7] and to relieve the anxiety resulting from nicotine withdrawal symptoms [8].

This chemical dependence can have other serious effects besides the actual addiction to nicotine and tobacco. For example, some brands of cigarettes are designed to contain or yield low nicotine levels. However, this leads many smokers to compensate for the low level nicotine by increasing the volume of smoke inhaled, leading to a two- to four-fold increase in their exposure to lung carcinogens. Thus, a much greater overall exposure results from smoking low nicotine cigarettes [9].

Smokers in one study increased the total number of cigarettes they smoked in response to smoking low nicotine yield cigarettes [10]. Smokers in another study also compensated by increasing their intake from each cigarette when cigarette smoke was diluted through the use of ventilated cigarette holders [11]. This belies the belief that low nicotine cigarettes are less harmful, or less addictive. It may also explain why the incidence of lung cancer and deaths from lung cancer have not declined despite the increasing trend for low tar and low nicotine cigarettes [9, 12].

Many individuals who are dependant on nicotine are able to give it up outside the context of a treatment programme. Others, however, require the assistance of a formal cessation

programme that may include behavioural and pharmacological interventions to achieve lasting abstinence [1].

### **The lungs**

Significantly increased incidences of lung cancer are reported for smokers, as an estimated 85%–90% of all cases of lung cancer are due to smoking. Smokers are between 20 and 30 times more likely to develop lung cancer compared to those who are not exposed to tobacco smoke [13].

Smoking causes a wide spectrum of respiratory and breathing-related diseases [12]. This includes airway diseases, such as chronic bronchitis and emphysema, where there is inflammation, narrowing and eventual destruction of the airways [14]. At least 80% of these cases are due to smoking [15]. These lung disorders cause progressive shortness of breath, frequent complicating illnesses, hospitalizations and severe disability, and require expensive treatments that do not reverse the course of the disease [16, 17]. Smoking leads to at least a twenty-fold increase in the risk of dying from a chronic obstructive lung disease [18]. The average lung function and lung capacity in smokers is consistently worse than in non-smokers, with up to double the rate of decline with age [19], even in smokers who do not develop chronic bronchitis or emphysema [19, 20].

People who are exposed to cigarette smoke earlier in their lives have a significantly increased chance of developing asthma [20, 21]. In people with asthma, tobacco smoke increases the rate of deterioration of the lungs' function and capacity, and over time worsens the condition and makes it more difficult to control. It leads to more frequent hospitalizations and emergency room visits [20, 22]. Smokers are also more likely to require mechanical ventilation (respirator) upon hospitalisation [23]. The risk of complications, such as lung infections, is significantly higher among smokers as compared to non-smokers [14].

In people who have already developed a chronic obstructive lung disease, such as chronic bronchitis or emphysema, stopping smoking results in a significant decrease in the frequency of hospitalisations [24], and slows the rate of deterioration of their lungs over time to near non-smokers' rates [17]. It also significantly improves their symptoms and shortness of breath [25]. Smokers suffer an increased risk of developing respiratory problems, along with other non-respiratory complications, leading to an increased risk of admission to intensive care following any surgery compared to non-smokers [22, 26].

Smoking is implicated as a major causative factor in a large variety of disorders that cause lung damage or fibrosis. Tobacco smoke is strongly believed to be an important factor in the development of a number of serious and fatal diseases that cause lung fibrosis for which there is no known effective medical treatment [14, 27, 28, 29].

Smokers are also at risk from a number of unusual lung diseases and disorders that affect only smokers, such as Langerhans cell histiocytosis, which currently has no known effective medical treatment [30, 31], and which may require lung transplantation. Other serious and unusual disorders cause lung bleeding, such as Goodpasture syndrome [14, 32].

