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ScienceDirect
Preventive Medicine 46 (2008) 4–5
Preventive Medicine
www.elsevier.com/locate/ypmed

Commentary

The benefit of public transportation: Physical activity to reduce obesity and ecological footprint

Yan Zheng

School of Earth and Environmental Sciences, Queens College and Graduate School and University Center of the City University of New York, Flushing, NY 11367, USA

Available online 4 December 2007

The 20th century witnessed exponential growth of the human population. A concurrent change was urbanization, with close to half of the world's population residing in urban centers at the beginning of the 21st century (McGranahan and Satterthwaite, 2003). Humans have domesticated nature with a net benefit to themselves such as enhancing food supplies, reducing exposure to predators and other dangers, and promoting commerce, often at a cost to other species (Kareiva et al., 2007). A concept, ecological footprint (EF, the amount of land required to produce the resources needed by a person annually), was first introduced in 1996 and immediately applied for cities (Wackernagel and Rees, 1996; Folke et al., 1997). The EF is comprised of resources used to meet a person's food, water, and most significantly, energy demands for housing and transportation that account for up to 90% of the EF. The concept provides a reasonable tool to demonstrate natural resource dependence of human activities to politicians and the public, although much work is needed to employ it as a cohesive analytical tool for management. Fortunately, advances have been made to assess the EF of water supplies (Jenerette and Larsen, 2006; Jenerette et al., 2006a; Jenerette, et al., 2006b), of transportation (Muniz and Galindo, 2005), and of household energy demand (Lenzen et al., 2004) and of its application in urban settings (Luck et al., 2001; Kaye et al., 2006; Du et al., 2006) and other land uses, barring the difficulty of estimating the EF of aquaculture production (Roth et al., 2000). The attractiveness of the EF is that it represents a single, quantifiable measure of human impact on the environment.

Using 2003 economic activity data, the EF of low, middle, and high income countries have been estimated at 0.8, 1.9 and 6.4 ha per person, respectively (Websource, 2007a). The EF of all countries averages 2.2 ha per person. In comparison, the biocapacity, e.g., the resource that is available for sustained human consumption, is 1.8 ha per person (Websource, 2007a). Rapid growth of the Chinese economy between 1981 and 2001 has led to an increase of the EF from around 1 ha per person (e.g. low income) in 1981 to around 1.5 ha per person in 2001 (e.g.. for those of medium income) (Chen and Chen, 2007). The EF of the United States is 9.6 ha per person, second only to the 11.9 ha per person in UAE (Websource, 2007a). The European Union has an average EF value of 4.6 ha per person (Websource, 2007a). The implication is that if the entire world were to adopt the life style of an average American, 5 planet Earths would be needed because the Earth has exhausted its existing bio-capacity and is running on a deficit.

Why do Americans have nearly twice the ecological footprint of other high income countries? Does this have much to do with the stronger dependence on automobiles in America? U.S. cities exhibit the highest dependence on the automobile, followed by Australian and Canadian cities, with European and Asian cities being more transit-oriented with higher levels of walking and cycling (Kenworthy and Laube, 1999a). In 1990, an urban American drove on average 11,155 km with a standard deviation (SD) of 1,470 km, 2.5 times higher than the 4,519 (SD: 707) km driven by an urban European (Kenworthy and Laube, 1999b). An urban American took 63 (SD: 47) transit trips for 357 km, whereas an urban European took 318 (SD: 102) transit trips for 1,320 km. The gross regional products of where urban Americans ($26,822) and urban Europeans ($31,721) reside are comparable (Kenworthy and Laube, 1999a). Thus, transportation patterns are not strongly related to differences in wealth between cities but vary with land use. Among 13 cities in the United States, 18.5 million residents of the New York metropolitan area drove 8,317 km, the least of all (Kenworthy and Laube, 1999b). The EF of the NY (155 transit trips) and Los Angeles (unknown transit trips) metropolitan areas are 7.3 and 12.2 ha per person (Luck et al., 2001). Assuming otherwise similar life styles in NY and LA, this difference seems to imply that better public transit in NY could have greatly reduced the EF. This is partly because buses and

E-mail address: yan.zheng@qc.cuny.edu.

doi:10.1016/j.ypmed.2007.11.019

trains use a factor of 8 less land than private automobiles on per person basis (Muniz and Galindo, 2005).

Yet a different conclusion is reached when energy consumed by automobiles and by public transit is used to estimate the EF. The energy consumptions by commuters in Barcelona via car, bus, motorbike, train, and underground are 0.0026, 0.0006, 0.0013, 0.0013, and 0.0013 GJ per passenger km, respectively (Muniz and Galindo, 2005). Using an energy-to-land ratio of about 0.01 ha/GJ, the EFs are estimated to be 2.6×10^{-5}, 6.1×10^{-6}, 1.3×10^{-5}, 1.1×10^{-5}, and 1.1×10^{-5} ha per passenger km for car, bus, motorbike, train, and underground, respectively. Even if every American stopped driving, the EF footprint would shrink only by around 0.3 ha per person. Is it possible that the energy-to-land ratio is greatly underestimated? If not, the contribution from private automobile usage to the American EF is only 3%. It is noteworthy that public transportation is still two to four times more energy efficient than cars. Furthermore, the land used to support a private automobile transportation system results in a larger EF than a public transportation system.

If public transportation is not sufficient to save much of the planet, why should urban centers continue to invest in it? The required motivation may lie in improvement of human health, specifically, reduction of obesity. In this issue, a study reports that walking and bicycling to work reduces overweight and obesity for men and women in Southern Sweden, although public transportation reduces overweight and obesity among men only (Lindström, 2008). Australian men who cycle to work are significantly less likely to be overweight and obese (39.8%) compared with those who drive to work (60.8%) (Wen and Rissel, 2008). Men who use public transport to get to work are also significantly less likely to be overweight and obese (44.6%). Again, these benefits were not clear in women. Although the reason for the gender difference is not well understood, women are less inclined to cycle in cities that are automobile-oriented (Garrard et al., 2008). To this end, a pedestrian network in Perth, Australia is found to increase the connectivity of a neighborhood (Chin et al., 2008). Others point out that promoting walking and biking will have to consider socioeconomic factors, urban and suburban differences, and involvement of community organizations.

A person who commutes by public transportation not only has a low EF, the energy spent may well save him (and less likely her based on this series of articles) from overweight and obesity. What is good for the environment is also very good for us. Historically, the sustainable development of urban centers has not received the attention it deserves internationally despite the corresponding concentrations of the wealth and consumption (McGranahan and Satterthwaite, 2003). Recently, cities such as New York (Alfsen-Norodom et al., 2004) have developed long-term sustainability development plans (Websource, 2007b). But the road to reduce the ecological footprint to the benchmark figure of 1.8 ha without exceeding the bio-capacity of the earth will be a hard and a long one, requiring fundamental changes in our energy consumption.

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