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EDITORIAL

Where Smoking was Banned in Public Places, Myocardial Infarctions were Markedly Decreased!

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ABSTRACT

Tobacco use is the single most important preventable health risk in the developed world. Smoking-related mortality is on the rise. Most smoking-associated deaths relate to lung cancer, chronic obstructive pulmonary disease and coronary heart disease. Epidemiological studies suggest that passive smoking is nearly as harmful as active. In the adult population passive smoking can cause coronary heart disease and lung cancer. Smoking ban in public places has been implemented in most countries of the Western World with a high degree of compliance. The results of several trials assessing the effectiveness of this measure in public health are encouraging, as a consistent decrease in the incidence of acute myocardial infarction has been reported for the period after the legislation. A brief overview of these data is herein provided.

KEY WORDS: *smoking; active smoking; passive smoking; secondhand smoke; smoking ban; myocardial infarction; acute coronary syndrome; morbidity; mortality*

INTRODUCTION

Tobacco use is the single most important preventable health risk in the developed world. Smoking is causatively related to a wide range of diseases, including many types of cancer, chronic obstructive pulmonary disease, cardiovascular, cerebrovascular and peripheral vascular disease, and peptic ulcer.[1] It is the second leading risk factor for mortality worldwide, accounting for almost 5 million deaths annually (3.84 million in men and 1 million in women), including 848 000 due to cardiovascular disease.[2] It is estimated that smoking-related mortality will rise worldwide from 3 million annually (1995) to 10 million annually by 2030.

Data from the World Health organization (WHO) confirm that smoking among males older than 15 years old in the Western Pacific Region exceeds 50%, while women smokers prevail in the European Region with their percentage reaching 22%. The rates at which adolescent boys use tobacco average around 18% globally.

Second-hand smoke is the smoke that is inhaled in restaurants, offices, homes or other closed spaces when people use tobacco products. There are more than 4000 chemicals in tobacco smoke, of which >250 are known to be harmful and over 50 are known to cause cancer. There is no safe level of exposure to second-hand tobacco smoke. In adults, passive smoking can cause lung cancer and coronary heart disease. In infants, it causes sudden death. In pregnant women, it causes low birth weight. Passive smoking causes >600 000 premature deaths per year. Epidemiological studies

Abbreviations
ACS = acute coronary syndrome(s)
AMI = acute myocardial infarction
COPD = chronic obstructive pulmonary disease
NSTEMI = non-ST-elevation myocardial infarction
STEMI = ST elevation myocardial infarction
WHO = World Health Organization

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suggest that passive smoking is nearly as harmful as active, in terms of cardiovascular health parameters and outcome such as platelet and endothelial function, arterial stiffness, atherosclerosis, oxidative stress, inflammation, heart rate variability, energy metabolism, acute coronary syndrome provocation and infarct size.[3,4] Every individual on the planet should be able to breathe tobacco-smoke-free air. Smoke-free laws protect the health of non-smokers, are or should be popular, do not harm business and encourage smokers to quit. All people should be protected by comprehensive national smoke-free laws that should be implemented and all individuals, groups, businesses and societies need to abide by (http://www.who.int/mediacentre/factsheets/fs339/en/).

CLINICAL STUDIES

Over the last decade significant effort has been made in the western world to change the smoking habits of the population. After the relatively poor results of the anti-smoking campaigns, several states have prohibited smoking in public places. The established deleterious effects of passive smoking have provided a strong moral rationale for this measure which aspires to reduce the morbidity and mortality associated with tobacco use. Several studies have been conducted in recent years to assess the efficacy of the enforcement of smoking banning laws. In a small region in Montana, *USA,* smoking was prohibited in workplaces and public places for 6 months in the year 2002. The evaluation of the hospital archives for these months during the years 1998-2003 revealed that during the law enforcement period there was a significant decrease in admissions for acute myocardial infarction (AMI) compared to previous and subsequent years. Moreover, in a nearby territory not subject to such a law, no difference in the number of admissions for AMI was noted.[5]

In 2005 smoking was banned in indoor public places in *Italy.* The discharge records of hospitals in the Piedmont region were examined and the incidence of AMI was compared between a time period during the smoking ban and the same months in the years before it. The rates of admission for AMI were significantly lower during the ban (922 vs 832 cases, sex- and age-adjusted rate ratio, 0.89; 95% confidence interval, 0.81–0.98) for people younger than 60 years old. When the whole study population regardless of age was evaluated, no difference was noted. This was also the case for individuals older than 60 years old. [6]

