

CHAPTER 7

Asthma and Air Pollution: Connecting the Dots

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INTRODUCTION

This chapter focuses on the relationship between asthma and car-induced increases of particulate matter in the air, on the one hand, and patient awareness of the link between air pollution and respiratory conditions, on the other. It begins with a discussion of the link between air pollution and asthma, subsequently turning to the phenomenon of “car culture” in general and in the Netherlands in particular as it relates to rising rates of air pollution and environmental health.

In the discussion section, I inquire why international health institutions and patient organizations have not put pressure on international environmental organizations, and national environmental ministries, let alone the actual polluters such as automobile industry. My discussion culminates in reflection on the massive corporate support for the ongoing use of motor vehicles, resulting in a situation in which patient organizations composed of pollution-related disease sufferers and their supporters are more focused on mitigation of the symptoms than addressing the ultimate causes of asthma.

In this chapter, I argue that to fully address the issue of respiratory health, international health organizations as well as national health ministries, patient organizations, and the general public must recognize the link between vehicular dependency, air pollution, and asthma. Consequently, I recommend explicitly linking vehicular dependency to the state of poor

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respiratory health, both in the specific case of the Netherlands and globally. More broadly, I argue that raising environmental health awareness among existing and potential asthma patients, by explicitly linking vehicular dependency to the state of poor respiratory health, may help in efforts to lobby the government to raise air quality standards and control polluting industries more effectively.

ASTHMA AND AIR POLLUTION

The respiratory system is a primary body nexus for diverse environmental threats to cluster, intermingle, and multiply their adverse impacts as well as a site for harmful disease interactions sparked by changing environmental conditions (Baer and Singer 2008; Singer 2013). Many conditions have been linked in some way to environmental pollution. Studies also have shown that food contaminants, indoor pollution, and climate change can all affect respiratory health (Asthma Fonds; Asthma UK; WHO 2014).

Asthma is a chronic disease characterized by recurrent attacks of breathlessness and wheezing, which vary in severity and frequency from person to person (WHO 2014). The prevalence of asthma has changed in recent decades due to better diagnostic and treatment technologies, on the one hand, and environmental factors, such as pollution or changing lifestyles, on the other (Kopnina and Keune 2010; WHO 2014). There is a growing awareness in the areas of environmental health and in fields as diverse as medical anthropology and toxicology of the negative effects of air pollution on occurrence of asthma (American Lung Association; EPA; NRDC; Helman 2007). As the collected essays in this volume demonstrate, medical anthropology in particular has heightened awareness of the centrality of culture to human experience, and brought about recognition of the importance of social structure and an environmentally mediated political economy on health.

Two key air pollutants affect asthma: ozone, found in smog, and particle (or particulate matter) pollution. Studies show a direct relationship between the number of hospitalizations for asthma and increases of particulate matter in local air, including dust, soot, fly ash, diesel exhaust particles, smoke, and sulfate aerosols (e.g., NRDC; Morris, Sale, and Wakefield 2000; Salam, Islam, and Gilliland 2008; Balmes 2009; Tramuto *et al.* 2011). Increasingly, the Centers for Disease Control and Prevention (CDC) has linked asthma and both indoor and outdoor air pollution. According to the American Lung Association, car exhaust, smoke, and factory emissions make outdoor air dangerous, while tobacco smoke, presence of dust mites, and household chemicals and inadequate ventilation of stoves are just a few of the indoor hazards that can impact respiratory health.

There is now strong evidence associating the development of asthma with residence near roads that have heavy traffic and especially those used by diesel-fueled vehicles, which are the source of most particulate matter pollution (EHHI; Independent 2004; Krivoshto *et al.* 2008; Vidal 2013). An Italian study of urban

air pollution and adult emergency room admissions for respiratory symptoms, for example, demonstrates that exposure to ambient levels of air pollution is an important determinant of emergency room (ER) visits for acute respiratory symptoms (Tramuto *et al.* 2011).

