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Editorial

Ambient Air Pollution and Hypertension: A Relationship that Strikes Around the Clock

positive association of high residential traffic exposure with blood pressure in nonmedicated participants, and an elevated odds ratio for prevalent hypertension, but the relationship of modeled air pollutants with blood pressure was inconsistent [24]; on the other hand, recent large studies and updated reviews support the idea that prolonged exposure to particulate matter could increase both prevalence and incidence of hypertension [17,18,25].

The more recent and updated systematic review with meta-analysis is provided by Cai et al. [26]. In this meta-analysis, the authors quantitatively assessed the associations between short-term and long-term exposure to ambient air pollutants and the risk of hypertension, and they observed that short-term exposure to sulfur dioxide and particulate matter and long-term exposure to nitrogen oxide and particulate matter were associated with an increase in hypertension risk. The results of the heterogeneity analyses showed significant heterogeneity for some analyses; however, all of the analyses showed increased odds ratios, providing strong evidence whereby both short-term and long-term exposure to the main air pollutants increases the risk of hypertension and suggesting that air pollution can promote hypertensive hemodynamic responses.

It can be hypothesized that hypertensive consequences of particulate matter exposure represent one of the most important biological mechanisms explaining the role of particulate pollution as a modifiable factor contributing to cardiovascular morbidity and mortality. Similarly, unhealthy consequences of indoor and outdoor air pollution act on worldwide population, with considerable public health implications. Furthermore, both short-term or long-term exposure to some air pollutants may increase the risk of hypertension.

As a consequence of the role of hypertension as the major risk factors for premature mortality worldwide, and of the global detrimental effects of air pollution, the findings summarized in our editorial demonstrate an unequivocal relationship between particulate pollutants and blood pressure and these results have large public health repercussions. In fact, it is well established that even small changes in blood pressure levels lead to consistent decreases in stroke, coronary heart disease and overall mortality.

It must be reminded that given the enormous prevalence of hypertension and the ubiquitous and continuous nature of air pollution exposure, even a modest association between air pollution and hypertension and a small effect on raising blood pressure and/or the prevalence of hypertension, i.e. the major risk factor for mortality and morbidity worldwide, would place a large number of people at increased risk for cardiovascular morbidity and mortality and so

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Cardiovascular disease is the leading cause of death in the World [1]. As the major risk factor for cardiovascular disease, hypertension has been identified as the most important cause of disability and the leading risk factor for death globally [2]. The causes of hypertension are complex and are related to genetic factors, lifestyle, diet structure, and environmental factors, including air pollution [3]. Long-term exposure to ambient air pollution increases cardiovascular mortality rates [4,5]. Air pollution has also been associated with the incidence of nonfatal myocardial infarction and stroke [6-8]. Hypertension is one of the most important risk factors for cardiovascular disease, and has been ranked as the leading cause for death and disability worldwide [9,10].

Many epidemiological studies have investigated the associations between air pollution exposure and hypertension, but the results remain controversial: some studies have shown an association [11-15], whereas other studies have found either no association or an association only for selected pollutants or limitation based on short-term or long-term exposure [16-19]. Furthermore, the previous published studies on hypertension and air pollution can be broadly divided into 2 categories: short-term and long-term studies. The former estimate the acute effects of air pollution exposure and mostly include time-series analyses over a few days. The latter evaluate the chronic effects of air pollution, such as cohort survival analyses over years of exposure.

The short-term and long-term effects of air pollution may have nonmutually exclusive biological mechanisms, that is, direct and indirect effects on the sympathetic nervous system, oxidative stress, endothelial and other hemodynamic function, and vascular tone [20-23]. Explicating the differences between the short-term and long-term effects of air pollution could provide further information for policy makers and clinical prevention for hypertension.

A growing body of evidences suggests a relationship between ambient air pollution and hypertension. A first comprehensive meta-analysis of 15 European population-based cohorts reported a weak

would have enormous implications and would be of considerable and growing global public health importance.

Both air pollution and hypertension are important worldwide public health problems. Even though a small risk of hypertension is induced by the air pollution exposure, it may bring a large population-attributable disease burden of hypertension because of the ubiquitous nature of air pollution. Therefore, if these exposures are avoided, they theoretically could reduce the incidence of hypertension; consequently, healthcare providers should be advised to educate their patients, in particular those at heightened cardiovascular risk, about the potential adverse hemodynamic effects of air pollution, in order to reduce individual exposure and subsequently moderate the effect of air pollution on public health.

In conclusion, the relationship between ambient air pollution and hypertension is a matter that strongly strikes around the clock, and so even any minimal disruption would be significantly useful. Even in case of short-term or long-term exposure to indoor and outdoor air pollution the risk of hypertension is increased. In light of this evidence, efforts to reduce exposure to air pollution should urgently be intensified, and supported by appropriate and effective legislation. Health professionals, including cardiologists, have an important role to play in supporting educational and policy initiatives as well as counselling their patients. Air pollution should be viewed as one of several major modifiable risk factors in the prevention and management of cardiovascular disease. Further research should explore the optimal methods of air pollution reduction and document the effects of this on the incidence of cardiovascular disease and related mortality in order to pressurize policy makers to intensify the efforts required for effective legislation on air pollution reduction.

