INTRODUCTION

Tobacco smoke is the single greatest preventable cause of death that currently kills approximately 5.2 million people worldwide each year, a figure expected to increase to more than 8 million a year by 2030. Half of those deaths occur between the ages of 30 and 69 years ***(Jha et al., 1999; Mathers et al., 2002)***, about 70% of these deaths occur in developing countries ***(Murray et al., 1997; Jha et al., 2006).***

Environmental Tobacco Smoke (ETS), also known as, Secondhand smoke (SHS); is a complex mixture of gases and particles that include smoke from the burning cigarette, cigar, or pipe tip (side stream smoke) and exhaled mainstream smoke. It includes more than 4,000 chemical compounds, with at least 250 chemicals known to be toxic, and more than 50 that can cause cancer, cardiovascular, chest and other diseases ***(National Toxicology Program, 2006).***

Environmental Tobacco Smoke remains a major global public health problem resulting in preventable human suffering and loss of many years of productive life. It also causes economic harm to families and countries due to lost workers, reduced productivity and increased health care costs ***(Shafey et al., 2009).***

The principal places where studies have measured exposures to Environmental Tobacco Smoke represent key microenvironments: homes, workplaces, and public places.

Because the workplace is second only to the home as the location where adults spend most of their time, smoking in the workplace has been a major contributor to total Environmental Tobacco Smoke exposure ***(U.S. Department of Health and Human Services, 2006).***

The World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC) calls on governments to "protect all persons from exposure to tobacco smoke," rather than just specific populations. This protection should be extended, according to Article 8.2, to include "indoor workplaces ***(WHO Framework Convention on Tobacco Control, 2003).***

The International Labour Organization (ILO) estimates that each year about 200,000 workers die because of exposure to Environmental Tobacco Smoke exposure in their workplace. Many countries conduct several surveys to monitor exposure to Environmental Tobacco Smoke, but the little of them was targeted to track and monitor the exposure in workplaces ***(Takala et al., 2005).***

Environmental Tobacco Smoke exposure has been measured by different methods; first by surveys using a questionnaire (based on self reported exposure) which is a subjective method. And by measuring biological markers of Environmental Tobacco Smoke, found in tobacco smoke (such as nicotine and cotinine) in bodily fluids (urine, blood, and

saliva); this method can give an objective measurement of Environmental Tobacco Smoke exposure, but it is technically difficult and time consuming.

Alternatively, measuring airborne aspects of Environmental Tobacco Smoke can directly indicate their average levels in an environment, and is easier to obtain than collecting biological samples. Airborne Particulate Matter P.M., which is a major component of air pollution, is a mixture of solid and liquid particles of different size. Proximal airways filter P.M. larger than 2.5 Microns, and human lung parenchyma retains P.M sized 2.5 Microns ($PM_{2.5}$) which is a significant component of Environmental Tobacco Smoke ***(US Environmental Protection Agency, 1997).***

Particles of this size are released in significant amounts from tobacco products, and are easily inhaled deep into the lungs, and are associated with pulmonary and cardiovascular disease and mortality, and associated with hospital admissions in many geographical areas ***(Hyland et al., 2004).***

Environmental Tobacco Smoke is a major source of indoor air pollution. Recent work confirms that tobacco smoke is a major, if not the major, indoor source of fine particulate pollution. In order to protect the public health, the US Environmental Protection Agency (EPA) has set limits of $15\mu g/m^3$ as the average annual level of $PM_{2.5}$ exposure and $35\mu g/m^3$ 24-hour exposure and set an Air Quality Index

according levels of fine particles in air ***(US Environmental Protection Agency, 1997).***

The issue of passive smoking in workplaces in Egypt has assumed increasing prominence in last few years. Non-smokers are increasingly vocal in expressing their pain and suffering from smoking colleagues**.**