Increases in adult asthma are equally true of childhood asthma. Recent studies show a clear relationship between exposure to air pollutants and both the occurrence of the disease and exacerbation of childhood asthma (GINA; Zmirou *et al.* 2004; McConnell *et al.* 2006). There is also growing evidence of asthma symptoms in children who live near congested roadways (Van Vliet *et al.* 1997; Venn *et al.* 2001; Nicolai *et al.* 2003; Jerrett *et al.* 2008). The recent population-based matched case-control study of children by Li *et al.* (2011) examined the relationship between individual exposure to air pollution and severity of asthma symptoms. The study found that asthma events were associated with proximity to primary roads with asthma events becoming less likely the greater the distance between a person's residence and a primary road. Simultaneously, there are also serious health risks associated with the use of asthma medication, particularly the long-acting Beta-agonists in most prescribed non-alternative asthma corticosteroid inhaled medication (e.g., Nieto *et al.* 2007; Ducharme *et al.* 2010; Kopnina 2010; Jacobs, Jones, and Macginnitie 2012).

ENVIRONMENTAL HEALTH AND SOCIAL JUSTICE

The issue of environmental health is related to a larger discussion in the social sciences about environmental justice and studies that show that the poorest people tend to live in the most polluted environments. In the rural areas of the developing world, the poor often have been forced into marginal areas (Sahsuaroglu *et al.* 2009). First, environmental justice seeks to redress inequitable distribution of environmental burdens to vulnerable groups and economically disadvantaged populations. Second, environmental justice highlights the unequal exposure to environmental risks and benefits in developed and developing countries. Third, temporal environmental justice refers to issues associated with intergenerational justice or concern for future generations of humans. In all three cases, environmental justice entails equitable distribution of burdens and benefits to different nations or social groups. By contrast, ecological justice involves biospheric egalitarianism or justice between species (Kopnina 2014a, 2014b).

Environmental racism, related to the three types of justice listed above, typically involves placement of economically disadvantaged or minority communities in proximity to environmentally degraded environments or, conversely, the placement of polluting industries or practices near disadvantaged communities (Melosi 1995; Singer and Hodge, this volume). Environmental racism includes any policy or practice that negatively affects the living environment of low-income or ethnically marginalized communities to a greater degree than affluent communities (Holifield 2001; Singer and Evans 2013).

PATIENT ORGANIZATIONS AND ASTHMA

There is considerable literature on how emerging patient organizations attempt to address environmental health issues. In recent years, patient group platforms were established and new legal instruments came into place, including Patients' Rights laws and Charters of the Rights of Patients. Patients' rights groups have also been more active at the European Union (EU) level since the late 1980s. Seen as the extension of human rights generally, the rights of patients is an issue that has become recognized in Europe in the past two decades. The European Consultation on the Rights of Patients, held in Amsterdam in 1994 under the auspices of the World Health Organization's Regional Office for Europe (WHO-EURO), defined principles and strategies for promoting the rights of patients, within the context of the health care reform process in Europe.

However, few nongovernmental organizations or patient organizations, such as the American Lung Association, Asthma UK, and Astma Fonds, embrace an understanding that would enable them to put pressure on air-control, pollution-control, or environmental standards agencies, let alone the actual polluters, such as the fossil fuel and car industries. The social composition of these groups tends to consist of educated, mostly middle-class individuals, as these tend to be more aware of risks as well as more "empowered" to act than the less privileged classes. The pursuit of health has become a prominent lifestyle goal among sections of the upper middle classes but often this is framed in terms of individual decisions and actions.

While changes in air quality and the release of greenhouse gases are tied to practices like the massive corporate support for the ongoing use of motor vehicles (Baer 2009; Singer 2013; Baer, this volume), and increased prominence of "car culture" globally, patient organizations seem more focused on treating the symptoms rather than addressing the ultimate causes of disease. In cases where patients' organizations' interests may clash with industrialist groups, the governments of most neoliberal democracies do not seem prepared to ignore industrial lobbies in favor of population health.

A famous example of the clash between industrialist and patients' groups' interests involves asthma patients' organizations and the tobacco industry. This will be further discussed below in the section entitled "Connecting the Dots." More broadly, the state of public health efforts focused on traffic and asthma seems quite uncertain, to say the least. There are some studies of emic understandings of asthma and environmental risks but they tend to be largely inconclusive (e.g., Brown *et al.* 2002, 2003).

CAR CULTURE AND ENVIRONMENTAL HEALTH

Anthony Giddens opens his book, *Politics of Climate Change* (2009), with a question about sports utility vehicles (SUVs):

Why does anyone, anyone at all, for even a single day longer, continue to drive an SUV? Their drivers have to be aware that they are contributing to a crisis of epic

proportions concerning the world's climate? On the face of things, what could be more disturbing than the possibility that they are helping to undermine the very basis of human civilization?

