ENVIRONMENTAL INTERVENTIONS TO HELP ADDRESS THE OBESITY AND ASTHMA EPIDEMICS IN CHILDREN

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I. INTRODUCTION

Childhood obesity and asthma rates in the United States have soared over the past three decades, raising both human suffering and economic health costs for today's children and the adults they will become. While the causes of these increases are complex and not yet fully understood, research indicates that environmental factors related to the built environment[1] may play a significant role, with poor community design and transportation systems that discourage physical activity contributing to obesity, and roadside air pollution contributing to asthma. Although reversing these epidemics will require interventions in many different arenas, a critical part of the solution will be addressing the negative impacts of the built environment on children's health. A number of policies currently under consideration can provide benefits to children's health while also reducing greenhouse gas emissions and other environmental ills.

Promoting policies that encourage opportunities for physical activity, reduce air pollution, and improve land use and transportation choices can create a healthier environment for children. Strengthening air quality standards can similarly protect youth, a particularly sensitive subpopulation. Funding federal research and supporting health impact assessments can also have a positive effect on our understanding of the link between health

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1. The term "built environment" refers to all physical space designed and constructed by humans, including housing, offices, commercial buildings, schools, green spaces, and transportation infrastructure.

outcomes and the environment. These strategies and practices cannot by themselves prevent the incidence and severity of childhood obesity and asthma, but they can help address these epidemics and evaluate the effectiveness of current interventions. Improving the built environment can make a substantial difference in children's quality of life and the economic and social costs associated with children's health care.

II. THE ROLE OF THE BUILT ENVIRONMENT IN THE CHILDHOOD OBESITY EPIDEMIC

Numerous studies in the last few decades have shown a profound increase in childhood obesity. The Institute of Medicine of the National Academies recently reported that obesity rates in the last thirty years have nearly tripled among children ages two to five and twelve to nineteen years.[2] During the same period, obesity rates have more than quadrupled among children ages six to eleven years.[3] Today, one in every three American children is obese or at risk of becoming so.[4]

Obesity-related illnesses, such as diabetes, asthma, sleep apnea, and gallbladder disease, have also risen sharply among children in the past few decades, causing the number, length, and economic cost of hospital stays for children with obesity and obesity-related diseases to accelerate.[5] According to a 2002 study published by the medical journal *Pediatrics*, the total days of care required by patients ages six to seventeen with obesity-related illnesses more than doubled over a twenty-year period, increasing from 152,000 days in 1979-1981 to 310,000 days in 1997-1999.[6] During the same time frame, the proportion of hospital costs dedicated to these patients jumped nearly fourfold from 0.43 percent (or $35 million) in 1979-1981 to 1.7 percent (or $127 million) in 1997-1999.[7] The rising costs associated with obesity are felt not only by hospitals, but also by families and schools,

2. INST. OF MED. OF THE NAT'L ACADS., REPORT BRIEF: PROGRESS IN PREVENTING CHILDHOOD OBESITY: HOW DO WE MEASURE UP? 1 (2006), http://www.iom.edu/Object.File/Master/36/984/11722_reportbrief.pdf.

3. *Id.*

4. *Id.*.

5. *See* Guijing Wang & William H. Dietz, *Economic Burden of Obesity in Youths Aged 6 to 17 years: 1979-1999*, 109 PEDIATRICS 1, 1-5 (2002), http://www.pediatrics.org/cgi/content/full/109/5/e81 (discussing the increasing economic costs related to childhood obesity and obesity-related diseases).

6. *Id.* at 2.

7. *Id.* at 3.

which experience great strain due to medical bills, student absences, and disrupted daily routines.

Although a combination of factors contributes to this obesity epidemic, one significant cause for its prevalence is physical inactivity among American youth. Increasing obesity rates demonstrate that fewer children are achieving a healthy balance between the calories they consume and the calories they expend.[8] Partially responsible for this imbalance are decreasing opportunities for physical activity in schools and the popularity of sedentary entertainment, such as video games, computers, and television, but a variety of built environment factors also keep children from exercising. As urban sprawl accelerates and roadways widen, fewer children live in walkable neighborhoods and many have difficulty accessing parks and other play spaces without driving. The dangers of high-speed traffic, unsafe sidewalks, and low-density community design also present barriers to activity. As a result, less than fifteen percent of children's trips to school in the United States are on foot or by bike,[9] while nearly half were in 1969.[10] A national survey conducted by the Centers for Disease Control and Prevention (CDC) confirms that changes in the built environment are contributing to this development; a significant portion of American parents cite distance (fifty-five percent) and traffic danger (forty percent) as reasons their children do not walk to school.[11]

Several environmental policies and practices can help counteract these trends and their influence on rising obesity rates. Much of the current focus is on changing the way, and the environment in which,

8. Ctr. for Disease Control and Prevention, Overweight and Obesity: Contributing Factors, http://www.cdc.gov/nccdphp/dnpa/obesity/contributing_factors.htm (last visited Jan. 15, 2007).