Egypt has three laws governing prevention of tobacco hazards: Law 52 of 1981, Law 85 of 2002 and Law 154 of 2007. Despite comprehensive tobacco control laws, implementation is still a challenge. The first tobacco control legislation was adopted in Egypt in 1981. This legislation had minimal scope, but represented the first step in a long-fought battle in the Egyptian parliament that concluded in 2007. There was another attempt in 1993 to adopt legislation that banned all kinds of tobacco advertising in the country, but it was defeated and undermined by the strong tobacco industry lobby, which was well aware of the sociopolitical dynamics of the country and was very well connected to the highest authorities who are decision-makers ***(Egypt, Egyptian Legislation on Tobacco Control, Law 52/1981, 85/2002 and 154/2007; Voice of truth, Cairo, WHO, 2003).***

In July 2007, new legislation was adopted with the following measures for the first time ***(Central Agency for Public Mobilization and Statistics, 2006):***

1. Establishment of a directorate of tobacco control in the Ministry of Health.
2. Establishment of an implementation/enforcement cell in the Ministry of Health to follow up on implementation.
3. Adoption of pictorial health warnings on all tobacco packs; this was implemented in August 2008.
4. Total ban on tobacco use in public places and cancellation of designated areas, although restaurants and bars were spared.
5. Adoption of the principle of taxation increase as a tool for controlling tobacco.
6. Establishment of a national coordinating mechanism; a high national committee for tobacco control was formed that involved multi-sartorial representation.

A plan of action was approved by the National Democratic Party to free Egypt from tobacco in 5 years.

However, in 2009, the most recent tobacco survey in Egypt "Global Adult Tobacco Survey" has revealed that 60.7% (6.5 millions) of workers who work indoors or in enclosed areas are exposed to passive smoking at their workplace, including 58.5% (4.3 millions) nonsmokers. For these workers, 34.5% of their worksites had policies “disallowing” smoking in any closed area, yet 31.1% have exposure in workplace. Exposure to passive smoking was 72.8% in governmental buildings, 49.2%in healthcare facilities and 89% in recreational places like cafes ***(GATS, 2009)***.

Accordingly, there is an urgent need in Egypt for valid and reliable methods to measure public health impact of Environmental Tobacco Smoke especially in public workplaces. Previous studies that have been done in Egypt were based on subjective methods in measuring ETS, and showed that ETS was prevalent in most of closed workplaces ***(GATS 2009)***.

The purpose of this study is to measure exposure to Environmental Tobacco Smoke in a sample of different public workplaces in Cairo using a sensitive airborne marker of Environmental Tobacco Smoke. Such data will support more progressive smoke-free policies and programs aimed at reducing passive smoking exposure in workplace in Egypt, and will provide base-line levels for monitoring the impact of tobacco control policies in the future.

AIM OF THE WORK

1. To measure exposure to Environmental Tobacco Smoke (using Particulate Matter, $PM_{2.5}$ levels) in 70 public workplaces in Cairo.

2. To measure the knowledge, attitudes and responses of workers in these workplaces toward passive smoking.

3. To find out prevalence of eye, nose, throat and chest irritation symptoms among non-smoking workers in these settings.

4. To measure Peak Expiratory Flow Rate (PEFR) as an indicator for ventilatory functions among sub sample of workers in these workplaces.

5. To identify factors related to violation of antismoking policies in these workplaces.

During the last decade the research has focused on the area of passive smoking; sometimes called Second-hand Smoke (SHS) or Environmental Tobacco Smoke (ETS). The first conclusive evidence on the danger of passive smoking arose in 1981 from a study showing that nonsmoking Japanese women married to men who smoked had an increased risk for lung cancer ***(Hirayama et al., 2000).***

Since then, a vast number of studies have appeared investigating the unfavorable effects of passive smoking. It is now generally accepted that passive smoking leads to increased prevalence of various cardiovascular diseases and increases the risk of death by at least 20% ***(Glantz et al., 1996).***

More importantly, recent data from nonsmoking adults have shown that passive smoking compromises health not only when individuals are exposed frequently for prolonged time as initially thought but also after a single brief exposure. This type of exposure could be of particular importance for occupational exposure to Environmental Tobacco Smoke at workplace. ***(Flouris et al., 2005; Sidorkewicz et al., 2006; Metsios et al., 2007; Flouris et al., 2008; Flouris et al., 2009).***

The principal places where studies have measured exposures to Environmental Tobacco Smoke represent key microenvironments of homes, workplaces, and public workplaces. Because workplace is second only to the home as the location where adults spend most of their time, passive

smoking in workplace has been considered as a major contributor to total Environmental Tobacco Smoke exposure ***(U.S. Department of Health and Human Services, 2006).***

