

## Health Impacts of Suburban Development Patterns

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Decades ago, Americans enthusiastically embraced the move from cities to the suburbs facilitated by the availability of the automobile, aggressive roadway and highway building policies, and mass production of affordable homes in suburban areas. Many residents of urban areas were eager to leave the poor living conditions of cities that resulted in health problems attributable to pollution, poor sanitation and overcrowding. However, research has shown that this explosion of development outside of urban areas has negative impacts on health.

The sprawl and suburban development patterns commonplace today are characterized by the wide distribution of the population across low-density residential areas; residential, commercial and institutional uses being separated; lack of defined activity centers like town centers; and road networks with large block sizes and poor access.<sup>1</sup> This separation of uses means that traveling from home to school, work, or retail areas is rarely attainable by walking or bicycling. Suburban residents often have no choice other than to drive on a daily basis to get to where they need to go. Thus, suburban development patterns contribute to an over reliance on motorized transportation, which directly affects health through air pollution, motor vehicle crashes, and pedestrian injuries and fatalities.<sup>2</sup>

Heavy automobile use in suburban communities contributes to emissions, which generate a number of pollutants including particles and ground-level ozone. Fortunately, data has shown reductions in emissions and improvements in air quality over the years, attributable to the Clean Air Act and technological innovations. For instance, the Environmental Protection Agency (EPA) has found that since 1990, Ozone (O<sub>3</sub>) (8-hour) has decreased 22%; coarse particles (PM<sub>10</sub>) (24-hour) have decreased 39%; and fine particles (PM<sub>2.5</sub>) (24-hour) have decreased 44%.<sup>3</sup> Although regional air quality also has shown improvement over time,<sup>4</sup> air pollution continues to be a concern in certain geographic areas of Delaware. The American Lung Association's (ALA) 2017 State of the Air Report gave New Castle, Kent and Sussex Counties the grades F, B and D, respectively, for number of high ozone days. In the time period evaluated in the report, New Castle County had 17 code orange days and one code red day. For particle pollution, New Castle County received an F grade, while Kent and Sussex Counties received A's.<sup>5</sup>

Exposure to air pollution has numerous negative health consequences, including premature death; asthma attacks; cardiovascular disease; lung cancer; developmental damage; susceptibility to infections; worsened symptoms of chronic obstructive pulmonary disease; lung tissue swelling and irritation; low infant birth weight; and wheezing, coughing and shortness of breath.<sup>6</sup> Based on 2010 data, the EPA estimated that there were approximately 160,000 PM<sub>2.5</sub> exposure-related and 4,300 ozone exposure-related premature deaths.<sup>7</sup> Analyses of the contributions of various sectors to air pollution show that approximately 53,000 PM<sub>2.5</sub>-related and 5,300 ozone-related early deaths every year are attributable to road transportation.<sup>7</sup>

Of particular concern are disparities in the health impacts of exposure to air pollution among different populations, with some demographic groups suffering more significant consequences compared to others. Children are particularly at risk, even beginning during the prenatal period

when a mother's exposure to higher particle pollution levels is linked to greater risk of preterm birth. Children are more susceptible to negative health outcomes of air pollution than adults because their lungs are still developing, their ability to fight infection is still developing, and they tend to have more respiratory infections. Additionally, children inhale more polluted air than adults because they spend more time outdoors and are more likely to be physically active while outside.<sup>8</sup> Data from the 2014 Delaware Survey of Children's Health show that 17% of Delaware children ages 0-17 have ever had an asthma diagnosis, compared with a national prevalence of 14%.<sup>9</sup>

Studies assessing racial differences in premature death from air pollution have yielded mixed results in terms of the disparities. Findings linking differential impacts of air pollution among different socioeconomic groups have been more consistent. For instance, a study of New Jersey residents revealed higher risks of premature death from long-term exposure to particle pollution in communities with a higher concentration of African-Americans, and lower home values and lower median income.<sup>10</sup>

Despite a reduction in motor vehicle crash deaths in the past century, the U.S. continues to experience 32,000 deaths and 2 million injuries annually from motor vehicle crashes.<sup>11</sup> Research has identified specific aspects of suburban development that contribute to vehicular crashes and pedestrian injuries and fatalities. The separation of uses mentioned previously means more time spent driving, which increases exposure to the dangers of the road and increases the likelihood of crashes. The very design of suburban roads also is to blame. In particular, major commercial thoroughfares and feeder roads combine high speeds, high volume of traffic, and frequent curb cuts for entering and exiting commercial areas.<sup>2</sup> A study using a county-based sprawl index composed of variables for residential density and street accessibility found that counties which are more compact had lower pedestrian fatality rates. The study's authors concluded that differences in pedestrian fatality rates between more and less sprawling areas may be attributable to vehicle speed. The wide, long streets of sprawling areas encourage higher speeds; pedestrians struck by cars traveling at higher speeds have a higher likelihood of dying than those hit by cars traveling at slower speeds.<sup>1</sup>

The State of Delaware has been working to address pedestrian injuries and fatalities in response to 2015 data from the National Highway Traffic Safety Administration showing that Delaware has the highest state pedestrian fatality rate per 100,000 population in the country (3.70 in 100,000).<sup>12</sup> Data from 2003- 2012 showed that pedestrians represented 15.9% of all traffic-related deaths in Delaware; 72.6% of pedestrian deaths were on arterial roads, which are designed to move the greatest amount of automobile traffic over long distances with little delay.<sup>13</sup> Delaware's number of pedestrian fatalities has continued to rise year after year, with a 2016 report showing a 100% increase in the number of pedestrian fatalities between the first half of 2015 (9 deaths) and the first half of 2016 (18 deaths).<sup>14</sup>