9. Ann M. Dellinger & Catherine E. Staunton, *Barriers to Children Walking and Biking to School-United States, 1999*, 51 MORBIDITY AND MORTALITY WKLY. REP. 701, 701 (2002), http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5132a1.htm (*citing* U.S. DEP'T OF TRANSP., FED. HIGHWAY ADMIN., OUR NATION'S TRAVEL: 1995 NPTS EARLY RESULT REPORT 29 (1997), http://npts.ornl.gov/npts/1995/Doc/NPTS_Booklet.pdf).

10. NAT'L SAFE KIDS CAMPAIGN, REPORT TO THE NATION ON CHILD PEDESTRIAN SAFETY 2 (2002), http://www.usa.safekids.org/wtw/documents/Research02.pdf (*citing* DARRELL A. BESCHEN, JR., U.S. DEP'T OF TRANSP., FED. HIGHWAY ADMIN., NATIONWIDE PERS. TRANSP. STUDY: TRANSP. CHARACTERISTICS OF SCHOOL CHILDREN 1 (1972), http://www.fhwa.dot.gov/ohim/1969/q.pdf).

11. Dellinger & Staunton, *supra* note 9.

students travel to school.[12] Promoting smart community design by building schools closer to students' homes, for example, may increase opportunities for children to be active and spend time outdoors. Taking steps to improve transportation infrastructure by adding street lamps, signage, traffic-slowing devices, and stoplights, and repairing deteriorating sidewalks or constructing pathways where none exist may also relieve safety concerns and remove barriers to physical activity. With the passage of the most recent federal transportation bill, the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), the Federal Highway Administration now provides states with federal funding to create Safe Routes to School (SRTS) programs.[13] This initiative, which strives to make walking and bicycling to school a safe and regular routine for students, has proven to be effective in enhancing opportunities for children's physical activity. A two-year study of fifteen Marin County public schools participating in California's SRTS program demonstrated a sixty-four percent increase in the proportion of students walking to school and a 114 percent increase in the proportion of students bicycling.[14] The CDC's Nutrition and Physical Activity Program has also created a community–based KidsWalk–to–School Initiative, encouraging improved pedestrian safety and healthy and walkable neighborhoods for children.[15]

Local governments and community developers can also make the built environment more conducive to physical activity by revising planning practices and zoning ordinances to facilitate mixed-use development. Siting stores and supermarkets that sell healthful foods within walking distance of homes can encourage exercise and generate healthier eating habits. Researchers in the San Francisco Bay Area found that individuals are more likely to walk to shopping

12. *See generally* EPA, TRAVEL AND ENVTL. IMPLICATIONS OF SCHOOL SITING (2003), http://www.epa.gov/smartgrowth/pdf/school_travel.pdf (evaluating the travel implications of school sites).

13. Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), Pub. L. No. 109-59, § 1404, 119 Stat. 1144, 1228-30 (2005).

14. Catherine E. Staunton, Deb Hubsmith & Wendi Kallins, *Promoting Safe Walking and Biking to School: The Marin County Success Story*, 93 AM. J. PUB. HEALTH 1431, 1432 (2003), *available at* http://www.ajph.org/cgi/reprint/93/9/1431; *see also* SUSAN D. KIRBY & MARLA HOLLANDER, CONSUMER PREFERENCES AND SOCIAL MKTG. APPROACHES TO PHYSICAL ACTIVITY BEHAVIOR AND TRANSP. AND LAND USE CHOICES: PAPER PREPARED FOR THE TRANSP. RESEARCH BOARD AND THE INST. OF MEDICINE (2004), http://trb.org/downloads/sr282papers/sr282KirbyHollander.pdf.