The International Labour Organization (ILO) has estimated that each year about 200,000 workers die because of exposure to Environmental Tobacco Smoke in their workplace ***(Takala et al., 2005).***

Many countries conduct several surveys to monitor Environmental Tobacco Smoke exposure, but the little of them was targeted to track and monitor the exposure in workplaces ***(WHO Framework Convention on Tobacco Control, 2003).***

The exposure to Environmental Tobacco Smoke has been first measured by questionnaires (based on self reported exposure) which is a subjective method, and by measuring biological markers of Environmental Tobacco Smoke, found in tobacco smoke (such as nicotine and cotinine) in bodily fluids (urine, blood, and saliva): this method can give an objective measurement of Environmental Tobacco Smoke exposure, but it is technically difficult and time consuming along with multiple factors that affect nicotine metabolism, such as age, race, and the level of exposure Environmental Tobacco Smoke ***(Mannino et al., 2001).***

Large representative surveys of Environmental Tobacco Smoke exposure at workplace have looked mainly at the patterns of exposure and the impact of policies to reduce

exposure, with the little of them that aimed to quantitatively measure the exposure.

In 1990, a study from California found 9.3 percent of nonsmokers who worked in a "smoke-free" worksite reported at least one episode of exposure at work during the two weeks before the survey ***(Borland et al., 1992).*** This proportion was higher at 51 percent among nonsmokers working in sites without a smoking policy ***(Brancker et al., 1990).***

Hammond (1999) reviewed studies of exposures to Environmental Tobacco Smoke among workers. The earliest personal sampling of workplace Environmental Tobacco Smoke exposure involved railroad workers studied between 1981 and 1984 in United States. Investigators collected more than 625 nicotine samples from participants wearing personal samplers at four railroad locations. Personal samples were collected from smokers and 191 from nonsmokers and results revealed that nonsmokers and smokers were exposed to similar levels of nicotine ***(Hammond et al., 1999).***

Many researchers have studied offices. Where smoking was allowed, there was a wide range of nicotine concentrations. For nearly half of the offices, there were detectable levels of nicotine indicating workplace smoking (more than 1µg/m^3). Most worksites had at least one sample above 10µg/m^3, and many studies reported concentrations greater than 40 µg/m^3 that indicate a heavy exposure to smoking ***(Vaughan et al., 2008).***

Offices at worksites that restricted smoking to designated areas generally had much lower concentrations of nicotine. Half of these worksites had a median concentration of less than 1µg/m^3, and only one site exceeded 2.5µg/m^3 ***(Vaughan et al., 2008)***.

Thus, workplaces policies decrease nicotine concentrations substantially but do not completely eliminate them. These results are consistent with questionnaire survey results cited above, where 9.3 percent of nonsmoking California workers in "smoke-free worksites" reported some Environmental Tobacco Smoke exposure.

A number of other studies have measured the nicotine concentrations in a variety of other workplaces, including fire stations and manufacturing, printing, and medical facilities. Although concentrations were lower in these settings than in offices, the results of the analyses showed that one-third of the workplaces that allowed smoking still had minimum values above 1µg/m^3 ***(Hammond et al., 1995).***

Studies used biological markers of Environmental Tobacco Smoke confirmed that its exposure in public places continues to affect nonsmokers. Several investigators have shown that persons with no home or workplace exposures still had detectable levels of cotinine in their serum ***(Pirkle et al., 1996).*** This finding suggests that many people are exposed to Environmental Tobacco Smoke in other locations.