## **The heart**

Smoking is clearly implicated in the development of coronary heart disease (narrowing and occlusion of the blood vessels supplying the heart) [33, 34, 35], leading to chest pains, shortness of breath, heart attacks, hospitalizations, disability and death [36, 37]. The risk of developing coronary heart disease as a result of smoking is increased by up to three-fold in men and six-fold in women [34, 35]. This clearly identified risk of developing a debilitating and deadly disease appears to be seriously unrecognized or underestimated by smokers [38]. The importance of stopping smoking for people who have suffered heart attacks cannot be overemphasized, as cessation cuts by almost half the recurrence rate of heart attacks [39], and the death rate of those who stop smoking after a heart attack [40].

Cigarette smoking is also an independent risk factor in the development of congestive heart failure [41], a condition that is caused by the heart's inability to function normally to meet the body's needs. It leads to weakness, fatigue, severe shortness of breath, frequent hospitalizations, and is associated with significantly short survival rates in patients afflicted with the condition [42, 43].

## **The major blood vessels**

### *Aortic artery*

Smoking is a clearly recognized risk factor and contributing factor in the development of two very serious conditions: abdominal aortic aneurysm (AAA) [44, 45, 46] and thoracic aortic aneurysm (TAA) [47]. Abdominal aortic aneurysm is the dilation, usually progressive, of a segment of the aortic artery, the body's largest artery originating directly from the heart which supplies the whole body with blood. It is a deadly condition if the aortic artery aneurysm ruptures [48], as it leads to internal bleeding, shock and cardiac collapse. More than 75% of people affected with abdominal aortic aneurysm are smokers [44]. Following diagnosis of the condition, patients who continued to smoke had a significantly higher rate of rupture of their abdominal aortic aneurysm and a notably shorter survival after their diagnosis [49]. An accelerated rate of expansion (dilation) of the thoracic aortic aneurysm was also noted in patients with a history of smoking [50]. Smoking also increases the risk of paralysis in both legs after surgery performed to repair thoracic aortic aneurysm [51].

### *Carotid arteries*

As with other arteries in the body, smoking affects the carotid arteries supplying blood to the brain and results in their narrowing (stenosis) and potential blockage [52, 53, 54]. This is a condition that increases the incidence of, and creates a predisposition to, even if initially without symptoms [55], different kinds of stroke [56, 57]. The complications following a stroke can include: paralysis, loss of speech, loss of sensation, blindness, disability and progressive dementia. Strokes may even lead to death [58].

After surgery to correct the narrowing of the carotid arteries and to reduce the chance of a stroke or the recurrence of a stroke, continued smoking was found to increase the chances of a recurrence of the narrowing of the carotid arteries [59].

### **The peripheral blood vessels**

Smoking is a major contributing factor in the development of atherosclerotic peripheral arterial diseases [60, 61], which is the roughening and narrowing of the arteries supplying the limbs. Atherosclerotic peripheral arterial diseases most commonly affect the lower extremities, with the potential to cause serious limitations in the ability to walk and to perform daily activities, to cause pain in the affected limb [60], and to create the potential for limb gangrene and the possible need for amputation [60]. Patients with peripheral arterial disease are at a very high risk of developing serious and life-threatening illnesses, such as heart attacks and strokes [61].

Treatment recommendations consistently stress smoking cessation as a first line therapy [62]. Another serious form of peripheral arterial disease in which smoking is central to the initiation and progression of the disease is thromboangitis obliterans or Buerger disease. It is strongly associated with heavy smoking and has a relatively early age of onset, at about 34 years of age [63]. This condition causes severe, progressive pain in the affected limb(s), ulcerations, gangrene, frequent amputations [63, 64] and recurrent hospitalizations [53], and for the majority of patients ends their working lives [63]. The only proven strategy to prevent progression of the disease and avoid amputation is the complete discontinuation of cigarette smoking or other use of tobacco [64]. The rate of limb amputations in patients who continued to smoke after their diagnosis has been shown to be double that of patients who stopped smoking [63, 64].

### **The nervous system**

Smoking also increases the risk of different types of dementia, and as smoking is recognized as a risk factor for cognitive decline [65] and vascular dementia [65, 66], smoking cessation is considered essential in the management of dementia resulting from vascular diseases [66].