Treating SUVs as a metaphor, Giddens goes on to provide a number of socio-economic, political, and psychological theories intended to account for the reasons that, despite environmental awareness, "we are all SUV drivers" (Giddens 2009: 2). Less apocalyptically, McShane (1994) and Holtz Kay (1997) express their concerns about widespread car use, linking it to a number of negative social and environmental effects. However, like Giddens, they do not discuss the effect of cars on environmental health.

Yet a number of health-related effects of cars have been discerned (see Baer, this volume). Aside from the links between and inhalation of harmful fumes and incidence of such diseases as asthma and cancer, there is an obvious toll claimed by traffic accidents (the statistics of which are truly frightening). Car driving also has been linked to health because of the lack of movement of the drivers (affecting their muscular and cardiovascular systems, and causing obesity). The very process of car production is polluting, causing immediate toxic pollution and far-reaching effects such as global warming. Threats to respiratory health being ushered in by global warming include ecosyndemics that entail harmful disease interactions sparked by changing environmental conditions (Singer 2013). Another consequence of having over a billion cars in the world is that an increasing area of land is covered by tarmac, allowing less of the green "filtering" that counteracts greenhouse gas buildup (Sperling and Gordon 2009; Kopnina and Keune 2010; Kopnina 2011).

WHAT DRIVES THIS CAR DEPENDENCY?

The automobile industry has long sought to highlight its products' appeal to people based on their desire for control, power, social status, and self-esteem. The idea of the car as a status symbol and the perception of driving as adventurous, thrilling, and pleasurable is now universal. These trends may be linked to the larger question of the apparent universality of a consumer culture appeal being driven by globalism. Kopnina (2013) has noted that despite differences in their religious, cultural, or social values or ideologies, Ukrainian, Zimbabwean, Brazilian, Japanese, Turkish, and Dutch citizens generally do not seem to be prepared to give up their personal possessions and comforts (such as cars) for the sake of (nonmaterialist) religious or ideological ideals. While "new urbanism," "smart growth," and eco-cities are gaining ground in contemporary discourse, hybrid and electric vehicles are increasing their market share, and "green" consumerism is becoming mainstream in many developed countries, none of this activity has made much difference, apart from fostering the illusion of progress (Rees 2009). In order to explain the cross-cultural love affair with cars more generally, we may ponder the widespread desire of human beings to distinguish their status and identity with the

markers of material possessions through “conspicuous consumption” (Veblin 1902), and other features of human nature (Rees 2008; Kopnina 2013). However, conspicuous consumption has not always been universal, as illustrated by counter-examples like northwestern potlatch and pacific yam display. Rather, conspicuous consumption could be seen as a reflection of a need generated within a particular historic context and mode of production rather than a universal human trait.

More specifically, car dependency can be linked to various socioeconomic features of advanced industrial societies. These features involve the power hegemony of the industry that produces cars, and the drivers’ addiction to cars, fueled by clever marketing strategies and governments’ support of this industry. The American car-maker Henry Ford started buying tracks of railroads in order to build highways for cars, turning a car into one of the symbols of being American, progressive, and successful.

James J. Flink (1975: 40–41) accounts for the American car culture in relationship to the government’s *laissez faire* policy in supporting the automobile industry and promoting cheaply produced products for mass consumption as playing on culturally constituted core values of individualism, autonomy, and freedom.

Aside from these affective factors, it is the speed, flexibility, and convenience of cars, and the affective benefits of driving, such as being independent, gaining a sense of personal identity and “enjoyment of driving,” that account for the globalizing love of cars (Lefrançois 1998; Stradling, Meadows, and Beatty 1999; Sandqvist and Kriström 2001). Steg (2005) reflects on the research, examining various motives for car use on the basis of a model of the meaning of material possessions, feelings of sensation, power, superiority, and arousal. This is similar to general observations about the social functions of “conspicuous consumption.” It is clear that people’s psychological attachment to cars, and the automobile industry’s calculated grip on the market, are not deterred by concerns about road safety, environmental sustainability, the impact of road kill on local species, and many other negative effects of cars. Despite the guilty feelings of a few individuals, cultural prioritizing of transportation and energy policies places “mobility” and “modernity” as priorities before one of the many “collateral damages” of cars (Desmond 2013).