15. Ctr. For Disease Control and Prevention, KidsWalk-to-School: Home, http://www.cdc.gov/nccdphp/dnpa/kidswalk/ (last visited Jan. 15, 2007).

areas in older, compact neighborhoods with grid-like streets than in newer, more sprawling neighborhoods.[16] Enhancing the availability and ease of using public transit may similarly promote physical activity. A study published in the *Journal of the American Planning Association* in 1995 found that walking was more common in neighborhoods oriented towards using mass transit than in those oriented towards driving privately owned vehicles.[17]

Local governments should also look towards developing and enhancing green spaces within their communities. Improving the accessibility, quality, and use of parks and recreational areas can create a physical environment that encourages activity among youth. One study cited in the *American Journal of Preventive Medicine* demonstrated a strong relationship between children's activity levels and the number of play spaces close to their homes.[18] The CDC's *Guidelines for School and Community Programs to Promote Lifelong Physical Activity Among Young People* similarly noted a positive correlation between physical activity among youth and the availability of convenient play spaces.[19] In this report, the CDC recommends that schools and communities focus on providing students with access to open spaces and facilities "free from violence and free from exposure to environmental hazards."[20]

Researchers and policymakers are increasingly recognizing the link between built environment variables, physical activity, and the incidence of obesity. The Institute of Medicine (IOM) and Transportation Research Board (TRB) issued a report in 2004 concluding that physical environments encouraging active lifestyles

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16. Reid Ewing, Tom Schmid, Richard Killingsworth, Amy Zlot, & Stephen Raudenbush, *Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity*, 18 AM. J. HEALTH PROMOTION 47, 48 (2003), http://www.smartgrowthamerica.org/report/JournalArticle.pdf (*citing* Susan L. Handy, *Understanding the Link Between Urban Form and Nonwork Travel Behavior*, 15 J. PLAN. EDUC. & RES. 183 (1996)).

17. James F. Sallis, Adrian Bauman & Michael Pratt, *Environmental and Policy Interventions to Promote Physical Activity*, 15 AM. J. OF PREVENTIVE MED. 379, 384 (1998), http://www.cvhpinstitute.org/daniel/readings/env.pdf (*citing* Robert Cervero & Roger Gorham, *Commuting in Transit Versus Auto. Neighborhoods*, 61 J. OF THE AM. PLANNING ASS'N 210 (1995)).

18. *Id.* at 383 (*citing* James F. Sallis et al., *Correlates of Physical Activity at Home in Mexican-American and Anglo-American Preschool Children*, 12 HEALTH PSYCHOL. 390, 390-98 (1993)).

19. CTR. FOR DISEASE CONTROL, GUIDELINES FOR SCHOOL AND COMMUNITY PROGRAMS TO PROMOTE LIFELONG PHYSICAL ACTIVITY AMONG YOUNG PEOPLE 4 (1997), http://www.cdc.gov/mmwr/PDF/RR/RR4606.pdf.

20. *Id*. at 10.

are beneficial for public health.[21] The IOM and TRB report highlights the promise of the built environment as a field for new interventions and suggests that Congress increase funding for greater research in this area.[22] Within the last year, the Trust for America's Health (TFAH) conducted a survey of state chronic disease directors, and although the respondents felt they currently had little or no influence over aspects of the built environment, they agreed on the importance of providing safe parks and pathways, applying smart growth principles, and making roads accessible for walking and biking.[23] For this reason, increasing lines of communication and opportunities for coordination between different branches of government will be crucial in developing effective interventions for children's health.

Multiple stakeholders can play a significant role in designing a built environment that promotes energy balance and improves patterns of physical activity. These stakeholders include federal, state, and local government, community developers, transportation planners, health advocates and researchers, environmentalists, community groups, and schools. A 2006 Institute of Medicine report, *Progress in Preventing Childhood Obesity: How Do We Measure Up?*, recommends that the U.S. Departments of Transportation and Health and Human Services take the lead in dedicating funding for research on the relationship between changes in built environment and levels of physical activity.[24] According to an article published in the *American Journal for Health Promotion*, "public health researchers can refine their understanding of physical activity, obesity, and morbidity by including urban form variables in their analyses."[25] Faculty at the Georgetown University Law Center have also identified five main legal avenues to promote a healthier built environment, including environmental regulation; zoning and related developmental requirements; building and housing codes; taxing

21. TRANS. RESEARCH BOARD, INST. MED., DOES THE BUILT ENVIRONMENT INFLUENCE PHYSICAL ACTIVITY? 13 (2004), http://onlinepubs.trb.org/onlinepubs/sr/sr282.pdf.

22. *Id.* at 8.

