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PROMOTING AND IMPROVING CHILDREN'S HEALTH PROTECTIONS

HEARING

BEFORE THE

SUBCOMMITTEE ON CHILDREN'S HEALTH

OF THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

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C O N T E N T S

PROMOTING AND IMPROVING CHILDREN'S HEALTH PROTECTIONS

TUESDAY, SEPTEMBER 29, 2009

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON CHILDREN'S HEALTH,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:33 a.m. in room 406, Dirksen Senate Office Building, Hon. Amy Klobuchar (chairman of the subcommittee) presiding.

Present: Senators Klobuchar, Alexander, and Merkley.

OPENING STATEMENT OF HON. AMY KLOBUCHAR, U.S. SENATOR FROM THE STATE OF MINNESOTA

Senator KLOBUCHAR. We will call the hearing to order for the Children's Environmental Health Subcommittee. I am pleased to be here today with our Ranking Member, Senator Alexander from Tennessee.

We have two panels with only two people each, so it won't be too lengthy, I hope, and we have some really important issues to cover. So I am going to give an opening statement, and then I think Senator Alexander will say a few words as well, and then we will hear from each of you.

I would like to extend a special welcome, first of all, to Dr. Mary Story, who is going to be on the second panel, who is back there, who is a professor at the University of Minnesota. We have worked together before, and she is the Director of the Robert Wood Johnson Foundation's Healthy Eating Research Program.

I have worked with Dr. Story many times and always appreciate her insight on the important issue of childhood obesity. Mary is incredibly dedicated to the health of children and truly understands how important it is to promote healthy lifestyles and environment for our kids.

We all have a stake in making sure that our children grow up happy and healthy. This is important not only for the well-being of our children, but for the well-being of our country. We need a strong, healthy work force in the future to keep our economy competitive, and we also want to have these kids have great lives. And increasingly, we are seeing major challenges and problems for the health of our children. And that is why this is the first hearing, but I am sure we are going to have more in the future.

I know personally that parents have an increasingly difficult job in today's world. As I left this morning at 6:45 a.m., I was yelling up to my 14-year-old, your lunch bag is on the door. Don't forget

it. The economic pressures, the time demands, the many outside influences that affect our kids, all of these and more make it an especially challenging time for America's families.

Today, I want to highlight some of the health issues facing our kids as a result of their external environments. As we consider landmark healthcare legislation in Congress, it is essential that we ensure that the health of our children is a part of any reform.

You know, when you are a mom of a 14-year-old and you walk into a middle school cafeteria, you get a sense first-hand of some of the issues confronting kids and confronting parents. When you walk in there sometimes, and she's been at a few different public schools, so I have seen the different scenes that they encounter, but on one side you will have French fries and on one side you will have green beans. Now, if you are a 12-year-old kid, which one do you think you are going to pick?

That is why I am such a strong supporter, as a member of the Agriculture Committee of the updated standards that we have in the children's nutrition bill for our schools that looks at the schools as a whole, and not just as one set of food versus the a la carte food versus the vending machines.

When we talk about how to combat obesity, asthma or diabetes, we must consider the environment that kids are in. That means the environment when they walk into that cafeteria line, and it means the environment where they walk to school or they take the bus, or they can go bike riding in the afternoon, or they have no place to bike ride. This is a large part of the issue that we are facing. We are talking about the neighborhoods, the roads, the buildings, the food sources and the recreation facilities where people live, play and work. This environment influences many of the decisions that kids and families make that are really with them for a lifetime.

I am interested in hearing from our experts about how we can proactively work to keep our children's environment healthy and safe. One of the biggest challenges we face is making sure young people are eating right and staying active. We all know about the growing obesity problem with kids. According to the Center for Disease Control, one out of every three children in the U.S. between the ages of 2 and 19 is overweight, and nearly a quarter of all kids between the ages of 2 and 5 are obese or overweight.

So in other words, a quarter of the kids come into our schools overweight and then when they graduate from high school, about a third of them are overweight.

When I was in school, recess and physical education classes, a time for kids to run around and play games, it was an important part of our day. I remember the President's physical fitness test. And while I never did that well on it, I had the second to the worst softball throw in 4th grade.

Senator Alexander, Gretchen Johnson had the worst. I don't want to call her out today at this public hearing.

But the point of it is it instilled in me a respect for exercise that led to me taking long distance bike trips with my dad and really having that be a part of my life.

Unfortunately, poor nutrition and a lack of exercise means kids have a greater chance of getting diseases like Type 2 diabetes,

heart disease and hypertension. Obesity also has an adverse impact on a child's academic and social performances. These consequences often last a lifetime, as obese youth are statistically more likely to be obese as adolescents and then as adults.

In addition to hurting our kids' health, obesity also hurts our economy. According to a recent study, the hospital cost of treating children for obesity-related conditions rose from $35 million during the years 1979 to 1981 to $127 million from 1997 to 1999. And since obese kids are more likely to be obese adults, the costs do not stop at childhood. Nationally, we spend between $51 billion and $78 billion on healthcare related to overweight adults. That is nearly 9 percent of all healthcare spending in the United States.

So what can we do to get our kids to exercise and eat healthy foods? Well, first we need to focus on prevention and ensure that kids have access to safe places to play and healthy foods. And that starts in our neighborhoods and our schools, and it starts in our homes. Studies have shown people living in more walkable communities have a reduced risk of obesity, and children with easy access to recreational facilities and playgrounds are more active than those with limited access.

Programs like EPA's Smart Growth America are working to build more pedestrian friendly communities and combat the prevalence of obesity. We are also working in the Agriculture Committee to increase, as I mentioned, nutrition standards for all food sold in schools.

Another issue where we have more work to do is asthma. Nearly 9 million children in the United States have asthma, and it is the leading serious chronic illness among our children. Outdoor air pollution worsens existing asthma. Outdoor pollutants known to trigger asthma attacks include ozone, particulate matter, nitrogen dioxide and sulfur dioxide. Children are already at greater risk from outdoor air pollution than healthy adults, since kids have smaller airways than adults, which are blocked easier, causing kids to breathe more rapidly.

Since children are less likely to acknowledge breathing difficulties that result from pollution and limit their exposure, asthma and the influence of environment are especially significant for kids.

When I entered the Senate, I fought to make our kids safer and healthier. I worked to get toxic toys off our shelves. We had a major consumer products bill which I think the Wall Street Journal called the most sweeping consumer legislation in 16 years. Senator Pryor and I and others on the Commerce Committee worked very hard to get the legislation passed.

The other and last topic I wanted to mention was the issue of formaldehyde. As you know, formaldehyde is used in many products as an adhesive or bonding agent for composite wood products. At room temperature, formaldehyde releases an invisible gas into the air.

Now, we know that formaldehyde in small concentrations is a normal part of our environment. It is in wood furniture that you probably have at home. However, the problem is exposure to formaldehyde gas in higher concentrations, especially over a prolonged period, if inhaled can cause nausea, asthma and other serious

health problems. We know because kids are smaller and have fewer pounds, this is exacerbated when it comes to children.

Most seriously, formaldehyde is listed as a probable human carcinogen by the U.S. Environmental Protection Agency. Estimates by the State of California suggest that daily prolonged exposure to formaldehyde may contribute to tens of thousands of cancer cases in the U.S. each year.

In recent years, there has been a growing concern about formaldehyde in composite wood products imported from other countries. In the U.S., our timber industry has come up with voluntary standards that they are meeting. This is a problem with foreign wood that is coming in, composite wood and others that is coming into our country. That is why Senator Crapo and I have introduced bipartisan legislation that would establish national standards for formaldehyde emissions in new composite wood products, and I am interested in the effect this chemical and others have on our kids. We are excited about this legislation. We have the support of environmental groups, consumer groups, as well as the timber industry.

I look forward to hearing from our panelists about these issues and other environmental health issues that are affecting our kids. They are the most vulnerable among us, and it is our responsibility to protect them and help them to grow up healthy.

With that, I would like to turn it over to Senator Alexander, cochair of this committee.

OPENING STATEMENT OF HON. LAMAR ALEXANDER, U.S. SENATOR FROM THE STATE OF TENNESSEE

Senator ALEXANDER. Thank you, Amy.

I want to congratulate Senator Klobuchar for conceiving of this hearing and hosting it, and I look forward to hearing what the witnesses have to say.

I have another hearing at 10:30 a.m., but I will be here for the next hour.

One of the most remarkable statements that I have heard in the last few years is the statement by distinguished journals such as the New England Journal of Medicine or the Institute of Medicine, the Trust for America's Health, others, who say today's children are likely to be the first generation to live shorter, less healthy lives than their parents. That is enough to cause you to stand up and stop and say, this is a country that is always getting better and better; that doesn't sound like the United States of America.

And one reason for that, of course, is the growing number of adult diseases that we see in children. Pediatricians tell me, I had a hearing at Maharry University last October and they talked about how many of these adult diseases, especially Type 2 diabetes, sometimes heart disease, other chronic illnesses the pediatricians are seeing in young children and the terrible consequences of a lifetime of those diseases is for them. And much of that comes from obesity, which is a function of diet and exercise.

So we know the problem, and we see the specific results, and we know what causes it. So I think part of our job here is to listen to the experts who can tell us not what comprehensive thing can we do, because we don't do comprehensive very well here. Our

country is too big and too complicated, and we like our freedom too much, but there are bound to be some important steps we can take in the right direction to deal with that part of the health problem.

And the other one that Senator Klobuchar mentioned has to do with clean air. One of the first pieces of legislation I introduced here when I became a Senator, and I did it with Senator Carper 6 years ago, was tough standards for sulfur, nitrogen and mercury. And that has been complicated some by the court decision that has knocked out the rule for sulfur and nitrogen, but I am looking forward to hearing testimony about what standards for sulfur and nitrogen and mercury we need.

We talk a lot about carbon around here, and I believe carbon is a problem, and we need to deal with it, but we know what to do about sulfur, nitrogen and mercury. We have the technology to get it out of the smokestacks, and my view is we ought to go ahead and do it.

I know that in Tennessee, the estimates are we have a million children, which is most of our children, who are at risk for asthma. According to the American Lung Association, there are a half-million people who have asthma. Chattanooga, Memphis and Knoxville have specific air pollution problems. And that not only affects our health, but it affects our ability to attract the Volkswagens of the world and their suppliers because they can't come if we don't meet our air quality standards.

So I am interested in both those issues that the Chairman has mentioned, one being practical steps toward obesity; and two being practical steps to go ahead and clean up the air of sulfur, nitrogen and mercury so that we have healthier children.

I look forward to the testimony. Thank you.

Senator KLOBUCHAR. Thank you very much, Senator Alexander, and thanks for your leadership in this area.

Senator Merkley.

OPENING STATEMENT OF HON. JEFF MERKLEY, U.S. SENATOR FROM THE STATE OF OREGON

Senator MERKLEY. Thank you, Madam Chair.

I simply associate myself with the comments of the distinguished Chair and the Republican leader and hope that we can get right to the testimony.

Senator KLOBUCHAR. OK. You see, people can work together in Washington.

Right, Lamar?

Senator ALEXANDER. Right.

Senator KLOBUCHAR. Exactly.

Here we go. I am going to introduce this panel first and then have each speak for 5 minutes.

The first, Dr. Peter Grevatt. Dr. Grevatt is both the Director for the EPA's Office of Children's Health Protection and Environmental Education and the Senior Adviser on Children's Environmental Health for EPA Administrator Lisa Jackson. Dr. Grevatt assists the EPA with his experience in risk assessment for critical public health issues. He has worked with members from local, State and national government and formerly in the EPA's Office of

Solid Waste as its Senior Science Adviser and Director of its Economics Methods and Risk Analysis Division.

Linda Birnbaum is the Director of the National Institute of Environmental Health Sciences and the National Toxicology Program. Having spent the previous 16 years—Dr. Birnbaum served as the EPA's Senior Adviser on Experimental Toxicology. She has been a Federal scientist for almost 29 years and has received many awards for her work as a toxicologist and her leadership in the field. She has authored over 600 peer reviewed publications and reports and is an Adjunct Professor of her field at both UNC Chapel Hill and Duke University.

Thank you very much. We look forward to hearing from both of you.

Dr. Grevatt.

STATEMENT OF PETER GREVATT, DIRECTOR, OFFICE OF CHILDREN'S HEALTH PROTECTION AND ENVIRONMENTAL EDUCATION, U.S. ENVIRONMENTAL PROTECTION AGENCY

Mr. GREVATT. Good morning, Madam Chair, and thank you and members of the subcommittee.

My name is Peter Grevatt, and I am the Director of the Office of Children's Health Protection and Environmental Education at the Environmental Protection Agency. And thank you for the opportunity to appear before the subcommittee to discuss EPA's efforts to promote and improve children's health.

As a parent of two school age children myself, I share with everyone here a vital interest in protecting our children in every way possible.

This hearing is a very important event for EPA. Ensuring that our children live, learn and grow in a safe environment is central to the Agency's work. Administrator Jackson has established three broad principles to guide EPA's work. The first is that science must be the determining factor in EPA decisionmaking. The second is adherence to the rule of law. And the third is that we must operate in transparency.

EPA's children's health activities are guided by these principles, as reflected in several recent actions, including the release for public comment of the reanalysis of data on perchlorate for regulatory determination, EPA's commitment to reconsidering the 2008 national ozone standard, and a recent unprecedented air toxics monitoring effort near schools.

Children's rapid development makes them vulnerable to toxicants during pregnancy and childhood. Children have a greater exposure to chemicals through behaviors such as crawling, putting objects in their mouths, and eating non-food items, and early life exposures can have serious consequences throughout a child's life.

Our work at EPA extends beyond protecting the natural environment. Our focus is not just on how human activities affect the environment. It is also about how the environment that we've created in our communities can affect our health and well-being.

Children's health issues touch almost every aspect of EPA's work, and we have recently established a five-part strategy to ensure protection of children's environmental health. First, EPA will work to ensure that our regulations provide for protection of chil-

dren. Already we have decided to reconsider the 2008 national smog standards to ensure that they are scientifically sound and protective of human health. Smog, which is known as ground level ozone, has been linked to asthma and other respiratory illnesses in children.

In addition, EPA will work to address the continuing disparity in exposures and health effects for some of America's children. For example, almost three times as many African American children have elevated blood lead levels compared to Caucasian children. Between 2004 and 2007, African American and Puerto Rican children, regardless of family income, reported higher levels of asthma.

EPA will work to improve the environment in public health for all of America's children.

Second, we will work to ensure safe chemicals management. TSCA, this country's chemical management legislation, was originally enacted in 1976 and is the only major environmental statute that has not been reauthorized. The TSCA inventory currently contains over 80,000 existing chemicals, few of which have been studied for their risks to children. It has proven difficult in some cases to take action to limit or ban chemicals found to cause unreasonable risks to human health or the environment, and there is a growing willingness in the U.S., including among industry, to work on efforts to reform TSCA.

And it is clear that the time has come to bring TSCA into the 21st century, and we are very hopeful that Congress will act to update TSCA so that we are better able to take action on chemicals that pose a concern, particularly chemicals that pose a concern for children.

Third, we will work with Federal, State, tribal and local public health agencies to design and implement community-based children's health programs. The Administrator and I understand the importance of interagency collaboration on children's environmental health issues, and we will reestablish a pivotal and influential role for EPA with other Federal departments and agencies addressing children's environmental health.

For example, we are currently working with a variety of Federal agencies and a diverse group of stakeholders to provide communities with the information and support they need to address children's environmental health issues in homes and schools and other environments where children spend much of their time.

Fourth, we will support research to better understand children's environmental health issues. The Children's Environmental Health Research Centers established in 1998 by NIEHS and EPA examine the interactions between key environmental exposures and a range of children's health outcomes, including growth and development, asthma, and neurodevelopmental disorders such as autism. Research results from the Children's Centers have led to novel findings associated with disease in children.

EPA is also a national collaborator in the National Children's Study, the largest ever study of children's health in the U.S., which will contribute to a better understanding of the role of environmental factors in health and disease.

Fifth, EPA will measure the effectiveness of our actions. Currently, EPA is developing appropriate indicators of its efforts in

protecting children's health. As an agency, we will enhance our ability to report on progress in protecting children's environmental health going forward.

I would like to thank you, Chairman Klobuchar and members of the subcommittee for the opportunity to talk to you today. Administrator Jackson and I share your commitment to children's environmental health, and we appreciate your ongoing interest in our efforts, and I look forward to answering any questions that you may have.

[The prepared statement of Mr. Grevatt follows:]

TESTIMONY OF
PETER GREVATT, PhD
DIRECTOR OF THE OFFICE OF CHILDREN'S HEALTH PROTECTION AND
ENVIRONMENTAL EDUCATION
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
SUBCOMMITTEE ON CHILDREN'S HEALTH
OF THE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

September 29, 2009

Good morning, Madam Chairman and Members of the subcommittee. My name is Peter Grevatt, and I am the Director of the Office of Children's Health Protection and Environmental Education at the U.S. Environmental Protection Agency (EPA). Thank you for the opportunity to appear before this subcommittee to discuss EPA's efforts to promote and improve children's health.

EPA's mission is to protect human health and the environment. Ensuring that our children are protected from exposure to unsafe levels of toxins and pollution or other environmental threats in their homes, schools or anywhere else is central to EPA's work. Children face greater threats from environmental pollutants than adults due to differences in their physiology, activity patterns and development. And not all children are the same: we continue to see disparities in exposures and health outcomes among the poor, African American, Latino, Native Americans and other ethnic minorities.

Children's health is a driving force behind Administrator Jackson's priorities. In her first few months at the Agency she took several important actions to help ensure protection of children's environmental health: She initiated an unprecedented air toxics monitoring effort near schools;

released a reanalysis of data related to EPA's perchlorate regulatory determination for public comment; and committed to reconsidering the 2008 national ozone standards.

Administrator Jackson has established three broad principles to guide the Agency's work.

The first is that science must be the determining factor in EPA decision making. When we make a decision that will affect the health and welfare of a community, we must be committed to the very best scientific analysis. This is the principle behind our efforts to reconsider the ozone standard – an effort which is driven by concerns for children's health.

The second guiding principle is adherence to the rule of law – hence our efforts to ensure safe chemicals management through full implementation of the Toxic Substances Control Act. We need to step up our efforts to assess and manage environmental exposures that are particularly harmful to children. Early life exposures can have life-long adverse effects.

Third, we must operate with transparency. Transparency is the principle behind our efforts to share information regarding air pollution in our cities and towns and near schools. Working with state, tribal and local officials we identified 62 schools in 22 states to monitor the levels of toxic air pollutants in ambient air. EPA will analyze the air toxics data and use it to inform the potential for health concerns near these schools. As part of our commitment to transparency, the results of these monitoring efforts are made publicly available at www.epa.gov/schoolair.

EPA is also concerned about eliminating disparities in children's environmental health. We have important obligations to look ahead and be proactive about preventing and, where necessary, mitigating the harmful effects of pollution on children's health and welfare. Many other issues, such as climate change, healthy communities, air quality, water quality, and waste management – are all important to children's health protection.

Why Focus on Children?

Children eat, drink and breathe more per pound than adults. When food, water, or air is polluted, children are exposed to more of the pollution than adults. For example, an average infant less than 6 months old consumes 2.5 times more water than an adult on a per pound basis.

Children can have greater exposure to chemicals through behaviors that are unique to childhood, such as crawling, putting objects in their mouths, and eating non-food items. Children also have unique exposures, through the umbilical cord and through breast milk, for example. Their bodies are rapidly developing. Exposure to toxic chemicals during critical windows of development can lead to disease or other serious effects on organ systems.

Children's vulnerabilities to toxicants can occur during pregnancy or childhood, as both are periods of rapid development. For example, the nervous system begins to rapidly develop in the embryo only days after conception and continues to develop through puberty. Early exposures can have serious consequences throughout a child's life.

Children's Health at EPA – A Brief History

Since the founding of EPA in 1970, in the Agency has played an important role in the nation's efforts to protect children's environmental health. For example, one of our early regulations mandated the removal of lead from gasoline, which continues to represent a landmark achievement in protecting children's health. Blood-lead levels of children born today are significantly lower than those born before EPA took action.[1] EPA's early establishment of national ambient air quality standards (NAAQS) for criteria air pollutants, such as particulates, sulfur dioxide (SO_2), lead and nitrogen dioxide (NO_2), have also contributed to significant reductions in children's exposures to airborne pollutants, particularly in urban areas.[2]

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[1] SOURCE: America's Children and the Environment. U.S. Environmental Protection Agency. http://www.epa.gov/envirohealth/children/index.htm. DATA: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey, http://www.cdc.gov/nchs/nhanes.htm

[2] Ibid.

In 1986, EPA was the first Agency to publish Guidelines for the Health Assessment of Suspect Developmental Toxicants that outlined principles and methods for evaluating data from animal and human studies, exposure data, and other information to characterize risk to human development, growth, survival, and function because of exposure prior to conception, prenatally, or to infants and children.[3]

In 1995, EPA established an Agency-wide policy to ensure that the unique vulnerabilities of children would be explicitly and consistently considered in our risk assessments, risk characterizations, and health standards.[4] In 1996, the *National Agenda to Protect Children's Health from Environmental Threats* expanded the Agency's activities to specifically address risks for children.[5]

In 1997, the President signed Executive Order 13045: *Protection of Children's Health from Environmental Health Risks and Safety Risks*.[6] The Order requires all federal agencies to assign a high priority to addressing health and safety risks to children, coordinate research priorities on children's health, and ensure that standards take into account special risks to children.

EPA established the Office of Children's Health Protection (OCHP) in 1997 to support the Agency as it embraced the 1996 National Agenda and the 1997 Executive Order. The mission of EPA's Children's Office is to make the health protection of children a fundamental goal of public health and environmental protection in the United States and around the world.

To inform Agency initiatives related to children's health, EPA established the Children's Health Protection Advisory Committee (CHPAC) in 1997. Through the Committee, leading researchers, academics, health care providers, NGOs, industry representatives, as well as, state and local government representatives advise EPA on regulations, research, and communications issues important to children's health.

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[3] Kimmel C. Health Assessment Of Exposure To Developmental Toxicants. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/D-87/210 (NTIS PB87209045).
[4] Policy on Evaluating Health Risks to Children. U.S. Environmental Protection Agency, Washington, D.C., http://www.epa.gov/osa/spc/pdfs/memohlth.pdf.
[5] Environmental Health Threats to Children. U.S. Environmental Protection Agency, Washington, D.C., EPA/175/F-96/001.
[6] 62 FR 19885. http://yosemite.epa.gov/ochp/ochpweb.nsf/content/whatwe_executiv.htm

Administrator Jackson has made clear that children's environmental health will be a top priority for EPA under her leadership. The Administrator has spoken broadly about the importance of children's environmental health, and recently provided leadership to the G8 environment ministers with a major address on the topic.

We have established a 5-part strategy to ensure protection of children's environmental health at EPA.

EPA's 5-part strategy on children's health, with some current examples

1. Regulatory Development and Policy Development

1a. Regulations:

EPA will work to ensure that regulations provide for protection of children's environmental health.

National Ambient Air Quality Standards (NAAQS): For example, EPA will confront the potentially harmful effects of criteria pollutants on the health of children. Already, we have decided to reconsider the 2008 national smog standards to ensure they are scientifically sound and protective of human health. Smog, which is also known as ground level ozone, has been linked to asthma and other respiratory illnesses in children.

"This is one of the most important protection measures we can take to safeguard our health and our environment. Smog in the air can cause difficulty breathing and aggravate asthma, especially in children," said EPA Administrator Lisa P. Jackson. "Reconsidering these standards and ensuring acceptable levels of ground-level ozone could cut health care costs and make our cities healthier, safer places to live, work and play."

The reconsideration covers both the primary and secondary ozone standards. EPA sets primary air quality standards to protect public health, including the health of sensitive groups, such as children and people with asthma. The secondary standard is set to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.

Pesticides: The law governing pesticides requires an additional safety factor to protect children in most cases. Over a 10-year period, EPA re-evaluated all food use pesticides to ensure that they were protective and eliminated uses where risks exceeded our level of concern. For example, all indoor uses of chlorpyrifos and diazinon were eliminated, as well as use of those pesticides on residential lawns based on unacceptable risks to children. Many food uses of methyl parathion were eliminated for that reason.

1b. Policy Development: Environmental Health Disparities

Two critically important environmental health issues -- lead exposure and childhood asthma-- demonstrate an inequality in exposures and health effects for some of America's children. Research indicates that children who belong to racial or ethnic minorities, often have greater harmful exposures and poorer health outcomes than white children.[7] EPA will work to improve the environment and public health for all, and that necessitates a special focus on health disparities and their causes. I would like to elaborate on this issue by discussion of childhood asthma and lead.

Asthma:

Asthma is a chronic disease affecting about 6.8 million children in the United States. It is a major reason for emergency room and hospital visits and missed school days. The burdens of asthma fall more heavily on African American children. In 2004 to 2007, African American children, regardless of family income, reported higher rates of asthma. Thirteen percent of African American children had asthma. This compares to 8% of White, 7% of Mexican-

[7] Dilworth-Bart JE and Moore CF, Mercy Mercy Me: Social Injustice and the Prevention of Environmental Pollutant Exposures Among Ethnic Minority and Poor Children. *Child Development*. 2006;77:247-65.

