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The Built Environment and Our Health

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Abstract: ***In this research project the correlation between our health and the built environment in which we live in is investigated. Specifically, this project answers the question, "Is our built environment more conducive to physical activity or is it more auto-centered?" And, "If we have a more bicycle and pedestrian friendly environment would we be healthier?" Although there are several factors that instigate the onset of an illness, clinical research has shown frequently that proper health maintenance and engagement in physical activities like walking and bicycling can counteract the pernicious consequences of these ailments. The objectives are met through a comprehensive survey of literature that addresses both the most ubiquitous diseases in the United States and the curative effects of physical activity that can ameliorate or even preclude these inflictions. The results of a survey questionnaire, which was distributed to faculty, staff, and graduate students, who live around the University of Delaware campus, are presented. Statistical analysis of the survey is presented, and shows that the majority of the respondents firmly believe that physical activity improves human health. Additionally, the survey results indicate that the majority of the respondents are in favor of a built environment whose infrastructural design is favorable to individuals who partake in walking and bicycling. Suggestions for future research in this area are presented.***

Keywords: Built Environment, Sustainability, Human Health, Suburbanization, Industrialization, Public Health, Urban Design, Urban Sprawl, Planning, Land-Use, Physical Activity

1. Introduction

Personally, I have always had a profound fascination with learning about human health and its epidemiological aspects. Salient diseases that have had a momentous effect on human development throughout history include but are not limited to: heart disease, stroke, cancer, diabetes, lung disease, hypertension, and obesity. Although there are several factors that instigate the onset of a malady, clinical research has frequently shown that proper health maintenance and engagement in efficacious physical activities like walking and bicycling can counteract the pernicious consequences of these ailments. Historically, pre-industrial society and its laborious tasks demanded the continual use of the legs, hands, and muscles of the human body. It has been only within the past century that we humans have developed a wholly mechanized society and have developed a propensity for the use of cars and machines, as opposed to our own physical capabilities. One possible epidemiological factor that I have always been fascinated with is the question, "Why isn't our built environment more conducive to physical activities?" For instance, I live and attend school in the small suburban town of Kennett Square, Pennsylvania. Pedestrian walkways and bicycle facilities for the purposes of recreational use, school attendance, and miscellaneous activities are either non-existent or are exceedingly dangerous to use. It seems to me that our entire built environment has been planned, designed, and constructed exclusively for auto use. For instance, if I could safely walk or bike to my high school from my house, it would take approximately twenty-five minutes and seven minutes, respectively. Interestingly, if I were to take the school bus to school, it would take me approximately thirty-five minutes. But unfortunately there are no adequate pedestrian walkways and bicycling facilities present and the existing roadway infrastructure has only been designed to cater to the needs of motor vehicles. Also, I don't believe that my community or I are alone in this respect! And there are countless other neighborhoods suffering from similar difficulties. Thus, modern transportation facilities do not render themselves practical for multi-modal use, such as walking and bicycling.

2. Purpose and Objectives

The principal intent of this research project is to investigate the correlation between the built environment and human health. Additionally, an examination of several pivotal diseases that have had substantial affect on human development and how physical activity can counteract these ailments will also be undertaken.

In order to achieve the main purpose of this work, I would like to accomplish the following objectives:

A. Conduct a survey of literature about the most common diseases in the United States
B. Understand how and why physical activity can abridge or even obviate these diseases, through reading and studying the most relevant literature
C. Conduct a survey of literature on how and why our built environment has been shaped the way it is i.e. unfriendly to walkers and bicyclists
D. Conduct a random survey of residents in different communities in and around the University of Delaware campus to understand their preferences with regards to walking and bicycling

3. Diseases in the United States

3.1 Heart Disease

Heart disease is a general term used to describe a wide variety of diseases that inflict the heart and blood vessels (cardiovascular system). Examples include coronary artery disease, cardiac arrhythmias, and congenial heart disease. The term "heart disease" can be used interchangeably with