The same team conducted a larger, country-wide study evaluating the occurrence rate of acute coronary syndromes (ACS) in a period of 5 years, from 2002 to 2006 which included three years preceding and two years following the smoking ban. The population was analyzed with regard to the age (above or below 70 years old) and several variables were included in secondary analysis, such as geographical distribution and fluctuations in all-cause hospital admissions. On a total number of events exceeding 900000, the rate ratio (RR) for all ages for the ban compared with the pre-ban period was 0.98 (95% confidence interval-CI 0.97–1.00). However, among people under 70 years of age, the RR of ACS for same comparison was 0.96 (95% CI: 0.95–0.98), representing a 4% decrease, regardless of the gender.[7]

Cesaroni et al examined the hospital archives in Rome and the regional register of causes of deaths to evaluate the incidence of ACS in individuals 35-84 years of age from 2000 to 2004 and compare it with 2005 data which represent the post-legislation period. In order to compensate for various confounding factors, information regarding indoor air pollution, influenza epidemics, weather conditions, cigarette sales and smoking habits of the population was taken into account. A statistically significant reduction occurred in acute coronary events after the smoking ban in 35- to 64-year-olds (RR 0.89, 95% CI 0.85 to 0.93) and in 65- to 74-year-olds (RR 0.92, 95% CI 0.88 to 0.97) reaching 12% and 8% respectively. In both age groups, out-of-hospital deaths and hospitalizations also decreased. In the oldest group (75- to 84-year-olds) no difference was detected. The cardiovascular event reduction was more apparent among men in the youngest population and young people living in low socioeconomic areas. According to particulate matter measurements and cigarette sales, the indoor air quality improved and smoking decreased. Thus, both passive and active smoking exposure rates dropped. Assessing the differential effect of these exposure conditions in cardiovascular events, the authors suggest that the benefits reported can be mainly attributed to the reduction of the exposure to passive smoking.[8]

A more extended study using data from four Italian regions showed that admissions for AMI decreased significantly within one year of the non-smoking law enforcement. However, the age and gender analysis revealed that this effect is apparent only in men and in the age classes 45-49 and 50-54 years of age.[9]

In *Ireland,* smoking ban in all enclosed public areas was introduced in 2004. Cronin et al examined data from a prospective register of all adult patients admitted due to an ACS in the hospitals of South-West Ireland from 2003 until 2007. By the first year of the implementation of the ban, the rate of admissions for ACS reduced by 12% in comparison to the previous year (177.9/100,000 from 205.9/100 000, 95% confidence interval [CI]: 164.0-185.1; P = 0.002). This result was confined to men and current smokers. A further reduction by 13% was noted during the third year of the smoking prohibition.[10]

However, smoking influence is not confined to cardiovascular system. A study assessing the total (non-trauma) and cause-specific mortality in patients over 35 years old was conducted in Ireland from 2000 until 2007, incorporating 3.75 years of post-ban follow-up. Adjustments for influenza activity, smoking prevalence and seasonality were made. The results were impressive with a 13% decrease in all-cause mortality

(RR: 0.87; 95% CI: 0.76–0.99), a 26% reduction in ischemic heart disease (RR: 0.74; 95% CI: 0.63–0.88), a 32% reduction in stroke (RR: 0.68; 95% CI: 0.54–0.85), and a 38% reduction in chronic obstructive pulmonary disease (COPD) (RR: 0.62; 95% CI: 0.46–0.83) mortality. Interestingly, decreases in mortality from ischemic heart disease, stroke, and COPD were recorded in individuals over 65 years old.[11]

In the Canton of Graubuenden, *Switzerland,* data on AMI (both STEMI and NSTEMI) admissions were collected from the tertiary hospital which holds the only cardiac catheterization laboratory, through the period of March 2008 to February 2009 (smoking ban active from March 2008) and were subsequently compared with those of the previous two years. In the two years preceding the prohibitory legislation, the number of patients suffering AMI was similar (229 vs. 242; p = not significant). In the following year the number dropped significantly to 183 (22% reduction, $p<0.05$ vs each of the previous two years). This result was mainly driven by a significant reduction in AMI rates in men (24%, $p<0.05$), while in women a non significant reduction of 17% was observed. Non smokers and patients with prior myocardial infarction or percutaneous coronary intervention enjoy more benefit.[12]