23. TRUST FOR AMERICA'S HEALTH, F IS FOR FAT: HOW OBESITY POLICIES ARE FAILING IN AMERICA 25 (2006), http://healthyamericans.org/reports/obesity2006/Obesity2006Report.pdf.

24. INSTITUTE OF MEDICINE OF THE NATIONA'L ACADEMY, PROGRESS IN PREVENTING CHILDHOOD OBESITY: HOW DO WE MEASURE UP? 263 (2006), http://books.nap.edu/openbook.php?record_id=11722&page=R1.

25. Ewing, *supra* note 16, at 48.

power; and spending power.[26] The 2006 Trust for America's Health report, *F is for Fat: How Obesity Policies are Failing in America*, recommends that communities require health impact assessments for proposed building and transportation projects.[27]

Lawmakers in Washington are starting to address the effects of the built environment on children's health. One example is the Safe Routes to School program passed as part of the SAFETEA-LU transportation bill in 2005.[28] The Healthy Places Act of 2006, introduced last session by Senator Barack Obama, also takes important steps, calling on federal, state, and local government to support health impact assessments[29] for new community planning and environmental policies and programs. The act would require the federal government to establish an interagency working group on environmental health[30] and a grant program to fund state and local efforts.[31] The act also calls for further research on the relationship between the built environment and health of community residents.[32] As discussed above, there is promise in taking these and other actions to reduce obesity rates and improve children's health through land use, housing, and transportation choices. While much of the focus of community built environment interventions has been on the benefits they may provide for children, it is worth noting that these changes may affect the entire population, enhancing health for adults as well.

III. ENVIRONMENTAL INTERVENTIONS FOR CHILDHOOD ASTHMA

Like obesity, the prevalence of asthma among children in the United States has reached historically high levels.[33] After significant increases in the 1980s and 1990s, when rates rose an average of 4.3 percent per year,[34] asthma now affects an estimated 6.5 million

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26. Wendy Collins Perdue, Lesley A. Stone, & Lawrence O. Gostin, *The Built Environment and Its Relationship to the Public's Health: The Legal Framework*, 93 AM. J. PUB. HEALTH 1390, 1392-1393 (2003), *available at* http://www.ajph.org/cgi/reprint/93/9.1390.

27. TRUST FOR AMERICA'S HEALTH, *supra* note 24, at 57.

28. Safe, Accountable, Flexible, Efficient Transportation Equity Act, SAFETEA-LU, 23 U.S.C. § 148 (2005)

29. Healthy Places Act of 2006, S. 2506, 109th Cong. § 4 (2006).

30. *Id.* § 3.

31. *Id.* § 5.

32. *Id.* § 6.

33. LARA AKINBAMI, NAT'L CTR. FOR HEALTH STATISTICS, THE STATE OF CHILDHOOD ASTHMA, UNITED STATES, 1980-2005, 1 (2006), http://www.cdc.gov/nchs/data/ad/ad381.pdf.

34. Ctr. for Disease Control and Prevention, "Asthma's Impact on Children and Adolescents," http://www.cdc.gov/asthma/children.htm (last visited Jan. 15, 2007).

children, or 8.9 percent of the population under age 18.[35] It is currently the most common chronic disease among children,[36] and it requires a significant amount of medical attention. According to a recent report by the National Center for Health Statistics, three percent of all hospitalizations for children in 2004 were attributed to asthma.[37] The same year, asthma-related visits to physician offices rose from less than forty visits for every 1,000 children in 1990 to eighty-nine visits for every 1,000 children.[38] If rates continue to climb at their current pace, the Pew Environmental Health Commission predicts, children born a generation from now will be twice as likely to develop asthma as children born today.[39]

The CDC currently estimates that the cost of treating childhood asthma is $3.2 billion per year.[40] Alongside this financial burden, the emotional toll on patients and their families can also be quite severe. Heightened asthma attacks and emergency room visits harm children's quality of life, restricting their activities and disrupting daily routines. As the third-highest cause of hospitalization among children under age fifteen, asthma accounts for 14 million school absences annually.[41] The disease also affects youth disproportionately compared to other age groups. In 2002, children under age eighteen accounted for 727,000 asthma-related emergency room visits out of more than 1.9 million from the general population.[42] According to a 2002 study, children five years old or younger have the highest asthma-related hospitalization and emergency room admittance rates among all age groups.[43]

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35. AKINBAMI, *supra* note 33, at 1.