Americans, 20% of Puerto Rican children, and 10% of American Indian and Alaskan Native children.[8]

Children may inherit a tendency to develop asthma, and racial and ethnic differences in the burden of asthma may be related to social and economic status, access to health care, and exposure to environmental triggers.[9] Asthma rates have increased worldwide.[10] The US rate increased 75% from 1980 to 1994. In 2005, 12.7% of children had been diagnosed with asthma at some point in their lifetime.[11] The largest increase was among children up to 4 years old (160%). Rates among children 5 to 14 years old increased by 74%.[12] Today, although asthma rates have stabilized, childhood asthma rates remain at an all time high.[13]

For the period 1980-2005, increases in asthma rates among poor minorities have been even larger than the averages.[14] They have also had larger increases in deaths from asthma.[15] EPA's policies to address asthma take minority children into special consideration. The EPA Asthma Initiative includes research, education and outreach to identify the environmental factors that cause asthma and asthma symptoms, and to replicate effective interventions to mitigate these factors in homes and schools.[16]

EPA sponsored the Asthma Health Outcomes Project—a 2006 study showing that asthma programs that address environmental triggers work best to improve health outcomes such as reduced emergency room visits, improved quality of life, and fewer missed days of school or work when they build strong connections with front-line health care providers and local

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[8] Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey. http://www.cdc.gov/nchs/nhis.htm

[9] Reviewed in: Asthma and Allergy Foundation of America and The National Pharmaceutical Council. Ethnic Disparities in the Burden and Treatment of Asthma. Washington, DC. January 2005. www.aafa.org

[10] National Institutes of Health. Global Strategy for Asthma Management and Prevention: NHLBI/WHO Workshop Report. National Heart, Lung, and Blood Institute, National Institutes of Health; 1995. NIH Publ. No. 95-3659

[11] Akinbami LJ. The State of childhood asthma, United States, from 1980 to 2005. Advance data from vital and health statistics; no 381, Hyattsville, MD: National Center for Health Statistics.

[12] Mannino DM, Homa DM, Pertowski CA, et al. Surveillance for Asthma—United States, 1960–1995. *MMWR Morb Mortal Wkly Rep.* 1998;47(SS-1):1–28

[13] Akinbami LJ. The State of childhood asthma, United States, from 1980 to 2005. Advance data from vital and health statistics; no 381, Hyattsville, MD: National Center for Health Statistics.

[14] Ibid.

[15] Lang DM, Polansky M. Patterns of asthma mortality in Philadelphia from 1969–1991. *N Engl J Med.* 1994; 331: 1542–1546

[16] http://www.epa.gov/asthma

communities.[17] In response, we launched the Communities in Action for Asthma Friendly Environments initiative in 2005-2006. This initiative creates a network of community programs--nearly 500--pursuing strategies to achieve positive health outcomes, including cultivating program leaders, establishing sound community relationships, maximizing cooperative opportunities, providing integrated health care services and implementing tailored environmental interventions. Leading programs in the Network are realizing 50-80% reductions in emergency department visits and hospitalizations, based on each program's tracking studies. These programs track outcomes for their enrolled patients-in general, they compare outcome endpoints at 12 months to baseline at time of enrollment.[18]

Lead:

It is often recognized that the removal of lead from gasoline and resulting lowered blood lead levels in children is a public health success story. The median concentration of lead in the blood of children 5-years old and under dropped from 15 micrograms per deciliter (µg/dL) in 1976-1980 to 1.4 µg/dL in 2005-2006, a decline of 91 percent.[19] The decline in blood lead levels is due to the phasing out of lead in gasoline and regulations reducing lead levels in drinking water, banning lead from paint, and restricting the content of lead in solder, faucets, pipes, and plumbing. Lead also has been eliminated or reduced in food and beverage containers and ceramic ware, and in products such as toys, mini-blinds, and playground equipment.

However, although this decline in lead poisoning rates is heartening and has been seen among all ethnic groups, lead levels continue to be highest among African-American children, whose median blood lead level remains significantly above that of other children.[20] Almost three times as many African-American children have blood lead levels above 10 ug/dl as do white and

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[17] http://www.epa.gov/asthma/ahop.html

[18] http://www.asthmacommunitynetwork.org

[19] SOURCE: America's Children and the Environment. U.S. Environmental Protection Agency. http://www.epa.gov/envirohealth/children/index.htm. DATA: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey, http://www.cdc.gov/nchs/nhanes.htm

[20] In 2003-2006, Black children had the highest median blood lead level of 2.3 µg/dL, compared with 1.4 µg/dL for White children and 1.5 for Mexican-American children. SOURCE: America's Children and the Environment. U.S. Environmental Protection Agency. http://www.epa.gov/envirohealth/children/index.htm. DATA: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey, http://www.cdc.gov/nchs/nhanes.htm

Mexican-American children. The disparity is even more pronounced when one looks at lower blood lead levels, which is increasingly important as research continues to show adverse effects at lower and lower blood lead levels. Residence in older housing, poverty, age, and being non-Hispanic black are still major risk factors for higher lead levels.[21] This is also seen on a community wide level; one inner-city prevalence study published in 2004 found that 27% of children in two inner-city Chicago communities had elevated blood lead levels.[22]

As part of an effort to address ongoing problems with lead, EPA recently issued an additional rule aimed at protecting children from lead paint hazards. The Lead Renovation, Repair and Painting Rule (40 CFR Part 745) provides broad protections against inadvertent lead poisoning by requiring contractors and construction professionals to be trained, certified and to use lead-safe work practices during renovation, repair and painting in pre- 1978 housing and child-care centers. The rule also requires contractors to provide a new lead hazard information brochure to property owners, tenants, and owners and operators of buildings that have child-occupied facilities as well as to the parents and guardians of children under age six using the facilities. The rule will be fully effective in April 2010. In addition, last month EPA announced plans to propose further strengthening and expanding the scope of these regulations.

EPA also provides funds to especially vulnerable communities though the National Community Based Lead Grant Program and the Targeted Lead Grant Program. These programs provide lead awareness training, develop local ordinances, build ongoing partnerships, provide education and surveillance, and highlight model lead-poisoning prevention strategies in communities with older housing, fewer resources, and other indicators of high risk. We also awarded nearly $1 million in grants to 15 tribes to reduce the incidence of child lead poisoning and support educational outreach and baseline assessments of exposure.

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[21] Pirkle JL, Kaufmann RB, Brody DJ, Hickman T, Gunter EW, Paschal DC. Exposure of the U.S. population to lead, 1991 - 1994. *Environ Health Perspect.* 1998;106:745-50.

[22] Dignam TA, Evens A, Eduardo E, Ramirez SM, Caldwell KL, Kilpatrick N, Noonan GP, Flanders WD, Meyers PA, McGeehin MA. High-Intensity Targeted Screening for Elevated Blood Lead Levels Among Children in 2 Inner-City Chicago Communities. *American Journal of Public Health* 2004;94:1945-1951.

2. Safe chemicals management and children's health

The Toxic Substances Control Act (TSCA), this country's chemical management legislation, was originally enacted in 1976 and is the only major environmental statute that has not been reauthorized. The TSCA Inventory currently contains over 80,000 existing chemicals, few of which have been studied for their risks to children. Unlike the laws applicable to drugs and pesticides, TSCA does not have a mandatory program where EPA must conduct a review to determine the safety of existing chemicals. In addition, TSCA places legal and procedural requirements on EPA before the Agency can request the generation and submission of health and environmental effects data on existing chemicals. It has also proven difficult in some cases to take action to limit or ban chemicals found to cause unreasonable risks to human health or the environment.

There is growing willingness in the United States, including among industry, to work on efforts to reform TSCA. It is clear that the time has come to bring TSCA into the 21st Century and we are very hopeful that TSCA will be updated by Congress so that we are better able to take action on chemicals that pose a concern, particularly chemicals that pose a concern for children.

3. Implementation of community-based children's health programs

The Administrator and I understand the importance of interagency collaboration on children's environmental health issues and we will reestablish a pivotal and influential role for EPA with other federal departments and agencies addressing children and clean air, clean drinking and surface water, and safe chemicals. We will also work with Tribes, states and local communities to design and implement policies that improve the environment and protect children. We will work to ensure safe and healthy places for children to live, learn, work and play by providing leadership and focus to America's community infrastructure, its homes, schools, child care centers, farmlands and workplaces.

A few examples are in our safe schools and homes efforts.

Schools:

Siting and Construction

When Congress passed the Energy Independence and Security Act (EISA) in 2007, EPA was directed to develop guidelines addressing healthy, high performance schools. Healthy schools provide a clean, safe, healthy and energy-efficient learning environment, encourage physical exercise through multiple transportation choices such as biking and walking, and reduce the need for additional buildings and facilities by sharing recreational and other facilities with the broader community.

EPA is collaborating with the Department of Health and Human Services, the Department of Education and a diverse group of stakeholders to develop guidelines to help states and communities make better decisions with respect to where new schools are located, and guidelines that will provide tools to communities to build a new generation of healthy green schools, and to ensure that existing schools are brought into good condition and maintained properly.

Homes :

Children spend more time in their homes than in any other environment, and are at greater risk from environmental hazards in the home than adults because of their rapid development, physiology and unique behaviors. Exposure to lead based paints and other environmental hazards in the home disproportionately impact children, the poor, and minorities. According to HUD's 2007 American Housing Survey, nearly 6 million households live with moderate or severe physical housing problems. About 24 million homes face significant lead-based paint hazards.[23] A growing body of research has persuasively linked substandard housing conditions with illness and injury. Housing-related health costs total in the billions annually.[24] For example, lead-based paint and other toxins in the environment that may cause lead poisoning,

[23] 2007 American Housing Survey. U.S. Department of Housing and Urban Development. http://www.census.gov/prod/2008pubs/h150-07.pdf
Jacobs DE, Clickner RP, Zhou JY, Viet M, Marker DA, Rogers JW, Zeldin DC, Broene P and Friedman W. Prevalence of Lead-based Paint in U.S. Housing. *Environmental Health Perspectives*. 2002;110(10):A559-A606.

[24] Leading our Nation to Healthier Homes: The Healthy Homes Strategic Plan. U.S. Department of Housing and Urban Development. 2009. http://www.hud.gov/offices/lead/library/hhi/hh_strategic_plan.pdf.

cancer, and neurobehavioral disorders have been estimated to have the potential to result in $52.9 billion in annual costs. [25]

EPA, HHS and HUD have recently embarked on a joint effort to respond to the Surgeon General's Call to Action on healthy homes though the development of a comprehensive healthy homes strategy. Through implementation of the joint strategy, EPA will take advantage of opportunities to leverage federal resources to provide states, Tribes and local communities with the necessary tools to help improve home environments, particularly in underserved communities.

Sustainable Communities:

Our work at EPA extends beyond protecting the natural environment. These days, more and more we're talking about the built environment. And our focus is not just on how human activities affect the environment. It's about how the environment we have created in our towns and cities and communities where we live can affect our health and well-being. Chronic diseases such as diabetes and asthma are influenced by environmental conditions.[26]. In low-income communities children are often at greatest risk from exposure to contaminants.[27] Housing and community-based interventions in low-income communities are likely to contribute to reducing health disparities in the US.[28]

Our **Community Action for a Renewed Environment** (CARE) grant program helps communities address multiple sources of toxic pollutants in their environments, and many of our CARE grantees are including children's health issues in their CARE projects. Through CARE, more than 1,300 homeowners received information and assistance on lead paint testing and 28 schools used EPA's chemical cleanout or Indoor Air Quality Tools for Schools programs.

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[25] Ibid.
[26] The Surgeon General's Call to Action To Promote Healthy Homes. U.S. Department of Health and Human Services. 2009. http://www.surgeongeneral.gov/topics/healthyhomes/index.html
[27] Leading our Nation to Healthier Homes: The Healthy Homes Strategic Plan. U.S. Department of Housing and Urban Development. 2009. http://www.hud.gov/offices/lead/library/hhi/hh_strategic_plan.pdf
[28] Ibid.

Pediatric Environmental Health Specialty Units:
With the Agency for Toxic Substances and Disease Registry, EPA supports the Pediatric Environmental Health Specialty Units, a program that provides advice to communities, healthcare providers, and parents on children's environmental health issues. These experts in environmental exposures work to prevent, diagnose, manage and treat environmentally driven health issues in children. They are located in hospitals in each of the ten EPA regional offices, and this model is being utilized in other countries as well, as evidenced by requests for consultations, trainings, workshops and presentations on how the program works.

4. Research and Science Policy
We will work with internal and external researchers to fill critical data gaps in understanding children's vulnerabilities, unique exposures, and health effects.

Children's Environmental Health Centers: The Children's Environmental Health Centers, established in 1998 by NIEHS and EPA, examine the interactions between key environmental exposures and a range of child health outcomes, including overall growth and development, asthma and respiratory health and neuro-developmental disorders such as autism. Collectively, these centers comprise a national network of scientific and community leaders, health care providers, and government officials with the common goals of preventing and reducing childhood diseases in the research areas under study and translating the findings to the affected communities and the broader public.

Children's centers have evolved over the past ten years to emphasize a multidisciplinary approach that includes basic, applied, and community-based participatory research. Research results from the children's centers have led to novel findings that have stimulated the broader scientific community to explore potential biological mechanisms in relevant pathways associated with disease pathogenesis in children.

National Children's Study
The National Children's Study is the largest-ever study of children's health in the US and is expected to examine the development of 100,000 children from before birth to age 21. Of high

relevance to EPA, the study will eventually provide data for investigating the effects of environmental exposures (chemical, biological, physical, and psychosocial) as well as gene-environment interactions on pregnancy outcomes, child health and development, and precursors of adult disease.

EPA is one of four agencies that have been leading the study since it was authorized by the Children's Health Act of 2000. EPA's scientific leadership and collaboration with the other lead federal agencies has improved the scientific basis for the NCS. We have conducted method development and evaluation studies, helped to develop the study hypotheses, and contributed to the development and the review of the study and its research plan. EPA will continue to participate in the planning and implementation of the Study to ensure that environmental issues are adequately addressed, that appropriate measures are assessed at critical time points, and that the study results help to meet Agency needs.

By studying the same children over time through their different phases of growth and development, including early life exposures, we hope to be able to better understand the role of environmental factors in health and disease. The study is expected to provide data that will play an important role in helping EPA establish policies that are based on science and protective of children's health. Household and community-level environmental measures analyzed together with biological indicators will help us identify health risk factors across the multiple life stages of early development.

The data generated from these activities are expected to directly inform interventions for EPA, public health stakeholders, manufacturers, designers and builders. The National Children's Study data are also expected to help EPA evaluate the consequences and the effectiveness of our regulatory decisions.

The design of the NCS creates a broad platform for investigating the factors contributing to injury, asthma, autism, obesity, mental illness, and other diseases. Additional studies of national or community import may be built upon this platform to answer more specific questions related to children's' health. .

5. Measuring the Effectiveness of EPA's programs

In all of these activities, it is essential for EPA to measure the effectiveness of our actions. EPA is developing appropriate indicators of its efforts in protecting children's health. *America's Children and the Environment* brings together quantitative information from a variety of sources to show trends in levels of environmental contaminants in air, water, food, and soil; concentrations of contaminants measured in the bodies of mothers and children; and childhood diseases that may be influenced by environmental factors.[29] The main purposes of the report are:

- To present indicators of key factors relevant to the environment and children in the United States;
- To inform discussions among policymakers and the public about how to improve federal data on children and the environment; and
- To help policymakers and the public track and understand the potential impacts of environmental contaminants on children's health and, ultimately, to identify and evaluate ways to minimize environmental impacts on children.

EPA's America's Children and the Environment website has recently been updated with the most current data available for measures of contaminants, body burdens and illnesses important for children's environmental health. The website presents data for 21 different indicators of children's environmental health, including measures for drinking water contaminants, blood mercury levels, and neuro-developmental disorders. Most of these indicators now present data up through at least 2006.

Conclusion

Thank you, Chairman Klobuchar, and members of the Subcommittee for the opportunity to talk to you today. As previously described, EPA has established a 5-part strategy to ensure protection of children's environmental health. This strategy includes: 1) regulatory and policy development, 2) safe chemicals' management: children's health, 3) implementation of

[29] America's Children and the Environment. U.S. Environmental Protection Agency. http://www.epa.gov/envirohealth/children/index.htm.

community-based children's health programs, 4) research and science policy, and 5) measuring the effectiveness of EPA's children's health activities. As evident by our strategy and actions, Administrator Jackson and I share your commitment to children's environmental health and we appreciate your ongoing interest in our efforts. Thank you again for inviting me to give testimony on this vitally important issue and I look forward to answering any questions you might have.

EPA Response to Questions for the Record:
September 29, 2009 Hearing before
SEPW Subcommittee on Children's Health
"Promoting and Improving Children's Health Protection"

Questions from Senator James M. Inhofe

QUESTION 1: EPA considers the specific value of born children and pregnant women, but not the unique value of the unborn child. Could you elaborate on whether EPA makes any effort to specifically protect and value unborn children?

Answer:

EPA is increasingly supporting efforts and investigations into prenatal environmental exposures. For example, EPA has supported grants, research grants and studies on prenatal exposures. In fiscal year 2008, EPA's Office of Children's Health Protection and Environmental Education awarded $514,951 in grants to address environmental health issues during the prenatal period. Grantees are educating pregnant women about environmental health risks, demonstrating the effectiveness of information dissemination and behavior change, and increasing the number of health professionals who are fluent in prenatal environmental health issues. Studies, conducted through Science to Achieve Results (STAR) grant funding and EPA/NIEHS Children's Environmental Health Centers, aim to further characterize the developmental origins of disease where environmental threats are known or suspected to play a role. By better characterizing the environmental risks to fetuses during specific window periods of development, EPA and our federal partners aim to develop more effective exposure prevention strategies to ensure healthy pregnancies and healthier children.

QUESTION 2: You mentioned the Lead Renovation, Repair and Painting Rule (40 CFR Part 745) which will be in effect by April 2010. As you may know, my office has requested information about how EPA will effectively train the estimated 186,811 renovators necessary by the April deadline. Is your office, or the Office of Prevention, Pesticides and Toxic Substances, willing to brief my staff about the progress made in training and continue to update us about the progress of implementing this rule?

Answer:

EPA would be happy to brief the Senator's staff.

EPA received letters dated May 19, 2009, and October 16, 2009, from you and Senator Vitter requesting information on the status of EPA's implementation of the Renovation, Repair and Painting (RRP) Rule. EPA responded to the May 19th letter on June 30, 2009, and a response to the letter of October 16th describing our most recent progress will be provided shortly.

QUESTION 3: What are you doing to ensure that your guidelines for high performance schools will result in measurable environmental and energy savings improvements?

Answer:

EPA, through its Green Buildings Workgroup, is currently identifying the justifiable, practical, and verifiable best practices that EPA recommends be incorporated into green building programs, standards, and rating systems. Several EPA programs have already established specifications for achieving an EPA-backed label, such as WaterSense, ENERGY STAR, or the Indoor airPLUS new homes indoor air quality label.

For example, through the ENERGY STAR program, EPA provides schools with guidance and tools to implement cost-effective strategies to achieving superior energy performance. Schools aiming to meet the guidelines for high performance are also encouraged to benchmark with EPA's Portfolio Manager based on actual energy usage of the building to understand and verify whole building energy and environmental performance. The cost-free online software tool gives school districts the ability to measure energy efficiency improvements over time while tracking reductions in greenhouse gas emissions and energy costs.

QUESTION 3(a): What are your specific goals for the healthy schools program?

Answer:

EPA's current healthy schools program activities are primarily intended to improve coordination and integration of a number of school-related programs that are located in different EPA program offices. The near term goals are to improve efficiencies, better leverage resources, and serve as a cross-agency platform to develop the guidelines required under EISA 2007, which created a new Title V of TSCA (Healthy High Performance Schools). In its 2006-2011 Strategic Plan, EPA also has an established goal for indoor air quality in schools: By 2012, the number of schools implementing an effective indoor air quality management plan will increase to 40,000 from the 2002 baseline of 25,000.

QUESTION 3(b): How are you balancing the schools need to re-circulate air more frequently to improve the "health" of the buildings, especially since this also means running heating and air conditioning systems more frequently, thus increasing energy use?

Answer:

Energy efficiency and indoor air quality are not mutually exclusive. For example, all buildings that earn EPA's ENERGY STAR for top energy performance must first meet indoor environmental quality standards. There are over 2000 ENERGY STAR qualified schools. Energy Star buildings are defined as meeting energy efficiency performance in the top 25 percent of their size class, while meeting industry standards for ventilation and other indoor criteria, proof that you can create a healthy indoor environment while still achieving high performance.

QUESTION 3(c): What are you doing to ensure that these high performance schools provide actual energy efficiency savings?

Answer:

Schools aiming to meet the guidelines for high performance are encouraged to benchmark with EPA's Portfolio Manager based on actual energy usage of the building to understand and verify whole building energy and environmental performance. The cost-free online software tool gives school districts the ability to measure energy efficiency improvements over time while tracking reductions in greenhouse gas emissions and energy costs.

QUESTION 3(d): How are you preventing the situation that occurred in Washington State, where some of the state's green schools actually cost as much as $0.40 more per square foot to operate than its best non-green school?

Answer:

By integrating ENERGY STAR into the guidelines for high performance schools, we are ensuring that energy efficiency is a critical component of these schools. Recent industry studies have shown that a number of buildings that have been classified as "green" are showing worse-than-average energy performance results, which can be attributed to a lack of focus on energy efficiency during the design, construction, and/or operation of the building. Another key issue is that the metrics often used during the design process to determine the potential energy efficiency of the building do not encompass all sources of energy use in the building and only compared the building design to minimum building code compliance. Since energy efficiency is the most critical component of cost-effective green building operation due to avoided energy costs over the lifetime of the building, the guidelines emphasize setting real whole building energy usage estimates at the design phase and to measure the actual energy use in operation.

QUESTION 3(e): How are you ensuring your guidelines are flexible enough to meet the needs of school districts from Fairbanks, AK to Miami, FL and not a one size fits all approach?

Answer:

EPA recognizes that decisions about where to build new schools are fundamentally local decisions. EPA's school siting guidelines will provide flexible recommendations for improving the decision-making process, and focus on helping communities conduct better environmental reviews of prospective sites and constructively engage community members.

EPA program guidelines for schools do address climatic or other local operating conditions. For example, schools that benchmark energy use in EPA's Portfolio Manager receive a 1-100 energy performance rating that normalizes for that school's local weather conditions and operating characteristics, such as size and number of computers. This means that school officials can assess how efficiently buildings use energy based on their individual schools in a specific climate zone.

QUESTION 4: What recommendations is your office making regarding TSCA reauthorization?

Answer:

The Office of Children's Health Protection and Environmental Education supports the Administration's principles for TSCA reform legislation. These six principles present goals for updated TSCA legislation that will give EPA the mechanisms and authorities to expeditiously target chemicals of concern and promptly assess and regulate new and existing chemicals. Protection of children's health is essential to these principles for TSCA reform. Specifically, the Administration's principles state that:

- Manufacturers should be required to provide sufficient hazard, exposure, and use data for a new or exiting chemical to support a determination by the Agency that the chemical meets the safety standard. Exposure and hazard assessments from manufacturers should be required to include a thorough review of the chemical's risks to children and/or other sensitive populations,
- EPA should have clear authority to take risk management actions that take into account children and/or other sensitive populations as well as cost, availability of substitutes and other relevant considerations, and
- EPA should have authority to set priorities for conducting safety reviews on existing chemicals based on relevant risk and exposure considerations, and practical deadlines should be set for completion of chemical reviews, in particular those that might impact children and/or other sensitive populations.

These principles are interdependent with the other principles, which may be accessed at: http://www.epa.gov/oppt/existingchemicals/pubs/principles.html.

Senator KLOBUCHAR. Thank you very much.
Dr. Birnbaum.

STATEMENT OF LINDA BIRNBAUM, DIRECTOR, NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES AND THE NATIONAL TOXICOLOGY PROGRAM

Ms. BIRNBAUM. Madam Chairwoman, distinguished subcommittee members, I am pleased to be here to present testimony on research supported by the Department of Health and Human Services. My name is Linda Birnbaum, and I am the Director of the National Institute of Environmental Health Sciences and Director of the National Toxicology Program within the Department.

As a public servant, scientist, mother and grandmother, I am convinced that a healthy environment is vitally important to a child's development and a child's health for his or her entire life. NIEHS has long recognized the critically important need for research on children's environmental health. We have spent more than $106 million on children's environmental health research this year. I would like to share with you some of our recent findings.

A scientist with the University of Southern California, supported by NIEHS, found that maternal smoking during pregnancy leads to permanent changes in the way a child's genes work without changing the genes themselves. We now understand that prenatal exposure to tobacco smoke is associated with a number of health problems later in life including childhood obesity, respiratory disease, and cancer.

USC researchers also found that new cases of asthma increased among children who exercise outdoors in communities where ozone levels are high, but not in areas where ozone is low.

Cognitive development of children is especially vulnerable to environmental effects. Recently, Columbia University scientists reported that a mother's exposure to an urban air pollutant known as polycyclic aromatic hydrocarbons, or PAHs, adversely affects the child's IQ. Children exposed to high levels of PAHs had IQ scores that were 4 points lower than those of less exposed children. Such a significant decrease impacts success in school.

Other Columbia researchers, working with children in Bangladesh, found that arsenic levels in drinking water were associated with decreases in IQ. These levels of arsenic are found in well water in some areas of the United States.

With regard to lead poisoning, NIEHS scientists studied the effect of chelation as a treatment of mild to moderate lead poisoning. Our research found that once lead is elevated in a child's blood, subsequent chelation treatment cannot restore lost IQ. This result supports the need for prevention.

The Superfund legislation directed NIEHS to fund research on the health effects of chemicals at Superfund sites and on technologies to clean them up. Building schools on former industrial properties is a common practice nationwide that can expose children to toxicants assumed to be contained below ground. Researchers in Brown University's Superfund Research Program are developing models that assess the fate and transport of these hazardous substances to the surface. They are working with communities to

improve school placement, thus empowering regulators and community groups with tools to prevent exposure among children.