Ecological modernization proponents and clever car manufacturers argue that electric or hybrid cars are much less harmful. At the same time, car manufacturers and automobile organizations introduce various schemes to encourage “ecological driving,” alternative fuels, CO₂ taxation, car-related noise reduction, and so forth. However, opponents point to the “rebound effect” of such technologies, namely (a) an increase in the number of vehicles; (b) an increase in fuel consumption in response to increases in technical efficiency; and (c) an increase in vehicle miles traveled (Greening, Greene, and Difiglio 2000). According to Isenhour (2010), the increasing affordability of energy-efficient vehicles also drives demand for resource extraction for new car production, regardless of the functionality of existing automobiles or the absence of plans for their disposal.

AIR POLLUTION AND TRANSPORTATION IN THE NETHERLANDS

The Netherlands relies for 92 percent of its energy on fossil sources. Emissions and waste include carbon monoxide (CO), particulate matter (PM10, PM2.5), nitrates (NO_x), sulfates (SO_x), heavy metals (As, Cd, Cr-VI, Ni, Hg, Pb), volatile organic components (VOCs), and polycyclic aromatic carbohydrates (PACs).

It appears that the Netherlands is one of the most polluted countries in Western Europe, according to the Dutch environmental group Stichting Natuur en Milieu (Foundation Environment and Nature). The organization bases its claim on a survey commissioned by the European Commission (NRC 2008). A number of studies published in the leading medical journal *Lancet* show that poor air quality in the Netherlands correlates with incidences of respiratory illness and death (Brunekreef and Holgate 2002; Hoek *et al.* 2002). With more than seven million passenger vehicles on its roads, the Netherlands is the sixth largest automotive market in Europe (ACEA). Car density in the Netherlands in 2009 was 462 per 1000 inhabitants, up from 371 per 1000 in 1991 (Eurostat 2014). This is remarkable, because the Netherlands is a territorially small country with a highly developed public transportation system and is an alleged leader in ecological modernization (Kopnina 2014a, 2014b). Do not those bicycles used by many Amsterdam residents account for greener transportation trends? Unfortunately not, as owners of the Dutch bicycles own cars as well, and the presence of bike lanes in all major Dutch cities does not stop the continuous expansion of Dutch motorways.

Within the European Union, the Netherlands appears to be one of the worst countries for air pollution in terms of emissions from diesel cars. In October 2011, the government of the Netherlands launched its Sustainability Agenda designed to examine how key sectors can help the country attain green growth, with the goal of having 15,000–20,000 electric cars on the roads by 2015 (OECD 2011). In an article titled “Dirty Dikes” in the *Economist*, the Netherlands is described as a “sink-hole of pollution” with its water “brimming with nitrates and phosphates, and the air is clogged with particulate matter”:

The Netherlands ... scores particularly badly on the quality of its soil, where those phosphates and nitrates linger in large quantities. They seep into surface water, the quality of which is also below EU guidelines. Emissions of nitrogen monoxide and dioxide are triple the EU average. Carbon-dioxide emissions rose by 15% between 1990 and 2010. Only vast purchases of emission rights keep the Netherlands below its Kyoto targets. (*Economist* 2012)

Despite European Environmental Agency regulations, emissions in the Netherlands had decreased much less than anticipated by the EU standards defined in the past decade, and in fact the number of (nonelectric) car users has increased (Eurostat 2014). Moreover, recent studies of Dutch children’s perception of cars indicate that future generations of Dutch citizens are not likely to start using public transport (Kopnina 2011; Kopnina and Williams 2012).

According to national research on Mobility in the Netherlands, Mobiliteitsonderzoek Nederland, there are 7348 million households in the country. Four out of five (79.1%) owns one or more cars. There are very few car-less families (4%), and four in five single-parent families own a car. According to Hans Jeekel (2011), 20 percent of the car-less persons in the country simply cannot afford a car.