Smoking-associated cognitive impairment and decline can begin as early as middle age, between the ages of 43 and 53 years [67]. Smoking has also been found to increase the risk of developing Alzheimer disease, while smokers who quit have a reduced risk of developing the disease [68].

### **Osteoporosis and skeletal health**

Osteoporosis is a serious medical condition that leads to a significantly increased rate of bone fractures, particularly vertebral (spinal) and hip fractures, in addition to well known complications, such as functional decline, chronic pain, psychological dysfunction and early mortality [69]. Another confounding factor may be the surgical and post-surgical complications that can result from surgical treatment of these fractures [70].

Smoking has been strongly identified as a significant risk factor to the development and acceleration of osteoporosis in both men [71] and women [72], although women are clearly disproportionately affected by osteoporosis. The vast majority of osteoporotic fractures occur in elderly women. These comprise vertebral compression fractures, Colle's fractures at the wrist, hip fracture and to a lesser extent fractures at other sites [74]. Smoking has also been found to be significantly associated with repeat bone fractures in menopausal women [75].

Evidence seems to support the fact that use of smokeless tobacco may also cause osteoporosis [76].

Tobacco avoidance has been recommended as a first line preventive measure against further bone loss and progression of osteoporosis [77, 78]. Smoking has been associated with severe spinal column degenerative diseases and with greater susceptibility to traumatic vertebral injury [79]. Certain spinal surgical procedures are less often successful in smokers compared to non-smokers [79]. Smoking also increases the risk of impaired bone healing after surgery [80] and leads to a lower rate of bone healing with more complications after treatment for fractures [70].

### **Male reproductive health**

#### *Fertility*

There is significant scientific evidence that smoking leads to a decreased sperm count, an increased frequency of abnormal sperm morphology [81], and an inferior quality of sperm in smokers compared with non-smokers [82]. Smoking by men was also associated with delayed conception and reduced fertility rates [83].

#### *Impotence*

The scientific and medical evidence that smoking is a significant risk factor for impotence is strong [84, 85, 86, 87]. Smokers are one and a half times more likely to suffer erectile dysfunction than non-smokers [86]. One study found that up to 81% of the study patients suffering from impotence were current or former smokers [87].

### **The digestive system**

In addition to the use of tobacco being a contributory factor in the development of many digestive system cancers, it is also a major contributing factor to other diseases of the digestive system.

#### *Peptic ulcers*

Smoking has been found to be the main factor in the development of peptic ulcers, both gastric and duodenal [88], a disorder that, in addition to causing pain, can lead to fatal bleeding or perforation of the stomach or duodenum into the abdomen. Continued smoking has also been found to lead to a negative effect on, and delayed healing of, duodenal peptic ulcers with a higher relapse rate [89].

#### *Gastro-oesophageal reflux disease*

Studies have found that smoking is associated with increased stomach acid reflux into the oesophagus [90], and that smoking is a risk factor in the development of gastro-oesophageal reflux disease [91]. Gastro-oesophageal reflux has also been found to be a risk factor for the development of laryngeal and pharyngeal cancer, independent of the effect of smoking on the development of such cancers [92].

### **Cancer**

The relationship between tobacco use and cancer cannot be overstated. Smoking is the direct cause of a significant number of cancers and a contributing factor to many other cancers. No other single product is known to do this.

### *Lung cancer*

Lung cancer deserves special attention as it is the leading cause of cancer mortality worldwide [93]; an estimated 85%–90% of all cases of lung cancer are due to smoking [13]. Some studies have suggested that women may be at a higher risk than men of developing lung cancer due to smoking [94, 95].

Epidemiological studies have shown that brands of cigarettes that contain less tar and nicotine only marginally reduce the risk of lung cancer mortality. Similarly, little difference in mortality has been found for lifelong filter versus non-filter smokers and for persistent smokers who switch from non-filter to filter cigarettes [12].

The risk of lung cancer declines steadily in people who stop smoking, until, after 10 years, the risk becomes 30%–50% of that in continuing smokers [12].

