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Second hand tobacco smoke: Composition, exposure and potential health hazards

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Abstract
Second hand smoke (SHS) is a common indoor pollutant which is produced by the practice of tobacco smoking. The SHS contains many toxic chemicals and exposure to these chemicals has a wide range of serious health effect on both those who smoke and those who do not. Children are particularly at the risk of serious health effects from second hand smoke. The present paper focuses on the exposure and chemical composition of SHS. The paper also spotlights the various other health hazards posed to an individual because of the exposure to SHS.

Keywords: Tobacco, Smoking, Second Hand Smoke (SHS), Health Hazards, Carcinogens.

1. Introduction
Second hand smoke (also known as environmental tobacco smoke) is the mixture of side stream smoke (the smoke released by a burning tobacco product) and mainstream smoke (the smoke exhaled by a smoker). Since most tobacco worldwide is smoked in the form of cigarettes, therefore cigarettes are the major and the most common source of SHS smoke. Other smoked tobacco products like cigars, pipes, water pipes, kreteks and bidis also produce SHS.

The health concerns caused by SHS continue to be a major problem all around the world. As per the Surgeon General report 2010 [1], more than 20 million Americans have died as a result of smoking since the first Surgeon General's report on smoking and health released in 1964 (Table-1). The bulk of them were adults with a history of smoking, but nearly 2.5 million were non-smokers who died from diseases caused by exposure to SHS. Another 100,000 were babies who died of sudden infant death syndrome (SIDS) or complications from prematurity, low birth weight, or other conditions caused by parental smoking, predominantly of smoking by the mother.

Table 1: Premature deaths caused by smoking and exposure to second-hand smoke, 1965-2014.

Cause of death	Total
Smoking related cancers	6,587,000
Cardiovascular and metabolic diseases	7,787,000
Pulmonary diseases	3,804,000
Conditions related to pregnancy and birth	108,000
Residential fires	86,000
Lung cancers caused by exposure to SHS	263,000
Coronary heart diseases caused by SHS	2,194,000
Total	20,830,000

Source: Surgeon General report 2014

The various researches made worldwide have revealed that prolonged exposure to SHS causes premature death and disability. It is estimated that SHS causes about 600,000 premature deaths worldwide every year; approximately the same number of people who are killed by measles or women who die during childbirth each year. Of all deaths attributable to SHS, 31% occur among children and 64% occur among women [2].

An estimated 617 people in UK died from the effects of passive smoking at work in 2003, of which 54 were long term employees of the hospitality industry. Another 11,000 deaths were attributable to passive smoking exposure in the home in adults aged 20 to ≥ 65 [3]. This accounts for around 2% of the current annual toll from all smoking related deaths in the UK [4].

In 2005, the California Environmental Protection Agency used population estimates in the US to show the number of annual estimated deaths from SHS exposure. For non-smokers the Agency estimated that:

- ~ 3,400 people die from lung cancer
- 46,000 die from cardiac-related illness
- 430 children die from sudden infant death syndrome (SIDS) [5].

2. Methodology

The present paper intends to review the exposure, chemical composition and various ill effects of second hand tobacco smoke. For this secondary datas from various government and non-government organisation reports, books, journals, websites, encyclopaedias, newspapers and periodicals were taken to endorse the points.

3. Exposure

It is only a myth that people who do not smoke are not exposed to the health problems that a smoker does. SHS exposes everybody to such problems. People can be exposed to SHS in homes, cars, the work place, and public places, such as bars, restaurants, etc. In a study carried out in United States, it was found that an estimated 88 million non-smokers were exposed to SHS in 2007-2008 [6]. Today about half of the children between ages 3 and 18 in the U.S are exposed to cigarette smoke regularly, either at home or in public places such as restaurants that still allow smoking [1]. Researches have revealed that about one third of adults are regularly exposed to SHS [2]. In Canada, about a quarter of non-smokers report regular exposure at home, in vehicles or in public places [7]. Studies reveal that about 43% of children are exposed to second hand tobacco smoke at home, worldwide [8]. The average percentage of 13-15 year olds living in a home where others smoke is summarized in table-2.

Table 2: Average percentage of 13-15 year olds living in a home where others smoke

WHO Region	Percentage of children exposed to SHS
Africa	28
Americas	41
South-East Asia	34
Europe	78
Eastern Mediterranean	38
Western Pacific	51
Total	43

Non-smokers who are exposed to SHS take in nicotine and toxic chemicals by the same route smokers do. The continuous exposure to SHS causes disease, disability and death.

4. Chemical Composition of SHS

SHS essentially comprises of a mixture of side-stream smoke released from the burning tip of a cigarette (or other burned tobacco product) and the main-stream smoke exhaled by a smoker. It is a blend of over 4000 gaseous and particulate chemical compounds that are potentially toxic to humans. Although the concentrations and the amount of these pollutants get diluted to practically nil in the outdoor air, they attain significant levels in the indoor air.