ASTHMA IN THE NETHERLANDS

According to the Dutch Ministry of Public Health, there are 519,800 (236,800 men and 283,000 women) registered asthma patients in the Netherlands, among whom 115,000 are children (Astma Fonds; RIVM 2014). In a Dutch cross-sectional study (Van Vliet *et al.* 1997) examining whether motor vehicle exhaust from freeways has an effect on the respiratory health of children, 1068 children attending schools situated less than 1000 meters from major freeways carrying between 80,000 and 150,000 vehicles per day in the Province of South Holland were asked to participate. Chronic respiratory symptoms reported in the questionnaire were analyzed using logistic regression. Distance from the freeway and traffic intensity was used as exposure variables. Coughing, wheezing, runny nose, and doctor-diagnosed asthma were significantly more often reported for children living within 1000 meters of the freeway. Those living closer to the freeway and to greater truck traffic exposure tended to be poorer, underprivileged, or members of minority groups. Environmental racism is also related to “transit racism,” as minority communities in the United States, for example, have higher morbidity rates (among other factors, due to traffic) than white communities and, as a result, are more readily affected by debates over environmental factors and subsequent public health and government efforts. Considering the international studies presented above, it is not unreasonable to assume that the Dutch data are consistent with general patterns of vehicular-related negative effects on respiratory health.

Remarkably, however, environmental awareness of the adverse effects of personal vehicle pollution and health in Dutch society is very low (Kopnina 2011, 2014a, 2014b). What does this tell us about the potential for linking car dependency with awareness of negative effects of traffic pollution and other health effects associated with cars? To answer this question, I examine more general trends in the health and antitoxin awareness movement.

HEALTH AND ANTITOXIN AWARENESS MOVEMENT

Concerns about the occupational hazards in industrial society have intensified since the turn of the previous century, and a global antitoxics movement has emerged, closely linked to a consumers’ movement that arose in the late 1960s. The publication of the book *The Silent Spring* by Rachel Carson in 1962 warned the public about the use of chemical pesticides and their influence on health and environment, and began a process of raising awareness of the dangers of environmental chemicals.

Awareness of environmental health risks was also triggered by the technology-caused disasters that have occurred since the turn of the twentieth century. One of the earlier examples of this occurred at the Love Canal chemical waste dump in Niagara Falls, New York, when the link between human illness and the dumping of chemicals in the water was discovered in the 1970s. Another example was the so-called toxic fog in London, UK, in 1952, which involved a combination of air pollution and extreme weather conditions; by some estimates this led to hundreds of lives being lost in less than a year, and thousands of cases of respiratory diseases (e.g., Bell, Davis, and Fletcher 2004).

Such disasters have caused heightened public awareness of environmental health risks and widespread public protests in Western countries. Zavestovsky (2010) traces the global antitoxics movement to 1971 when David Weir, who was working for the US Peace Corps in Afghanistan, noticed that a packet of Kool-Aid he had bought listed cyclamates among its ingredients. This sweetener had been recently been banned in the United States. This discovery led to Weir's investigation into the problem of US corporations dumping their banned products on overseas markets. Weir (1987) subsequently published a book focusing on the dumping of pesticides, illustrating how chemical companies were protecting profits by selling, or dumping, products that had been banned in their country of production in countries without such stringent regulatory infrastructure.

One of the worst accidents of the previous century, the Bhopal disaster in India in 1984, was caused by a gas leak from Union Carbide India Ltd. which killed at least 4000 local residents instantly and caused health problems in perhaps 500,000 others, people who still suffer from chronic disease consequential to gas exposure (Morehouse and Sarangi 2005). Following this, there was the Chernobyl accident, oil spills in the Gulf of Mexico, and, more recently, the Fukushima nuclear disaster.

What is worrying is not the sudden and intense occurrence of industrial disasters so much as the common everyday pollution, such as the particulate matter emitted by cars, or the massive amounts of plastic found in the oceans, seas, lakes, rivers, and city parks. According to Zavestovsky (2010), just as the consumer movement identified multinational corporations as the primary source of new risks related to the global spread of harmful consumer products, so too did the nascent global antitoxics movement come to see multinational corporations as the driving force behind new toxic risks. In fact, many environmental health threats are the result of the by-products of the manufacturing of consumer goods, or the processing of the raw materials to make those goods. Yet, focusing strictly on the risks related to the goods themselves, as the consumers' movement does, is insufficient. For example, through drift and absorption into groundwater, the chemicals used in agriculture and elsewhere are having a much broader impact. So too are the indirect consequences of car ownership, through the building of roads, parking lots, garages, and so on, which has caused a decline in natural areas, and a lowering of the quality of air.