"cardiovascular disease." To clarify, when discussing heart disease and its epidemiological aspects, most researchers and organizations are primarily referring to coronary artery disease. Killing more than 600,000 people annually in the United States, coronary artery disease is the most common type of heart disease. Coronary artery disease occurs when the major blood vessels that transport blood, oxygen, and nutrients to the heart become damaged. The accumulation of cholesterol-containing deposits (plaque) along the arterial walls causes the deterioration of the arteries. When cholesterol-containing deposits obstruct these major blood vessels, blood flow to the heart and other essential organs is acutely diminished, causing significant impairment to the human body. Moreover, the continuous accretion and coagulation of blood along the arterial walls can lead to the formation of thrombi, also known as blood clots. Should a blood clot completely obstruct a major blood vessel, blood supply to a specific region of cardiac muscle is lost, leading to loss of oxygen and the subsequent demise of the surrounding tissue.

The most pervasive symptoms of heart disease include:

- Angina (chest pain)
- Shortness of breath
- Palpitations (irregular heartbeats)
- Increased heart rate
- Weakness or dizziness
- Nausea
- Excessive perspiration

High blood pressure, high LDL cholesterol, and smoking are salient risk factors that lead the onset of heart disease. Presently, approximately half of all Americans (49%) have at least one of the risk factors.

Treatment options for heart disease are contingent upon the severity to which the disease has affected the body. Ultimately, physicians and other health professionals will prescribe a remedy that will maximize the both the quantity and quality of life. Initially, treatment plans may include strong medications that mitigate certain symptoms. For instance, anticoagulant agents like aspirin or warfarin may be administered to thin the blood platelets, preventing any possible thrombi formation. Beta-blockers, more formally known as beta-adrenergic blocking agents, are another notable class of drugs commonly administered to heart disease patients. Acting as a hormonal regulator, beta-blockers prevent the secretion of adrenaline, consequently slowing the heart rate and preventing cardiac muscle stress. Additionally, patients may find themselves on daily regiments of calcium channel blockers, medications that impede the movement of calcium ions into the cells of the heart and blood vessels, which can relax the heart by widening vascular tissues and maximizing blood flow. Non-pharmacological treatment options include healthy eating, routine exercise, and smoking cessation. If the disease has progressed beyond the stages of noninvasive repair, then the health professional will most likely recommend a surgical or interventional procedure to correct the malformation. Surgical and interventional treatment options include: angiography and coronary artery bypass grafting.

3.2 Cancer

Cancer is a general term used to describe disorders in which the body's cells divide abnormally without any restrictions. A functioning human cell undergoes a period of division in order to grow and repair. When cells become old or damaged, they are replaced with newer cells that have exited the cell division cycle. Sometimes this process can become defective, consequently resulting in abnormal cell growth. The root cause of such defection is a genetic malformation located within the genetic material (DNA) of the body's cells. Specific genes that may control the cell's division cycle can become mutated or altered. This leads to an amplification of the cell division cycle, resulting in the rapid development of abnormally growing cells. There are also external risk factors that can hasten the onset of cancer. These include – physical carcinogens, chemical carcinogens, biological carcinogens, ageing, tobacco use, alcohol, unhealthy diet, physical inactivity, and chronic infections. With no restrictions, these cells will continue to grow and divide into one large mass – a tumor. Tumors can be classified as benign or malignant. Benign tumors do not disseminate and invade other tissues. Malignant tumors, however, (cancer) invade and occupy nearby tissues. It is important to note that not all cancers form malignant tumors. For example, Leukemia is defined as the cancer of the bone marrow and blood. These defective cells circulate in one's bloodstream, rather than amalgamating into one large tumorous mass. Scientific researchers have discovered more than one hundred types of cancer. Cancer types are usually grouped into broader categories. These include:

- Carcinoma
- Sarcoma
- Leukemia
- Lymphoma and myeloma
- Central nervous system (CNS) cancer

In today's global society, cancer is the leading cause of death, accounting for approximately 8.2 million deaths in 2012. Specifically, lung, liver, stomach, colorectal, and breast cancers cause the most cancer deaths each year. Additionally, scientific researchers have predicted a 8 million increase in the number of annual cancer cases within the next two decades.