With funding from the NIEHS Superfund Program, Harvard University is working in Tar Creek, Oklahoma, with the local health center, community groups and the county health department in establishing a birth cohort and asking questions that are directly relevant to this community. For example, how does metal waste change in the environment, making exposure more or less likely? And are exposed children affected by these metals?

The scientists are helping those responsible for clean up and educating residents in ways to reduce exposures.

Dr. Grevatt mentioned the NIEHS-EPA Children's Centers, which not only support multidisciplinary research grants, but are adding formative centers to foster new research. The Children's Centers are expanding their initial focus on asthma, pesticides, and neurobehavioral disorders into birth defects, childhood cancer, diabetes, pubertal development and the relationship of fetal exposure and adult disease.

Our Breast Cancer and Environment Research Centers investigate the impact of prenatal and childhood exposures on breast development and the altered risk of adult breast cancer. A primary focus of this study is on endocrine disruptors and personal care or household products.

The National Toxicology Program is supporting animal studies to investigate the effects of some of these compounds. Studies have been completed and are underway on estrogenic compounds, including genistine found in soy products and bisphenol A. A wide variety of herbal supplements, chemicals used in everyday products, and even radiation from cell phones are being investigated in multiple generations of animals. These studies are critical in linking environmental exposures during pregnancy and childhood with a variety of health effects not only on growth and development, but also on late life diseases such as Parkinson's and cancer.

The National Children's Study is another major project of importance to children's health. NIEHS and EPA are the two lead agencies, and our scientists have been integral in its planning. The CDC provides essential support through its analyses of blood, breast milk and urine for more than 100 chemicals. Enrollment efforts are now underway at seven locations.

The National Children's Study is an unprecedented opportunity to answer difficult questions about many of the diseases and exposures I have mentioned.

These are only a few examples of the critically important research being funded by the NIEHS and the NTP and a short description of the impact this research will have on the health of our children.

And I am happy to answer any questions.

[The prepared statement of Ms. Birnbaum follows:]

Subcommittee on Children's Health
Committee on Environment and Public Works
United States Senate
Hearing on Children's Environmental Health
September 29, 2009

Statement of
Linda S. Birnbaum, Ph.D., DABT, ATS
Director
National Institute of Environmental Health Sciences
National Institutes of Health
and
Director, National Toxicology Program
U.S. Department of Health and Human Services

Madam Chairwoman and distinguished members of the Subcommittee, I am pleased to appear before you today to present testimony on research supported by the Department of Health and Human Services (HHS) on effects of the environment on children's health. My name is Linda Birnbaum; I am the Director of the National Institute of Environmental Health Sciences (NIEHS) within HHS's National Institutes of Health (NIH), and Director of the National Toxicology Program (NTP).

As a public servant, a scientist, a mother, and a grandmother, I am convinced that a healthy environment is vitally important to the healthy development of a child. We know that young children are especially vulnerable to adverse health consequences of a wide variety of environmental exposures. They receive a proportionately greater exposure compared to their size than adults do; their behaviors can result in excess exposures; the active growth of children's organs and tissues enhances their susceptibility to environmental damage; and the body's mechanisms for reducing toxicity or excreting toxic substances may not be not fully operational in young children.

We also know much more about the linkages between environmental exposures and specific diseases and dysfunctions – not just childhood diseases, but effects of prenatal and childhood exposures that can show up years later, for example, as reproductive problems or cancer. In some cases, environmentally linked diseases such as asthma can affect an individual's entire life, with potentially large impacts on both quality of life and health care costs. In other cases, we are only starting to unravel the connection between the fetal and/or childhood environment to other diseases or conditions. These are some of the new areas of research which are benefiting from our cutting-edge scientific tools and uncovering the scientific information we need to make our children and our entire population healthier.

Since NIEHS was established in 1966, it has recognized the critically important need for research on children's environmental health and has made a major investment in this area. Other Institutes at NIH also support research in this area, including the Eunice Kennedy Shriver National Institute of Child Health and Human Development, the National Institute of Allergy and Infectious Diseases (NIAID), and the National Cancer Institute (NCI). In FY 2008, NIEHS spent more than $106 million on children's environmental health research. Today our program is more vibrant than ever. I would like to share with you some recent scientific findings from NIEHS-funded research.

For instance, asthma is a disease of children, as well as adults, and is of huge public health concern. Allergens found in the environment clearly trigger asthmatic attacks, but we are still learning about how the environment exerts its effects either as a cause of primary asthma or as a trigger of symptoms in an asthmatic child. A new NIEHS-funded study by researchers at the University of Southern California (USC) has found that maternal smoking during pregnancy can

cause lifelong effects in the child through specific pattern modifications in DNA molecules. *In utero* exposure to tobacco smoke can lead to changes in the way genes work without changing the genes themselves.[1] This kind of research will give us important insights into understanding how what happens in the womb is tied to health outcomes later in life. For example, prenatal exposure to smoke is associated with a number of health problems later in life, including childhood obesity[2], respiratory disease, and cancer.[3]

An important report on a link between asthma and air pollution, specifically ozone, came out of collaboration between the NIEHS and the USC. Researchers found that the incidence of new cases of asthma was associated with high exercise levels outdoors in communities with high levels of ozone. Exercise in areas of low ozone did not increase asthma risk.[4]

The same NIEHS researcher published a report a few years ago from a study in Mexico City (an area with high ozone exposure) showing that asthmatic children having a specific gene variant are more susceptible than those with a normal gene to a decline in lung function from ozone exposure – but that the children with the gene variant also derived greater benefit from supplementation with vitamins C and E in reversing some of the observed decline in lung function.[5]

The neurological and cognitive development of children is especially vulnerable to some environmental effects. This past summer, a study from the NIEHS/Environmental Protection Agency (EPA)-funded Children's Environmental Health Center at Columbia University reported that a mother's exposure to urban air pollutants known as polycyclic aromatic hydrocarbons (PAHs) can adversely affect a child's IQ. PAHs are chemicals released into the air from the

burning of coal, diesel, oil and gas, or other organic substances such as tobacco. In urban areas, motor vehicles are a major source of PAHs. The study found that children exposed to high levels of PAHs in New York City had full scale and verbal IQ scores that were 4.3 and 4.7 points lower than those of less exposed children, a statistically significant difference. A difference of more than four points, the average seen in this study, is educationally meaningful in terms of decreased success in school.[6]

Other recent studies looking at the effects on IQ of various environmental agents show similar results. For example, researchers at Columbia University working with a cohort of children in Bangladesh found that both arsenic[7] and manganese[8] levels in drinking water were associated in a dose-dependent fashion with decreases in intelligence. The same levels of arsenic studied in this research are found in well water in some areas of the U.S.[7] (This work was supported by the NIEHS Environmental Health Center Program and the NIEHS Superfund Research Program.) In addition, a researcher at NIEHS led an important study[9] to test the efficacy of chelation treatment of mild to moderate lead poisoning with respect to effects on IQ (the Treatment of Lead in Children, or TLC study). This study established that once lead is elevated in the blood, subsequent treatment with chelators cannot restore the "lost" IQ, affirming the importance of primary prevention of lead exposure.

The Superfund Amendments and Reauthorization Act of 1986 ("SARA") authorized NIH to fund university-based research ($49.6 million in FY 2009) to conduct the science needed for human health risk assessment and decision-making for remediation of hazardous waste sites. Based on population numbers from the US 2000 Census, it is estimated that almost 1 million children under the age of five are living within one mile of a Superfund site in the United States and Puerto Rico; within a four-mile buffer, the number of children under the age of five increases to

over 5 million. Almost 14 million children between the ages of five and 17 live within four miles of a Superfund site.

Researchers at Brown University's Superfund Research Program have been using a science-based approach to advise communities on the site location of schools. Siting schools on former industrial properties is a practice that may put children at risk of exposure to toxicants previously assumed to be contained below ground. Vapor intrusion is a complex process that is difficult to predict and has been the cause of many misguided school development projects throughout the Northeast, particularly in environmental justice communities. The researchers at Brown have developed models[10] that provide a science-based assessment of the fate and transport of these hazardous substances in the subsurface. These investigators are working with the Rhode Island Department of Environmental Management, translating their research findings into improved sampling and modeling techniques to inform city planners about vapor intrusion risks prior to building on a site. In addition, the Brown University Superfund Community Outreach Project is working to develop alternative models for school siting through an Environmental Equity Stakeholder Workgroup. Through their work, the researchers have empowered regulators and community groups with tools to prevent exposure among vulnerable youth.

Another NIEHS-funded Superfund researcher at the University of California at Berkeley is exploring the causes of the DNA mutations that produce childhood leukemia by asking parents about their exposures to household chemicals, such as paints and solvents. The researcher found that the risk of acute lymphoblastic leukemia (ALL) is significantly associated with paint exposure, with a higher risk observed when paint was used postnatally by a person other than the mother. No significant association was found between petroleum-based solvent (i.e., toluene and

xylene) use and ALL risk overall. However, a second rarer form of childhood leukemia, acute myeloid leukemia, was associated with petroleum-based solvents, but not with paint exposure.[11]

NIEHS funding of research projects in the Tar Creek Superfund site (Tar Creek, OK) assisted the local Board of Health in monitoring blood lead levels among children and pregnant mothers, allowing them to direct limited public health resources to prevent lead exposure, educating the community about methods to limit exposure, and assessing the movement and toxicity of metals in the local environment. A birth cohort at Tar Creek, the MATCH study (Metals Assessment Targeting Community Health), was founded in 2002 from funding obtained from the Superfund Research Program. The project was a collaboration between Harvard University, Integris Baptist Regional Health Center, L.E.A.D Agency, and the Ottawa County Health Department.

MATCH is unique because it partnered with both community groups and local health care providers to combine research on both human health effects work in children with environmental ecological research on metal chemistry and movement in the environment. While individually such studies may be common, they are typically done by separate teams that do not plan integrated work or share data. Doing them together under a single umbrella is a unique aspect of the NIEHS Superfund program. This collaboration drove the research toward questions that were directly relevant to the Tar Creek community, such as how metal waste undergoes chemical changes in the environment--making exposure more or less likely, and whether children who are exposed are impacted by these metals. MATCH investigators have given presentations to participants in the study, local community groups, and regulatory agencies such as EPA, HHS's Agency for Toxic Substances and Disease Registry (ATSDR), and the Oklahoma Department of

Environmental Quality, helping those agencies responsible for the remediation of the site and educating study participants in ways to reduce exposure.

A study in a population of pregnant women with relatively low arsenic exposures in the same Tar Creek, OK, locality showed that arsenic was associated with impaired glucose tolerance during pregnancy and therefore may be associated with increased risk of gestational diabetes.[12] Gestational diabetes poses significant risks to the developing child, as well as an increased risk of Type 2 Diabetes in the mother later in her life; gestational diabetes is associated with increased risk of stillbirths, major congenital malformations, and complications during delivery and the perinatal period. Infants born to mothers with impaired glucose tolerance or full-blown gestational diabetes are at increased risk of subsequent impaired glucose tolerance and obesity.[13]

Researchers from the Duke University Superfund Research Program recently learned that exposure to fipronil, a new pesticide being introduced to replace organophosphates for both household and agricultural use, results in the same adverse effects on neurodevelopment as the organophosphates. They also showed that the metabolic alterations evoked by early-life exposure to compounds often classified as "developmental neurotoxicants" support the idea of the potential involvement of environmental contaminants in the dramatic increase in childhood obesity and diabetes.[14,15]

NIEHS partners with EPA in funding the Children's Environmental Health Centers program. The Centers form a national network of university-based programs that fosters communication, innovation, and research excellence with the ultimate goal of reducing the burden of morbidity among children as a result of exposure to harmful environmental agents. The Centers: (1)

capitalize on the research findings and resources from ongoing epidemiology and clinical studies of pregnant women and children; (2) enhance the application of novel findings and approaches in areas of basic or mechanistic research to human studies; (3) develop and apply new or improved biomarkers to best characterize exposure effects on human biology and to predict long-term clinical consequences; (4) train new investigators who can address emerging issues in children's environmental health; and (5) ensure active participation of stakeholders and communities in the research process and translation of research findings in order to enhance effectiveness of the research and facilitate translation of research into policy and practice. The Children's Environmental Health Center Research Program not only continues to support the multi-project, multi-disciplinary research project grants that have been its mainstay over the past ten years, but is adding new "Formative Centers" to foster new research ideas in children's environmental health that are in the early phase of scientific inquiry and where the preliminary data or partnerships may be limited. The total investment by NIEHS and EPA for these two programs will be $12 million, with $9 million annually to support six comprehensive Research Programs and an additional $3 million to support approximately four Formative Centers beginning in FY 2010.

The Children's Centers Program is expanding into new areas of research including birth defects, childhood cancer (leukemia), diabetes, pubertal development, and the fetal basis of adult disease. It is enhancing the basic sciences directed towards additional children's environmental health issues such as epigenetics, trans-generational effects, diet, oxidative stress, and epithelial cell sensitivity. Its investigators and NIEHS staff are exploring possible collaborations with the National Children's Study, the Pediatric Environmental Health Specialty Units (a national network of regional centers of excellence funded jointly by ATSDR and EPA), and national and

regional birth defect surveillance programs. The Children's Center program continues its mentoring and support of new investigators and also actively supports the engagement of new community groups involved in children's environmental health issues.

The NIEHS Breast Cancer and Environment Research Program, co-funded with NCI, is investigating whether periods of susceptibility exist in the development of the mammary gland, when exposures to environmental agents may impact the breast and endocrine systems that can influence breast cancer risk in adulthood. It is examining the determinants of puberty in girls and integrating environmental, genetic, biologic, lifestyle, and socioeconomic factors, in recognition of the studies linking breast cancer risk to pubertal maturation. A major area of study is the role of chemicals in the environment, with a primary focus on hormonally active agents (endocrine disruptors) and the use of personal care or household products that are sources of these agents. A major accomplishment across Centers is the measurement of 51 environmental agents and their metabolites in biospecimens from approximately 1,190 girls who were enrolled in the study before breast development began. The types of chemicals measured include phenols and phthalates found in many personal care products and plastics; phytoestrogens found in foods; persistent pesticides (such as DDT); flame retardants used in hard plastic and foam furniture; polychlorinated biphenyls (PCBs); perfluorinated compounds used in a variety of materials, most notably Teflon; and cotinine, a tobacco smoke metabolite. The data include the first report in children of extraordinary levels of a number of hormonally active chemicals such as enterolactone, benzophenone-3, and monoethyl-phthalate. This investigation confirms that significant levels of such chemicals are found in the girls, and the data provide important additional information to the National Health and Nutrition Examination Survey (NHANES) data for U.S. citizens.

In the National Toxicology Program (NTP), which I also direct, additional work is underway in animal studies to look at the effects of some of these compounds. The NTP is an interagency program that coordinates toxicity testing across the federal government, providing toxicological evaluations on substances of public health concern through its testing and scientific analysis activities. The NTP has carried out studies[16,17] in animals exploring the fetal basis for adult disease. We are learning of more ways in which exposure to specific types of chemicals, even at very low levels, can disrupt our endocrine systems and affect children's development. NTP scientists have examined numerous substances that affect endocrine signaling processes for their influence on development. Studies have been performed or are underway on estrogenic compounds including genistein, found in soy products, and bisphenol A (BPA). A wide variety of herbal supplements, chemicals used in everyday products such as plastics or fabrics, and even radiofrequency radiation emissions from cellular telephones are being studied in multiple generations of laboratory animals. These studies are critical to understanding any potential linkages between environmental exposures during pregnancy and in early-life stages with a variety of effects, sometimes subtle, not only on growth and development, but on late-life chronic degenerative and proliferative diseases such as Parkinson's disease or cancer.

The NTP established the Center for the Evaluation of Risks to Human Reproduction (CERHR) to enhance its scientific evaluations. Following comprehensive reviews of the scientific literature, this Center issues monographs that carefully assess all the available evidence, including what is known about current human exposures, about how a given environmental chemical, physical substance, or mixture may cause adverse effects on human reproduction and/or development. To our knowledge, CERHR is the only program of its kind. Its monographs are recognized as

authoritative evaluations by many regulatory agencies.[18] For example, CERHR evaluations were cited as the basis for the listing of five different phthalates: 1-bromopropane, 2-bromopropane, and methanol, as reproductive or developmental toxicants in California.

The impact of CERHR analysis activities was most evident during the significant public attention given to the recent evaluation of BPA. Bisphenol A is a chemical produced in large quantities, primarily for use in the production of polycarbonate plastics and epoxy resins. People, including children, are exposed to BPA in food and beverages when it leaches from the protective internal epoxy resin coatings of canned foods and also from consumer products such as polycarbonate tableware, food storage containers, water bottles, and baby bottles. The CERHR report concluded that current human exposure is of "some concern" for effects on the development of the prostate gland and brain and for behavioral effects in fetuses, infants and children. Based on these findings, NTP has included BPA in its testing program; in addition, NTP is partnering with U.S. Food and Drug Administration's National Center for Toxicological Research to obtain data for constructing models of BPA kinetics to understand the effects of different exposure levels. NIEHS gave a high priority to BPA research in the grants program undertaken with stimulus funds from the American Recovery and Reinvestment Act of 2009 (ARRA). NIEHS is spending $14.9 million in ARRA funds on ten projects focusing on BPA. Our total investment in BPA research is more than $31 million.

CERHR is currently conducting an evaluation of soy infant formula, which exposes infants to high levels of naturally occurring estrogenic compounds at a stage of development when circulating estrogens are usually very low. Soy formula use is common, and there is public health concern about its effects on infants and young children.[19] Other NIEHS programs are also

looking at soy formula. Soy-fed infants have much higher exposure to endocrine-active compounds in their diets than do cow milk- or breast milk-fed infants. Soy-fed infants may be the group with the highest exposure to any environmental estrogen.[20] It is not known, though, whether these soy exposures are high enough to act as hormones in children. Researchers at NIEHS have begun an observational study with infants and toddlers to see whether feeding with soy formula can result in hormonal effects; this work will advance the field of endocrine disruptor science and provide better information for the use of policymakers and parents.

The NIEHS is supporting research that examines both the developmental origins of obesity and the possibility that environmental exposures during development play an important role in the current epidemic of obesity, diabetes, and metabolic syndrome. Most of the current data are from animal studies; there are data showing weight gain in rats and mice after developmental exposure to a number of different substances. This new hypothesis broadens the focus on obesity from solely genetics and lifestyle to include environmental exposures. It also poses questions about time of susceptibility to obesity from being an adult onset problem to being an early life exposure/developmental problem. This is an emerging area of research that NIEHS is exploring.

Epidemiology studies support the findings in animals and show a link between exposure to chemical such as PCBs, DDT, and some persistent organic pollutants and the development of obesity. In addition, the use of soy-based infant formula containing genistein has been positively associated with obesity later in life.[21]

A number of studies point to a relationship between obesity in children and asthma. Scientists in Australia showed an association between asthma symptoms and obesity in a cohort of 4- to 5-year-old children.[22] A meta-analysis of the effect of high body weight, either at birth or later in childhood, showed that these children are at an increased risk for future asthma. Potential biological mechanisms include diet, gastro-esophageal reflux, mechanical effects of obesity, allergy, and hormonal influences.[23]

I also want to mention the NIEHS involvement in the National Children's Study (NCS). This research project has been designed to study the effects of environmental influences on the health and development of 100,000 children across the U.S., following them from before birth until age 21. NIEHS is one of the four lead agencies on the study, and our scientists have been part of the discussion and planning since its inception. Enrollment in pilot studies is underway at seven locations. The NCS has the potential to give us an unprecedented opportunity to answer some of the difficult questions about many of the diseases and exposures that I have mentioned in this statement.

As well as NIEHS, HHS's Centers for Disease Control and Prevention (CDC) emphasizes the necessity of effective prevention programs to alleviate children's exposure to harmful environmental elements. CDC's National Center for Environmental Health (NCEH) has several programs in this area. One such program is Built Environment- Healthy Places, which focuses on healthy community design to prevent health effects such as asthma, obesity, diabetes, and attention deficit disorder. Additionally, the Lead Poisoning Prevention Program has had great success in its efforts to eliminate elevated blood lead levels in children. Also, the CDC Asthma National Control Program and its many partners make up the public health response to asthma

control. Its goals are to reduce the number of deaths, hospitalizations, emergency department visits, school days or workdays missed, and limitations on activity due to asthma.

These are but a few examples of critically important environmental health research and programs at HHS and the immediate and tangible impact they will have on the health of our nation's children. I am happy to answer any questions that you have.

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Questions from Senator Inhofe

Q: In addition to the areas of on-going research described in your testimony, are there additional areas of research that would significantly contribute to a better understanding of the effects of environmental exposures on children's health?

A: A significant opportunity for potential breakthroughs in understanding the effects of environmental exposures on children's health can be found in studies of effects of early exposure: prenatal, perinatal, and early childhood exposures. There are many dimensions of this research question which NIEHS-funded researchers are just beginning to address. What are the environmental agents of concern? How are they exerting their effects? We are rapidly learning about new mechanisms of toxicity, in which environmental agents at relatively low doses affect pathways such as endocrine systems and epigenetic processes. At the same time, we must also improve our scientific approaches to the complexity of exposure scenarios. Lastly, we need to improve our methods for assessing actual exposures, always the weakest link in environmental epidemiology.

Endocrine systems in the body are able to effect robust changes in response to a very small amount of hormone. The concern with "endocrine disrupting chemicals", which can mimic hormonal actions, is that a level of exposure much lower than required for other types of toxicity could be exerting serious adverse effects. We are learning that there is widespread exposure to some compounds with endocrine disrupting activity, such as Bisphenol A (BPA). The highest estimate daily intakes of BPA occur in infants and children; however, data on the human health effects of BPA is limited. To fill this important data gap and to provide the science needed to understand human risk, NIEHS is increasing its support for both laboratory research and epidemiology focused on effects of BPA exposure. NIEHS will invest approximately $30 million over two years on BPA-related research. This includes existing grants, the newly awarded Recovery Act grants and supplements, in-house research and National Toxicology Program (NTP) projects. The NTP effort is part of a larger five-year commitment to collaborate with the U.S. Food and Drug Administration's National Center for Toxicological Research to examine long-term health outcomes resulting from developmental exposures.

The science of epigenetics has opened entirely new areas of research on how environmental agents exert their effects. Epigenetic processes are a system of controls within the cell that are literally superimposed on top of the cell's genetic sequence and that direct the "turning on" and "turning off" of genes. We are just beginning to learn how chemical and physical agents in the environment affect living organisms by affecting epigenetic processes, impacting development of conditions such as cancer, autoimmune, respiratory, and cardiovascular diseases. NIEHS is moving strongly into this emerging area of research, studying epigenetic effects of such exposures as arsenic and ultraviolet radiation.

As we move forward in describing and characterizing these novel pathways of environmental action, we must also integrate the new knowledge we are acquiring about multiple ways that different exposures interact with each other. Children, like adults, encounter their environments

not as single chemicals but as a complex and ever-changing panoply of agents, making the task of determining risk all the more challenging. In addition, levels of specific nutrients in the diet can have an impact on how environmental chemicals are taken up, stored or excreted from the body. For example, research has shown that providing dietary calcium supplements to pregnant women reduced lead exposure in the fetus. The more we know about the interactions of complex exposure scenarios, the better we can tease out the most hazardous agents and design effective interventions.

Another exciting new area of environmental health research with important implications for children's health is the development of new technologies for measuring real-world exposures. Several recent projects have been funded which will give researchers a much more accurate picture of how children interact with their environment. This knowledge of actual exposure levels is critical for determining whether an exposure can be traced to a specific health outcome. One project is developing a new robotic sampler capable of mimicking children's floor activities for the collection of relevant data on young children's exposure to indoor air pollutants (particulate matter, pesticides, allergens, endotoxins and airborne fungi) that can be used as a safe and a better estimate to personal exposure monitoring in research studies of young infants and toddlers. Also, four environmental sensors (for aerosols and particulate matter and light enough for use with children) are under development as part of the NIH's Genes, Environment and Health Initiative that will assist in better environmental characterization of childhood exposures.

NIEHS is also one of four lead agencies on the National Children's Study (NCS), with the Eunice Kennedy Shriver National Institute of Child Health and Human Development, the Centers for Disease Control, and the Environmental Protection Agency. The overall goal of the NCS is to provide information that will ultimately lead to improvements in the health, development, and well being of children. The primary aim of the NCS is to investigate the separate and combined effects of environmental exposures (chemical, biological, physical, and psychosocial) and gene-environment interactions on pregnancy outcomes, child health and development, and precursors of adult disease. To enhance the synergy of these research programs and promote the development of cutting-edge exposure technology, testing in the NCS cohort is planned for one of the sensors from the GEI program: a tiny but versatile monitor that measures both acute and chronic exposures known to affect inflammatory responses in asthmatic children. This is just one example of the importance of this national investment to our knowledge of children's environmental health. The NCS will also serve as a resource for future studies of child health and development; it will assemble a high quality database and repositories of environmental and biological samples that can be used to address future research questions.

Senator KLOBUCHAR. Thank you very much.

We will start with Senator Alexander.

Senator ALEXANDER. Thanks, Madam Chairman.

Thank you for the testimony.

Dr. Grevatt, you talked about environmental triggers. Can you expand on what you mean by environmental triggers?

Mr. GREVATT. Environmental triggers of disease. I mean, it is well understood that many of the diseases that we are concerned about in kids have multiple factors that contribute to them, both genetic factors and lifestyle factors, but certainly we know in the case of asthma that there are a number of triggers, indoor air pollutants and outdoor air pollutants, as well as other factors within homes that contribute to asthma attacks. And so those are the triggers that I am talking about.

Senator ALEXANDER. Do you have established research about whether sulfur dioxide or nitrogen oxides are environmental triggers for children?

Mr. GREVATT. I believe that both sulfur dioxide and nitrogen oxides can contribute to the onset of asthma attacks, but less is understood about what causes the disease of asthma in the first place, but the triggers that I am referring to is what causes the onset of the asthma attacks.