CONNECTING THE DOTS

Social scientists need to continue to draw connections between particular environmental problems (e.g., global warming, toxic dumping, pollution) and human health problems, such as asthma (Baralt 2010; Kopnina and Keune 2010). Whitelegg (1993) provides a critical environmental analysis of European transportation, asserting that the conceptual basis of current transportation policy must be changed to ensure future sustainability. Congestion in cities, pollution, the health-damaging effects of traffic, privatization of transport infrastructure, and the social distribution of mobility are discussed in the context of European modernity. Through such contextual examination of European modernity, Whitelegg also gains insights into affective motives that perpetuate car culture. Thus, we need to look more closely at similar studies demonstrating that symbolic and affective motives are linked to cars and thus to psychological resistance to abandoning cars in favor of public transport use (Van Vugt, Meertens, and Van Lange 1995; Tertoolen, Van Kreveld, and Verstraten 1998; Abrahamse *et al.* 2009), as well as studies linking corporate pressure from the automobile industry on both consumers (through marketing) and government (through public lobbying and financial contributions) (Baer 2009). We need to ask the following questions: Are weak government policies targeted at reducing car use likely to affect drivers' choices? Given the relative balance of power of patients' and consumers' groups, on the one hand, and polluting industries, on the other, is government failure to protect the weaker party and allow the powerful industrial lobbies to have their way likely to continue?

Other actions, such as government support for polluting industries (e.g., in the United States the Obama administration's bailout of the auto industry), clearly indicate that political preference is strongly biased toward industry, rather than public health. Public attitudes toward policy measures for reducing private car use testify to complex and not always rational (in terms of price or effort reduction) but often social and effective considerations for car use (Loukopoulos *et al.* 2005). Such studies of car use suggest that policy makers should not exclusively focus on instrumental motives, but should also consider the many social and affective motives involved. Thus, on the one hand, if international health organizations such as WHO, as well as national health ministries, patient organizations, and general publics, were to recognize the direct link between vehicular dependency and asthma, the case for addressing car culture could be made stronger. Strategic policy efforts then should explicitly link the present pattern of mobility to public health. But also – and quite significantly – researchers could help the public to realize that governments may never do enough to address health issues in the status quo because they have vested interests in industries, including polluting industries, that have large financial and political leverage.

Due to rapid culture change, children are more likely to depart from the attitudes and habits of their parents, including with regard to transportation (Kopnina and Williams 2012). Thus, it may be of paramount importance to address existing – and changing – attitudes of children, who may yet find new ways for sustainable transportation. Research on parent–child transition of values may provide a clue to the formation of views of future transportation

users. Because of the increasing tendency of parents to take children by car to various activities, children's attitudes might be partially influenced by the habits their parents develop for them (Lindén and Carlsson Kanyama 1999; Nilsson and Küller 2000). Considering the proverbial wisdom and empirical reality that parents worry about their children's health, we may postulate that rising environmental health awareness in connection to cars among parents might have a greater effect not only on their own choice of transportation, but on that of the future generations. Thus, another strategic policy move would involve targeting both parents and children for increasing recognition of the negative effects of cars on children's health.

To sum up, a number of recommendations can be drawn. It appears that psychological attachment to cars and the automobile industry's calculated grip upon the market is not deterred by concerns about road safety, environmental sustainability, and many other negative effects of cars. Adult asthma patients and parents of children with asthma need to be made more aware of the direct connection between private transport use and the occurrence of asthma. It is also of paramount importance to address existing attitudes of children to transportation. Making this additional health concern more explicit will assist in making progress in consciously reducing car dependency.

In order to enable this change a number of stakeholders need to consider certain actions. Researchers need to inform the public about the connection between cars and respiratory health. Ideally, concerted efforts by the public could inform governments' strategic policy making, which could reinforce the positive loop of awareness and action. Strategic policy needs to target both parents and children in recognizing the negative health effects of cars, particularly in regard to transportation. The greatest challenge of this strategic policy will be to control the perpetrators, the powerful fossil fuel energy corporations and the car industry. Last but not least, it could help if we, the researchers, looked more often in the mirror to see how our own "mobility" and adaptation to modern comforts can contribute to making clear the linkages that will enable improvement in environmental health on a global scale.

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