36. PEW ENVTL. HEALTH COMM'N, ATTACK ASTHMA: WHY AMERICA NEEDS A PUBLIC HEALTH DEFENSE SYSTEM TO BATTLE ENVIRONMENTAL THREATS 8 (May 2000), http://healthyamericans.org/reports/files/asthma.pdf.

37. AKINBAMI, *supra* note 33, at 5.

38. *Id.* at 4.

39. PEW ENVTL. HEALTH COMM'N, *supra* note 36, at 4.

40. CTR. FOR DISEASE CONTROL AND PREVENTION, ASTHMA'S IMPACT ON CHILDREN AND ADOLESCENTS, http://www.cdc.gov/asthma/children.htm (last visited Jan. 15, 2007).

41. *Id.*

42. CTR. FOR DISEASE CONTROL AND PREVENTION, ASTHMA PREVALENCE, HEALTH CARE USE AND MORTALITY, 2002, http://www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm (last visited Jan. 19, 2007).

43. Eva Y. Wong, Julia Gohlke, William C. Griffith, Scott Farrow, & Elaine M. Faustman, *Assessing the Health Benefits of Air Pollution and Reduction for Children*, 112 ENVTL. HEALTH PERSP. 226, 226 (Feb. 2004) (*citing* Ctr. for Disease Control and Prevention, *Surveillance for Asthma—United States, 1980-1999*, 51 MORBIDITY AND MORTALITY WKLY. RPT. 1 (2002), *available at* http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5101a1.htm.

Childhood asthma is influenced by a complex web of factors, and numerous studies show that the environment plays a significant role. One of the most serious environmental factors contributing to the disease's prevalence and severity among youth is exposure to poor air quality. A number of air pollutants, including particulate matter, ozone, and nitrogen dioxide, are associated with asthma, impaired lung development, and other respiratory symptoms in children. The Children's Health Study conducted in southern California, for example, found significant reductions in lung development among youth exposed to higher levels of particulate matter, elemental carbon (a marker for diesel exhaust), and nitrogen oxides.[44] Another study in southern California has shown that children engaged in heavy exercise in areas with high ozone levels are more prone to developing asthma.[45] The adverse health effects of these air pollutants are disproportionately experienced by youth because their bodies are still developing and their lungs have greater sensitivity.[46]

While a variety of sources contribute to poor air quality, car and truck exhaust have been frequently implicated. Proximity to roadway "hot spots," where air pollution is particularly high, has an especially negative effect on children's respiratory health. A recent study examining the relationship between childhood asthma and traffic pollution in California concluded that local exposures to outdoor nitrogen dioxide and other freeway-related pollution harm children's respiratory health.[47] In this study, the prevalence of asthma in fact increased the closer children's homes were in proximity to freeways.[48] Researchers in Europe similarly found in one study that children whose homes were within 150 meters of a main roadway had a higher risk of wheeze, [49] while a second study showed those living within 100

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44. W. James Gauderman et al., *Association Between Air Pollution and Lung Function Growth in Southern California Children* 162 AM. J. RESPIRATORY CRITICAL CARE MED. 1383, 1385-89 (Oct. 2000); *see also* W. James Gauderman et al., *The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age*, 351 NEW ENG. J. MED. 1057 (Sept. 2004).

45. Rob McConnell, Kiros Berhane, Frank Gilliland, Stephanie J. London, Talat Islam, W. James Gauderman, Edward Avol, Helene G. Margolis & John M. Peters, *Asthma in Exercising Children Exposed to Ozone: A Cohort Study*, 359 THE LANCET 386, 386 (Feb. 2002); Erratum in 359 THE LANCET 896 (Mar. 2002).

46. Wong et. al, *supra* note 43, at 226.

47. W. James Gauderman, Edward Avol, Fred Lurmann, Nino Kuenzli, Frank Gilliland, John Peters & Rob McConnell, *Childhood Asthma and Exposure to Traffic and Nitrogen Dioxide*, 16 EPIDEMIOLOGY 737 (Nov. 2005).

