Secondhand Smoke: The Evidence of Danger Keeps Growing

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Secondhand smoke increases the risk of fatal and nonfatal coronary heart disease by about 30% (1,2). This effect, while appearing consistently in many epidemiologic studies, is larger than one would expect based on the dose of smoke that passive smokers receive compared with smokers (2): the effect is about one third that observed in smokers whereas the relative dose of smoke is much smaller. Previous investigators have shown that this apparent disparity may be because several aspects of the cardiovascular system, including platelets (3,4) and endothelial function (5–7), are very sensitive, even to the comparatively low doses of smoke (compared with smoking) that nonsmokers inhale when around secondhand smoke. Indeed, some of the effects of secondhand smoke on the cardiovascular system in nonsmokers are comparable to the effects of smoking in smokers, perhaps because the effects of the toxins in the smoke saturate at relatively low exposures. In this issue of the *Journal,* Panagiotakos et al (8) document one more effect of secondhand smoke: an increase in inflammation, which is a precursor of atherosclerotic plaque (9). In particular, they showed not only that white blood cells, C-reactive protein, homocysteine, fibrinogen, and oxidized low-density lipoprotein (LDL) cholesterol levels were increased among those exposed to secondhand smoke, but that the increases were similar to what was observed in smokers.

The mechanisms by which secondhand smoke increases the risk of heart disease are multiple and include an increase in oxidized LDL cholesterol, increase platelet adherence, mitochondrial damage, and oxidative damage (4,10). Rather than happening in isolation, these mechanisms interact with each other. In addition, secondhand smoke damages the endothelium, a vital layer of coronary arteries (11). The endothelium secretes vasodilating substances such as nitric oxide and prevents inflammatory cells from attaching to the vessel wall. Secondhand smoke interferes with the production of nitric oxide (12–14).

The study of Panagiotakos et al (8) has several strengths but also some limitations. The size of the random sample, the ability to control for potential confounders (e.g., diet, physical activity), and assessment of secondhand smoke exposure at home and at work, are some of the strengths of this study. The facts that the data are cross-sectional, that there was no biochemical validation of secondhand smoke exposure (e.g., cotinine levels), and that levels of exposure are classified only as regular or occasional, are some limitations of the study. The percentage of people who report current exposure (38% of never-smoking men and 33% of women) seems low, given that the prevalence of current smoking in the sample (48% of men and 38% of women) is high. This fact raises the possibility that the authors are underestimating actual exposure. The effects of this underestimation, however, will bias the results towards the null. The elevated levels of inflammatory markers found in this study are surrogate markers of inflammation that would lead to atherosclerotic disease and ultimately to an increase in the risk of heart disease. To validate their results, it would be desirable to have the results of a prospective study.

Although Panagiotakos et al (8) studied the effect of long-term exposure to secondhand smoke, it is important to note that some of the cardiovascular effects occur very quickly, some within minutes. Using the coronary flow velocity reserve as a surrogate of endothelial function, Otsuka et al (6) showed that after 30 minutes of breathing secondhand smoke, the endothelial function of coronary arteries of nonsmokers is compromised to a level similar to what is observed in a regular smoker. Platelet function (15) and oxidation of LDL cholesterol (16) show similar rapid responses. In addition, heart rate variability (a predictor of cardiac death or arrythmic events after myocardial infarction) in healthy people has been shown to decrease by 12% after 2 hours of breathing secondhand smoke in an airport lounge (17). Three hours of secondhand smoke exposure leads to significant increases in the circulating white blood cell counts (18). It would be desirable to know if other inflammatory markers, such as C-reactive protein, fibrinogen, and homocysteine, respond as quickly to secondhand smoke and how long it takes the effect to resolve after the exposure ends.

Even if only about 35% of the people in the study (conducted in Greece) are exposed to secondhand smoke at work or in their daily lives, this exposure still represents an important public health problem. In addition to heart

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disease, secondhand smoke increases the risk of lung and other cancers and of respiratory problems, thereby accounting for 53,000 deaths annually in the United States (15,19,20). The solution for secondhand smoke exposure is simple and straight forward: smoke-free environments. In addition to protecting nonsmokers from the toxins in secondhand smoke, smoke-free environments lead to a 3.8% decrease in the absolute prevalence of smoking and a three cigarette per day decrease among continuing smokers—a 29% drop in total cigarette consumption (21). Because the risks of heart disease fall so quickly when exposure to tobacco smoke ends, the California tobacco control program, which stressed smoke-free laws, not only reduced cigarette consumption, but also led to a large decrease in heart disease mortality (22,23).

Although creation of smoke-free environments makes a valuable contribution to public health, it costs the tobacco industry billions of dollars in lost sales (21–23). For more than 3 decades, the tobacco industry has worked in the shadows to generate a false controversy about the fact that secondhand smoke is dangerous. Through scientific consultants around the world who have been hired and managed by industry lawyers to obscure their connection to the tobacco industry, the industry has financed research that supports its political position (24) that secondhand smoke is just another indoor air contaminant and should not be regulated (25,26). Despite the industry's well-orchestrated secondhand smoke campaign, the scientific evidence behind the harmful effects of secondhand smoke keeps growing and the pressure for smoke-free environments continues to spread.

Although most of the attention and justification for creating smoke-free workplaces and public places has been to prevent cancer, the fact is that the effects of secondhand smoke on the heart and vascular system occur more quickly and account for the largest fraction of the disease and death that is caused by secondhand smoke (15,19,20) Clinicians and public health advocates should educate their patients about the dangers that secondhand smoke poses to heart health and urge them to take appropriate personal and public policy steps to end this exposure.

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