### *Other cancers*

Tobacco use has been firmly linked to the risk of developing the following cancers: laryngeal cancer; oesophageal cancer; urinary bladder cancer; pancreatic cancer; kidney cancer; oral cavity and pharyngeal cancer; and stomach cancer [14, 96, 97]. Oral cavity cancer has been linked to both smoking and smokeless tobacco use [98].

Tobacco use has also been linked to the risk of developing colorectal cancer, liver cancer, cervical cancer, nasal sinuses cancer, and leukaemia [96, 97]. It has also been found to be an independent risk factor in the development of a type of skin cancer called squamous cell carcinoma [99].

Long-term and short-term smoking has been found to be associated with a two-fold increase in the risk of certain types of ovarian cancers [100], and is a major risk factor in the development of uterine cervical cancer [101]. Several studies and reports suggest that both passive and active tobacco smoke exposure cause an increased risk of breast cancer [102, 103]. There appears to be an association between cigarette smoking and a significantly higher risk of developing pulmonary metastatic disease (cancer spread to the lungs) among women with breast cancer. This may explain the noted higher breast cancer fatality rate among smokers [104]. Tobacco users, including light users, have also been found to be at a higher risk for the spread of other types of cancer [105].

Smoking cessation reduces the risk of many tobacco-related malignancies, including cancers of the larynx, oesophagus, pancreas and urinary bladder [12].

### **Oral and dental health**

For both men and women, cancer of the mouth and pharynx ranks sixth overall in the world; although it is the third most common cancer among men in many countries [98]. Tobacco use, through both smoking and smokeless tobacco, is a major risk factor for oral cancer and pre-cancerous conditions [98, 106, 107].

It is also a significant risk factor in the development of a very wide spectrum of oral and dental diseases, and pathological conditions and lesions. These include mucosal lesion, such as smoker's melanosis (which is the abnormal dark pigmentation of the oral mucosa), keratotic patches, nicotinic stomatitis, leukoplakia, palatal erosions and black hairy tongue [107, 108].

Tobacco use is associated with tooth staining, abrasions, dental carries and tooth decay. It is also associated with increased prevalence of periodontal and gingival disorders, including periodontitis, acute necrotizing ulcerative gingivitis and weakened defence and repair ability of the gingival tissue [108, 109]. This is in addition to increased alveolar bone loss, increased pocket depth and a higher rate of implant failures [108, 109].

### **Skin and hair**

There is a strong link between smoking and squamous cell carcinoma. Smoking has been found to be an independent risk factor in its development of this skin cancer, the rate of its development being affected by the number of cigarettes smoked [99].

Other effects of smoking and tobacco use on the skin and hair are numerous, and include premature skin wrinkling and ageing, particularly of the facial skin, in men and women [110, 111, 112]. This effect increases with the number of cigarettes smoked [111]. A strong link is suggested between smoking and tendency to greyness [113], baldness and hair loss [113, 114].

Smoking is a clinically important contributing factor in increased incidence and severity of acne [115]. Smoking and tobacco use are also associated with a number of skin diseases, such as psoriasis [116], eczema [117] and palmo-plantar pustulosis [118, 119]. Palmo-plantar pustulosis is a common chronic skin disease that is very resistant to treatment, causing pustular lesions to develop on the palms and on the soles of the feet [120].

Smokers have also been found to be at a greater risk of complications involving the surgical site following certain types of facial surgery [121].

### **Smoking and the senses**

#### *Vision*

In some parts of the world, cigarette smoking is a major cause of untreatable visual impairment [122], and is significantly associated with cataract and glaucoma [123], Grave ophthalmopathy [124, 125] and age-related macular degeneration. Smoking is the only known preventable risk factor associated with any form of age-related macular degeneration [126, 127]. Continued smoking may perpetuate further ocular damage and lead to permanent blindness as a result [123].

#### *Hearing*

Smoking is one of the main risk factors for hearing impairment and loss [128, 129]. It has been found that smokers are significantly more likely to suffer from hearing loss as a result of exposure to noise as compared to non-smokers [130].