48. *Id.*

49. Andrea J. Venn et al., *Living Near a Main Road and the Risk of Wheezing Illness in Children*, 164 AM. J. RESPIRATORY CRITICAL CARE MED. 2177 (Dec. 2001).

meters of a freeway were more likely to have chronic cough, wheeze, and asthma attacks.[50] Another study in California concluded that living in high density traffic areas worsened symptoms for asthmatic Hispanic children.[51]

Communities can help counteract these outcomes with built environment strategies that aim to reduce traffic density and exposure to traffic-related pollutants. Increasing the availability, quality, and use of buses and trains, for example, can reduce the number of cars on the road and thus the amount of pollutants entering the air. Promoting smart community design over urban sprawl and encouraging active transit by improving sidewalks and pedestrian pathways can also relieve dependence on personal vehicles, as the number of miles traveled by cars and trucks increases as neighborhoods become less dense and less walkable.[52] The positive health effects of minimizing exposure to transportation-related pollutants was demonstrated during the 1996 Summer Olympics, when Atlanta took steps to reduce automobile traffic within the city by 22.5 percent, and the number of acute asthma events among children decreased by forty-two percent.[53] The CDC attributed this result to improved air quality due to increased alternative transportation use, fewer cars on the road, and lower emissions.[54]

Local and state zoning policies can also be effective tools in protecting children's respiratory health. As suggested by the literature above linking asthma prevalence and proximity to freeways, siting residential areas away from roadway "hot spots" can help limit exposure to poor air quality. Because children's "occupational

50. P. van Vliet et al., *Motor Vehicle Exhaust and Chronic Respiratory Symptoms in Children Living near Freeways*, 74 ENVTL. RESEARCH 122 (1997).

51. Ralph J. Delfino et al., *Asthma Symptoms in Hispanic Children and Daily Ambient Exposures to Toxic and Criteria Air Pollutants*, 111 ENVTL. HEALTH PERSP. 647 (2003).

52. Allen Dearry, *Editorial: Impacts of Out Built Environment on Public Health*, 112 ENVTL. HEALTH PERSP. A600, A600 (August 2004), *available at* http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1247487 (*citing* J. Holtzclaw et al., *Location Efficiency: Neighborhood and Socioeconomic Characteristics Determine Auto Ownership and Use-Studies in Chicago, Los Angeles, and San Francisco*, 25 TRANSP. PLAN. TECH. 1 (2002)).

53. M.S. Friedman, K.E. Powell, L. Hutwagner, L.M. Graham & W.G. Teague, *Impact of Changes in Transportation and Commuting Behaviors During the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma*, 285 J. AM. MED. ASS'N. 897 (2001).

54. Chris S. Kochtitky, H. Frumkin, R. Rodriguez, A.L. Dannenberg, J. Rayman, K. Rose, R. Gillig & T. Kanter, *Urban Planning and Public Health at CDC*, 55 MORBIDITY AND MORTALITY WKLY. REP. 34, 35 (Dec. 2006) (citing M.S. Friedman, K.E. Powell, L. Hutwagner, L.M. Graham & W.G. Teague, *Impact of Changes in Transportation and Commuting Behaviors During the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma*, 285 J. AM. MED. ASS'N. 897 (2001)).

exposures", or those that occur while students are attending school, have also been associated with increased asthma risks when those schools are located near highways, siting schools away from roads with high traffic can also help protect children from harmful emissions. One study conducted in Holland found that children attending school near highways with heavy truck traffic had increased rates of allergic sensitization as well as respiratory symptoms.[55] Another study conducted in the San Francisco Bay Area noted increased exposure to fine particle pollution and higher rates of asthma and other respiratory disease in schools located downwind of and close to major highways.[56] The American Academy of Pediatrics has called for considering air pollution from highways in the siting of new schools and avoiding proximity to "hotspots" from transportation sources.[57] The state of California has adopted a law requiring new schools to be sited at least 500 feet from major roadways, unless specified conditions of health safety are met.[58]

The fact that children are particularly susceptible to health problems related to poor air quality and roadside pollution that are often influenced by community design highlights the need for environmental interventions to reduce children's exposures. The National Ambient Air Quality Standards (NAAQS) established under the Clean Air Act, which form the foundation for clean air policy in the United States, are an important policy arena in which to focus.[59] The NAAQS play a critical role in driving local, state, and federal interventions to reduce exposures to air pollution by defining statutory targets for ambient air quality throughout the country and communicating to the public the air concentrations that are deemed safe to breathe based on scientific evidence. Establishing stronger standards could compel states to find ways to reduce these pollutants through built environment improvements and transportation control measures, such as park-and-ride lots, high-occupancy-vehicle lanes, and mass transit facilities. Statutory language within the Clean Air

55. Nicole A.H. Janssen, et al., *The Relationship Between Air Pollution from Heavy Traffic and Allergic Sensitization, Bronchial Hyper-responsiveness, and Respiratory Symptoms in Dutch Schoolchildren*, 111 ENVTL. HEALTH PERSP. 1512 (Sept. 2003).