The pervasive signs and symptoms of cancer include:

- Unexplained weight loss
- Fever
- Fatigue
- Pain
- Skin discolorations

The three most common treatment options for cancer patients include: surgery, radiotherapy, and chemotherapy. Other, less utilized treatments include: hormone therapy, immunotherapy, and gene therapy. Moreover, specialized

medications and rehabilitation complement the course of treatment. Ultimately, the goal of cancer treatment is to either extirpate the disease or prolong the patient's quality and quantity of life. Cancers that are detected and treated early have positive prognoses. In addition to medicinal treatment plans, some physicians prescribe palliative care to ameliorate some of the patient's pain and suffering. Although not necessarily a curative treatment option, palliative care, also known as supportive care, can relieve the patients of some of their physical, psychosocial, and spiritual issues through the intervention of nutritionists, social workers, chaplains, massage therapists, and family members.

3.3 Lung Disease

Lung disease is a generic term referring to a group of disorders that prevent the lungs from functioning normally. The lungs are spongy respiration organs that transfer oxygen into the bloodstream and remove carbon dioxide.

There are four main types of lung disease:

- Airway disease – asthma, emphysema, bronchiectasis, and bronchitis
- Lung tissue diseases (Interstitium) – pulmonary fibrosis and sarcoidosis
- Lung circulation diseases – pulmonary hypertension and pulmonary embolus
- Air sac (Alveoli) diseases – pneumonia, tuberculosis, and lung cancer

Lung diseases can arise from a multitude of varied causes, including: smoking, inhalation of toxic chemicals like radon and asbestos, infections, and genetic factors. Globally, some 235 million people suffer from asthma. In the United States alone, approximately 7.8% of the population (or 23.3 million Americans) suffered from asthma in 2010, including 7 million children. Moreover, chronic obstructive pulmonary disease, a term that refers to two lung diseases, chronic bronchitis and emphysema, is the fourth leading cause of death in the United States, claiming an estimated 120,970 lives in 2006.

The pervasive signs and symptoms of lung disease include:

- Difficulty breathing
- Shortness of breath
- Hampered ability to exercise
- Chronic cough
- Chest tightness
- Discomfort while breathing
- Sputum (mucus) production
- Periodic respiratory or chest infections
- Weight loss

Lung conditions are usually treated with medications like corticosteroids and others. Although these pharmacological options may provide temporary symptom relief, they have not proven effectual treatment options over the long run. Physicians and other health professionals may also prescribe oxygen therapy to improve one's quality of breathing. Additionally, pulmonary rehabilitation through physical exercise, breathing exercising, emotional support, and counseling demonstrated success in improving the quality of life for lung disease patients. If all else fails, the last resort is surgery, specifically a lung transplantation to remove the diseases pulmonary tissues permanently.

3.4 Obesity

Obesity is a medical condition in which the body has accumulated significant amounts of excess fat. Individuals are considered obese if their body mass index (BMI) has surpassed 30 kg/m^2. Factors that play a role in the onset of obesity include: genetic makeup, overeating, eating foods high in saturated fats, physical inactivity, certain medications, medical problems, and pregnancy.. Obesity increases the likelihood of developing other, potentially significant medical conditions like diabetes mellitus, heart disease, stroke, arthritis, and cancer. In the United States, more than one third of adults (or approximately 78.6 million) of the population in considered obese. Also, the highest prevalence of adult obesity was found in the Midwest (29.5%) and the South (29.4%).

The pervasive signs and symptoms of obesity include:

- Unusually tight clothing
- Scale indicates evident weight gain
- Accumulation of extra fat around waist
- Higher than normal waist circumference
- Body mass index greater than 30 kg/m^2