Senator ALEXANDER. I see. And would you suppose that limiting the discharges from power plants of sulfur and nitrogen oxide would be beneficial to the health of children with asthma?

Mr. GREVATT. I think it is important to look at all the opportunities that we have to protect kids from various environmental pollutants, those that you mention and others, from a number of sources, yes.

Senator ALEXANDER. Dr. Birnbaum, Senator Carper and I have prepared legislation that would provide strict national limits on sulfur, nitrogen and mercury emissions from power plants. And we have submitted that to the EPA for its analysis and comment and technical advice. Has your office had a chance to look at that bill yet?

Ms. BIRNBAUM. I am not sure whether we have or not, but we have a great deal of research that we are conducting on the health effects of all the pollutants you mentioned. And we know that all of those pollutants have long lasting effects on children's asthma, respiratory health, and intelligence as well.

Senator ALEXANDER. Since this is a piece of legislation that we would like to move pretty quickly, could I ask your office to take a look at that, and if EPA is still in its analysis of the bill or even if it is not, to give us your thoughts about how your research connects with the standards that we suggest in the bill?

Ms. BIRNBAUM. We will be happy to do that.

Senator ALEXANDER. What have you found out about mercury? You know, sulfur and nitrogen, we have been regulating for a while, and it blows around the world coming out of power plants. But there is some evidence that mercury comes out of coal-fired power plants and doesn't blow very far, and so it affects adults and children near the power plants.

Have you done any research on mercury and its effect on children, and especially whether it comes from power plants?

Ms. BIRNBAUM. We have done a great deal of work looking at effects of mercury, and we know that both inorganic mercury, which is what comes out of the stack, and the methylmercury, which is produced when the mercury lands on, you know, on lakes and gets into fish, have severe impacts on neurodevelopment and behavior in children. So that is a great concern that we have had for many years.

Senator ALEXANDER. But do you have an opinion, or has your research shown whether the mercury that causes the problem comes from a nearby source like a power plant within 20 miles? Or whether it comes, like sulfur dioxide might, comes from a power plant that is hundreds of miles away?

Ms. BIRNBAUM. We have not conducted research on the fate and transport of mercury. I believe EPA has done quite a bit of that.

Senator ALEXANDER. Those are all my questions at the moment, Madam Chairman.

Senator KLOBUCHAR. Thank you very much, Senator.

I talked at the beginning of my statement about obesity and exercise, and I think I will have more questions for the second panel about that. I think we know what the causes of obesity are, for the most part, and we know what we need to do to solve it. But I would like to focus with both of you on some of the issues with some of these diseases that we are hearing a lot about with kids, outside of the obesity issue.

The first that I hear a lot about, besides this obesity exercise issue, when it comes to kids is autism. And I just wondered, and again people are searching for a cause. They are trying to figure if it is environmental or what the issues are. And I know it is a very hotly charged issue because so many parents understandably are upset about it.

Could you just talk sort of concretely about what, and I am sure NIH is investigating it, but what EPA is doing right now in terms of looking at potential environmental causes?

I am going to start with Dr. Grevatt.

Mr. GREVATT. Yes, thank you.

A number of things we are doing to look at environmental causes related to autism and other neurodevelopmental disorders, including the support that I mentioned that we jointly provide for the National Children's Research Centers, which are looking at these sorts of key issues, trying to understand the role of environmental factors in autism.

We can be certain that autism is not just a disease that is driven completely by environmental factors, but to the extent that there are environmental factors that we can control, we think it is critical.

Senator KLOBUCHAR. What are the factors you are looking at exactly?

Mr. GREVATT. Different neurodevelopmental toxicants such as mercury, lead, other heavy metals. I think at this point there is really a high level of uncertainty about what the specific environmental contributors to autism, other neurodevelopmental disorders are. ADHD is another issue that many are concerned about, as well as the broad set of autism spectrum disorders.

Senator KLOBUCHAR. Dr. Birnbaum.

Ms. BIRNBAUM. We have a great deal of research, and as you know, the Interagency Autism Act of 2006 established a cross-agency effort to coordinate some of the autism research, and we participate in that actively. We fund not only some of the basic research, which is trying to develop animal models which will enhance our ability to test individual pollutants, but also we are doing a number of epidemiology studies. We have two large ones, one called CHARGE being conducted at the University of California at Davis, and the other called EARLI, which is a multi-center study. And both of these are looking at the multiple environmental impacts that could be associated with autism.

We know that almost all complex diseases have both an environmental and a genetic component. So one of the exciting things about the EARLI study that just started, and this has recruited 1,200 women who already have one child with autism. So we know that there is a genetic predisposition for those women that a second child might also have autism. And we are following that up to understand how the environment can impact what happens with subsequent births.

I did want to mention very briefly that in addition, there are many different environmental triggers of obesity that are beginning to be understood. So for example, air pollution is associated. There is growing information that in areas of high air pollution, there is more obesity in children there, a clear association.

Senator KLOBUCHAR. And again, thank you for this answer. If I could just finish autism, and then we will move to this.

Ms. BIRNBAUM. Sure.

Senator KLOBUCHAR. I just want to say there is just growing frustration that so many parents, including parents I know. And I know there is some discussion, well maybe they are just identifying it when they didn't identify it before. And I really don't think that is true. I think we are starting to see increasing numbers, and that makes me think that it is perhaps something outside of genetics or something has happened.

Ms. BIRNBAUM. We know it is something complicated. We know it is not simple. We know that the exposures are occurring either in the womb or in the first year or so of life. Children are frequently diagnosed with autism between 18 and 24 months, so it is some very, very early impact on their neurodevelopment.

Senator KLOBUCHAR. Right. I appreciate your looking into this, and I am sure we are going to focus on this more going forward.

But to the obesity issue, and I didn't mean to say there weren't environmental factors. That is what this hearing is about. I just meant that it seems easier to see some of the root causes. But could you elaborate on why you think the air pollution connection?

Ms. BIRNBAUM. Well, it is not only air pollution. We are seeing that a number of early pesticide exposures and then exposures to some of the old persistent organic pollutants that are out there, that children who are exposed in utero to these kinds of pesticides go on later in life, not so late in life actually, to begin to be heavy and that this persists.

There are a series of studies that have been conducted now starting after World War II where populations have been followed. And what they found is that where there were some kind of early life

restriction on nutrition, and I am not talking about actual malnutrition, but a deficit of certain foods, for example, after World War II in Europe. They followed those patients or those subjects now for 50 or 60 years, and what they find is that those who had some kind of early life stressful event such as under-nutrition in fact go on to have a higher incidence not only of obesity, but cardiovascular disease, diabetes and cancer.

And in fact, we can now model those kinds of exposures in our different animal studies, which provide support for the reality of these findings. And the human epidemiology studies looking at some of these individual pollutants are beginning to support these findings.

Senator KLOBUCHAR. So you are talking about having some under-nourishment in the womb or when a baby is born?

Ms. BIRNBAUM. What is very interesting is that when children are born, these children are not what you would call growth-retarded. They are not so small that previously would just have thought, oh, that is a little bit of a little baby. But in fact, we are finding that even a 5 percent detriment in newborn weight as compared to what they should have been is associated with, as they grow, obesity and a plethora of other adverse outcomes.

Senator KLOBUCHAR. Right, and I don't think people always think about this. They think, well, if you have a littler baby, then, you know, they are going to be little. And in fact, this malnourishment and not getting the right nutrients can later lead to a higher——

Ms. BIRNBAUM. Right, but it is not only malnourishment. I think it is very important, you know, we are quick to blame obesity on people's lifestyle, eating too much, eating the wrong foods, not exercising enough. But this new understanding that there may be early developmental insults that can in fact predispose you to these things is a very important understanding.

Senator KLOBUCHAR. And may help us to solve some of it.

OK. Very good.

Senator Merkley.

Senator MERKLEY. Thank you, Madam Chair.

Thank you for your testimony.

Dr. Grevatt, in your testimony, you have a reference to the Toxic Substances Control Act being the only major environmental statute that has not been reauthorized, and that it has "proven difficult in some cases to take action to limit or ban chemicals found to cause unreasonable risks to human health."

Can you give us some examples of those types of situations where chemicals have been found to cause unreasonable risk, but it has been difficult to take action?

Mr. GREVATT. Yes, thank you. I think probably the best known challenge in terms of TSCA was with the attempted ban on asbestos, which ultimately was proved unsuccessful under TSCA. And there has been quite a bit that has been accomplished under TSCA, so the message here is not so much that we haven't been able to accomplish anything in TSCA. There has been quite a bit.

But our belief and the Administrator's belief is that going forward in order to safely manage chemicals, we need some stronger tools than we have available to us in TSCA today.

Senator MERKLEY. Then does that example pretty much stand by itself, or are there dozens of examples of that nature, or a few more that are significant that you want to mention?

Mr. GREVATT. I think there are a number of other examples. I would be happy to provide you with specifics later, but there are a number of other examples where the provisions in TSCA make it difficult for EPA to obtain some of the information that we need in order to support whatever approach that we think is appropriate.

Senator MERKLEY. That would be helpful. I will ask you to follow up and provide that information. That would be great.

Mr. GREVATT. Be glad to.

Senator MERKLEY. And I wanted to turn, Dr. Birnbaum, to lead. And in your testimony, you note that we got it out of gasoline, and we removed it from paint, but that it still remains a significant issue. Is that primarily due to drinking water? And what else can be done?

Ms. BIRNBAUM. Well, much lead is coming from older homes and older facilities where lead was present, for example, in the paint and in other places. So that exposure to lead via dust is a major route of childhood exposure. In certain areas, there has been lead found in drinking water, and that has been due to lead soldering that was used in pipes, and when some of the procedures were changed for disinfection of water, it changed the pH and more lead leached out of the pipes. But I think that the major exposure to childhood lead is largely through dust in older buildings and older facilities.

Senator MERKLEY. Thank you.

I want to turn in the time I have to this issue of endocrine systems and endocrine disrupters. If one tracks the change in the age at which puberty occurs over a significant length of time, I don't know if that is decades or 100 years or what kind of data we have, has there been a significant shift?

Ms. BIRNBAUM. Yes, there has been a dramatic decrease in the age of puberty, and a lot of that is probably due to better nutrition. Some of it is due to increased obesity, but you cannot explain all of the change in puberty from those two factors.

Senator MERKLEY. Which brings us to the endocrine disrupters?

Ms. BIRNBAUM. Yes, it would. Many, many chemicals have the ability to alter our hormone system. I think it is important to understand that the purpose of our hormones is to maintain our normal physiology and maintain us on an even keel. And that even a slight alteration of some of our hormonal balance, especially at a key window which occurs during development, can have long lasting consequences.

Senator MERKLEY. So in your testimony, there are many, many items that are mentioned ranging from a compound found in Teflon to epoxy resin, coatings of canned foods, polycarbonate tableware, food storage containers, water bottles, baby bottles. This list, apart from the Teflon, I think is the role of, is it BPA? Can you talk a little bit about this compound, and I guess it is softener in plastics, and what kind of evidence is mounting that it is a significant issue?

Ms. BIRNBAUM. OK, well, I can talk both about the compound that is present in Teflon is not BPA.

Senator MERKLEY. Right.

Ms. BIRNBAUM. That's perfluorooctanoic acid or other perfluorinated compounds. But the compound you mentioned in the other places you mentioned is BPA. And BPA used to be called a weak estrogen, but now we understand that in fact in certain circumstances, it can be a very strong estrogen. It is present in over 93 percent of the American population based on the CDC monitoring of our population. And we find that the way it is handled in the body is different in infants than it is in adults. And infants have more difficulty eliminating the BPA than adults do, for example.

There have been over 900 peer reviewed studies published on the health effects of BPA, and we know that development is a critical time for susceptibility to BPA. We know that it is associated with long-term changes in the reproductive organs and in reproductive behavior, and there are effects on the brain development as well that are persistent. And there is growing evidence that there are effects on the heart as well.

And in fact, some of the effects on the cardiovascular system, there have been associations reported in adults with elevated BPA within the background population, but people within the background population who have higher BPA than others appear to have an increased risk of heart disease as well. So there are many, many different effects that are being reported.

We are currently conducting research on BPA so that this past year we have actually had a $31 million program specifically trying to look and definitely understand the potential health consequences of BPA exposure.

Senator MERKLEY. Can I give one question to follow up on that?

Then have you all put out recommendations in terms of should parents not use plastic baby bottles, pacifiers? Or is there a series of recommendations? Or do you also plan any sort of regulatory action?

Ms. BIRNBAUM. We are not a regulatory agency. We are a research agency, but we have published two large documents. One was a consensus statement developed by many of our NIEHS-funded researchers that reviewed all of the literature on BPA health effects. And 2 years later, the NTP has evaluated all the literature related to developmental and reproductive exposures to BPA, and the conclusion of that was that there was definitely some concern for exposure to BPA for a number of different health effects.

We have been working very closely with our colleagues at FDA as they look to make the regulatory decisions about BPA.

Senator MERKLEY. Thank you.

Senator KLOBUCHAR. All right. I just had one last question before we go on to our next panel, something I raised in my opening statement.

Dr. Birnbaum, I understand that your institute's National Toxicology Program's report on carcinogens will reconsider the classification of formaldehyde from its current status of "reasonably anticipated to be a human carcinogen" and are considering naming it a carcinogen. As I mentioned, Senator Crapo and I just introduced

a bill that will phase in new national standards for formaldehyde in composite wood products, understanding that there are trace levels in products, but setting a .01 parts per million standard.

Can you tell us about some of the benefits of limiting formaldehyde exposure for kids?

Ms. BIRNBAUM. Well, we know that formaldehyde is extremely irritating. We know that it can actually stimulate an asthmatic response. And then there is growing evidence that in fact, from a number of studies, especially some recent ones that were just released from the National Cancer Institute, that formaldehyde appears to be associated with an increase in cancer in people as well.

We expect to have an external peer review of all the information that we will use to make a listing decision of whether it is a known or reasonably anticipated to be carcinogen. That peer panel will be held in November.

Senator KLOBUCHAR. OK. Thank you very much. So it is OK for dissecting frogs a few times a year, but possibly harmful in prolonged exposure.

Ms. BIRNBAUM. Most people who are now doing dissections with formaldehyde are doing it under a hood so that the fumes are wafted away, and they are not inhaling them.

Senator KLOBUCHAR. OK. I didn't know that. I was just thinking back to my elementary school days.

[Laughter.]

Senator KLOBUCHAR. All right. I want to thank both of you.

Any follow ups?

Senator ALEXANDER. Well, does that mean we can't take kids to the Natural History Museum, because President Teddy Roosevelt skinned all the animals and used formaldehyde and put them there?

Ms. BIRNBAUM. Well, most of the formaldehyde has ether, they are either enclosed in glass, or if they are not, that the formaldehyde at least that Teddy Roosevelt did has long since evaporated from the material.

Senator KLOBUCHAR. I think what we are talking about here are some of the trailers in Katrina and some of the other concerns from in wood products in homes and this long-term exposure.

Ms. BIRNBAUM. And I think that is a valid concern.

Senator KLOBUCHAR. OK. Thank you very much. Thank you, both of you. It was very enlightening. We look forward to having you back again.

We will bring up our second panel.

OK, very good. Welcome to our second panel. I already mentioned Dr. Mary Story from the University of Minnesota. She is a Professor with the School of Public Health and an Adjunct Professor at the U of M's Department of Pediatrics. She is also Director of the Robert Wood Johnson Foundation's Healthy Eating Research Program. Her expertise lies in studying childhood obesity and eating habits.

Dr. Story is widely published on the topic of childhood nutrition and obesity and is on the editorial board for the Journal of the American Dietetic Association.

Also with us, Dr. Reid Ewing is a prolific writer and researcher on the topic of urban planning and development. At the moment,

he is also the Associate Editor of the Journal of the American Planning Association and a columnist for Planning Magazine.

The doctor has been directly involved in politics as well, having served two terms in the Arizona State Legislature and working in the Congressional Budget Office on urban policy. He received his master's degree and Ph.D. in city urban planning from Harvard University and MIT respectively. Right now, he is a Professor with the University of Utah's Department of City and Metropolitan Planning.

Thank you both. We look forward to hearing from you for 5 minutes each, and then we will have questions.

Dr. Story.

STATEMENT OF MARY STORY, PROFESSOR, DIVISION OF EPIDEMIOLOGY AND COMMUNITY HEALTH, UNIVERSITY OF MINNESOTA

Ms. STORY. Madam Chair, members of the subcommittee, thank you for the nice introduction and for inviting me to testify, and asking me to address one of the most important health threats facing our children today, obesity.

You mentioned that nearly one in three children and adolescents in this country are overweight or obese. That is more than 23 million children and teenagers. We must intentionally reverse the epidemic of childhood obesity or our families, communities, our States and our Nation will face a future of deteriorating health, lower worker productivity, and increasing need for social services and healthcare support.

How did we get to this point? There is no easy answer. There is no single answer. We know that the current food environment is not conducive to healthy eating. Few children eat the recommended amount of fruits and vegetables, and children today eat too much fat, sugar and calories. We also know that children are not as physically active either in school or outside of school.

To address the obesity epidemic, we must change the environment for our children. We need to remove the barriers to make sure that the healthy choice is the easy choice. This can only be done with the engagement of parents, schools, communities, industry, government and the media. We know that it is an individual's decision what and how much to eat and how much physical activity they get. But individual behavior change can only occur in a supportive environment with accessible and affordable healthy food choices and opportunities for regular physical activity.

I wanted to briefly highlight three areas in the environment that play a critical role for children: communities, schools and childcare.

First, the community environment. Many of our communities do not provide access to healthy, affordable food or have parks or safe places for children to play. Too often, people have to rely on convenience or corner stores that offer few healthy foods and at higher prices because they don't have access to full service grocery stores.

Research shows that greater access to supermarkets may be related to a reduced risk for obesity. There is now a movement across many States and communities to offer incentives to attract full service supermarkets back into lower income urban and rural communities. This initiative was recently backed by the Institute of

Medicine. Whatever Congress can do to further these efforts is worth pursuing.

The second area is the school environment. Recent research, and we have plenty of it, shows that our school environments are not as healthy as they could or should be. In fact, kids have wide access to junk food and soda throughout the school day in cafeterias, vending machines and school stores, and less than 5 percent of elementary schools are providing students with daily physical activity.

Senator Klobuchar, you have been such a great leader in the area of improving the school environment, from supporting efforts to get rid of junk food in schools, to helping strengthen local school district wellness policies. These efforts are critical to changing the school environment to make the healthy choice the easy choice, in fact, the default choice, and to promote the short and long term health of our children.

It is a similar situation in childcare facilities. You mentioned the staggering statistic that one in four preschool children today is already obese or overweight. USDA's Child and Adult Care Food Program serves more than 3 million children in childcare centers and childcare homes. Congress can improve the nutritional quality of meals and snacks in the program by having stronger nutrition standards in line with the dietary guidelines for Americans, such as serving low fat milk, restricting fried foods and sugared beverages, and providing a healthier food environment.

We know you have a particular interest in this area, and we appreciate your leadership in making sure that children get a healthy start in life.

In closing, I would like to say that we need health in all policies approach, transportation policies, climate change legislation, child nutrition programs, the stimulus package, and of course health reform. All of these need to be viewed through the lens of health, especially children's health.

Thank you for the opportunity to address the subcommittee on this important issue.

[The prepared statement of Ms. Story follows:]

Testimony of Mary Story, Ph.D., R.D.

Before the Senate Environment and Public Works' Subcommittee on Children's Health

Director, Healthy Eating Research National Program Office
Professor , Division of Epidemiology and Community Health and Associate Dean for Students, University of Minnesota School of Public Health
Member, Institute of Medicine Committee on Childhood Obesity Prevention
U.S. Senate

September 29, 2009

Senator Klobuchar, Member of the Subcommittee, thank you for this opportunity to testify about the number one health threat facing our children today and generations to come—obesity.

I am Mary Story, a professor and associate dean in the School of Public Health at the University of Minnesota and the director of Healthy Eating Research, a national program of the Robert Wood Johnson Foundation focused on environmental and policy strategies to promote healthy eating among children and reduce childhood obesity. I have over 20 years of experience researching obesity and nutrition in children and adolescents and serve as a Member of the Institute of Medicine Committee on Childhood Obesity Prevention.

I commend you for holding a hearing today to examine the environmental factors that affect the health of our children. My work has always been driven by the belief that we must provide our children with the best start in life and health. Giving children a healthy start will help ensure future generations of healthy adults. In doing so, we must ensure they have healthy air to breathe, clean water to drink and play in, access to healthy foods, and safe places to walk, run, bike and play.

As a parent and a nutritionist, I am concerned about what American children are eating – too much fat, sugar and empty calories and not enough fruits and vegetables. In addition, children are not getting enough physical activity. This imbalance has led to the serious problem of obesity. Some experts warn that if obesity rates continue to climb, today's young people may be the first generation in American history to live sicker and die younger than their parents' generation. Things have to change.

Introduction to Problem:
Obesity rates have soared among all age groups, increasing more than four-fold among children ages 6 to 11 over the past four decades. Today nearly one third of children and adolescents are overweight or obese. That's more than 23 million kids and teenagers. [1,2]

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[1] Ogden C, Carroll M and Flegal K. "High Body Mass Index for Age Among US Children and Adolescents, 2003–2006." *Journal of the American Medical Association*, 299(20): 2401–2405, May 2008.

And significant disparities exist. For example, 38 percent of Mexican-American children and 34.9 percent of black children ages 2 to 19 are overweight or obese compared with 30.7 percent of white children in the same age range. [3]

The health of our children is at great risk, impacting not only their quality of life – and those around them, but also placing significant financial pressure our health system. Economist Eric Finkelstein recently reported that annual medical expenditures attributable to obesity have doubled in the past decade and may be as high as $147 billion per year.[4]

Environment: Where our children live, learn and play

As we examine the environmental factors that have led us to this public health epidemic, it is important to define "environment." For childhood obesity prevention, an environmental approach means focusing on the physical places where children live, learn and play. The goal is to ensure that these environments support and encourage healthy eating and physical activity.

Over the past 40 years, we've learned a great deal about what it takes to keep our children healthy. Research now tells us that our children's physical and social environments affect their health even more than we previously imagined. How kids live and what they have access to directly impacts their behavior and health.

Unfortunately, many of our communities are unhealthy. In addition to poor air quality and hazardous waste – areas that other panelists are discussing, many communities do not have access to healthy affordable foods or have parks or other safe areas for physical activity. Too often people have to rely on small stores, convenience stores and hybrid gas stations where there is a smaller selection of healthy foods at higher prices because they don't have access to full-service grocery stores. In many lower-income communities there a dearth of public transportation, walking or bike paths – including safe routes to and from school.

As a result children eat poorly and and don't have enough opportunities to be active so their health suffers. Ultimately, we all pay a price—higher health care costs, increased school absenteeism and reduced economic growth.

And while we know it is an individual's decision what and how much to eat or how much activity they get, we also know that individual behavior change can only occur in a supportive environment with accessible and affordable healthy food choices and

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[2] Ogden C, Flegal K, Carroll M and Johnson C. "Prevalence and Trends in Overweight Among US Children and Adolescents, 1999–2000." *Journal of the American Medical Association*, 288(14): 1728—1732, October 2002.

[3] Ogden C, Carroll M and Flegal K. "High Body Mass Index for Age Among US Children and Adolescents, 2003–2006." *Journal of the American Medical Association*, 299(20): 2401–2405, May 2008.)

4 Finkelstein E, Trogdon J, Cohen J and Dietz W. "Annual Medical Spending Attributable to Obesity: Payer-and-Service-Specific Estimates." *Health Affairs*, 28 (5): w822-w831. Published online July 2009.

opportunities for regular physical activity. Americans are fighting an uphill battle to maintain a healthy weight, eat healthy and be active because so many factors in our environment are working against us. It is hard to eat healthy when the most prevalent options are fast-food restaurants and convenience stores. And if you don't have access to safe parks, playgrounds and sidewalks, it's hard to be active. Where we live and work and go to school matters and affects what people eat and how active they are.

I'd like to examine three environments with the Subcommittee today—community – community, school and child care—and would like to work with all of you to implement common- sense solutions so all of our children can grow up in a healthy environment.

The Community Environment

It is important to examine the overarching community and neighborhood environment from both a food access and physical activity point of view.

Research shows that better access to supermarkets is related to having a healthier diet. For example, one study found that with each additional neighborhood supermarket there was a 32 percent greater likelihood of eating five or more daily fruit and vegetable servings. Conversely, other studies have shown that youth who have greater access to convenience stores consume fewer fruits and vegetables.[5] And we know there is great inequality in access to different types of food stores according to income, race, ethnicity and urbanization.

All of this is important because findings from studies examining relationships between access to food stores and obesity suggest that greater access to supermarkets may be related to a reduced risk for obesity. At the same time, greater access to convenience stores may be related to an increased risk for obesity. There is movement across many states to offer incentives to attract full-service supermarkets back into lower- income, rural and urban areas, an initiative recently backed by the Institute of Medicine.[6] Other opportunities to improve food access include improving the availability and accessibility of farmers' markets, establishing mobile stores and providing shuttle services so residents can access supermarkets.

And while I know my fellow panelist, Dr. Reid Ewing will speak to the physical environment, I would be remiss if I didn't at least touch on it as the characteristics of neighborhoods and community can influence children's daily activity levels. As mentioned earlier, children across the country do not get enough physical activity.. The Institute of Medicine recently released its *Local Government Actions to Prevent Childhood Obesity* report, a report I was proud to be a part of, and highlighted the

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[5] Morland K, Wing S, Diez-Roux A. "The contextual effect of the local food 27. environment on residents' diets: the Atherosclerosis Risk in Communities Study." *American Journal of Public Health*, 92(11): 1761–1767, November 2002.