56. Janice J. Kim, et al., *Traffic-Related Air Pollution near Busy Roads: The East Bay Children's Respiratory Health Study*, 170 AM. J. RESPIRATORY CRITICAL CARE MED. 520 (Sept. 2004).

57. Janice J. Kim, et al., *Ambient Air Pollution: Health Hazards to Children*, 114 PEDIATRICS 1699, 1705 (Dec. 2004).

58. West's Ann. Cal. Educ. Code § 17213 (2004), as amended by S.B. 352.

59. Clean Air Act, 42 U.S.C. § 7409(b)(1) (2000).

Act requires the U.S. EPA to establish standards that protect the public health,[60] *including sensitive subpopulations*, with an adequate margin of safety.[61]

Unfortunately, current and recently finalized NAAQS for particulate matter and ozone fail to achieve the Clean Air Act's goal of adequate public health protection for children. In March 2006, the U.S. EPA's Children's Health Protection Advisory Committee wrote a recommendation letter documenting scientific evidence that indicates the particulate matter pollution concentrations in the current standards are above levels associated with harm to children's health.[62] Numerous studies also demonstrate that children are harmed by ozone concentration levels considerably below the current 8 hour NAAQS of 0.08 ppm.[63] Setting the nation's air quality standards at levels that accurately reflect the scientific literature is a critical step in protecting children's health and reducing asthma rates, and the built environment can be an effective tool in helping to meet those goals.

The Clean Air Act contains another provision that can be applied to protecting children's health, specifically from near highway exposures. Under the 1990 Amendments to the Clean Air Act, transportation projects must "conform to" the purposes of State Implementation Plans (SIPs) for meeting the NAAQS.[64] As a result, the construction of new transportation projects in areas that either are out of attainment of NAAQS or have just recently come into NAAQS attainment must not cause new or worsened violations of air quality standards.[65] Given children's sensitivity to near highway exposures, the "hot-spot" rule recently promulgated by the EPA to ensure conformity with the 1997 fine particulate matter standards is

60. *Id.*

61. 42 U.S.C. § 7408 (f)(1)(c) (2000).

62. Letter from Melanie A. Marty, Chair, Children Health Protection Advisory Committee, to Stephen L. Johnson, Administrator, U.S. Environmental Protection Agency (Mar. 3, 2006), *available at* http://www.net.org/documents/soot.pdf.

63. *See* Janneane F. Gent, et al., *Association of Low-Level Ozone and Fine Particles With Respiratory Symptoms in Children With Asthma* 290 J. AM. MED. ASS'N. 1859 (2003);
Mortimer et al., *The Effect of Air Pollution on Inner-City Children with Asthma,* 19 EUROPEAN RESPIRATORY J. 699 (2002).

64. PM2.5 and PM10 Hot-Spot Analyses in Project-Level Transportation Conformity Determinations for the New PM2.5 and Existing PM10 National Ambient Air Quality Standards, 71 Fed. Reg. 12467 (Mar. 10, 2006).

65. *Id.* at 12469.

also of critical importance.[66] This rule, however, falls short of ensuring that new highway projects do not expose children and others living nearby to fine particulate pollution levels exceeding national standards. Some of the reasons include failure to require quantitative estimates of fine particulate matter concentrations despite the existence of EPA models to do so; failure to require new projects to avoid delays in attaining air quality standards or to aid in reducing or eliminating air quality standard violations; and granting the Department of Transportation broad authority to exempt categories of projects from hot spot requirements. While the law provides a strong potential tool for reducing the public health of highway-related air pollution, its current implementation prevents effective attainment of this potential benefit.

IV. POLICY INTERVENTIONS FOR CHILDHOOD OBESITY AND ASTHMA COME TOGETHER IN THE BUILT ENVIRONMENT

One reason for policymakers to focus on land use and transportation interventions for childhood obesity and asthma is that actions to produce public health benefits for one particular illness can often result in a cascade of other health and environmental benefits. Because land use decisions influence the amount of time individuals spend in their cars and the number of miles they travel,[67] promoting smart community design, for example, can both increase physical activity and help counteract the negative effects of air pollution on children's health. Encouraging mixed land use and alternative transportation options, especially active and public transit, can also both provide direct health benefits and reduce greenhouse gas emissions and polluted water runoff.[68] In addition, relieving safety concerns and distance barriers that impede opportunities for physical activity and increase reliance on personal vehicles can in turn help limit the amount of pollution entering the air.