In the subsequent year the results remained the same, indicating that public health improvement was consistent over time. The late results were also compared with data from a nearby region where no smoke-free laws were active, as an estimate of the temporal distribution of AMI throughout the country. In this area the incidence of AMI did not show any change during the 3-year period of evaluation. Furthermore, markers of air pollution were measured and there was no relationship to the occurrence of AMI.[13]

In the *UK,* smoke free legislation was enforced in July 2007. Hospital admissions for coronary events of patients older than 16 years of age, from 2004 to 2012, were analyzed by age, sex and socio-economic status. Between the first and last two years of the study (2005-2006 and 2010-2011), AMI admissions decreased overall by 41.6% in men (from 325.3/100000 to 190/100000) and by 42.6% (from 148.7/100000 to 85.3/100000) in women (rate ratios 0.584 and 0.574 respectively), without any significant differences with regard to the socio-economic level.[14]

In *Spain,* Aguero et al compared the occurrence rate of AMI between a four-year period before the smoking ban law implementation (2003-2005) and a three-year period following this legislation (2006-2008). Data were derived from the discharge reports of the reference hospital of the region and from all death certificates containing causes of death compatible with AMI, in order to include out-of-hospital coronary events. A decrease in population AMI incidence in the post-ban period (relative risk [RR]: 0.89; 95% CI: 0.81–0.97) was observed especially among women (RR: 0.82), people aged 65–74 years (RR: 0.82) and passive smokers (RR: 0.85). Similar results were obtained when evaluating for hospitalized patients only. AMI-related mortality was also reduced in the years following smoking prohibition (RR:0.82; 95% CI: 0.71–0.94). [15]

A study coming from *Germany* analyzing the hospital records from 2006 to 2010 confirmed the previous findings of decrease in admissions due to STEMI after the implementation of the smoking-free laws, from 65 /month in 2006-2007 to 55/month in 2008-2010, which corresponds to 16% reduction ($p < 0.01$). This result was particularly obvious among non smokers, while smokers did not seem to benefit from this preventive measure.[16]

In the *Netherlands,* de Korte-de Boer et al evaluated the incidence of out-of-hospital sudden cardiac death based on the ambulance registry in the region of South Limburg. A small but statistically significant reduction of 6.8% ($p=0.043$) was observed post-ban compared with the pre-ban period.[17]

In the city of Bowling Green, *Ohio,* smoking was declared illegal in public places in March 2002. The rate of hospital admissions for smoking-related diseases was evaluated for a period from 1999 to2005 and compared to corresponding data from another city in the same state where no such law was in power. The results were positive with the largest reduction observed for coronary heart disease, where rates were decreased significantly by 39% after 1 year and by 47% after 3 years following the implementation of the ordinance in the study city ($p=0.036$). In the control one, no significant change was noted ($p=0.183$).[18]

In *France,* over 867,000 hospitalizations for ACS were recorded between 2003 and 2009. The admission rate variation, adjusted for age and gender was investigated before and after the smoking-free laws. In contrast with the aforementioned studies, all reductions reported were statistically insignificant. The authors in order to explain the result comment that coronary events were decreasing in the country well before the smoking ban legislation and that the rates of active smoking increased during the study period. [19]

A national smoking ban was implemented in *Denmark* in 2007. According to a study, spanning a 7-year period (5 years before and 2 years after implementation of the smoking ban), a significant reduction in the number of AMI-admissions was found in the last 3 years of the study period. The significant reductions were found one year before the ban (relative rate -RR = 0.86, 95% confidence interval -CI 0.79-0.94), one year after the ban (RR = 0.77, 95% CI 0.71-0.85) and two years after the ban (RR = 0.77, 95% CI 0.70-0.84).[20] The authors concluded that their results could be explained by the incremental enactment of smoking bans in Denmark and the implementation of a nation-wide ban on industrially produced trans-fatty acids in food in 2004.[20]

CONCLUSION

In conclusion, smoking ban has been implemented in most countries of the Western World with a high degree of

compliance. Several trials have been conducted to assess the effectiveness of this measure in public health. The results are encouraging, as a consistent decrease in the incidence of cardiovascular episodes has been reported for the period after the legislation. The benefit seems more important in younger patients, in males and in passive smokers, a result that can be expected since the aim of these laws was to reduce secondhand smoke exposure and prevent smoking-related morbidity in non smokers.

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