[6] IOM (Institute of Medicine). 2009. Local Government Actions to Prevent Childhood Obesity. Washington, DC: The National Academies Press

following promising strategies for changing and improving physical activity environments:

- Plan, build and maintain a network of sidewalks and street crossings that connects to schools, parks and other destinations, and create a safe and comfortable walking environment;
- Adopt community policing strategies that improve safety and security of streets and park use, especially in higher-crime neighborhoods;
- Collaborate with schools to implement a Safe Routes to Schools program;
- Build and maintain parks and playgrounds that are safe and attractive for playing, and in close proximity to residential areas;

  Collaborate with school districts and other organizations to establish agreements that would allow playing fields, playgrounds, and recreation centers to be used by community residents when schools are closed (joint-use agreements); and

- Institute regulatory policies mandating minimum play space, physical equipment and duration of play in preschool, afterschool and child-care programs.

The School Environment

Schools play an important role in shaping the dietary and physical activity behaviors of our children. Overweight and obese children tend to miss more school, which may affect academic performance. In addition, strong evidence links healthy nutrition and physical activity behaviors with improved academic performance and classroom behavior. Yet, recent research shows that our school environments aren't as healthy as they could be. School districts across the country that are part of the National School Lunch Program are mandated to have a local school wellness policy addressing nutrition and physical activity. The most comprehensive review of these wellness policies to date tells us the following about the school environment:[7]

- While most students nationwide are enrolled in a school district with a wellness policy on the books, these policies are weak, failing to provide our children with the healthy foods and physical activity they need to learn and grow,

- In most cases, school districts required strong nutritional guidelines for school meals, but imposed weaker restrictions on what is sold in *à la carte* lines, vending machines and school stores, meaning most kids may have access to junk food and soda throughout the school day.

- Additionally, the majority of students were enrolled in a district with a policy that did not address integrating nutrition education into core subjects.

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[7] Chriqui JF, Schneider L, Chaloupka FJ, Ide K and Pugach O. Local Wellness Policies: Assessing School District Strategies for Improving Children's Health. School Years 2006-07 and 2007-08. Chicago, IL: Bridging the Gap Program, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago, 2009.

- In addition, while more than 30 percent of students were enrolled in a school district that required physical activity outside of physical education, the majority of policies did not require physical activity breaks throughout the day.

- It is important to note, that although national recommendations are that children should engage in 60 minutes of moderate activity most day s of the week, estimates show that only 3.8 percent of elementary schools provide daily physical activity.

- Further, only 18 percent of elementary-school students were enrolled in a district with a strong policy that required daily recess.

While improvements have been made in the school food environment especially in the area of ensuring school meals meet the minimum U.S. Department of Agriculture (USDA) school meal standards, we need to ensure that these standards are updated. For example, standards pertaining to competitive foods, foods and beverages sold outside of the reimbursable school meal programs, still need substantial improvements. High-calorie, low-nutrition foods are still widely available in many schools, especially middle and high schools – in vending machines, cafeterias and fundraisers. Junk food has no place in schools. The USDA nutrition standards for all foods sold outside of the school meal program need to be updated. The school environment needs to promote the health of our children.

The Child Care Environment

It is a similar story in our child-care facilities. Most children in this country are in child care. It is estimated that there are about 100,000 childcare centers and 200,000 family day care homes across the country. The majority of infants and children up to age 5 spend an average of 29 hours per week in some form of child-care setting.[8] And more than half of young people ages 5 to 14 years also spend time in a regular child-care setting.[9] And we know that the obesity problem starts at an early age with 24.4 percent of children ages 2 to 5 already obese or overweight.[10] The early childhood years are an important period for developing healthy brains, healthy food preferences and motor skills.

As many of you know, there are many types of child-care arrangements, but the federal government does play a role in this area. The USDA and designated state agencies administer the Child and Adult Care Food Program (CACFP), which provides meals and snacks to nearly 2.1 million children in center-based care and almost 900,000 children in family child-care homes. Yet, beyond the CACFP meal pattern requirements, which are not consistent with the Dietary Guidelines for Americans, there are no federal regulations

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8 Iruka I, Carver P. Initial results from the 2005 NHES Early Childhood Program Participation Survey (NCES 2006–075). Washington, DC: U.S. Department of Education. National Center for Education Statistics; 2006.

9 Johnson J. Who's minding the kids? Child care arrangements: Winter 2002. Washington, DC: Current Population Reports, P70–101. U.S. Census Bureau; 2005.

10 Ogden C, Carroll M and Flegal K. "High Body Mass Index for Age Among US Children and Adolescents, 2003–2006." *Journal of the American Medical Association,* 299(20): 2401–2405, May 2008

for nutrition or physical activity that govern child-care facilities. This means that the types of food and beverages our children are served and the amount, frequency or type of physical activities they are provided vary widely across states. Recent studies have shown that children who attend such child-care centers may not be offered the recommended share of certain key nutrients that are essential for healthy brain development, including iron, zinc and magnesium. For example, one study showed that foods consumed during child care generally supplied 50 percent to 67 percent of children's requirements for energy and nutrients, with the exceptions of niacin, iron and zinc.[11] Other studies have shown that preschool children may not be meeting national recommendations for physical activity. For example, one study showed that preschoolers averaged 7.7 minutes of moderate-to-vigorous physical activity per hour of attendance.[12] Child-care policies and practices can greatly influence physical activity levels.

It is my hope that more attention will be paid to these child-care settings in the future, as all our children need a healthy start in life. The Institute of Medicine is in the process of updating the nutrition standards for the CACFP meal patterns – this is a start. But more needs to be done to encourage states to adopt strong policies and practices that promote a healthy child-care environment for this critical population.

Recommendations and Closing:
We are here today because we all believe we need to change the environments in which we live. Sometimes, it takes new public policies to make sustainable and lasting change happen—like when states work to improve the quantity and quality of physical education in schools; school boards ban junk food in school vending machines; transportation planners integrate bicycle lanes and walking paths into road construction projects; and cities offer incentives to build new supermarkets in underserved areas.

As Congress and the Administration work to address obesity and the health of children in general, I would recommend a highly coordinated strategy across all agencies, with the goal of ensuring health is part of all policies. This means that government needs to integrate health into all areas of public policy development—with a particular focus on areas outside of health that affect our well being—things like housing, education, employment and the economy. The goal is to recognize the value of a healthy public—not only on an individual basis, but to the country as a whole in terms of economic success and global competition. For example, we know that healthy children learn better and are more attentive in school, therefore the adoption of a health in policies strategy related to education moves the ball forward in ensuring our students are successful, and provides them with the resources they need to be fit and healthy. At the very least, I would recommend coordinating childhood obesity prevention efforts across the U.S. Department of Health and Human Services, Department of Agriculture, the Department of Transportation, Environmental Protection Agency, the Department of Education, the

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11 Briley M, Jastrow S, Vickers J, Roberts-Gray C. Dietary intake at child-care centers and away: Are parents and care providers working as partners or at cross-purposes? *Journal of the American Dietetic Association.* 1999;1999(99):950–954

12 Pate R, Pfeiffer K, Trost S, Ziegler P, Dowda M. Physical activity among children attending preschools. *Pediatrics.* 2004;114:1258–1263.

Department of Interior, the Department of Housing and Urban Development and the National Institutes of Health.

Whether we are looking at transportation policies, climate change legislation, child nutrition programs, how to spend stimulus money in communities, and of course—health reform, approaching these decisions with a focus on the impact these policies and programs will have on health—especially children's health, will be an important step in addressing the short and long-term health issues across the country.

November 5, 2009

Question from Senator James M. Inhofe: *"You urge coordination among various federal agencies, including EPA, to address childhood obesity. Given that the oversight of the EPW Committee only reaches to EPA for purposes of this discussion, absent federal land use regulations, are there other ways you believe that EPA could constructively impact obesity rates in kids?"*

Dear Senator Inhofe,

Thank you for your question regarding what the Environmental Protection Agency can do help address the rising obesity rates among children. Here are a few thoughts for you to consider.

First, on the EPA web site, EPA encourages consumers, as part of its "Pick 5 for the Environment" initiative, to "commute without polluting". In fact, this is listed as #2 out of 10 ways to help the environment. This is what is listed as Number 2: " Commute without polluting! Use public transportation, carpool, walk, or bike whenever possible to reduce air pollution and save on fuel costs. Learn more about commuting wisely".

This is a great recommendation as the research shows that using public transportation, or walking and biking to and from work, school, or around the neighborhood, is linked to lower obesity rates. Given that EPA lists this on their site, it would be helpful to know what specific efforts the agency is taking to help Americans, and especially children, walk and bike more, and how they are monitoring progress in this area. Also encouraging and supporting walking to school programs would have the co-benefits of helping the environment and increasing physical activity to reduce child obesity.

Second, EPA does work with other federal agencies and departments, like the Department of Transportation, and as part of "transportation conformity", helps ensure that federal funding and approval for highway and transit projects are consistent with air quality goals established by states. There may be some opportunities to encourage states and localities, especially with recent stimulus funds, to build and strengthen green spaces, parks, and trails.

Third, EPA has provided funding recently for the development of urban food cooperatives, encouraging sustainable food practices. The agency can be should be encouraged to continue these efforts and could also be encouraged to study such efforts to determine their impact not just on environmental factors, but perhaps on food intake.

Fourth, EPA encourages consumers to drink tap water. Research shows that soda intake is linked to obesity. EPA could also encourage consumers to drink more water as a substitute for other higher calorie options as part of its messaging about the safety and "environmental friendliness" of tap water.

I am happy to address any questions or provide further information.

Mary Story PhD
Professor, School of Public Health
University of Minnesota
Minneapolis Minnesota

Phone: 612.626-8801; email: story@umn.edu

Senator KLOBUCHAR. Thank you very much.
Dr. Ewing.

STATEMENT OF REID EWING, PROFESSOR, DEPARTMENT OF CITY AND METROPOLITAN PLANNING, UNIVERSITY OF UTAH

Mr. EWING. Thank you, Madam Chairman.

I am going to deviate from my written testimony pretty substantially.

Senator KLOBUCHAR. We always like surprises here.

[Laughter.]

Mr. EWING. OK. Well, I don't know how surprising it will be, but rather than talking about evidence-based research, which was the centerpiece of my written testimony, I am going to briefly mention that and then go on to things Congress can do to solve the problem.

Senator KLOBUCHAR. That is good.

Mr. EWING. So the evidence linking the built environment, the design of communities, to public health is pretty compelling. One of the most heavily researched subjects in my field, urban planning, is the effect of the D variables, density and diversity of land uses and design of streets, the effect of that on people's travel choices. And that literature is pretty hard to criticize. It is strong.

There is some literature as well, although less, that says that these compact walkable communities increase people's overall levels of physical activity, including walking and other forms of physical activity. And there is even some literature, and this is the weakest of the three, that says that people living in these walkable communities tend to weigh less than comparable individuals living in suburban sprawl. That is literature that only goes back about 5 or 6 years, but studies have been pretty consistent in finding that.

So we now know with some certainty that there is a link between the way we design our urban areas and the health of adults. There is a little less literature on children, but one can extrapolate, I think, with some assurance.

So my own work, I have looked at children's decision to walk to school and found that it is very much related to the distance. It argues for neighborhood schools, as opposed to large schools drawing from much larger areas. I have also found that sidewalks on the major roads leading to school will increase the likelihood of children actually walking, rather than being driven.

I guess I did the first study linking obesity to urban sprawl, obesity in children, and found that children living in compact walkable areas are less likely to be obese than those living in, again, a sprawling suburb. So that is the evidence.

Now, what to do about the problem? You have a number of bills already introduced. One would continue funding of the Safe Routes to School Program. It is S. 1156. It was introduced by Senators Harkin, Burr, Sanders, Merkley and Collins, I believe. And it would continue a program that began in 2005 to provide moneys for sidewalk improvements, for bikeways, for traffic calming along access roads to school. So that is before you and certainly worth considering.

A second piece of legislation, Senate Bill 584, is called the Complete Streets Act of 2009. All federally funded roads, were this to

pass, would be required to accommodate all users, not just motor vehicles, but pedestrians and transit users and bicyclists as well. Oregon has been doing this since 1971, and it is one of the reasons why they have such great bike facilities and such great pedestrian facilities.

The third bill is probably the most sweeping. It is related to climate, and your committee will have partial jurisdiction over it. It was introduced by Senators Carper and Specter, and it is called the Clean Low Emissions Affordable Transportation Act of 2009. Ten percent of the funds from the auctioning of carbon emissions allowances would go into a pot, and that pot would fund low emission transportation improvements like bikeways and sidewalks.

In addition, States and large metropolitan areas would be required for the first time to develop transportation greenhouse gas reduction plans as part of their long range transportation planning. And smaller metropolitan planning organizations could qualify for those funds if they chose to prepare plans.

So these three pieces of legislation would all lead to the kinds of infrastructure improvements that might make our society more active and children in particular.

Thank you very much.

[The prepared statement of Mr. Ewing follows:]

THE UNIVERSITY OF UTAH

Department of City & Metropolitan Planning
375 S 1530 E RM 235 AAC Salt Lake City, Utah 84112-0370 (801) 581-8255 FAX (801) 581-8217

Testimony of Professor Reid Ewing before the Subcommittee on Children's Health, Senate Committee on Environment and Public Works, Tuesday, September 29, 2009

Madam Chairman and Subcommittee Members

I am Reid Ewing, a professor of City and Metropolitan Planning at the University of Utah. Thanks for the opportunity to appear before the Subcommittee. I can only speak to the issue of children's health from the limited perspective of urban planning. But from that perspective, I will tell you what is known from the research literature.

The most heavily researched subject in urban planning is the relationship between community design and people's travel choices. From dozens of studies, I can say with assurance that people living in compact urban areas walk more than those living in suburban sprawl. The key variables are density of population, diversity of land uses, and design of streets, the so-called 3Ds. From about 20 studies, I can say with some assurance that people living in compact urban areas are less likely to be overweight than comparable individuals (same age, ethnicity, education, income, etc.) living in suburban sprawl. The literature strongly suggests that community design and development patterns make a difference when it comes to travel, physical activity, and obesity.

Having made these declarative statements, I need to provide some caveats. First, the vast majority of studies conducted to date relate to adults, not children. Second, the few studies that have looked at overall physical activity suggest that people living in suburban sprawl can compensate for the lack of walking by engaging in other physical activity. Third, while development patterns are correlated with physical activity, the nature of most study designs prevents us from making strong cause-effect statements. It is possible, in particular, that some of that strong relationship between community design and walking is due to something referred to as self-selection, where people who want to be physical active chose to live in walkable neighborhoods as opposed to the neighborhoods changing the behavior of people.

Now to my own studies. I have researched children's likelihood of walking or bicycling to school. I have done this in three very different metropolitan areas: Gainesville, Houston, and Portland. In the Gainesville study, the two most important factors in the decision to walk to school were living close to school and having sidewalks on the major streets. In Houston, distance to school was significant, as was population density. In Portland, distance to school was significant, as was presence of sidewalks. These results argue for neighborhood schools (smaller schools drawing from nearby neighborhoods) and for safe-route-sidewalk improvements.

I have also studied childhood obesity (risk of being overweight) and found that, as with adults, after controlling for income and other differences, children living in sprawling suburbs are more likely to be overweight than those living in compact cities. This argues for the three Ds, higher population density, greater diversity of land uses, and pedestrian-friendly urban design, meaning short blocks, relatively narrow streets, buildings close to the street, sidewalks, street trees, and the like.

Thanks for the opportunity to speak today, and I would be happy to answer any questions you may have.

Reid Ewing
Professor of City and Metropolitan Planning
University of Utah

Relationship Between Urban Sprawl and Weight of United States Youth

Reid Ewing, PhD, Ross C. Brownson, PhD, David Berrigan, PhD

Background: Among United States youth there is an obesity epidemic with potential life-long health implications. To date, relationships between the built environment and body mass index (BMI) have not been evaluated for youth, and have not been evaluated longitudinally.

Objectives: To determine if urban sprawl is associated with BMI for U.S. youth.

Methods: Using data from the 1997 National Longitudinal Survey of Youth (NLSY97), both cross-sectional and longitudinal analyses were conducted. Hierarchical modeling was used to relate characteristics of individuals, households, and places to BMI. Individual and household data were extracted from the NLSY97. The independent variable of interest was the county sprawl index, which was derived with principal components analyses from census and other data.

Results: In a cross-sectional analysis, the likelihood of U.S. adolescents (aged 12–17 years) being overweight or at risk of overweight (≥85th percentile relative to the Centers for Disease Control growth charts) was associated with county sprawl (p=0.022). In another cross-sectional analysis, after controlling for sociodemographic and behavioral covariates, the likelihood of young adults (aged 18–23 years) being obese was also associated with county sprawl (p=0.048). By contrast, in longitudinal analyses, BMI growth curves for individual youth over the 7 years of NLSY97, and BMI changes for individual youth who moved between counties, were not related to county sprawl (although coefficient signs were as expected).

Conclusions: Cross-sectional analyses suggest that urban form is associated with being overweight among U.S. youth. The strength of these relationships proved comparable to those previously reported for adults. Longitudinal analyses show no such relationship. It is unclear why these approaches give different results, but sample sizes, latent effects, and confounders may contribute.

(Am J Prev Med 2006;31(6):464–474)

Introduction

In the United States, the prevalence of overweight and obesity has been steadily rising for all age, gender, race, and education subgroups.[1–9] Over the past 3 decades, obesity has more than doubled for preschool children aged 2–5 years and adolescents aged 12–19 years, and has more than tripled for children aged 6–11 years.[5]

As in adults, obesity in children causes hypertension, dyslipidemia, chronic inflammation, increased blood clotting, endothelial dysfunction, and hyperinsulinemia.[10] Children who are obese have greater prevalence of type 2 diabetes, sleep apnea with daytime somnolence that makes learning difficult, asthma, hypertension, orthopedic problems, and gall bladder disease.[11] About 41% of obese children and 80% of obese teens will become obese adults.[12]

To address the obesity epidemic and its health consequences, there is growing interest in built environments that encourage physical activity. The first studies reporting a direct relationship between the built environment and obesity were published in 2003.[13–16] After controlling for age, education, fruit and vegetable consumption, and other sociodemographic and behavioral covariates, Ewing et al.[13] found that adults living in sprawling counties had higher body mass indices (BMIs) and were more likely to be obese (BMI ≥30) than were their counterparts living in compact counties. Independent studies have since generally confirmed these original findings.[17–25] Specifically, all macrolevel (county or larger) studies, and all but one

From the National Center for Smart Growth Education and Research, University of Maryland (Ewing), College Park, Maryland; Department of Community Health and Prevention Research Center, Saint Louis University School of Public Health (Brownson), St. Louis, Missouri; and Applied Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute (Berrigan), Bethesda, Maryland

Address correspondence and reprint requests to: Reid Ewing, PhD, University of Maryland, ARCH-Center for Smart Growth Research & Education, 1112 Preinkert Field House, College Park MD 20742. E-mail: rewing1@umd.edu.

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microlevel (neighborhood) studies, have found significant relationships, in the expected direction, between sprawl-like development patterns and BMI, after controlling for sociodemographic and other influences.

All of the above studies focused on adults and relied on cross-sectional data. Less is known about the built environment–obesity relationship for youth. There are many fewer studies, data are highly localized, and results are mixed. For low-income preschoolers in Cincinnati, overweight was not associated with proximity to playgrounds and fast food restaurants, nor was it associated with the level of neighborhood crime.[26] For San Diego adolescents, no significant relationship was found between BMI percentile and community design variables.[27] On the other hand, Australian youth were more likely to be overweight or obese where neighborhood traffic was perceived to be heavy or road safety was a concern to parents.[28]

Nearly all evidence of association between the physical environment and physical activity is based on cross-sectional data.[29] The documented relationship between walking and the built environment could as well be due to individuals who want to be physically active selecting walkable environments (self-selection), as due to walkable environments causing individuals to become more physically active than they would be otherwise (environmental determinism).[30]

In the planning literature, the possibility of self-selection has been addressed in various ways,[31–44] including the use of longitudinal data to study changes in travel behavior following moves between more- and less-accessible places.[45] Recently, Plantigna and Bernell[46] modeled residential choice and obesity jointly. Using the Ewing et al.[13] sprawl index, they confirmed the finding of direct association between sprawl and BMI in adults. However, they concluded that the direction of causality was the reverse of that posited in the original paper, specifically that individuals with higher BMIs were choosing to live in high-sprawl counties rather than high-sprawl counties raising the BMIs of average individuals.

The present study extends research on sprawl and obesity to American youth and conducts the first longitudinal analyses of the built environment and BMI change in an attempt to control for self-selection.

Methods

This research began in 2005 and continued into 2006, as a seventh year of longitudinal data became available from the National Longitudinal Survey of Youth 1997 (NLSY97). Initially, cross-sectional relationships were analyzed for a sample of American adolescents in a single year: 1997. The likelihood of being overweight or at risk of being overweight was related to the degree of sprawl in the adolescent's county of residence. Then, for the same cohort 5 years later, when all had grown up, the likelihood of being obese was related to the degree of sprawl in the young adult's county of residence.

Table 1. Sample sizes (n) by year for NLSY97 Rounds 1–6 (1997–2003)

Year	Sample size (n)
1997	8984
1998	8386
1999	8209
2000	8081
2001	7883
2002	7898
2003	7756

Two longitudinal analyses were conducted to follow up on positive findings in the cross-sectional analyses. In the first longitudinal analysis, BMI growth curves were related to the degree of sprawl for individual youth who remained in the same county for the entire series. Growth curves, characterized by intercepts and slopes, varied from individual to individual in predictable ways. In the second longitudinal analysis, BMI changes for individual youth moving between counties were related to differences in the degree of sprawl between new and old counties, again controlling for other influences.

The influence of self-selection was minimized in three ways: (1) **through the use of youth data,** assuming that the choice of residential location is the parents' and a youth's attitudes toward physical activity are not factored into the choice; (2) **through the use of built environmental data at the county level,** assuming that even if a household's choice of neighborhood is based on a desire for physical activity, the choice of county or region is based on other considerations such as job access and housing costs; and (3) **through the use of longitudinal data,** assuming that a youth's attitudes toward physical activity do not change overnight, and hence, any change in activity level following a move is due to the change in residential environment.

National Longitudinal Survey of Youth

Subjects in this study were youth surveyed as part of NLSY97. Although the focus of these surveys is on employment, extensive data are collected on other matters, including health, making this longitudinal survey suitable for the purposes of this study. For details on survey design, see the NLSY97 User's Guide.[47]

The original NLSY97 cohort consisted of 8984 American adolescents. Later rounds have followed these individuals into young adulthood, with some attrition along the way (Table 1). In the original cohort, the 8984 respondents came from 6811 unique households. One thousand eight hundred sixty-two households included more than one NLSY97 respondent.

Through a licensing system, NLSY97 geocode files were acquired by the authors. These files include the county of residence for each respondent in each survey year, which makes it possible to link individual records to place-level variables.

Only members of the NLSY97 cohort living in metropolitan areas were included in the analysis. Urban sprawl is a metropol-

Table 2. Variable definitions and sample statistics (in parentheses) for the initial cohort of 8984 respondents[a]

Individual variables		
BMI (each round)	Body mass index (continuous)	21.9 kg/m^2 (mean)
Age (each round)	Age in years as of interview date to nearest month (continuous)	14.9 years (mean)
Gender	Male (dichotomous)	51.2% (male)
Race/ethnicity	White non-Hispanic, black non-Hispanic, Hispanic, other race (categoric)	26.0% (black non-Hispanic) 21.2% (Hispanic) 3.5% (other race)
Smoker (each round)	Smoked one or more cigarettes per day in last 30 days (dichotomous)	9.0% (smoker)
Cigarettes (each round)	Number cigarettes smoked in last 30 days (continuous)	21.7 cigarettes (mean)
Work (each round)	Total hours worked at employee-type jobs during the year (continuous)	42.2 hours (mean)
Education (each round)	Highest grade completed (continuous)	7.7 years (mean)
TV watching (1997 and 2002)	Total hours watched per week (continuous—midpoint of ranges for 2002)	18.9 hours (mean)
Exercise (2002)	Days per week exercising for 30 minutes or more (continuous)	2.6 (mean for 2002 cohort)
Fruit and vegetable consumption (2002)	Times per week consuming fruits or vegetables (continuous—midpoint of ranges)	10.5 (mean for 2002 cohort)
Household variables		
Gross Household Income (1997)	Less than $25,000, $25,000–$49,999, $50,000–$74,999, $75,000 or more, income missing (categoric)	22.8% ($25,000–$49,999) 14.0% ($50,000–$74,999) 12.7% ($75,000 or more) 30.4% (income missing)
Parents' highest grade (1997)	Less than high school, high school graduate, some college, college graduate (categoric)	31.5% (high school) 24.7% (some college) 24.1% (college)
Place variables		
County sprawl (2000)	Sprawl index for county of residence (continuous)	116.2 (mean)
Crime rate (2000)	FBI crime rate per 100,000 people (continuous)	4809 crimes (mean)
Heating degree days (1971–2000)	Average annual heating degree days, relative to a base temperature of 65°F	4088 degree days (mean)
Cooling degree days (1971–2000)	Average annual cooling degree days, relative to a base temperature of 65°F	1415 degree days (mean)

[a]For exact wording of NLSY97 questions, go to www.bls.gov/nls/quex/y97qucxcbks.htm. Statistics apply to the combined sample of 8984 initial respondents: a cross-sectional sample representative of the U.S. population and a supplemental sample of black or Hispanic youths. Minorities were oversampled to permit analysis across race or ethnicity. Sample weights permit comparisons between the full NLSY97 sample and the national population in the same age range.

itan phenomenon, involving cities and their suburbs; low-density rural areas may produce very different relationships between the built environment, physical activity, and obesity.[48,49]

Individual- and Household-Level Variables

Body mass index (kg/m^2) was computed from self-reported height and weight. For adolescents, the Centers for Disease Control and Prevention (CDC)'s revised U.S. growth charts and software (available at www.cdc.gov/growthcharts) were used to determine BMI percentiles relative to age and gender reference groups. All adolescents at or above the 85th percentile were assigned to the overweight or at risk of overweight category.