The eventual goal of obesity treatment is to reach and maintain a healthy body weight. Health professionals usually prescribe weight loss programs that mandate changes in eating behavior and increase in physical activity. Treatment methods tend to vary according to one's level of obesity. The key to weight loss is a reduced-calorie diet. All patients cutback on their typical consumptions. Furthermore, obesity patients must adopt a healthy-eating plan that emphasizes lean protein, whole-grain carbohydrates, and fruits and vegetables. In regards to exercise, obesity patients need at least 150 minutes a week of moderate to intense physical activity to prevent further weight gain. Patients can interval their exercise regiments accordingly. Additional lifestyle changes include participation in a behavior modification program. Professional therapists and counselors can help patients address their emotion and psychological issues related to eating. Depending on the intensity of one's obesity, physicians and other health professionals may prescribe weight-loss medication in addition to other lifestyle changes. In some cases, patients may qualify for weight-loss surgery. Weight-loss surgery is the most effectual weight loss technique; however, the procedure poses serious risks. Common weight-loss surgeries include: gastric bypass, laparoscopic adjustable gastric banding (LAGB), gastric sleeve, and biliopancreatic diversion with duodenal switch.

3.5 Diabetes Mellitus

Diabetes mellitus is a general term that describes a group of metabolic diseases associated with abnormally high blood

glucose levels for an extended period of time. The pancreas, a glandular organ located within the gastrointestinal system, produces insulin and glucagon, both metabolic hormones that regulate the breakdown of macromolecular compounds like carbohydrates and fats. In order for the body to maintain a constant blood glucose level, a series of metabolic processes take place to achieve a hormonal homeostasis. Chiefly, insulin's processes lower the body's blood glucose levels. On the contrary, glucagon's processes raise the body's blood glucose levels. For instance, when one consumes a meal, it is presumed that he or she's blood glucose levels increase as glucagon is released into the bloodstream. When this increasing level supersedes the body's normal homeostatic conditions, the pancreas to counterattack glucagon's effects excretes insulin. However, should there be an absence of insulin, blood glucose levels will continue to increase unboundedly. Sufferers of diabetes mellitus lack insulin, resulting in an abnormally high blood glucose level. According to data from the National Diabetes Statistics Report, 2014, in 2012, 29.1 million Americans, or 9.3% of the population, had diabetes mellitus. Furthermore, diabetes mellitus remains the 7th leading cause of death in the United States in 2010.

Diabetes mellitus, a rather general term, bifurcates into two sub branches: diabetes mellitus type 1 and diabetes mellitus type 2.

Type 1 diabetes is characterized as an autoimmune disorder in which the pancreas' insulin cells are attacked by the body itself. The disorder is most often diagnosed in children and young adolescents. However, type 1 diabetes can occur at any age. Interestingly, the exact causes of type 1 diabetes are not fully understood in the medical field, although some agree that there is a strong genetic influence. Presently, 15,600 youths are diagnosed with type 1 diabetes annually. Despite extensive research on a possible cure, type 1 diabetes remains irremediable.

The most pervasive symptoms of type 1 diabetes include:

- Frequent urination
- Increased thirst
- Increased hunger
- Blurry vision
- Chronic fatigue
- Deep, rapid breather
- Abdominal pain

Individuals with type 1 diabetes must self-administer insulin via an injection needle or an insulin pump. Maintaining a healthy and active lifestyle is also beneficial to blood glucose management in type 1 diabetes patients.

Type 2 diabetes, the most common form of diabetes mellitus, is characterized as a chronic metabolic disorder in which the pancreas produces either inadequate amounts of insulin or defective insulin. This is known as insulin resistance, a condition in which the body develops insulin but does not use it efficaciously. Type 2 diabetes is most often diagnosed in patients over the age of thirty. However, there has been an alarming increase of youth cases in recent years, primarily due to a rise in obesity and poor health. Excess weight, inactivity, poor health, and genetic makeup seem to be contributing factors to the onset of type 2 diabetes.

Symptoms of type 2 diabetes are very similar to those of type 1 diabetes, except for a few distinguishing features:

- Areas of darkened skin
- Bladder, kidney, skin, or other infections
- Pain or numbness in the hands or feet

Similar to the circumstances associated with type 1 diabetes, there is no cure for type 2 diabetes. But patients can manage their condition fairly well by maintaining a healthy and active lifestyle through exercise and dieting. If these are not enough, health professionals may prescribe anti-diabetic medications that stimulate insulin production and decrease blood glucose levels.