References

- World Health Organization (2015) Cardiovascular diseases (CVDs) Fact Sheet. WHO.
- Santulli G (2013) Epidemiology of cardiovascular disease in the 21st century: Updated numbers and updated facts. *J Cardiovasc Dis Res* 1: 1-2.
- Hansson GK (2005) Inflammation, atherosclerosis, and coronary artery disease. *N Engl J Med* 352: 1685-1695.
- Brook RD, Rajagopalan S, Pope CA 3rd, Brook JR, Bhatnagar A, et al. (2010) Particulate matter air pollution and cardiovascular disease: An update to the scientific statement from the American Heart Association. *Circulation* 121: 2331-2378.
- Chen H, Goldberg MS, Villeneuve PJ (2008) A systematic review of the relation between long-term exposure to ambient air pollution and chronic diseases. *Rev Environ Health* 23: 243-297.
- Tonne C, Yanosky J, Gryparis A, Melly S, Mittleman M, et al. (2009) Traffic particles and occurrence of acute myocardial infarction: a case-control analysis. *Occup Environ Med* 66: 797-804.
- Lipsett MJ, Ostro BD, Reynolds P, Goldberg D, Hertz A, et al. (2011) Long-term exposure to air pollution and cardiorespiratory disease in the California teachers study cohort. *Am J Respir Crit Care Med* 184: 828-835.
- Miller KA, Siscovick DS, Sheppard L, Shepherd K, Sullivan JH, et al. (2007) Long-term exposure to air pollution and incidence of cardiovascular events in women. *N Engl J Med* 356: 447-458.
- Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, et al. (2003) Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension* 42: 1206-1252.
- Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, et al. (2012) A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 380: 2224-2260.
- Chan C, Yang H, Lin R (2008) A community-based study on the association between hypertension and air pollution. *Epidemiology* 19: S286-S286.
- Oudin A, Strömberg U, Jakobsson K, Strohm E, Lindgren AG, et al. (2011) Hospital admissions for ischemic stroke: does long-term exposure to air pollution interact with major risk factors? *Cerebrovasc Dis* 31: 284-293.
- Guo Y, Tong S, Li S, Barnett AG, Yu W, et al. (2010) Gaseous air pollution and emergency hospital visits for hypertension in Beijing, China: a time-stratified case-crossover study. *Environ Health* 9: 57.
- Szyszkowicz M, Rowe BH, Brook RD (2012) Even low levels of ambient air pollutants are associated with increased emergency department visits for hypertension. *Can J Cardiol* 28: 360-366.
- Guo Y, Tong S, Zhang Y, Barnett AG, Jia Y, et al. (2010) The relationship between particulate air pollution and emergency hospital visits for hypertension in Beijing, China. *Sci Total Environ* 408: 4446-4450.
- Brook RD, Kousha T (2015) Air Pollution and Emergency Department Visits for Hypertension in Edmonton and Calgary, Canada: a case-crossover study. *Am J Hypertens* 28: 1121-1126.
- Chen H, Burnett RT, Kwong JC, Villeneuve PJ, Goldberg MS, et al. (2014) Spatial association between ambient fine particulate matter and incident hypertension. *Circulation* 129: 562-569.
- Giorgini P, Di Giosia P, Grassi D, Rubenfire M, Brook RD, et al. (2015) Air pollution exposure and blood pressure: an updated review of the literature. *Curr Pharm Des* 22: 28-51.
- Chen SY, Wu CF, Lee JH, Hoffmann B, Peters A, et al. (2015) Associations between Long-Term Air Pollutant Exposures and Blood Pressure in Elderly Residents of Taipei City: A Cross-Sectional Study. *Environ Health Perspect* 123: 779-784.
- Zhong J, Urch B, Speck M, Coull BA, Koutrakis P, et al. (2015) Endotoxin and β -1,3-d-glucan in concentrated ambient particles induce rapid increase in blood pressure in controlled human exposures. *Hypertension* 66: 509-516.
- Brook RD, Brook JR, Urch B, Vincent R, Rajagopalan S, et al. (2002) Inhalation of fine particulate air pollution and ozone causes acute arterial vasoconstriction in healthy adults. *Circulation* 105: 1534-1536.
- Mills NL, Miller MR, Lucking AJ, Beveridge J, Flint L, et al. (2011) Combustion-derived nanoparticulate induces the adverse vascular effects of diesel exhaust inhalation. *Eur Heart J* 32: 2660-2671.
- Lundbäck M, Mills NL, Lucking A, Barath S, Donaldson K, et al. (2009) Experimental exposure to diesel exhaust increases arterial stiffness in man. *Part Fibre Toxicol* 6: 7.
- Fuks KB, Weinmayr G, Foraster M, Dratva J, Hampel R, et al. (2014) Arterial blood pressure and long-term exposure to traffic-related air pollution: an analysis in the European Study of Cohorts for Air Pollution Effects (ESCAPE). *Environ Health Perspect* 122: 896-905.
- Dong GH, Qian ZM, Xaverius PK, Trevathan E, Maalouf S, et al. (2013) Association between long-term air pollution and increased blood pressure and hypertension in China. *Hypertension* 61: 578-584.
- Cai Y, Zhang B, Ke W, Feng B, Lin H, et al. (2016) Associations of Short-Term and Long-Term Exposure to Ambient Air Pollutants With Hypertension: A Systematic Review and Meta-Analysis. *Hypertension* 68: 62-70.

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