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66. *Id.* at 12474.

67. REID EWING & RICHARD KREUTZER, UNDERSTANDING THE RELATIONSHIP BETWEEN PUBLIC HEALTH AND THE BUILT ENVIRONMENT: A REPORT PREPARED FOR THE LEED-ND CORE COMMITTEE at 3 (May 2006), *available at* http://www.goforyourlife.vic.gov.au/hav/admin.nsf/Images/leed_public_health.pdf/$File/leed_public_health.pdf.

68. *See* Elizabeth Brabec, Stacey Schulte, & Paul L. Richards, *Impervious Surfaces and Water Quality: A Review of Current Literature and Its Implications for Watershed Planning*, 16 J. PLANNING LITERATURE 499 (2002); *see also* Chester L. Arnold Jr. & C. James Gibbons, *Impervious Surface Coverage: The Emergence of a Key Environmental Indicator*, 62 J. AM. PLANNING ASS'N 243 (1996).

In some instances, interventions for childhood obesity and asthma may appear to come into conflict. Policies designed to improve opportunities for physical activity by promoting increased density, mixed land use, and transit-oriented development could potentially place more children in close proximity to highways and other transportation-related pollution sources. Exposures to poor air quality might also increase as policies for locating schools near or within existing neighborhoods aim to combat school sites at the rural edge of communities and encourage walking and biking as modes of transportation for students.[69] The potential conflict between built environment interventions for childhood obesity and asthma points to the need for strengthening Clean Air Act rules to avoid localized hot spots related to highway traffic. It also suggests that state and local laws and policies that promote school siting within existing communities need to take into account air quality and other environmental implications of in-fill school construction, including locations on or near former industrial hazardous waste sites. In addition to siting choices, children's air pollution exposures from close-by highways may be mitigated by other means, such as green barriers and other aspects of construction.[70]

V. CONCLUSION

In 2004, Allen Dearry of the National Institute of Environmental Health Sciences authored an editorial in *Environmental Health Perspectives* on the importance of understanding the impacts of community design and transportation on health outcomes.[71] Although reducing the rates of childhood obesity, asthma, and other related diseases is a challenging task with no single, clear solution, considering improvements to the built environment is one significant step. An increasing number of studies show that creating healthier communities will promote healthier lifestyles and enable children to

69. *See* EPA, TRAVEL AND ENVIRONMENTAL IMPLICATIONS OF SCHOOL SITING (Oct. 2003), *available at* http://www.epa.gov/smartgrowth/pdf/school_travel.pdf; *See also* MARYA MORRIS, AM. PLANNING ASS'N, RETHINKING COMMUNITY PLANNING AND SCHOOL SITING TO ADDRESS THE OBESITY EPIDEMIC (May 2004), *available at* http://www.niehs.nih.gov/drcpt/beoconf/postconf/overview/morris.pdf.

70. *See, e.g.,* THOMAS A. CAHILL, VEHICULAR EXPOSURES AND POTENTIAL MITIGATIONS DOWNWIND OF WATT AVENUE, SACRAMENTO, CA: REPORT TO THE HEALTH EFFECTS TASK FORCE, BREATHE CALIFORNIA OF SACRAMENTO-EMIGRANT TRAILS (Oct. 23, 2006), *available at* http://www.sacbreathe.org/Air%20Quality/Cahill%20Final%20Draft%2011-17.pdf.

71. Dearry, *supra* note 52.

breathe cleaner air. Reevaluating the built environment will also allow children to take fuller advantage of recreational opportunities, such as playing outdoors and walking to school.

Because children are particularly vulnerable to the harmful effects of air pollutants and the lack of physical activity, multiple parties must come together to expand efforts to create a safer, more accessible built environment around children so community design encourages rather than inhibits activity. identifying needed changes to the built environment and implementing those changes successfully will require cooperation from a wide array of stakeholders, including government, developers, transportation planners, community groups, environmentalists, schools, and families. Researchers and policymakers must now focus on understanding the important role the built environment plays in determining children's health.[72] As the Pew Environmental Health Commission reported in 2000, "chronic health problems might be preventable if only we knew more about the complex interactions among the social, biological, and environmental factors that affect us and how to intervene to prevent disease."[73] Taking steps towards these improvements will benefit children, families, schools, and the overall health of our communities and the environment.

72. Ewing, *supra* note 16, at 48.

73. PEW ENVTL. HEALTH COMM'N, *supra* note 36, at 17.