### *Smell*

Smoking has been found to cause long-term deficits in olfaction (the ability to smell), with double the rate of these deficits evident in smokers compared with non-smokers. This deficit improves in smokers who stop smoking [131].

## **Smoking and general health**

### **Smoking and surgical outcomes**

The occurrence of problems relating to healing of surgical wounds have been found to be significantly higher in smokers than in non-smokers [132, 133], in addition to higher surgical wound infection rates overall [134]. The overall rate of complications in smokers after surgery has been shown to be significantly higher compared with that of non-smokers, including in-hospital death rates [135], admission to intensive care units and respiratory tract infections and complications [16, 22, 135].

### **Smoking and the immune system**

Cigarette smoke and nicotine have a suppressive effect on the immune system [24], which explains, in part, the number of increased respiratory tract infections [14] and increased rates of wound infections after surgery in smokers [134].

### **Smoking and diabetes**

Smokers are at an increased risk of developing type 2 diabetes, and patients with diabetes who are smokers are at an increased risk of diabetic nephropathy, retinopathy, neuropathy, coronary heart disease, stroke and peripheral vascular disease [136, 137], and experience a higher rate of related limb amputations [138].

### **Smoking and tuberculosis**

Smokers are at an increased risk of contracting active pulmonary tuberculosis [139, 140], and they also appear to develop more cases of extra-pulmonary tuberculosis [139]. This risk increases with the number of cigarettes smoked [140]. It has been suggested that exposure to environmental tobacco smoke increases children's risk of acquiring tuberculosis [139].

### **Smoking and autoimmune disorders**

#### *Rheumatoid arthritis*

Cigarette smoking appears to be an important risk factor in the development [141, 142] and the increased severity of rheumatoid arthritis [141].

#### *Thyroid gland*

Smoking significantly increases the risk of developing Grave disease (a thyroid disorder where the thyroid gland is overactive) [124, 143], Grave ophthalmopathy (the eye disorder associated with Grave disease) [143], toxic nodular goitre [124] and Hashimoto thyroiditis (a thyroid gland autoimmune disorder) [143].

### **Systemic lupus erythematosus**

Cigarette smoking significantly increases the risk of developing systemic lupus erythematosus, an autoimmune disease that can affect almost any organ or system in the body causing a wide range of complications, including: kidney failure, heart and heart valve disorders, arthritis, brain disorders, skin disorders and lung disease, including fibrosis and respiratory failure [144].

**Smoking and venous thrombosis**

Smoking is an important and an independent risk factor in the development of venous thromboembolism [145, 146], which is the development of blood clots in the veins and the lodging of some of these clots in the blood vessels of the lungs. It is a potentially fatal condition with serious long-term consequences in many patients, including disabling shortness of breath [147].

**Smoking and sleep**

Smokers have been shown to be significantly more likely than non-smokers to suffer from difficulties in going to sleep, daytime sleepiness [148, 149], problems staying asleep and minor accidents [148]. Smoking has also been also associated with nightmares, disturbing dreams and difficulty in waking up [149].

## **Women and smoking**

### **General health**

The impact of smoking on women's health deserves special attention, as women are susceptible to almost all of the tobacco health hazards that men are exposed to, in addition to a number of diseases, tumours and conditions that particularly affect women. Some studies have actually shown that women are at an even greater risk of developing certain diseases as a result of smoking than men. In a large study of women's health, death from all causes was found to be much higher (twice as high) among women who smoked; this was already apparent by the age of 35–44 years [20].

Women are threatened by a range of health problems associated with smoking which include cancer, cardiovascular and lung diseases, an increased risk of different types of dementia, fertility problems and osteoporosis.

Abstinence from smoking is important for the immediate and future health of women. Also, controlling the extent of women's involuntary exposure to second-hand smoke is critical as the number of women exposed to smoke released into the environment through burning cigarettes is far greater than the number of women who actually smoke [150].