Cafes, cafeterias, and other recreational workplaces are worksites as well as public places where smoking is frequently unrestricted or restricted in a manner that does not effectively decrease exposure. Servers and bartenders working in environments where smoking is permitted may be exposed to high levels of Environmental Tobacco Smoke ***(Jenkins et al., 1999).***

In a survey of 1,224 residents from Minnesota, 57% of the respondents reported exposures to Environmental Tobacco Smoke: 44 percent reported exposures in restaurants, 21% reported exposures at work, and 19% reported exposures in venues. A quarter of the respondents in the NHAPS study reported exposures in restaurants or bars on the previous day for an average of two and one-half hours ***(Klepeis et al., 2001).***

Environmental Tobacco Smoke has long been considered a nuisance that interferes with the enjoyment of food. One approach to reducing exposures of nonsmokers has been to establish smoking and nonsmoking sections in restaurants. Nonsmoking sections generally do have lower concentrations of Environmental Tobacco Smoke, but they neither eliminate exposure nor reduce concentrations to insignificant levels ***(Lambert et al., 1993).***

Another study of seven restaurants in Albuquerque, New Mexico, found that half of them had concentrations above $1\mu g/m^3$ in the nonsmoking sections ***(Lambert et al., 1993).***

Similar results were noted in more than half of 71 restaurants surveyed in Indiana where nicotine concentrations were above 2µg/m^3 in the nonsmoking sections ***(Hammond et al., 2002).***

In a study of waiters exposed to Environmental Tobacco Smoke, the average nicotine concentration was as high as 5.8µg/m^3, with the upper end of the range at 68µg/m^3 ***(Maskarinec et al., 2000).***

Hammond (1999) reported that nicotine concentrations in cafes were somewhat higher than in restaurants; average values were between 6 and 14µg/m^3. Out of the 37 samples from company cafeterias in Massachusetts that allowed or restricted workplace smoking, two-thirds had nicotine concentrations that were above5 µg/m^3 ***(Hammond et al., 1999).***

Among the highest concentrations of nicotine measured in public places were those found in cafes, bars and venues, where reported values were generally greater than 50µg/m^3 and occasionally were above 100µg/m^3 Bartenders had higher exposures than waiters, at an average concentration of 14µg/m^3 and a maximum exposure of more than 100µg/m^3 ***(Maskarinec et al., 2000).***

Since 1986, the U.S. Surgeon General's report "The Health Consequences of Involuntary Smoking", has outlined the need for a more valid and reliable method to more accurately determine and assess the exposure to Environmental Tobacco Smoke and to characterize the impact of exposure

especially at workplace, and in other environments ***(U.S. Department of Health and Human Services, 1986).***

The report noted that without a more valid and reliable evidence, policymakers could not draft and implement effective anti-smoking policies to reduce and eliminate exposures. Since the publication of that report, the investigators have made significant advances in the development of more reliable methods.

Measuring airborne aspects of Environmental Tobacco Smoke can directly indicate their average levels in an environment, and is easier to obtain than collecting biological samples. In addition, there are methods available for rapid analysis of these airborne markers ***(Lambert et al., 1993).***

Particulate Matter; $P.M_{2.5}$ is a marker which represents the concentration of particulate matter in the air less than 2.5 microns in diameter. Particles of this size are released in significant amounts from all burned tobacco products. $PM_{2.5}$ measurements have been shown to correlate well with levels of Environmental Tobacco Smoke from tobacco smoking ***(Kura et al., 2005).***

Studies have found that particles of this size are easily inhaled deep into the lungs and proximal airways filter P.M. larger than 2.5 Microns and human lung parenchyma retains P.M sized 2.5 Microns ($PM_{2.5}$).It is also associated with pulmonary and cardiovascular disease and mortality, and

associated with hospital admissions in many geographical areas ***(US Environmental Protection Agency, 1997; Hyland et al., 2004).***

The advance in accurate measuring of exposure of Environmental Tobacco smoke at workplace was of great help for policymakers to take more progressive actions for smoke-free workplaces.

Several studies have revealed that employers and governments worldwide are taking decisive action to protect workers from the harm caused by Environmental Tobacco Smoke. Hundreds of millions of people worldwide are protected by 100% smoke-free policies in their workplace ***(Global Voices for a Smokefree World, 2007).***

Numerous studies have documented significant declines in hospital admissions for heart attacks following the implementation of comprehensive smoke-free laws ***(Barone-Adese et al., 2006).***

Respiratory symptoms among bar workers in Scotland decreased by 26% after smoke-free legislation was implemented in 2006; asthmatic bar workers experienced reduced airway inflammation and reported an improved quality of life ***(Menzies et al., 2006).***

Also it was found that seven out of every 10 smokers want to quit smoking, and smoke-free policies can help