In 2015, former Governor Jack A. Markell created the Advisory Council on Walkability and Pedestrian Awareness to convene state agencies, local governments, non-profit organizations and citizen advocates. The Council was tasked with supporting and making recommendations for: identifying and fixing gaps in pedestrian paths and sidewalks; designing crosswalks, sidewalks, and pathways in the most effective way possible and ensuring compliance with the Americans with Disabilities Act; reviewing traffic rules to support a safe pedestrian environment; and developing strategies for pedestrian safety education and awareness.<sup>15</sup>

The design of communities also influences opportunities for physical activity, and has been linked to the nation's increasing obesity rate. The separation of uses in suburban communities is a barrier to active travel modes. Residents of suburban communities have fewer opportunities for walking and biking for utilitarian reasons, and spend more time in the car. This reduces the amount of time available for engaging in physical activity, which is essential to good health because it lowers the risk for heart disease, stroke, type 2 diabetes, depression and some cancers, and helps with weight management.<sup>16</sup> The 2008 Physical Activity Guidelines for Americans recommend adults engage in at least 150 minutes per week of moderate-intensity, or 75 minutes per week of vigorous-intensity aerobic activity, or an equivalent combination of both types of aerobic activity. Children and adolescents should participate in 60 minutes or more of physical activity each day.<sup>17</sup> The guidelines allow for increments of at least 10 minutes of aerobic activity, which can easily be achieved by walking for recreation or utilitarian reasons.

Numerous studies have examined the association between sprawling development and declines in physical activity rates and increases in obesity over time. One study found that the land use mix (distribution of development across residential, commercial, office and institutional land uses within one kilometer of an individual's home), time spent in the car, and distance walked were significantly associated with obesity, when adjusting for age, income and educational attainment. Each kilometer walked was associated with a 4.8% reduction in the odds of obesity; each additional hour per day in the car resulted in a 6% greater chance of being obese.<sup>18</sup> Another study found that after controlling for age, education, fruit and vegetable consumption, and other sociodemographic and behavior variables, residents living in more compact counties had lower body mass index (BMI) and lower odds of obesity and chronic diseases, compared to residents of less compact counties.<sup>19</sup> Finally, the Nurses Health Study found that study participants living in higher-density counties had lower BMI and higher levels of physical activity per week than participants in lower-density counties. Among older study participants, increasing density – of population, intersections or facilities – was associated with a greater chance of meeting the physical activity recommendations by walking.<sup>20</sup>

There is also a body of research showing the impact of sprawl on mental health. Long daily commutes can result in stress that affects well-being and social relationships. Civic engagement can suffer as those with long commutes find themselves with less time to spend with family and friends, or to engage in community activities. This can contribute to a decline in a community's social capital.<sup>2</sup>

There are also environmental consequences of suburban development and sprawl, like declines in water quantity and quality and intensification of heat island effects, that impact human health.<sup>2</sup> Natural landscapes like forests, wetlands and grasslands capture and enable rain and melting snow to gradually filter into the ground, but the impervious surfaces of roads, parking lots and rooftops more prevalent in urban and suburban communities do not enable this type of infiltration. Instead, melting snow and rain stay at the ground's surface and quickly run off in large quantities, taking along with them oil, grease, toxic chemicals, pesticides and heavy metals. These pollutants end up in streams, rivers and lakes, where they harm fish and wildlife, kill native vegetation, pollute drinking water, and damage recreation areas.<sup>21</sup>

Sprawl has the potential to expand the heat island effect in urban areas, particularly when development has included road construction and cutting down numerous trees.<sup>2</sup> An analysis of the occurrence of extreme heat events (EHE) over decades found that the average number of EHEs each year increased across all cities. However, the rate of increase in EHEs in the most

sprawling cities was more than two times greater than for the most compact cities.<sup>22</sup> Extreme heat can contribute to fainting, swelling of extremities, cramps, heat exhaustion and heat stroke. Those at greatest risk of heat-related health concerns are seniors, the socially isolated, persons with certain health conditions or on specific medications, and persons living on higher floors of multi-story dwellings.<sup>2</sup>

In Delaware, projects like Plan4Health and Planners4Health are bringing together planners and health professionals to address obesity and chronic disease by identifying and implementing land use and transportation planning strategies that support healthy lifestyles by improving opportunities for active recreation, active transportation and access to healthy food. The final outputs of both projects have been informed by input from various stakeholders and community members to ensure the strategies fit within the community context. While dense, mixed-use development patterns have been shown to support healthy lifestyle behaviors by increasing walking and biking, this approach is not always feasible or even supported by residents. In some instances, other improvements on a smaller scale are feasible and can garner public support and make an impact. Examples include the addition of bike lanes on wide, low-traffic roads to create an interconnected bike route or the installment of recreational amenities within existing green space adjacent to a residential community. While intended primarily to encourage physical activity, these interventions can positively affect the environment through lower emissions as increasing numbers of people bicycle and improve mental health as residents engage with other community members in the open space. These serve as examples that development can contribute to improvements across various health outcomes.

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