Gaseous (or vapour phase) components of secondhand smoke known to damage health include: benzene; carbon monoxide, nitrogen oxides, acrolein, formaldehyde, acetaldehyde, carbonyl sulphide, hydrazine, pyridine, styrene and toluene. Particulate matter in secondhand smoke contains a number of potent carcinogens. The most studied of these include polycyclic aromatic hydrocarbons (PAHs) including benzo (a) pyrene, aromatic amines 2-naphthylamine and 4-aminobiphenyl, and the tobacco-specific nitrosamines N'-nitrosonornicotine (NNN) and 4-(methylnitrosamino-) 1-(3,pyridyl)-1-butone (NNK). A number of carcinogenic heavy metals, and weaker carcinogens that induce tumours in various organs, are also present in the particulate matter [9].

The concentrations of individual constituents in SHS can vary with time and environmental conditions. Field studies of these constituents and representative data have been extensively summarized in the following table [9, 10],

Table 3: Concentration of selected constituents in second-hand tobacco smoke

Constituent	Concentration
Nicotine	10–100 μg/m^3
Carbon monoxide	5–20 ppm
Benzene	15–30 μg/m^3
Formaldehyde	100–140 μg/m^3
Acetaldehyde	200–300 μg/m^3
1,3-Butadiene	20–40 μg/m^3
Benzo[a]pyrene	0.37–1.7 ng/m^3
NNK	0.2–29.3 ng/m^3
NNN	0.7–23 ng/m^3

Source: IARC Monographs Vol.100E [11]

5. Health Effects of Second Hand Smoke (Shs)

Evidence regarding the health impacts of SHS exposure have been established over decades. An exhaustive report on health consequences of involuntary smoking by the United States Surgeon General, and reports by the United States Environmental Protection Agency, recently highlighted the increased risks of several diseases similar to those seen among smokers, in persons exposed to SHS at home or at work place [12, 13].

SHS exposure has several immediate as well as long term health effects. It can reduce lung function, exacerbate respiratory problems, trigger asthma attacks, reduce coronary blood flow, irritate eyes and cause headaches, coughs, sore throats, dizziness and nausea. Following are some of the major ill-effects that SHS can have on the non-smoker's health:

5.1 SHS and Lung Cancer

In 2004, the International Agency for Research on Cancer (IARC) concluded that a non-smoker living with a smoker has a significantly increased risk of lung cancer, by approximately 24% for women and 37% for men [10]. The 2004 SCOTH (the UK Government-appointed Scientific Committee on Tobacco and Health) report revealed that exposure to SHS increases the risks of lung cancer in non-smokers by 24% [14]. Similarly, the 2006 US Surgeon General's report and review of the evidence concluded a

causal link between SHS exposure and lung cancer, with the risks of developing lung cancer increasing by 20-30% for non-smokers who live with a smoker [15]. Recently, a systematic review of 20 papers published in 2011 reported an increased risk of lung cancer of 25% among those exposed to SHS in the workplace [16].

5.2 SHS and Coronary Heart Disease

Studies have consistently revealed that exposure to SHS increases the risk of coronary heart disease (CHD) in non-smokers. In the 1990's heart disease caused by passive smoking was estimated to have been the third leading cause of preventable death in the United States, ranking just behind active smoking and alcohol use [17].

The SCOTH report estimates that non-smokers exposed to SHS have a 25% increased risk of heart disease. The Institute of Medicine in the United States confirms that exposure to SHS is a cause of heart disease in non-smokers [18]. Other estimates have found an increased risk of heart disease between 25-35% [10].

Research has established this fact that even a brief exposure to environmental smoke increases the tendency of blood to clot, restricting blood flow to the heart, and can produce a serious and even lethal effect on patients with heart disease. It has been recommend that people who are at risk of heart disease should avoid all places that allow smoking indoors [19].

5.3 SHS and Chronic Respiratory Effects

SHS contains many chemicals that can quickly irritate and damage the lining of airways. Even brief contact can activate respiratory symptoms, including cough, phlegm, wheezing and breathlessness. Persons who already have asthma or other respiratory problems are at especially high risk for being affected by SHS. The IARC research showed that the strongest causal effect of SHS exposure is chronic respiratory symptoms in adults [10].

5.4 Health effects of SHS on Children

SHS increases the risk of cancer and reduced respiratory function (cough, wheezes) among children. In addition, a child is at risk of bronchitis; middle ear infection; pneumonia; meningococcal or meningitis infection and sudden infant death syndrome (SIDs). Children are believed to be especially vulnerable to SHS as they breathe faster thereby inhaling more pollutants than adults. Children also ingest higher quantities of tobacco smoke pollutants due to more hand-to-mouth behaviours [20]. Research has found that after exposure to similar levels of tobacco smoke, cotinine levels (a metabolite of nicotine used to measure SHS exposure) in children are about 70% higher than in adults [21]. Globally, about 40% of children are reported to be exposed to SHS [22]. Children from socio-economically disadvantaged backgrounds are generally more heavily exposed to SHS.

6. Conclusion

It has been globally established that people continue to be exposed to second hand smoke at home, in the workplace, and in other public places. Though SHS is involuntarily act of smoking, yet it can cause a wide range of adverse health effects, including cancer, cardiovascular diseases, respiratory infections and asthma. Thus exposure to SHS is a substantial cause of mortality and ill health of the general public and is particularly more dangerous to the children. A complete smoke free environment is the only proven way to protect the people from the harmful effects of second hand smoke otherwise non-smokers too would continue to be exposed to the same health hazards as the smokers do.

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