### **Female reproductive health**

The scientific literature offers clear support for an association between smoking and decreased female fertility [151, 152]. Smoking also increases the rate of spontaneous abortion of chromosomally normal fetuses and increases the incidence of placental abruption, placenta praevia, bleeding during pregnancy, premature rupture of the membranes [152] and stillbirths [153], which further reduce women's reproductive capability. Evidence also suggests that women smokers reach menopause 1 to 2 years earlier than non-smokers [152].

All these risks to fertility and the outcome of pregnancy are minimized or absent in former smokers [151].

### **Smoking and oral contraceptives**

In women using the currently available form of oral contraceptives, the increased risk of cardiovascular diseases and heart attacks seems to occur mainly in women who smoke [154, 155, 156], with heavy smokers being at a greatly increased risk of a heart attack [157]. Every effort should be made to encourage smoking cessation among potential users of oral contraceptives [155]. Oral contraceptive users who do not smoke and have normal blood pressure (normotensive) have not been found to have an increased risk of heart attack [156].

Oral contraceptives may also increase the risk of stroke in women who smoke [156, 158], as studies have noted a correlation between smoking and oral contraceptives in causing cerebral thrombosis [159]. The risk of venous thrombosis and pulmonary embolism are increased in oral contraceptive users who are also smokers [160].

### **Smoking and pregnancy**

There is growing awareness of the harmful effects of smoking during pregnancy. Smoking, through exposure to substances like nicotine and carbon monoxide, is associated with a number of serious complications during pregnancy, including increased rates of spontaneous abortion [161], premature delivery [161, 162] and low birth weights [161]. Smoking during pregnancy has been associated with intrauterine growth retardation [162, 163]. Low birth weight has been shown to occur even with low levels of exposure [164], and smoking cigarettes with low tar or nicotine concentration does not reduce the risk of having babies who are small for the duration of the pregnancy [165]. Exposure of pregnant women to environmental tobacco smoke has been shown to be associated with low birth weight in the infants of exposed non-smoking mothers [12, 162], and to have an added negative effect on the infant's birth weight in smoking mothers [162].

Smoking during pregnancy also leads to an increased infant death rate around the time of birth (perinatal mortality) [166], up to one and a half times the average rate [162]. Maternal smoking is also thought to be associated with sudden infant death syndrome [162].

### **The course and outcome of pregnancy**

Smoking not only increases the risk of cervical and uterine cancer in women [101], but has also been shown to create fertility problems and complications during pregnancy and childbirth. Consequently, the harmful effects of smoking on the course and outcome of pregnancy cannot be overemphasized. There is much evidence to show that smoking complicates the course of pregnancy, endangers the life of the mother, threatens the life of the fetus, and places the newborn at great risk of immediate and long-term complications, and possibly even death.

Nicotine replacement therapy for pregnant smokers does not seem to be as effective as in non-smokers for a variety of reasons [172], which may include a faster rate of nicotine metabolism during pregnancy requiring a higher dose of nicotine replacement therapy [172, 173]. As nicotine replacement therapy has proven to be a somewhat challenging task during pregnancy, it is even more critical for women to abstain from smoking, for their own health and that of their children.

### **Smoking and lactation**

Tobacco by-products are transmitted in breast milk and may decrease breast milk production [167]. Smoking has been associated with a lower level of some vitamins, such as vitamin E [168] and vitamin C [169], in the mother's milk.

The degree of exposure of the breastfed infant to nicotine was found in one study to be related to the number of cigarettes smoked by the nursing mother [170]. Mothers who are smokers are significantly less likely to intend to breastfeed, less likely to initiate breastfeeding and more likely to breastfeed for a shorter duration than non-smokers [171]. Several studies have found a dose-response relationship between the number of cigarettes smoked each day and breastfeeding intention, initiation and duration that persists even after taking into account additional factors [171].

This leads to a significant number of infants of smoking mothers missing out on the well known benefits of breastfeeding, which only confounds the other health hazards these infants are exposed to as a result of their exposure to environmental tobacco smoke and pregnancy-related tobacco exposure.