Previous studies have shown that obesity prevalence depends on many sociodemographic and behavioral covariates.[1–9,50–55] Accordingly, the following individual variables were extracted from NLSY97: gender, race/ethnicity, age, cigarette use, hours worked, and highest grade completed by the youth respondent (Table 2). The reference groups for discrete variables were females, white non-Hispanics, and nonsmokers (less than one cigarette per day).

Household variables were extracted as well: household income and the highest grade attained by a household member (who was nearly always a parent) (Table 2). The reference groups were households with annual incomes of less than $25,000 and households with highest grade attained of less than a high school degree; 2108 households either did not report income or reported unrealistically low incomes (<$5000 per year). To keep from losing so many observations and still retain a variable viewed as critical to understanding

youth obesity (household income), an income-missing category was created.

For youth, obesity prevalence is related to TV watching.[56,57] To control for this effect, and explore a possible causal pathway through which sprawl may affect weight, hours of TV watched each week were also extracted from NLSY97. In the first round (1997), NLSY97 asked only a subsample of respondents about hours of TV watched (primarily those aged 12–14 years). In the sixth round (2002), all respondents were asked about TV watching.

Two key determinants of BMI are exercise and diet. The first round of NLSY97 included questions on exercise ("In a typical week, how many days do you engage in exercise that lasts 30 minutes or more?") and diet ("In a typical week, how many days do you eat at least some green vegetables or fruit?). Unfortunately, these questions were asked only of respondents aged 13 years. In the sixth round, similar questions were asked of the entire remaining cohort (Table 2). Hence, exercise and diet could be included in the models, but only for a single round in a cross-sectional analysis.

Place-Level Variables

The same county sprawl index was used to model the built environment in this study as in the original study of adult obesity. It is a composite of six variables related to residential density and street accessibility, combined through principal components analysis.[13] The sprawl indices of Ewing et al.[13] have been validated in obesity and other research.[17,20,25,46,58–60]

The index was computed for additional counties or county equivalents to have sprawl data for more NLSY97 respondents. The 954 counties or county equivalents in the expanded sample represent the vast majority of counties lying within U.S. metropolitan areas, as defined by the U.S. Census Bureau in December 2003. (A total of 1135 counties and independent cities lie within metropolitan statistical areas, as such areas were defined in December 2003. By combining independent cities and counties whose land areas were merged in the Natural Resources Inventory [NRI], and dropping counties that did not meet density and area thresholds [tract areas <0.001 square miles and tract densities <100 persons/sq mi], this study ended up with sprawl measures for 954 counties and independent cities. Alaska counties, Puerto Rican municipios, the District of Columbia, and some independent cities in Virginia were excluded for lack of NRI data.) In 2000, almost 82% of the U.S. population lived in metropolitan counties for which county sprawl indices are now available.

The more compact the development in the county, the higher the value of the county sprawl index. Scores range from a high of 352 to a low of 55. At the most compact end of the scale are four New York City boroughs, San Francisco County, Philadelphia County, and Suffolk County (Boston). At the most sprawling end of the scale are outlying counties of metropolitan areas in the Southeast and Midwest United States. The county sprawl index is skewed. Few counties in the United States approach the densities of New York or San Francisco. (A list of counties and their sprawl scores is available on request from the corresponding author.)

A few built environment and health studies have included additional place-based variables representing safety or climate.[20,22,26,60] In a second-generation study of sprawl and obesity like this one, it was deemed necessary to control for both types of variables. Suburban counties have lower crime rates than urban counties, an effect potentially absorbed by the sprawl index in the absence of controls. Sprawling sunbelt counties have hotter climates than the rest of the country, another effect potentially soaked up by the sprawl index.

The Federal Bureau of Investigation crime rate per 100,000 population in 2000 was the chosen measure of crime. The rate includes both violent and property crimes.[61] Average annual heating-degree days and cooling-degree days for the period 1971 to 2000, relative to a base temperature of 65°F, were the chosen measures of climate. Heating- and cooling-degree days were averaged across weather stations in each county that has them (805 counties in this sample have from 1 to 20 stations). For counties without weather stations, values came from the closest county with stations.[62]

Hierarchical Modeling

Hierarchical (multilevel) models were estimated with HLM 6 (Hierarchical Linear and Nonlinear Modeling) software.[63] A hierarchical approach was required to account for dependence among observations, individuals, and households. This dependence violates the independence assumption of ordinary least squares (OLS) regression. Standard errors of OLS regression coefficients will be underestimated, and OLS coefficient and standard error estimates will be inefficient. Hierarchical modeling overcomes these limitations, accounting for the dependence among cases and producing more accurate estimates. Within a hierarchical model, each level in the data structure (e.g., repeated observations within individuals, individuals within households, and households within counties) is formally represented by its own submodel. The submodels are statistically linked.

In this study, hierarchical linear models were estimated for the continuous outcome (BMI), while hierarchical nonlinear models were estimated for dichotomous outcomes (being overweight or at risk of being overweight, or being obese). In some models, only the intercepts were allowed to randomly vary across higher level units, while all of the regression coefficients were treated as fixed. These are referred to as "random intercept" models. In other models, regression coefficients were allowed to randomly vary across higher level units as well, and interactions between individual, household, and place characteristics were captured. These are called random coefficient models.

First Cross-Sectional Analysis

The first cross-sectional analysis used Round-1 (1997) data because: (1) the sample was largest in the first round of NLSY97; (2) all subjects were adolescents; and (3) additional data were collected in a supplemental survey of parents, including their household incomes. The first round was the only round in which parents were interviewed. Excluding missing values and extreme outliers, BMI data were available for 8531 (95%) of the first-round respondents. (Respondents whose BMIs, based on reported weight and height, were <10 or >60 were dropped from the sample.) Of these, 6760 respondents (75% of the total cohort) lived in counties for which sprawl indices were available.

In this cross-sectional analysis, the odds of being overweight or at risk of overweight were regressed on individual characteristics in Level-1 models. The intercepts and coefficients of Level-1 models were regressed on household characteristics in Level-2 models. Initially, the intercepts and coefficients of Level-2 models were regressed on the county sprawl index, crime rate, and degree days in Level-3 models. When crime and climatic variables proved insignificant in all combinations and depleted the sample of counties, these were dropped from the Level-3 models.

All models included random effects. The sample was weighted using cross-sectional weights for Round 1. Cross-level interactions among individual, household, and place characteristics were seldom significant, and never sufficiently large to affect the relationship between county sprawl and a respondent's likelihood of being overweight or at risk of overweight. So the final cross-sectional models were of the random intercept form.

Second Cross-Sectional Analysis

The second cross-sectional analysis used Round-6 (2002) data because this was the first round to ask **all** respondents about physical activity, diet, and TV watching. BMI data were available for 7240 cohort members (81%) in the sixth round. (Respondents whose BMIs, based on reported weight and height, were <10 or >60 were dropped from the sample.) Of these, 5815 respondents (65% of the total cohort) lived in counties for which sprawl indices were available.

Whereas all youth respondents from the same households lived together in 1997, by 2002, respondents had grown up, and many were living in separate households. This required the use of a different hierarchical model structure than in the first cross-sectional analysis. Rather than individuals being treated as nested within households and households as nested within counties, individuals had to be independently identified with counties of residence. The best model structure that could be devised was two level, with the odds of being obese regressed on individual characteristics in Level-1 models, and intercepts and coefficients of Level-1 models regressed on county sprawl, crime, and climatic variables in Level-2 models. Again, crime and climatic variables proved insignificant in all combinations, and were dropped. All models included random effects. The sample was weighted using cross-sectional weights for the sixth round (2002).

The use of obesity as an outcome measure was prompted by the earlier study of sprawl and obesity in adults, where sprawl proved most strongly related to the dichotomous outcome, obese/nonobese.[15] All respondents had reached age 18 by 2002, and hence could be categorized by the adult standard of obesity (BMI ≥30). Age was included as a covariate to capture the natural increase in BMI with age.

First Longitudinal Analysis

The first longitudinal analysis used data for all NLSY97 rounds currently available, from 1997 through 2003. Growth curves were estimated for respondents who lived in the same county throughout the survey. BMI data were available for 6677 cohort members (74%) who participated in all seven rounds. (Respondents whose BMIs, based on reported weight and height, were <10 or >60 were dropped from the sample for the round in question.) Of these, 3667 (41% of the total cohort) remained in the same county for all rounds surveyed, and that county was one for which a sprawl index is available.

In the Level-1 models, BMIs of individual youth were modeled in terms of age, age-squared, cigarette use, and hours worked.[64] A quadratic specification was chosen based on plots of median BMI versus age. The intercepts and coefficients of Level-1 models were regressed on fixed individual and household characteristics in Level-2 models. The intercepts and coefficients of Level-2 models were regressed on county sprawl, crime, and climatic variables in Level-3 models. Crime and climatic variables were dropped when they proved insignificant. All models included random effects. The sample was weighted using panel weights for the entire seven rounds.

The use of BMI as an outcome measure was prompted by the mixed sample of adolescents and young adults in this longitudinal database. Overweight is assessed differently for children and adults; it is based on population characteristics for children (BMI percentiles relative to a reference population) and on health risks for adults (fixed BMI cut off points). CDC growth charts are available only up to age 240 months. For the most recent round (2003), less than 20% of the original NLSY97 cohort was still in this age range. Even for children, there may be some advantage in measuring changes in weight (as opposed to absolute weight levels) in terms of BMI rather than age-referenced BMI.[65]

Individual and household characteristics could not be represented in separate models because HLM 6.0 is limited to three levels, and place characteristics occupied Level 3. Given the restriction to three levels, the combination of individual and household characteristics in a single model was viewed as least damaging to the assumption of independence among observations (because most individuals in the data set came from different households).

Second Longitudinal Analysis

The models estimated in the second longitudinal analysis were repeated-measures models, because many individuals moved more than once.[63] The data were drawn from all consecutive rounds of NLSY97 from 1997 through 2003. BMI data were available for 3567 intercounty movers. (Respondents whose BMIs, based on reported weight and height, <10 or >60 in either round were dropped from the sample.) On average, about 8% of respondents moved between counties in any given round. The great majority (2427 or 68%) moved between metropolitan counties for which sprawl indices are available. Slightly more than half of these moved from less sprawling to more sprawling counties, while an almost equal number moved in the opposite direction.

In the second longitudinal analysis, Level-1 models related BMI of individual youth, after an intercounty move, to his/her BMI before the move plus various changes in status between rounds. In Level-2 models, the intercepts and coefficients of Level-1 models were regressed on individual characteristics that remained fixed over the course of the longitudinal survey, specifically gender and race/ethnicity. In Level-3 models, intercepts and coefficients of Level-2 models were regressed on baseline (1997) household characteristics. All models included random effects. The sample was

Table 3. Cross-sectional relationship between adolescent overweight or risk of overweight, socioeconomic and behavioral characteristics, and county sprawl index, 1997

	Overweight/risk of overweight (base model)			Overweight/risk of overweight (with TV watching)		
	Coeff	*t*	*p*	Coeff	*t*	*p*
Age	−0.0427	−1.50	0.13	−0.0149	−0.32	0.75
Male	0.500	7.07	<0.001	0.482	5.34	<0.001
Black non-Hispanic	0.431	4.42	<0.001	0.452	3.52	0.001
Hispanic	0.137	0.69	0.49	0.341	1.51	0.13
Other race	0.194	1.27	0.21	0.342	1.72	0.09
Smoker	−0.0042	−0.03	0.97	0.258	1.29	0.20
Hours worked	0.00096	0.35	0.73	0.00060	1.26	0.21
Hours TV watching	—	—	—	0.0130	4.50	<0.001
Income $25–$50k	−0.125	−1.08	0.28	−0.080	−0.49	0.62
Income $50–$75k	−0.240	−1.37	0.17	−0.230	−1.05	0.30
Income ≥ $75k	−0.431	−2.96	0.004	−0.422	−2.06	0.04
Income missing	−0.261	−2.54	0.011	−0.359	−2.45	0.015
High school grad	−0.0182	−0.16	0.88	−0.0120	−0.08	0.94
Some college	−0.136	−1.08	0.28	−0.0838	−0.56	0.57
College grad	−0.411	−3.77	<0.001	−0.325	−2.60	0.010
County sprawl index[a]	−0.0030	−2.30	0.022	−0.0045	−2.47	0.014

[a]Higher values of the index correspond to more compact development, lower values to more sprawling development.

weighted using custom weights for respondents in the sample of movers.

It is common to use "lagged endogenous" variables as predictors in economic and planning research. BMI before the move was included as a Level-1 predictor to capture a host of factors that determine a person's BMI at a given age—some known and measurable, but most unknown and immeasurable. Change in age of respondents between rounds was included because more time between interviews translates into more time for weight gains. The time between intervals of NLSY97 was surprisingly variable for an annual survey (from 1 to 27 months). Changes in hours worked and household size were included to control for other lifestyle changes that might have accompanied moves. The change in built environment was represented by the difference in the degree of sprawl between new and old counties of residence. For movers to more compact counties, the difference was positive; for movers to more sprawling counties, the difference was negative.

Results

First Cross-Sectional Analysis

In this cross-sectional analysis, the odds of being overweight or at risk of being overweight were higher for males than females, higher for blacks than whites, lower for adolescents with college-educated parents, lower for adolescents from high-income households (≥$75,000 per year), and lower for adolescents from households with missing income data (Table 3). This last finding may be due to the concentration of nonrespondents at the tails of the income distribution.[66] Unit nonresponse (household refusal to participate in surveys) tends to be highest among low-income households. Item nonresponse (household refusal to answer specific income questions) may be highest among high-income households.

Controlling for individual and household characteristics, the county sprawl index was related to overweight or risk of overweight in the expected direction at a significant level (t=−2.30, p=0.022). Because higher values of the index correspond to more compact development, a negative coefficient was expected. The odds of being overweight or at risk of overweight in a more sprawling county, one standard deviation below the mean county index, were 1.16 times the odds in a more compact county, one standard deviation above the mean index (95% confidence interval=1.02–1.31). Comparing the extremes, an adolescent living in Jackson County KS, the most sprawling county, had 2.41 times the odds of being overweight or at risk of overweight compared to an otherwise comparable youth living in Manhattan (New York County), the most compact county.

In a second model estimation, TV watching was added as an individual covariate. TV watching had the expected relationship (+) to being overweight or at risk of overweight (t=4.50, p<0.001). Despite a smaller sample, county sprawl was more significant with the TV variable in the model (t=−2.47, p=0.014). Adolescents in compact areas watch slightly more TV than those in sprawling areas. It may be that they have more time for TV in compact areas because they spend less time in travel. The county sprawl index soaks up some of the effect of TV watching when the former alone is included as a covariate.

Crime and climatic variables were also tested. Coefficients and significance levels for various combinations of place-level variables are presented in Table 4. In combination with county sprawl and individual and household characteristics, these variables failed to explain any variance in overweight/risk of overweight,

Table 4. Cross-sectional relationship between adolescent overweight or risk of overweight, county sprawl index, and other place-level variables, 1997 (controlling for socioeconomic and behavioral characteristics)

	Overweight/risk of overweight (base model)			Overweight/risk of overweight (with crime rate)			Overweight/risk of overweight (with crime rate and heating degree days)			Overweight/risk of overweight (with crime rate and cooling degree days)		
	Coeff	*t*	*p*	Coeff	*t*	*p*	Coeff	*t*	*p*	Coeff	*t*	*p*
County sprawl index[a]	−0.00262	−1.97	0.049	−0.00295	−2.13	0.034	−0.00289	−2.10	0.037	−0.00278	−1.99	0.047
Crime rate	—	—	—	0.000018	0.89	0.38	0.000016	0.82	0.41	0.000013	0.61	0.54
Heating degree days	—	—	—	—	—	—	−0.000007	−0.29	0.77	—	—	—
Cooling degree days	—	—	—	—	—	—	—	—	—	0.000029	0.51	0.61

[a]Higher values of the index correspond to more compact development, lower values to more sprawling development.

and because they cut into sample size due to missing county data, they were dropped from the final model. Differences in coefficients and significance levels of the county sprawl index between Tables 3 and 4 are due to the use of different county samples and loss of degrees of freedom.

Second Cross-Sectional Analysis

In the second cross-sectional analysis, involving young adults, the odds of being obese increased with age, decreased with highest grade completed, was higher for blacks than whites, and higher for Hispanics than non-Hispanics (Table 5). When added to the model, the number of times respondents exercised per week proved highly significant with the expected sign (−). The number of hours of TV watching also proved highly significant with the expected sign (+). The number of times per week eating fruits or vegetables had the expected sign (−) but was not significant. Cigarette smoking likewise had the expected sign (−) but was not significant.

The association between the county sprawl index and obesity was statistically significant after controlling for exercise, diet, and TV watching. It was not significant without these variables. The difference is due to the fact that young adults living in compact counties tended to exercise a little less, and watch a little more TV, than those living in sprawling counties, effects soaked up by the sprawl index when these variables were omitted from the model. After accounting for all covariates, a young adult living in Jackson County KS, had 2.18 times the odds of being obese compared to an otherwise comparable youth living in Manhattan (New York County).

Again, crime and climatic variables were not significant in combination with county sprawl and individual characteristics.

Table 5. Cross-sectional relationship between young adult obesity, socioeconomic and behavioral characteristics, and county sprawl index, 2002

	Obesity (base model)			Obesity (with exercise, fruit/vegetable consumption, and TV watching)		
	Coeff	*t*	*p*	Coeff	*t*	*p*
Age	0.182	5.75	<0.001	0.165	5.20	<0.001
Male	0.0041	0.05	0.96	0.0406	0.50	0.62
Black non-Hispanic	0.527	5.18	<0.001	0.407	3.91	<0.001
Hispanic	0.419	3.94	<0.001	0.373	3.51	0.001
Other race	0.305	1.49	0.14	0.285	1.37	0.17
Cigarettes	−0.00014	−0.76	0.45	−0.00031	−1.61	0.11
Hours worked	0.000073	1.61	0.11	0.000090	1.98	0.047
Highest grade completed	−0.133	−4.85	<0.001	−0.104	−3.71	<0.001
Times exercise	—	—	—	−0.0577	−3.11	0.002
Times eat fruits or vegetables	—	—	—	−0.00590	−1.24	0.22
Hours TV watching	—	—	—	0.0213	5.44	<0.001
County sprawl index[a]	−0.0022	−1.57	0.12	−0.0026	−1.98	0.048

[a]Higher values of the index correspond to more compact development, lower values to more sprawling development.

First Longitudinal Analysis

In the first longitudinal analysis, BMI increased with age through adolescence and young adulthood, but at a declining rate of increase (Table 6). The coefficients of age and age-squared were positive and negative, respectively, and highly significant. As expected from much past research, BMI fell with increasing cigarette consumption.

As for other individual and household characteristics, this longitudinal analysis generally confirmed the results of earlier cross-sectional analyses. BMI at the mean age was higher for males than females, higher for blacks than whites, higher for Hispanics than non-Hispanics, lower for youth from higher-income households (≥$50,000 per year), and lower for youth from households with missing income data.

Cross-level interactions were significant for two Level-2 variables. The regression coefficient of age was positively related to the male and Hispanic variables, meaning that during their adolescent years, males gained weight faster than females and Hispanics gained weight faster than non-Hispanics. Only significant interaction terms were retained in the final model.

There is one important way in which the results of the cross-sectional analyses were not confirmed. Controlling for other predictors, neither BMI at the mean age nor BMI growth with age was related to county sprawl, although both had the expected signs. The discrepancy in the results was not due to different outcome variables used in the longitudinal and cross-sectional analyses, because the outcome variable BMI was tested with the first cross-sectional database and was as strongly related to sprawl (after controlling for age and gender) as the outcome actually modeled, being overweight or at risk of overweight.

Table 6. Longitudinal relationship between BMI growth for individual youth, socioeconomic and behavioral characteristics, and county sprawl index, 1997–2003

		BMI	
	Coeff	*t*	*p*
Age			
Base	1.053	11.24	<0.001
Male	0.0429	2.24	0.025
Hispanic	0.0925	3.25	0.002
County sprawl index	–0.00014	–0.37	0.71
Age^2	–0.0144	–5.39	<0.001
Cigarettes	–0.0010	–6.99	<0.001
Hours worked	–0.00008	–2.67	0.008
Male	0.742	4.32	<0.001
Black non-Hispanic	1.130	4.23	<0.001
Hispanic	0.755	2.72	0.007
Other race	0.536	1.52	0.13
Income $25–$50k	–0.459	–1.59	0.11
Income $50–$75k	–0.749	–2.24	0.025
Income ≥$75k	–0.845	–2.69	0.008
Income missing	–0.926	–3.64	0.001
High school grad	0.352	1.19	0.24
Some college	0.225	0.76	0.45
College grad	–0.377	–1.32	0.19
County sprawl index[a]	–0.00082	–0.28	0.78

[a]Higher values of the index correspond to more compact development, lower values to more sprawling development.

Table 7. Longitudinal relationship between BMI for movers before and after moves, change in sprawl index, other changes between rounds, and certain individual characteristics, 1997–2002

		BMI (after move)	
	Coeff	*t*	*p*
BMI (before move)	0.917	51.6	<0.001
Change age	0.638	3.03	0.003
Change cigarettes	–0.00023	–0.62	0.54
Change work hours	–0.00008	–1.00	0.32
Change in household size	0.0110	0.37	0.71
Male	0.164	1.55	0.12
Hispanic	0.224	1.58	0.11
Change in county sprawl index[a]	–0.00022	–0.16	0.88

[a]Higher values of the index correspond to more compact development, lower values to more sprawling development.
BMI, body mass index.

Second Longitudinal Analysis

In the second longitudinal analysis, a youth's BMI after a move was most strongly associated with his or her BMI before the move (Table 7). This was expected. BMI after a move was also significantly associated with changes in age between rounds (time between interviews). This was also expected, because longer periods between interviews left more time for weight gains. Change in number of cigarettes smoked had the expected sign (–), because smoking tends to depress weight, but its coefficient was not significant.

Fixed individual and household characteristics had the expected signs but proved to be marginal predictors of BMI, both directly and through interactions with Level-1 covariates. Thus, only two covariates weakly related to BMI were retained in the Level-2 submodel, those being the male and Hispanic variables. These two groups tend to gain weight faster than others. No covariate was retained in the Level-3 submodel, leaving only unique random effects for each household at Level 3.

Controlling for other predictors, the difference in degree of sprawl between counties had the expected sign in the Level-1 equation (–) but was not even close to statistically significant. Recall that a positive value of this variable corresponds to move to a more compact county. The lack of significance of this and other variables that proved significant in cross-sectional analyses may be due to the relatively small sample of movers, and also to the fact that year-to-year changes in BMI are small for individuals (SD=0.59), whereas

differences in BMI are large across individuals at any given point in time (SD=4.36 in the first cross-sectional sample).

Discussion

The growing interest in policy and environmental effects on youth health is indicated by the new focus on these issues in scientific journals as well as new initiatives of governmental and nongovernmental organizations such as CDC (Kids Walk-to-School Campaign); National Institutes of Health (Ways to Enhance Children's Activity & Nutrition Campaign); and Robert Wood Johnson Foundation (Childhood Obesity Initiative). Although there is a consistent and voluminous literature showing a relationship between the built environment and physical activity, the role of the built environment in the obesity epidemic has only recently been studied. Further, the literature to date has focused on adult obesity and has been strictly cross sectional, with all the limitations that this implies.

In cross-sectional analyses, after controlling for sociodemographic and behavioral covariates, adolescents living in sprawling counties were more likely to be overweight or at risk of overweight than those living in compact counties. Likewise, young adults living in sprawling counties were more likely to be obese.

Accounting for TV watching and exercise, relationships between sprawl and overweight or obesity grew stronger. Young adults living in compact counties tend to exercise a little less, and watch a little more TV, than those living in sprawling counties. Presumably, the former compensate by being more active in their routine daily activities. Although not classified as formal "exercise," they may walk to lunch rather than drive, walk up stairs in a multistory environment, or take public transportation to work that requires a walk at one or both ends.

The relationship between sprawl and overweight for U.S. youth actually proved stronger than that between sprawl and obesity for adults in the original study by Ewing et al.[13] (as measured by model coefficients, and hence, odds ratios: the coefficient of sprawl was 0.0030 for adolescents, 0.0026 for young adults, and 0.0021 for older adults). Significance levels were lower in this study only because the sample of individuals, and hence the sample of counties represented within the sample, was smaller in this study than in the original study.

In contrast to the cross-sectional analyses, longitudinal analyses showed little or no association between sprawl and weight gain among youth. The most that can be said is that the county sprawl index had the expected sign (–) in both longitudinal analyses.

It is unclear why these approaches give such different results, but sample sizes, confounders, and latent effects may contribute. Cross-sectional analyses examine individuals who are already overweight/obese, whereas the focus in longitudinal analyses is on **changes** in overweight/obesity. Year-to-year changes in BMI are likely to be small, and it may take several years before environmental effects are fully felt.

This study was exploratory. The built environment was measured at the county level, which is a large area compared to the living environments of most youth.[67] The availability and quality of parks, bike trails, and other physical activity settings were not modeled.[68] Objective measures of physical activity and diet were not available.[69] Self-reported measures of obesity were used, which vary in validity across population subgroups.[70] Residential preferences were not modeled, which leaves in doubt the direction of any causal relationship between sprawl and obesity. Due to the small number of studies in the literature and inconsistent findings, it would be premature to conclude that urban sprawl either does or does not cause obesity in any population cohort.