4. Correlation between Disease and Physical Activity

4.1 Heart Disease

The American Heart Association recommends that individuals perform moderate to intense physical activity for at least 30 minutes every day. Moderate to intense physical activity improves the body's insulin sensitivity. Also, physical activity has been shown to improve the health of blood vessels by promoting a lower blood pressure. Individuals who partake in routine physical activity possess blood vessels with better vascular wall function, for blood vessels dilate in response to the increased blood flow associated with physical activity, keeping them lithe and flexible. Specifically, cardiovascular or aerobic exercise like walking, jogging, skiing, and bicycling strengthens the heart and lungs and improves the body's ability to expend oxygen. As one's ability to utilize oxygen improves over time, daily activities can be performed with less fatigue. Additional benefits of exercise on cardiovascular risk factors include a reduction in one's bad (LDL) cholesterol and an increase in one's good (HDL) cholesterol. Psychologically, physical activity has been shown to reduce stress and anxiety, and increase self-confidence. Researchers have found that for heart attack patients that have participated in formal exercise regiments, the death rate is reduced by approximately 20% to 25%. Additionally, people who maintain an active lifestyle have a 45% lower risk of developing heart disease than do inactive and sedentary people.

4.2 Cancer

Research has shown innumerably that physical activity reduces the risk of developing cancer. The American Cancer Society recommends that adults perform in at least 150 minutes of moderate to intense physical activity each week. Regular moderate to intense physical activity helps maintain a healthy body weight by balancing one's caloric intake. Obesity is a significant risk factor in the development of colon, rectum, breast, endometrium, kidney, pancreas, and

esophagus cancers. Physical activity can help prevent certain cancers via both direct and indirect effects, including regulating sex hormones, insulin, and prostaglandins. Prostaglandins, chemical messengers involved in the inflammation process, are directly influences by physical activity. Less inflammation indicates slow cell growth, which diminishes chance mutation during DNA replication of cells in the human body. Additionally, routine physical activity balances the body's energy. Interestingly, research has indicated direct associations between physical activity and some notable cancers including: breast, colorectal, endometrium, and advanced prostate cancer. Researchers have shown that physical activity may prevent breast cancer tumor development by lowering hormone levels, improving the immune response, and assisting with weight maintenance. Another study found that women who exercised modestly after an initial diagnosis of breast cancer had improved survival rates compared with more sedentary women in the same circumstances. In regards to bowel cancer, studies have shown that physical activity promotes regular bowel movements, which encourages the excrement of cancer-causing substances in undigested food.

4.3 Lung Disease

Although physical activity does not directly counteract the pernicious effects of lung disease, it does assist in substantial symptom relief for patients suffering from breathlessness and muscle fatigue. Studies have shown that physical activity increases physical capacity, decreases breathlessness, reduces muscle fatigue, improves airway activity, and improves quality of life for patients suffering from chronic obstructive pulmonary disease (COPD). It is important to note that physical activity reverses the process of deconditioning in patients with COPD. Patients enduring shortness of breath on a daily basis become accustomed to such constricted respiratory conditions. Research has shown that physical activity lowers stress and anxiety levels in such patients, and also increases blood flow to their brains, thereby increasing cognitive function. Lung disease patients in general undergo a process of muscular disuse atrophy in which the muscles lose mass from prolonged inactivity. Consequently, this process can lead to a degenerative cycle of muscle loss followed by disability. Routine strengthening exercise can build muscular endurance and instill a sense of functionality in lung disease patients.

4.4 Obesity

Physical activity coupled with lifestyle alterations can significantly prevent obesity. As a confidence-boosting regime, physical activity reduces depression and anxiety, thereby increasing one's motivation to become persistent towards their exercise and weight loss goals. Furthermore physical activity increases one's total energy expenditure, which ensures an energy balance in the body and assists in weight loss. Strengthening exercising like sit-ups, pushups, and weight lifting increase muscular endurance and energy expenditure, making it easier to control weight. Also, physical activity plays a direct role in decreasing fat around the waist, decelerating the development of abdominal obesity. Through its promotion of weight loss, energy balance, and fat reduction, physical activity is undoubtedly a chief factor in preventing the onset of obesity.