## **Smoking and infant and child development**

### **Adverse effects of prenatal tobacco exposure**

Infants exposed to tobacco before birth are at an increased risk of low birth weight and death around the time of birth. Low-birth-weight babies are prone to a number of subsequent complications, such as recent epidemiological and experimental studies have also shown that abnormal fetal growth can lead to serious complications and disorders extending well beyond the neonatal period [166].

A number of birth defects and deformities are associated with smoking during pregnancy, such as cleft lip/palate [174, 175], clubfoot [175] and limb defects [176, 177]. Studies also support the conclusion that fetal exposure to environmental tobacco smoke in utero (during pregnancy) is associated with adverse effects on the infant's future pulmonary function, and creates a predisposition to asthma [178, 179], and possibly bronchial hyper-responsiveness in childhood [178]. Smoking during pregnancy and lactation has also been found to be linked to the development of eczema in children of smoking mothers [180].

Environmental tobacco smoke exposure is also associated with diminished attention span, which hinders the intellectual development of the child [181] and diminishes their intellectual abilities later in life [182]. It has been found to be associated with a decrease of up to 15 IQ points in some studies [181]. Epidemiological studies also suggest that prenatal tobacco exposure is associated with higher rates of behavioural problems, risk taking behaviour [167, 182] and failure at school [182].

Prenatal tobacco exposure has been shown to be significantly associated with deficits in learning and memory. Specifically, prenatal tobacco exposure has been associated with deficits in verbal learning and design memory, as well as slowed responses on a test of eye-hand coordination. In addition, exposed children demonstrated a reduced ability for flexible problem-solving and exhibited greater impulsivity [182].

### **Smoking and children's health**

The risks to infants and children exposed to tobacco smoke begin during pregnancy, and include: increased incidence of sudden infant death syndrome [183]; childhood infections [184, 185, 186, 187]; middle ear infections and bronchitis [184, 188]; and a negative impact on their overall respiratory health and lung development [12, 184, 188]. It reduces their lung function and capacity [189], and their overall physical and cognitive (mental) development [12], and alters their intelligence and behaviour [167, 190]. It also leads to an increase in hospitalization rates [187]. Infants whose mothers did not smoke, but whose fathers did, are also at risk of reduced birth weight [191]. Environmental tobacco smoke exposure also increases children's risk of developing asthma and is responsible for causing a greater number of asthmatic attacks [184, 187].

Tobacco by-products are transmitted in breast milk and may decrease breast milk production [167]. For children breastfed by smoking mothers, the risk of developing lung cancer is significantly increased [185, 192]. Also, the risk of developing other cancers, such as nasal

and sinus cancer [193], brain tumours, leukaemia and lymphoma (blood and lymphatic system cancers) is also increased [192].

Another serious effect of parental smoking is the significantly increased likelihood that their children will become smokers themselves [194, 195], and therefore become subject to all the health hazards associated with tobacco use, in addition to the risk-taking behaviour in adolescents that is associated with smoking [167, 182]. Earlier age of initiation of smoking has been found to be predictive of more dependant smoking, less interest and confidence in the ability to quit, poorer diet, less use of seat belts, and more illness and hospitalization later in life [196].

In some countries, cigarette smoking is the foremost modifiable risk factor for adverse pregnancy outcomes [173]. Mothers who smoke voluntarily expose future generations to life-threatening and debilitating diseases. Smoking affects children's health directly, but also indirectly, through a diversion of the family's financial resources [197], which may expose them to malnutrition and hunger [197,198], inadequate medical care and education [198], adding to the health toll they already incur through being involuntarily exposed to tobacco smoke. This exposure also contributes to children's future smoking behaviour, and may create an addiction to nicotine long before they are capable of making an informed and an independent choice [194].