In conclusion, this study raises important questions regarding the potential effects of the built environment on the risk of obesity in youth. Given the enormous public health and economic consequences of childhood obesity, there is a pressing need for follow-up research that overcomes the aforementioned limitations.

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Benenson Distinguished Lecture

Donald A. Henderson, MD, MPH, will be the honored guest speaker for the inaugural Benenson Distinguished Lecture, to be held on April 13, 2007, in conjunction with the 25th anniversary of the San Diego State University Graduate School of Public Health.

Honoring Abram S. Benenson, MD, for his years of service to the world, for his work in the areas of public health, military medicine, and "shoe-leather" epidemiology, the lecture series will be an annual event at the GSPH.

Check the SDSU GSPH website at http://publichealth.sdsu.edu/eventsmain.php for details of the 25th anniversary celebration events and the specific time for the Benenson Distinguished Lecture.

School Location and Student Travel

Analysis of Factors Affecting Mode Choice

Reid Ewing, William Schroeer, and William Greene

This study is the first to examine the relationship between mode of travel to school and the full range of factors that might affect mode choice. With data from Gainesville, Florida, a multinomial logit model was estimated to explain school mode choice for a sample of K–12 students. Students with shorter walk or bike times to school proved significantly more likely to walk or bike. If confirmed through subsequent research, this finding argues for neighborhood schools serving nearby residential areas. Students traveling through areas with sidewalks on main roads were also more likely to walk. If confirmed, this finding argues for "safe routes to school" sidewalk improvements. As noteworthy as the significant factors are those that did not prove significant. School enrollment was not significant after controlling for travel time between home and school. Larger schools may draw students from larger areas and thereby indirectly affect mode choices. But school size does not appear to have a direct effect on mode choices. Land use variables such as density and mix also were not significant. The travel behavior literature emphasizes the importance of such variables in travel decision making. Apparently, school trips are different. They tend to be unlinked to other activities, and thus reduce the need for proximity to other land uses. They are mandatory; thus the walking environment may be less important than it is with discretionary travel. And school trips involve children, who may be less sensitive to walking conditions than are their adult counterparts.

According to the recently released 2001 National Household Travel Survey (NHTS), fewer than 15% of students between the ages of 5 and 15 walked to or from school, and a mere 1% biked (*1*). In 1969, at the time of the first Nationwide Personal Transportation Survey (predecessor to NHTS), 48% of students walked or biked to school (*2*, derived from table on p. 9 that applies to students in elementary and intermediate grades, the closest counterparts to the 5 to 15 age range reported for 2001). A survey by the Centers for Disease Control and Prevention (CDC) found that even children living close to school were not walking or biking in large numbers; only 31% of children ages 5 to 15 who lived within a mile of school walked or biked (*3*). In 1969, the comparable figure was close to 90% (*2*, derived from table on p. 9 that applies to students in elementary and intermediate grades, the closest counterparts to the 5 to 15 age range reported for 2001).

Why the decline in walking and biking to school? In the CDC survey, parents cited long distances as a primary barrier to their children walking or biking to school. Schools have been increasing in size and drawing students from ever-larger areas. Between 1940 and 1990, the total number of elementary and secondary public schools fell by 69% despite a 70% increase in the U.S. population (*4*). School campuses have been increasing in size as well, partly because of minimum acreage requirements adopted by state and local school authorities. So-called mega schools are typically placed in outlying areas, where large sites are available and land prices are low (*5–14*). This means relatively few students live within comfortable walking or biking distance of these schools, which may account for much of the decline in walk and bike mode shares.

Yet, as already noted, even short school trips are now made primarily by automobile, indicating that other factors are at work. A poor walking environment has been linked to automobile dependence in the general population and would be expected to discourage walking and biking to school. "Poor walking environment" means a built environment of low densities, little mixing of land uses, long blocks, incomplete sidewalks, and other hallmarks of sprawl (*15–17*).

This study is the first to examine the relationship between mode of travel to school and the full range of factors that might affect mode choice.

FACTORS INFLUENCING SCHOOL MODE CHOICE

A literature search uncovered four previous studies relating mode choice on the journey to school to built environmental factors. They collectively suggest that children are more likely to walk or bike to small schools in walkable neighborhoods than to large schools in remote locations. The percentage of students walking to school was found to be four times higher for schools built before 1983 than for those built later (an average of 16% walk to older schools versus 4% to newer schools) (*5*). School age is not a very good proxy for the whole range of factors that distinguish small schools in walkable neighborhoods from mega schools in remote areas, so results of this study must be considered suggestive instead of definitive.

A study of fifth-grade students at 34 California public elementary schools showed that walking and biking rates were associated with neighborhood population density (positively) and school size (negatively), this after controlling for the percentage of students on public welfare and the percentage of ethnic minorities (*18*). The number of intersections per street mile, a measure of walkability, was related to walking and biking rates in simple pairwise correlations but not in multiple regression models with other variables. The use of aggregate travel data is a serious limitation of this study.

A study of school mode choice in California found that walking and biking to school were more likely when a household lived within

R. Ewing, National Center for Smart Growth, Preinkert Field House, University of Maryland, College Park, MD 20742. W. Schroeer, ICF Consulting, 241 Cleveland Avenue South, Number 18, St. Paul, MN 55105. W. Greene, Kaufman Management Center, New York University, 44 West Fourth Street, Room 7-78, New York, NY 10012-1126.

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a mile of the school (*19*). Walking and biking were less likely when a household had more licensed drivers to provide rides. These were the primary influences on school mode choice. Certain pedestrian-friendly design features had positive influences on walking and biking, such as the presence of street trees within a quarter mile of school; other features had negative influences, such as short blocks and mixed land uses. The limitation of the study to only six school sites meant there was little variance in built environmental conditions across survey respondents, and the significance of these variables accordingly was limited.

A British study found a significant relationship between mode choice and perceived distance from home to school, with the probability of traveling by automobile instead of by foot increasing from 20% at a 0.5-mi distance to 50% at 1.25 mi and 80% at 2 mi (*20*). Household automobile ownership and parent employment status were also significant determinants of school mode choice, as were parental attitudes about the natural environment and automobile culture. The absence of built environmental variables, and the use of perceived instead of actual distances to school, were limitations of this study.

MODEL SPECIFICATION AND STRUCTURE

Black et al. (*20*) speculated that the choice of travel mode for the school trip is an integral part of the household decision-making process. Whether an automobile is available at all depends on the household's decision about automobile ownership, which may be linked to residential location and employment decisions, which in turn may be linked to schooling decisions from the primary grades through high school. We could envision a complex joint-choice model in which school mode choice is determined simultaneously with residential location, parent employment status, and household automobile ownership levels. Estimation of such a model is beyond the scope (and data availability) of this study, as it was in Black et al.'s study (*20*). Instead, the simplifying assumption is made that residential location, employment, and automobile ownership decisions are exogenous to the choice of travel mode.

Fully Specified Models

Transportation modeling usually treats mode choice as an application of consumer choice theory, grounded in the notion that people choose among alternatives—be they means of getting to work or brands of ice cream—to maximize personal utility or net benefit to themselves. After deciding to go between points A and B, people weigh the comparative travel times, costs, and other attributes of competing modes. Traveler characteristics (e.g., income) also influence mode selection. These two attribute sets—characteristics of trip interchanges and characteristics of travelers—are used by transportation modelers to explain mode choices.

Travel behavior research by land-use analysts takes a different approach to the same subject. While the effects of income and other traveler characteristics are captured in much the same way as in travel modeling, the focus is not on trip interchanges but on trip ends—specifically, the characteristics of origins and destinations. Thus, those interested in how traditional neighborhood designs influence mode choices concentrate mainly on the densities, land-use mixes, and walking environments at the origin and destination ends of trips. Too often, how competing modes fare in terms of travel time and cost is ignored.

Model misspecification leads analysts to read too much or too little into estimated relationships (*21*). Statistically, the influences of omitted variables get soaked up by the modeled variables—which means transportation modelers end up overstating or understating the importance of travel time and cost, while land-use researchers end up misinterpreting the importance of the built environment.

In the case of school trips, the literature suggests that mode choice also may depend on school location (more or less accessible), school size, and grade level.

Alternative Model Structures

McFadden developed the multinomial logit (MNL) model to explain choices made among alternatives when attributes of the alternatives themselves, and attributes of decision makers, both influence outcomes (*22*). In the choice of travel mode for trips to school, the attributes of alternative modes such as travel time, and attributes of students and their households such as income, would be expected to influence choices (see Figure 1).

McFadden extended his discrete choice model to include situations in which certain alternatives share important, unobservable qualities. In these cases, the application of MNL violates one of the basic assumptions, called the independence of irrelevant alternatives, upon which the MNL is built. This leads to erroneous predictions of discrete choice probabilities.

A nested logit model structure overcomes the independence of the irrelevant alternatives problem. One nested structure tested in this study has an upper level nest with car and non-car modes as available choices, and the lower level nest with school bus, walk, and bike as available choices, conditioned on a non-car choice occurring at the higher level (as in Figure 2).

The mathematical form of the nested logit model is characterized by the appearance in the model of inclusive values in the probabili-

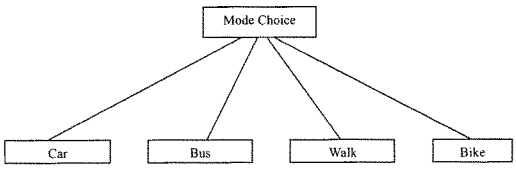


FIGURE 1 MNL structure of mode choice.

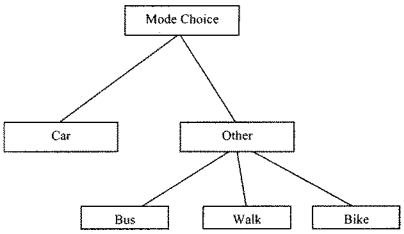


FIGURE 2 Nested logit structure of mode choice.

ties of the alternatives. For the nested logit model to be consistent with an underlying theory of utility maximization, the coefficients of the inclusive values must be between 0 and 1. The inclusive value coefficients for all nested structures tested in this study were in excess of 1.0, which argues for the MNL structure, especially in the absence of strong evidence of shared unobservables. Thus, the MNL model was chosen as the preferred specification in this study.

A well-specified multinomial model of school mode choice would take the form:

$$P_k = \exp(U_k) \Big/ \left[\sum_{l \in K} \exp(U_l)\right]$$

where P_k is the probability of choosing mode k for a school trip and U_k is the utility function for mode k defined as follows:

$$U_k = \alpha_k + \beta T_k^{ij} + \gamma SE^m + \theta SC^n + \delta BE^i + \omega BE^j + \epsilon_k$$

where

- α_k = vector of constants;
- T_k^{ij} and β = trip characteristics and corresponding parameter vectors for trips from i to j by mode k, including travel time;
- SE^m and γ = socioeconomic characteristics and corresponding parameter vectors for a student from household m, characteristics such as income and automobile ownership;
- SC^n and θ = school characteristics such as enrollment and corresponding parameter vectors for school n;
- BE^i and δ = built environmental characteristics and corresponding parameter vectors for origin i, with i being a neighborhood, census tract, traffic analysis zone (TAZ), or other small area (the vector may include measures of density, land use mix, walking quality, and site design);
- BE^j and ω = built environmental characteristics and corresponding parameter vectors for destination j; and
- ϵ_k = an extreme-value error vector specific to mode k.

Given the requisite data, a logit model can be estimated that assigns a probability to a student from household m, traveling between origin i and destination j, choosing mode k for the trip to school n. The MNL model will capture most of the variables that affect the utility, or benefit, of choosing a particular mode for the school trip in question.

DATA SOURCES AND VARIABLES

Gainesville, Florida, was chosen as the study area for two reasons: the availability of two regional travel diary surveys that, combined, offered a relatively large sample of trips to analyze; and the availability of many variables characterizing the built environment in Gainesville that could be used as independent variables in explaining mode choice.

Travel Data

Two travel diary surveys were conducted at about the same time in Alachua County, Florida, home of Gainesville and the University of Florida. The first was a survey during the first half of 2001 under the auspices of the Gainesville Metropolitan Transportation Planning Organization (MTPO). It was a standard travel survey, beginning with telephone interviews to screen and recruit households; followed by a mail-in travel survey with demographic questions and travel diaries; and concluding with inputting, geocoding, and editing survey responses.

A second survey was conducted in the last half of 2000 by the Florida Department of Transportation (FDOT). This survey involved a much larger sample than the first. It too involved a screener survey to recruit participants and a mail-in travel diary survey with demographic questions. There was sufficient overlap in study area and survey content to permit the two surveys to be combined, thereby yielding a larger sample of usable responses.

The following table summarizes sample data for the two surveys. A total of 15,980 trips were reported, from which school trips could be extracted and mode choices analyzed. In both surveys, the intention was to identify all K–12 school trips and only K–12 school trips. This task proved far more painstaking than expected. For details on how this was accomplished, see the full report upon which this paper is based (*23*).

	MTPO Survey	*FDOT Survey*
Households	374	1,766
Persons	726	3,089
Trips	3,073	12,907

Travel Time and Distance Data

Interzonal travel times were obtained from the Gainesville regional travel model, a conventional four-step travel demand model. The model generates travel time "skims," or minimum travel times from zone to zone, as inputs to trip distribution. Skims were available for all travel modes modeled in the four-step process, which in this case meant automobiles and transit. They were not available for walking or biking because these modes are not modeled in Gainesville.

To estimate walk and bike travel times between (and within) zones, minimum path distances were extracted from zone-to-zone highway skims and nominal speeds of travel were applied to each. Typical walking speed of children was assumed to be 3 mph, while typical biking speed was set at 12 mph.

School bus travel times could have been determined only with great effort. It would have been necessary to know the distance from home to pickup point, routing from pickup point to school, routing from school to drop-off point, and distance from drop-off point to home. It also would have been necessary to know the number of school bus stops along the way and, from that, average running speed

for each route. It is not even clear that the choice of school bus as a mode of travel is sensitive to travel time, given other considerations such as parental convenience and service availability.

This gave the following set of travel time variables:

- Estimated automobile drive time between zones by minimum path,
- Estimated walk time between zones by minimum path, and
- Estimated bike time between zones by minimum path.

One would assume that the longer the travel times by walking and biking relative to the automobile, the lower the utility of these modes. As for school bus travel, one would assume that beyond the threshold distance from home to school, where bus service becomes available to students, the utility of school bus travel is independent of travel time. This hypothesis was not testable with the current data set, and a literature search uncovered no evidence one way or another on this point. This becomes an issue for future research.

Socioeconomic Data

As this study drew on two different surveys, only where equivalent questions were asked in both surveys could data be used. The FDOT survey, for example, asked about bicycle ownership, while the MTPO survey asked about rainfall on the date of travel. These variables could not be used to explain school mode choices for lack of complete data sets.

The following data overlapped between the two surveys:

- Number of household members,
- Number of household motor vehicles,
- Number of vehicles per household member,
- Annual household income, and
- Driver's license owned by student (1 if yes, 0 otherwise).

The number of vehicles per household member was the only measure of vehicle supply relative to demand available for both surveys. Vehicle availability would have been better represented by vehicles per driver or vehicles per driving age household member.

The utilities of walking, biking, and school bus riding were expected to decline with vehicle availability, possession of a driver's license, and perhaps with household income.

School Data

School enrollment data for public schools were obtained from the Alachua County School District. For private schools, it was necessary to contact schools individually. Schools were located by TAZ from their addresses with the help of MapQuest and a Gainesville TAZ map.

For FDOT survey respondents, matching school trips to specific schools proved tricky. Instead of the usual travel diary method of asking respondents for the addresses of destinations or closest cross streets and geocoding the results, this survey provided respondents with a generalized TAZ map of Alachua County and asked the respondents to identify the TAZs of origin and destination. For about half of all school trips, respondents chose TAZs with schools in them, and the match was obvious. For the other half of trips, the generalized nature of the map left respondents with only a generalized idea of where trips began and ended. They were often off by a TAZ or two from the closest school location. Matches were made in these cases based on closeness of the TAZ to the one reported by the respondent and based on the grade level of the respondent corresponding to the grade levels of the school.

For the MTPO survey, matching school trips to schools was pro forma, because respondents nearly always provided the names of places where trips started and ended. Schools were identified by name and were already located within known TAZs.

Two data elements were included in the data set: school enrollment level and high school (1 if yes, 0 otherwise).

The utility of walking and biking was expected to decline with enrollment, as schools would be drawing from larger areas. Whether this variable would be significant after controlling for travel time to and from school was anyone's guess. It is certainly possible that school size would have an additional negative effect on walking and biking due to, for example, the tendency for large schools to be placed on large sites with deep building setbacks and acres of parking hostile to pedestrians.

Built Environmental Data

The final set of variables related to the built environment around the school and home or other trip end. Many land use travel studies have represented the built environment in sophisticated, multidimensional ways (*4*). However, to the authors' knowledge, the Gainesville database characterizes the built environment more completely than any to date, quantifying more qualities of the built environment.

Data on the built environment were available from multiple sources. All variables were estimated for TAZs in the Gainesville metropolitan area. A subset of available variables was tested, those that held the most promise of explaining walk and bike trips.

From socioeconomic input data files for the Florida Standard Urban Transportation Model Structure (FSUTMS), Gainesville's conventional four-step model, came three data elements:

- Overall density = (residents + jobs)/area. This variable measures the overall density of a TAZ in terms of people either living or working within the TAZ. The use of a combined measure of density is desirable when the amount of land devoted to individual uses is unknown, as in Gainesville TAZs.
- Jobs–residents balance = $1 - [\text{abs}(\text{jobs} - c \times \text{residents})/(\text{jobs} + c \times \text{residents})]$. This variable measures the degree of land use balance between jobs and residents at the TAZ level, where abs is the absolute value of the expression in parentheses and c is the regional ratio of jobs to residents. Values of jobs–residents balance range from 0 when a TAZ has only jobs or residents, not both, to 1 when a TAZ has the same ratio of jobs to residents as the region as a whole. Values are intermediate when TAZs have both jobs and residents, but one predominates. This variable was also measured for commercial jobs alone.
- Job mix = $-[\text{commercial jobs} \times \ln(\text{commercial jobs}) + \text{industrial jobs} \times \ln(\text{industrial jobs}) + \text{service jobs} \times \ln(\text{service jobs})]/\ln(3)$. This variable measures the degree of land use mixing at the TAZ level; ln is the natural logarithm of the expression in parentheses. Values of job mix range from 0 when all jobs in a given TAZ are concentrated in one sector, to 1 when jobs are evenly divided among the three employment sectors represented in the FSUTMS database. The number 3 in the denominator is the number of different land uses. This functional form is commonly known as an entropy variable.

From the property appraiser's database (parcel layer in the county's geographic information system) came the following land use intensity variable for commercial properties: commercial floor area ratio (FAR) = commercial floor area/(43,560 × commercial land area). The constant 43,560 converts acres of land into square feet, which, when divided into square feet of floor area, yields a FAR. Only pedestrian-oriented commercial uses were included in the calculation—specifically, retail uses; finance, insurance, and real estate offices; general office buildings; and commercial lodging.

From the county's bicycle and pedestrian level-of-service database came the following data elements.

- Proportion of street miles with street trees,
- Proportion of street miles with bike lanes or paved shoulders,
- Proportion of street miles with sidewalks, and
- Average sidewalk width.

These variables were available only for arterial and collector streets. From the county's geographic information system came street density = centerline street miles per square mile. This variable measures street network density, including local streets as well as arterials and collectors.

Characterizing a TAZ's location within the larger region are regional accessibility indices. Conventional four-step models such as Gainesville's automatically generate regional accessibility indices as inputs to trip distribution. Regional accessibility indices, which appear as the denominator of a conventional gravity model, are computed by multiplying the number of trip attractions for each attracting zone by a friction factor inversely related to travel time from the trip-producing zone to the attracting zone, summed over all attracting zones. The more attractions nearby, the higher the accessibility index of a producing zone.

$$\text{accessibility}_{ip} = \sum_{j \in J} \text{attractions}_{jp} \times \text{friction factor}_{ijp}$$

where

$\text{accessibility}_{ip}$ = accessibility index of zone i for trip purpose p,
attractions_{jp} = number of trip attractions in zone j for the particular trip purpose, and
$\text{friction factor}_{ijp}$ = interzonal friction factor for trips from zone i to zone j, again, for said trip purpose.

Accessibility indices are available for five primary trip purposes in the Gainesville model, two of which are based on broad measures of trip attraction: accessibility index for home-based other trips (which includes school trips) and accessibility index for non-home-based trips.

Both accessibility indices were normalized on a scale of 0 to 1 by dividing absolute values by the highest value for the entire urbanized area.

From the land use travel literature, one would expect the utility of walking, and perhaps biking, to increase with virtually all built environmental variables defined in this section.

Data Summary

The original data set contained 819 K–12 school trips for which origin and destination TAZs were known. Three cases were lost for lack of travel mode data. Four cases were dropped because the mode of travel was transit bus, and another seven were dropped because the mode was "other." Samples were too small to model these mode choices separately. Two cases were missing school enrollment data. Eleven cases were missing household size or vehicle ownership data, resulting in undefined per capita vehicle ownership. These cases were dropped to maintain a full complement of independent variables for subsequent analysis.

The greatest loss of cases was due to unknown household income. As is often the case in travel surveys, household income went unreported by a large number of respondents. The sample size could have been maintained at 792 observations by excluding household income, but instead a smaller sample and more complete set of variables were used. From a theoretical perspective, household income was too important to be omitted from the mode choice analysis. From a practical standpoint, the independence of household income from other explanatory variables including vehicle ownership per capita ($r = 0.11$) meant that household income was bringing something unique to the analysis. Eighty-one cases had to be dropped for lack of income data, but only three cases were in the underrepresented categories of walking and biking.

Two additional cases were lost when walk and bike modes were removed from all choice sets in which estimated travel times by these modes exceeded 1 hour (see the next section for a discussion of restricted choice sets). In these two anomalous cases, the bike mode was chosen even though estimated interzonal travel time by bike exceeded 1 hour. In all other cases, when either walk or bike was chosen, estimated travel times by these modes were less than 1 hour.

Complete data sets, including all variables defined previously, were available for the remaining 709 school trips. The possibility that systematic bias had been introduced was checked for by dropping cases; comparing the mean values of variables contained in the original and reduced samples indicated no such bias.

The following table presents mode of travel for the final sample of school trips. Figure 3 presents the built environments of two Gainesville high schools with contrasting mode splits.

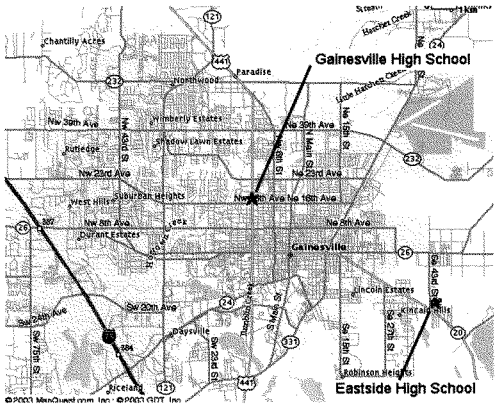
Mode	*Count*
Car	548
School bus	105
Walk	32
Bike	24
Total	709

MODEL ESTIMATION

All MNL and nested logit mode choice models were estimated with full information maximum likelihood and the LIMDEP/NLOGIT software. The universal choice set for the student population studied consisted of four travel modes: automobile, school bus, walking, and biking.

Individual Choice Sets

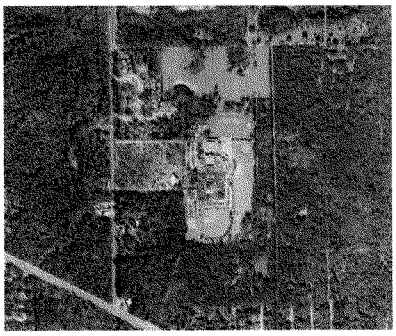
Practically speaking, certain modes were unavailable to certain students, and their choice sets had to be restricted. For school trips in this sample, estimated walk times ranged up to 488 minutes, while estimated bike times were as high as 122 minutes. No student could be expected to walk or bike this far. Therefore, a cutoff value of 60 minutes was established for travel times by these modes. Walk and bike modes were removed from the choice sets for trips having



(a)

Sampled Trips
Auto trips 38 (85%)
Walk trips 6 (13%)
Bike trips 1 (2%)
Average auto trip length: 4.24 miles

(b)



Sampled Trips
Auto trips 19 (100%)
Average auto trip length: 8.42 miles

(c)

This figure applies to students in elementary and intermediate grades, the closest counterparts to the 5–15 age range reported for 2001.

Where school bus, walk, and bike modes share unobservables, the inclusive value in a nested logit model is given by

$$I_{nonauto} = \sum \log(e^{U_{bus}} + e^{U_{walk}} + e^{U_{bike}})$$

Though weather conditions generally could have been determined for the FDOT date of travel from historical weather reports, they would not necessarily apply to a particular time and place of travel within the Gainesville area.

Only two bike trips exceeded the cutoff value and were lost to the sample. No walk trips exceeded the cutoff value and none were lost to the sample.

FIGURE 3 Sampled schools: (*a*) map, (*b*) Gainesville High School, and (*c*) Eastside High School (same scale).

walk and bike travel times in excess of the cutoff value. Hundreds of school trips in the sample were restricted to two or three modes. Yet, nearly all these trips were by automobile or school bus anyway, so removing walk and bike modes from the choice sets did not deplete the sample appreciably. The model was estimated with these choices eliminated from the available choice set for these individuals.

The opposite situation applied to school bus trips. To qualify for school bus service, students in the Alachua County School District generally must live 2 or more miles from school. Accordingly, the school bus mode was initially removed from the choice sets for school trips of less than 2 miles. However, this restriction was later lifted because of the large number of school bus trips lost to the sample. A review of the school district's policy indicated that exceptions to the minimum distance rule are made when a student faces hazardous walking conditions or qualifies for "courtesy" busing by virtue of living along a bus route and for various other reasons.

Variable Selection

The automobile was treated as the base mode. The utilities of other modes were modeled relative to the automobile. The automobile having been selected as the base mode, the next decision was whether to include estimated automobile time between zones as the sole variable in the automobile utility function, as is sometimes done in mode choice modeling, or alternatively to set automobile utility equal to zero and add variables to other equations to achieve a similar fit. No model raised the significance of automobile travel time to the conventional .05 level (although some came close). For this reason, and to simplify interpretation, automobile utility was zeroed out in the final model.

Travel time estimates were included in the utility functions of walk and bike modes. As there was no reason to assume that time spent walking and biking would have the same disutility, travel time coefficients were estimated independently for the walk and bike modes. Travel time was left out of the school bus utility function for lack of any credible estimate of travel time by that mode.

All plausible combinations of socioeconomic, school, and built environmental variables were tested as explanatory variables in the utility functions of the walk, bike, and school bus modes. Variables were retained only if they proved significant at the .05 probability level.

MODEL RESULTS

The best-fit model is presented in Tables 1 and 2. These tables present the same basic information in different forms. In Table 1, coefficient values and t-statistics indicate the effects of independent variables on mode choice probabilities. The convergence of the MNL model was found to be satisfactory. The log likelihood at convergence is −425, and the log likelihood with constants only in the utility function is −494. The pseudo-R^2 of the model is thus [1 − (−425/−494)] or 0.14 relative to the model with only constants.

In Table 2, the marginal effects of independent variables on mode choice probabilities are expressed as elasticities—that is, as percentage changes in probabilities associated with a 1% change in each independent variable. Elasticities are commonly used in travel research to summarize relationships between travel outcomes and explanatory variables. The values presented are point elasticities at the mean values of the independent variables.

Travel Time Influences

As expected, students with shorter walk and bike times to and from school are significantly more likely to walk and bike, respectively. The probability of biking is particularly sensitive to travel time; an elasticity value of −2.63 means students are averse to even small increases in travel time by bike. Perhaps this is because even small differences in travel time by bike represent large differences in distance traveled (relative to distance traveled on foot). The probability of walking is less sensitive to travel time but still is significantly affected by it. The elasticity value is −0.66.

TABLE 1 MNL Model Parameters for School Bus, Walk, and Bike Modes, with Automobile as Base Mode

Variable	Bus		Walk		Bike	
	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
Constant	-1.054	-6.44	2.385	2.40	-1.301	-3.87
Annual household income (in thousand dollars)			-0.0334	-3.33		
Per capita household auto ownership			-4.570	-3.61		
License ownership indicator (1 if the individual holds a drivers license, 0 otherwise)	-2.513	-4.23				
Walk time for the trip (minutes)			-0.0527	-3.98		
Bike time for the trip (in minutes)					-0.1504	-4.07
Average sidewalk coverage for origin and destination TAZs			1.480	2.09		
Average home-based other accessibilities for origin and destination TAZs	-1.130	-2.37				
Restricted log-likelihood						-982.9
Log-likelihood with constants only						-493.9
Log-likelihood at convergence						-425.4
pseudo-R^2						0.139
Number of observations						709

TABLE 2 Point Elasticity Estimates from MNL Model

Variable	Bus	Walk	Bike
Annual household income (in thousand dollars)		-0.84	
Per capita auto ownership for the household		-1.16	
License ownership indicator (1 if the individual holds a drivers license, 0 otherwise)	-0.91		
Walk time for the trip (in minutes)		-0.66	
Bike time for the trip (in minutes)			-2.63
Average sidewalk coverage for origin and destination TAZs		0.42	
Average home-based other accessibilities for origin and destination TAZs	-0.31		

Built Environmental Influences

Of the many built environmental variables, the proportion of arterials and collectors with sidewalks along them proved to have the most significant influence on walking. Values of sidewalk coverage for origin and destination zones are highly correlated for walk trips, precluding the use of both variables in the same utility function. Instead, values of sidewalk coverage for the origin and destination zones were averaged, and the average was then used as an explanatory variable. The probability of walking to school has an elasticity of 0.42 with respect to average sidewalk coverage.

Interestingly, the built environment did not have a significant effect on biking. Even the proportion of arterials and collectors with bike lanes or paved shoulders along them proved insignificant. The arterials and collectors with paved shoulders tend to be in less-developed areas, so this particular variable may not reflect the general bicycle-friendliness of the area.

One built environmental variable, regional accessibility for home-based other trips, proved related to school bus use. The more accessible the location, the less attractive the school bus relative to other modes, including the automobile. School buses may be serving as a mode of last resort for parents, chosen when parents cannot provide rides themselves because of excessive distances between home and school. As with sidewalk coverage, home-based other accessibilities are correlated for origin and destination zones and therefore were averaged to create a single variable that reflects conditions at both origin and destination. The probability of taking a school bus has an elasticity of −0.31 with respect to average regional accessibility.

Socioeconomic Influences

Students from households with higher incomes and more vehicles per capita are less likely to walk to school than to take a car, school bus, or bicycle. The probability of walking is most strongly related to vehicles per capita; its elasticity is −1.16. Less strongly related is household income, with an elasticity of −0.84. It is obvious why greater vehicle availability would make walking less attractive relative to car travel. It is less obvious why greater vehicle availability would make walking less attractive relative to other modes, or why higher income would have this effect independent of vehicle availability. These two variables individually and together may have a strong enough influence on mode choice to overwhelm other factors favoring walk trips, such as a short distance to and from school.

Students holding drivers' licenses are less likely to take a school bus than those without drivers' licenses. This makes perfect sense. Students living too far from school to walk or bike are prime candidates for school bus service until they reach driving age, at which time they become prime candidates for driving themselves if their families' financial situation permits it.

Omitted Variables

Notably absent from the utility functions of different modes are school variables. Enrollment did not prove significant after controlling for travel time between home and school. Larger schools may draw students from larger areas and thereby indirectly affect mode choices. But school size does not appear to have a direct effect on mode choices.

Also absent from the utility functions were land use variables such as density and mix. The travel behavior literature emphasizes the importance of such variables in travel decision making. Apparently school trips are different. They tend to be unlinked to other activities, thus reducing the need for proximity to other land uses. They are mandatory, which may render the walking environment less important than with discretionary travel. And they involve children, who may be less sensitive to walking conditions than are their adult counterparts.

DISCUSSION OF RESULTS

In this study, students with shorter walk and bike times to school proved significantly more likely to walk and bike. If confirmed through subsequent research, this finding argues for neighborhood schools serving nearby residential areas. Students traveling through areas with sidewalks on main roads were also more likely to walk. If confirmed, this finding argues for "safe routes to school" sidewalk improvements.

The findings are only partly consistent with earlier studies of school mode choice. Distance from home to school was found to be

significant in two previous studies, a result confirmed by this study. Elements of the built environment around a school were found to be significant in two previous studies, as in this study.

But which built environmental factors influence school mode choice remains an issue. Specifically, neighborhood population density proved important in one earlier study, street tree coverage in the vicinity of school was important in another study, and age of schools (presumably a proxy for traditional neighborhood design, which in turn is a proxy for higher density and finer land-use mix) was important in a third study. None of these variables proved significant in the present study. On the other hand, sidewalk coverage was significant in this study, a result that has not been confirmed.

The role of school size in mode choice also requires further study. Student enrollment proved significant in one earlier mode choice study, but not in this study. It is tempting to say this is because this study controlled for travel time to school, while the earlier study did not, but the school size variable proved insignificant in all model specifications. So whether school size has a direct effect on school mode choice, beyond its effect on travel time to school, remains an issue.

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Senator James M. Inhofe

1. You urge coordination among various federal agencies, including EPA, to address childhood obesity. Given that the oversight of the EPW Committee only reaches to EPA for purposes of this discussion, absent federal land use regulations, are there other ways you believe that EPA could constructively impact obesity rates in kids?

Response for Reid Ewing

Here is my response.

There are many things that EPA can do through its existing partnerships with other Federal agencies, state governments, and municipalities that are already working to build more walkable communities. For example, many local governments want to ensure that kids have safe walking routes to school and that redevelopment in their suburban downtowns or along their small town main streets efficiently accommodates all modes of travel including walking. This requires walking to be convenient and safe. The transportation and urban design professions have made considerable progress in developing new approaches, but local codes and design manuals have not always kept up. Grants and technical assistance to communities can be a critical catalyst to producing better street designs and more effective public investments that ensure people who want to walk for certain trips are able to do so. EPA provides this kind of technical assistance through its Smart Growth Implementation Assistance Program.

Senator KLOBUCHAR. Thank you very much, Dr. Ewing.

I think we will turn to Senator Merkley. I now know why he is such a bike rider, given Oregon's emphasis. I have seen him bike ride. We have gone bike riding together, but I will say that Senator Mark Warner put us to shame. His bike didn't have a basket on it, remember?

[Laughter.]

Senator KLOBUCHAR. But I will say that I have been out in Oregon myself. I know that they have amazing bike opportunities out there.

So, Senator Merkley.

Senator MERKLEY. I think it is Oregon in competition with Minnesota and the lake system.

Thank you very much for your testimony.

Dr. Story, you talked about several different factors. And I wanted to know if when changes have been made in the school setting whether follow up studies have shown any significant results? I believe that some schools have significantly changed the structure of their lunch offerings from high corn syrup frozen food to much healthier lunches. Others have removed junk food from vending machines. Others have eliminated specific choices such as soda drinks or candy bars.

Do we have any kind of follow up studies that show whether these changes at the school level make an impact?

Ms. STORY. Yes, we do. And we, through our Healthy Eating Research Program from the Robert Wood Johnson Foundation, we funded several of the studies that have really tried looking at evaluating district and States that have actually removed the junk foods from the schools. And they have shown that when you reduce the soft drinks in schools, kids don't make up. They don't just drink more away from school; that it really does reduce their caloric intake, and the same with other, you know, of the other unhealthier food. So removing those, changing the school environment really does help improve the overall caloric intake.

Some of the concerns that I have been hearing about lately is with the school wellness policies or schools that have policies to take out the foods from the vending machines and school stores. Some schools now are still having fundraisers, so that they are selling soft drinks and these really unhealthy foods during the school day at school events. So we really need to have much stronger policies in the schools.

And the school wellness policies, which was a mandate in the last Child Nutrition Reauthorization that said that every school district had to have a school wellness policy, those are not being implemented as planned. So we really have to strengthen the local school wellness policies to really be able to implement stronger nutrition standards.

Senator MERKLEY. I saw an article somewhere this past year that was related to activity in schools, and it had two features. One was that the increased activity was related to being a better fit with grade school children and their need to move around. And so they were actually replacing some sit-down desks with stand-up desks, and then providing more often kind of break times, maybe 5 minutes an hour where everybody stretches or has a little activ-

ity around the room. They were finding better academic results concentration, but also kids were burning more calories.

Is there research on that? This was an interesting article, but is there research yet on that type of changes in elementary schools as it might impact obesity or also impact academic performance?

Ms. STORY. There is much more research now. I don't know with taking the desks out of school, but just having——

Senator MERKLEY. Not the desk, but the chairs.

Ms. STORY. The chairs. But there is research from the University of Kansas that showed that just increasing the amount of recess that children get and physical activity is related to higher performance on, you know, academic performance and learning. And it makes sense. I mean, if you are sitting all day, kids can't learn. So there really is research now that really shows that link with physical activity.

And recess in many schools now has really been engineered out of the school day, or else we were just talking before this where it might be at the very end of the school day, a 20-minute recess which really makes no sense, but we have seen schools that have not had any recess.

Senator MERKLEY. Thank you.

And Dr. Ewing, thank you for your research on the community impact. This is something that Portland and other cities in Oregon have been paying a lot of attention to and trying to increase the likelihood that kids will walk to school, have safe routes so parents feel comfortable allowing them to do so, and certainly to ride bikes more.

Are there any kind of really new developments in this research?

Mr. EWING. Developments? Well, there is a lot of research. I guess the best development was the decision by the Robert Wood Johnson Foundation to start funding this kind of research, and it has led to a plethora of studies. There were no studies of the effect of community design, density of population and diversity of land use mixes prior to 2003, and now there are something like 20, many funded by the Foundation. So that is a big development.

Also, I could make available to your committee three literature reviews. I didn't write them, but became aware of them. And it is possible that your staff wouldn't be aware of them. They are good. They basically make the points we have been making up here.

Now, the side of the energy equation I am interested in is physical activity, and you (Ms. Story) are on the other side of that equation with diet and caloric intake. And we could probably both provide you with some very good literature reviews.

Senator MERKLEY. Thank you. I appreciate your testimony.

Mr. EWING. You are welcome.

Senator KLOBUCHAR. Thank you very much.

I think, Dr. Story, the thing I was most struck by in your testimony when you said 5 percent of elementary schools have physical education. Do you want to talk about that? Do you mean that they don't have recess, or they don't have gym time? Or are you bulking them together?

Ms. STORY. That is 5 percent, it is actually 3.8 percent of elementary schools that have daily physical education.

Senator KLOBUCHAR. So it is daily. Exactly. And I my daughter was at one school that was 90 percent free and reduced lunch, where the teachers did an incredible job trying to work hard and get these kids up to speed, but they didn't really have any place to go. And so I saw first-hand the difference when she went to a bigger school, a middle school where they had gym every single day.

And when they had health, which was about a third of the year, and that is when they stopped doing gym, they actually had them wear pedometers every day. And at the end of the day, she would be running in place in our little apartment in Virginia to try to get her steps in. And that is a vast difference in what I have seen at some schools everywhere in this country, where they say, well, you just have gym for a third of the year or a fourth of the year. And that is a real problem because then they are not getting that daily physical education that you are talking about.

So one thing that I wanted to ask about as well is that you were talking about the changing world here where families aren't getting nutritious food. And I know that because of economics, because of just time constraints, many of them, as you point out, are going to convenience stores or going to fast food places.

Could you talk about how this changing environment has influenced the health of our children?

Ms. STORY. Research has shown that, like in low income communities and in rural communities, there is less grocery stores. And even, as an example, in our home State, North Minneapolis, which is one of the poorest neighborhoods in Minneapolis, there are 68,000 residents and two grocery stores. One was just recently, they have an ALDI's and a Cub. Many other places, there is a grocery store in many suburbs, one for every 10,000 residents.

So in the last 10 years, grocery stores, large supermarkets have moved out of low income areas. And the research really has shown the last 2 years that if you are relying mainly on convenience stores, that you are more likely to be overweight, and bringing in a new grocery store or bringing a kind of full service grocery stores may be related to this reduction in obesity.

So many communities now are starting to look at ways to bring in healthy foods such as fruits and vegetables, which often are nonexistent in convenience and grocery stores. And we have seen families who have to get their food out of a gas station or drug store, where it is really expensive.

So that is where I think the environment is so critical. You can't tell people to eat healthy when they don't have access to healthy foods in their neighborhood.

Senator KLOBUCHAR. I would agree that there is a low income aspect of this that is very difficult. But also, I think that time constraints for all families with kids, because I can tell you I have bought a few meals in gas stations.

So my question is, one of the things we are looking at in the healthcare bill is putting at least calories, having them more accessible at restaurants and at fast food places. So at least you know, because as you know, a number of them offer some low calorie options. They are, and it is great, but people, you can't really tell how many calories are in each thing sometimes, and sometimes when

you ask, they give you this huge book and it is really embarrassing. Like you go, oh, could I see your calories? And I am sure you need that for background if you are looking for certain nutrients and things.

But what we are trying to work on is that there is some way to do it, just for at least the calories, to make it easier, and they do that at some chain restaurants already. But could you comment on that?

Ms. STORY. Right now, 50 percent of the food dollar, 50 percent of the food dollar is spent eating out in the United States. And much of it now, too, is the fast food restaurants. And for families that are really stretched for time, you know, the dollar menus, you know, it is just really appealing.

And so to have the calories labeled in the restaurants, and right now there are several, well, in Oregon or at least in Multnomah County, and Seattle, King County, Philadelphia, New York City, California, all have passed labeling laws for labeling calories.

In the healthcare reform, we are hoping that there will be the passage so that all chain restaurants, and this is restaurants with more than probably 15 restaurants, would be able to have the calories labeled. And it has been, we have really funded some research that really has shown that it really, people do choose less calories. People have no idea how much calories are in food. Even studies that they have done with registered dietitians and asking them to estimate the amount of calories in food, it is really hard to estimate.

It has only been since 1993 that we have had nutrition facts on the back of packages, and now it is really hard to imagine the time when you couldn't look on the back of a food package and really see the calories that were in that serving. And I think because 50 percent of the food dollar is spent eating out, we need to have the same kind of disclosure, the same information for consumers to make wise choices.

Senator KLOBUCHAR. OK, thank you very much. Just one last question for you. In your testimony, you talked about several agencies, HHS, EPA, Department of Agriculture, that currently are working to combat the child obesity issue. Do you think there is enough communication across these agencies?

Ms. STORY. No, I don't, and I think that a recommendation would be that the agencies really form an Obesity Task Force and really work together.

Senator KLOBUCHAR. Thank you. Now, I know you have a plane to catch, Dr. Story, and if you want to leave a little earlier, I am just going to have a few questions of Dr. Ewing. So I know you have to get back to Minnesota, which I know everyone would like to do right now. So thank you very much.

Ms. STORY. Thank you.

Senator KLOBUCHAR. Dr. Ewing, I was thinking of what you said about the accessibility of paths and walking paths, bike paths. For a while, when we moved out here, we were in an apartment in a very heavy density area, it will go unnamed, where literally you couldn't take a walk because there were so many lights and it wasn't timed in any way. And I couldn't believe the difference that made for our family taking walks, versus now we are renting a

house in a neighborhood, and it is easier to do. And there are sidewalks, and it is just easier to take walks or to go on a bike ride or something like that.

And so you talked about these ideas for legislation. Do you want to just talk about the history of this? Have there been improvements in this country? You know, you mentioned certain States that have done a better job of it. And are there links that we see between healthier families, lower obesity rates, and this kind of accessibility to paths for walking and bicycling?

Mr. EWING. I don't know of any work at that geography. Colorado has the fewest overweight adults, as it turns out, and they have for ever so long. And Mississippi, as I recall, has the most as a percentage of their adult population, the problem is there are so many confounding factors that would cause Colorado to have low rates of obesity in adults and Mississippi have high rates.

So most of the research we do at this point is at the scale of the individual. You will find a large number of individuals using a national data base, and we have weight and height information for them from which we can determine whether they are obese or not or what their body mass index is. And then we look at the area they live in, a small area, a quarter-mile around their house, or maybe the county they live in. And it is at that level that most of the research has been done simply because you can then say with greater certainty that one thing is causing another, that it is bike paths and sidewalks that are causing kids to walk to school, as my research showed.

So there are leading States. Oregon is incredible in all the things they have done. I mentioned them earlier in my testimony. I guess I am most impressed with the State of Oregon and the requirements that have been handed down to regional entities and metropolitan planning organizations there in Portland Metro.

They have not only pushed for bike paths and sidewalks, but they have also tried to keep blocks short, and short blocks are a very important determinant of walking. And they have tried to increase densities, and they have shops within walking distance of homes. And they have drawn an urban growth boundary around all of Portland, which has made all this happen.

So the model, and it is really very much in the climate bill I mentioned before, is California to a degree. Some of the planning they are doing now for climate change, and Oregon and Washington State is another leader.

Senator KLOBUCHAR. You know, one of the things I notice is that when kids have to walk, say, miles, in a mile zone, that makes a big difference. And if they are all walking, to me as a parent, it feels safer because you have a bunch of kids walking at the same time, but obviously that safety concern is always there.

I saw an article a few months ago about, it might have been in Europe, where they were basically doing a walking bus with elementary kids, which I think is actually cheaper to have someone who would have been the bus driver, who would have been driving the bus, who is maybe walking like 2 miles with these kids, and goes to the corner and they have to be there, and then they are walking this whole group, and suddenly you have 25 kids walking

together with someone in charge. Is that going on anywhere in the United States?

Mr. EWING. I believe it is. I have seen photos of walking school buses, of all the little kids tagging along. I can't tell you where it is done. My area of expertise is urban planning, but from the reading I have done in this particular literature, I think that there are places that have been promoting walking school buses, and walk your kid to school days have been pretty common.

And perhaps you can help with that, too.

Ms. STORY. Yes, we could. Jim Seles directs the active living research, which is the counterpart to the RWJF Healthy Eating Research, and I can contact him and get information for you on the walking school buses and the studies that have really been done around that.

Senator KLOBUCHAR. Thank you.

Most of my questions of you, Dr. Ewing, were about Federal policy, and you really answered most of those in your opening statement, which I appreciate, having some of your ideas on how we can advance this on the Federal level, in addition to the local level.

So I wanted to thank both of you here. I think we have a big job in front of us. I think we have an Administration that is very focused on this issue, from the First Lady planting the healthy garden on down to all of their weight lifting and various healthy activities, and strong arms and things like that. We really haven't had that kind of focus. I think that is good.

But I also think that we need to do things in terms of actually putting incentives into law. And for me, we start with this school nutrition bill, which will send a clear message when you look at kids getting 30 to 50 percent of their calories in school, so they really aren't given a choice. They aren't given a bad choice, just don't give it to them, and that's just how it is.

I think the second piece of this is recess and exercise, and whether or not that is more encouraged on the local or State level is something that we have to look at as we look at the reauthorization of No Child Left Behind, or as they call it in my State, Leave the Money Behind. But you know, the hope is to try to make some changes here on the State and Federal level and get out that message about exercise in the schools that has got to be a key piece of this.

The third would be as we look at environmental policies and urban planning policies, and tying resources to making sure you have those exercise options available. And the fourth, and probably the most pertinent for what we are doing right now, is the healthcare reform debate. We know that Safeway reduced the expenses for their healthcare by 13 percent by aggressive wellness policies with families and tying premiums to exercising and things like that. So, what can we do in terms of making sure we put those incentives in place with health care so that we have them?

And I would say the last thing is what we started with here with our first panel is just looking at these environmentally related diseases outside of obesity and outside of some of the things we just talked about with our panel, and that is autism and asthma and some of the things that we have been seeing on the rise with kids. And we are making sure we are pushing with the agencies to come

up with the causes, and then hopefully the solution as we see more and more parents struggle with it.

And I am sure there is overlap between some of these, you would argue, with obesity and some of these other diseases. We just don't want this to be the step-child of all this, but it is getting overlooked as we look at healthcare reform, because I just see it as something we have not been paying enough attention to.

I still remember when Paul Wellstone ran for office, and he had a T.V. commercial that ran in Minnesota where he had kids in highchairs trying to write checks. And basically the theme was these kids don't have a lobbying arm. They don't have the kind of access to Washington that other groups do. And that is what we have to remember as we go forward with the healthcare and environmental policy.

So I want to thank you all for taking the time to testify. As I mentioned, this will be the first of many hearings and other legislation that we do in this area, and I am looking forward to working with all of you. Thank you.

Ms. STORY. Thank you.

Senator KLOBUCHAR. We will keep the record open for 2 weeks for the submission of material.

The hearing is adjourned.

[Whereupon, at 10:58 a.m. the subcommittee was adjourned.]

[An additional statement submitted for the record follows:]

STATEMENT OF HON. JAMES M. INHOFE,
U.S. SENATOR FROM THE STATE OF OKLAHOMA

As a father and grandfather, protecting the health of children—born and unborn—is a personal priority. I believe the best way to protect children's health is to use the best available science to properly assess risk. Moreover, in addition to valuing and protecting pregnant women the science should specifically value and protect the well-being of unborn children.

Current science reflects that in some cases children can be more susceptible, in other cases less susceptible, and in some cases equally susceptible to environmental exposures when compared to adults. On a body weight basis children can have greater exposure than adults. EPA takes this susceptibility to exposure differential into account when EPA assesses potential risks to children.

Despite what some allege, children are not always at greater risk from carcinogenic compounds than adults. In some instances children can have a greater susceptibility, but in other instances they are much more resistant. EPA's current risk assessment methods are highly protective and are designed to protect all individuals, including children and other subpopulations, over their entire lifespan.

As we hear from the witnesses today it is also important to understand that the major threats to children are not based on environmental exposures. Rather, most threats to children are a function of behavior and lifestyle and are largely preventable:

• Statistics from the Centers for Disease Control show that unintentional injuries—nearly half of which are motor vehicle accidents—continue to be the leading cause of death for children aged 1–14. Nearly all of these accidents are preventable.

• CDC statistics show that for children under 1 year of age, the number of deaths has decreased by nearly 40 percent since 1980. The leading cause of death in children under 1 year continues to be congenital abnormalities, and the proportion of deaths attributable to such conditions has remained constant at about 20 percent despite changes in environmental exposures. Other major factors in mortality of children under 1 year of age include disorders related to short gestation and low birth weight, sudden infant death syndrome, and maternal factors such as smoking, alcohol consumption, and injury.

• In 2004, the National Institute of Medicine's Board on Children, Youth, and Families noted that issues related to metabolic syndromes are increasing rapidly. For example, the Federal Interagency Forum on Child and Family Statistics re-

cently noted that the proportion of children ages 6–17 who were overweight or obese tripled from 1976 to 2004.

I look forward to hearing perspectives on how the Federal Government can strengthen protections for children from environmental exposures. I also hope to hear from EPA and the researchers on what efforts are being made to specifically value and protect the health and well-being of unborn children.