## **Environmental tobacco smoke**

In recent years there has been growing knowledge and awareness of the dangers and serious adverse health effects of environmental tobacco smoke exposure [199]. The health hazards of environmental tobacco smoke exposure affect almost every organ and system in the body with a wide spectrum of ailments and diseases, and it has been clearly implicated as the cause of death in many of those who were exposed to it [200]. Environmental tobacco smoke exposure acquires special importance when it comes to considering the negative health impact on children.

Environmental tobacco smoke has been scientifically implicated in causing a number of cancers, including lung [184, 185, 200–205], nasal and sinus cancers [193]. The Council on Scientific Affairs, American Medical Association, agrees that environmental tobacco smoke should be classified as a human carcinogen (a substance that causes cancer in humans) [185], and the Environmental Protection Agency has classified it as a Class A (known human) carcinogen [12].

It has been clearly shown that exposure to environmental tobacco smoke causes a significant increase in the risk of developing coronary heart disease [200, 201, 206] and an associated increase in deaths related to it [207, 208]. Coronary heart disease is a condition that leads to chest pains, shortness of breath and heart attack—an extremely serious and potentially fatal condition. There is evidence that environmental tobacco smoke may cause narrowing of the carotid arteries, which supply the brain with blood—a condition that causes a predisposition to strokes [52].

A full spectrum of lung diseases results from environmental tobacco smoke exposure, including lung cancer [202, 203, 204], asthma [20, 21, 209], a worsening of existing asthma [210], and a more rapid deterioration of lung function [186]. Tobacco industry workers, including those who do not smoke or have never smoked, also experience lung disorders, such as acute respiratory symptoms, occupational asthma, worsened lung function [211] and even fibrosis of the lung [212].

The notion of ventilation, (spatial) separation or air cleaning as a control measure for the health risk of environmental tobacco smoke exposure indoors is not scientifically valid, as it takes an impossible level of ventilation and air exchange (about 50,000 litres per second per occupant) to achieve the minimal threat to health due to such an indoor exposure [150].

Strong scientific arguments have warned of outdoor cigarette smoke exposure as a potential health hazard [213, 214]. This issue is further complicated by the fact that tobacco industries have experimented with and used additives in tobacco to mask the odour and appearance of cigarette smoke. There has been little or no evidence of testing for the generated level of toxicity, and no evidence of standard toxicity testing to determine the potential impact of the new additives' health hazards. Furthermore, there is the potential for actually increasing the concentration of some of the toxic or carcinogenic substances due to such cigarette design changes [215].

The tobacco industry has also gone to great lengths to battle the issue of environmental tobacco smoke exposure [216], to influence public opinion [217], and to discredit the available scientific evidence pointing to the hazards of environmental tobacco smoke exposure [218]. They have done this through scientific and public relations programmes created specifically for this purpose, but which are made to appear independent of the tobacco industry [218].

## **Smoking prevention and cessation**

The devastating effects of smoking and tobacco use, and the dangerously flawed notion or perception that tobacco use is harmful only to those who choose to use it, is clearly untrue. The benefits of stopping smoking are self-evident when faced with the range of possible harmful effects that tobacco use can inflict. The major conclusions on the health benefits of smoking cessation made in a report by the U.S. Surgeon General were as follows [219]:

1. Smoking cessation has major and immediate health benefits for men and women of all ages. Benefits apply to persons with and without smoking-related diseases.
2. Former smokers live longer than continuing smokers. For example, people who quit smoking before the age of 50 have one half the risk of dying in the next 15 years compared with continuing smokers.
3. Smoking cessation decreases the risk of lung cancer, other cancers, heart attacks, strokes and chronic lung disease.
4. Women who stop smoking before pregnancy or during the first 3 to 4 months of pregnancy reduce their risk of having a low-birth-weight baby to that of women who have never smoked.
5. The health benefits of smoking cessation far exceed any risks from the average 2.3 kilogram weight gain or any adverse psychological effects that may follow quitting.

The importance of prevention of initiation cannot be overemphasized given its impact on future smoking behaviour, the addictive nature of nicotine, the vulnerability of the young, and the role social norms and pressures play.

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