4.5 Diabetes Mellitus

Mild to intense physical activity lowers one's risk for developing type 2 diabetes by keeping blood glucose, blood pressure, and cholesterol levels on target. Physical activity helps insulin absorb glucose into all the body's cells, including the muscles, for energy. When one begins physical exertion, he or she burns both fatty acid compounds and glucose. During and after exercise, the falling glucose levels are detected by the cells inside the pancreas, which relax their output of insulin. Additionally, this lowered blood glucose level is an indication to the liver to release glucose reserved into the blood supply. Thus, exerting energy and using muscles is the perfect treatment for diabetes, as it lowers blood glucose levels, lowers fatty acid levels, and reduces stress on the pancreas. However, it must be noted that type 1 diabetes patients need to monitor their insulin levels before, during, and after physical activity to ensure their blood glucose levels do not rise or fall substantially. Nevertheless, physical activity has scientifically justified itself a worthy system of diabetes prevention and management.

5. Our Built Environment

Only within the past century, the United States of America has undergone an infrastructural transformation that has led to the development of a so-called "built environment" – buildings, roads, transportation systems, land use patterns and other human designed elements of the landscape. Prior to the advent of World War II, city organization and design was coordinated around the dispersion of the community's population. Neighborhoods were generally mixed-use, walkable, and interconnected. Yet, the emergence of relatively inexpensive automobiles and auspicious governmental policies prompted officials to focus their zoning, design, and infrastructural development efforts towards industry and the needs of the car. Municipal zoning ordinances segregated residential from commercial and industrial development. Developers favored low housing density options as opposed to the preferred housing option for the sprawling middle class. Moreover, there was a physical separation of where people live and where they work, shop, partake in recreational activities, and relax. Thus, this new system of development, known as urban sprawl, essentially gave rise an auto-dependent society in which the needs of the car, not the needs of society, are favored. The automobile became the most prominent mode of transportation as suburban communities dispersed along the boundaries of cities and street accessibility greatly diminished.

The disappointing notion is that society has developed a penchant for the use of cars and machines, as opposed to its own physical capabilities. Neighborhoods and communities have become increasingly obstructed by traffic. Suburban developments are being redesigned in such a way that is not conducive to the safety, health, and accessibility of society. Within the span of one generation, the percentage of children walking or biking to school has dropped significantly, from

approximately 50% in 1969 to just 13% in 2009. Conventional infrastructural design, not conducive to health and safety, has contributed significantly to soaring rates of obesity. With no safe, secure, and accessible walking and bicycling facilities, the children of today's society are compelled to remain inactive. It is appalling to note that 23% of children do not participate in a any form of physical activity. Also, pedestrians are more than twice as likely to be struck by a vehicle in locations that do not contain sidewalks.

Studies have indicated direct correlations between our built environment and human health. A 2003 study determined the relationship between urban sprawl and human health. It found that individuals residing in these conventionally designed sprawling communities had higher rates of hypertension, increased rates of obesity, and walked less for leisure. Thus, research has shown a direct association between our built environment and the human health of society's members. Furthermore, a 2004 study of the Atlanta region found that land use mix had was the strongest contributing factor to obesity. Each quartile increase in mixed-use development indicated a 12.2% reduction in the likelihood of obesity. Also, each additional hour spent in a car per day was associated with a 6% likelihood of developing obesity.

There have been emerging urban design movements that have worked to promote interconnected, high density, and walkable neighborhoods. The "new urbanism" movement is related to regionalism, transit-oriented development (TOD) and environmentalism. According to its foundational text, the "new urbanism" movement advocates "the restructuring of public policy and development practices to support the following principles: neighborhoods should be diverse in use…communities should be designed for the pedestrian." A typical neo-traditional design encompasses these very qualities by de-emphasizing auto dependency and promoting walkability of pedestrian friendly streets.

The four key concepts of "new urbanism" include:

- Ensure a walkable city by investing in sidewalks and narrow streets
- Promote walking as opposed to auto dependency through the construction of on-street parking
- Mixed building design
- Strong emphasis on community

Another urban design approach that has been gaining prominence is the "complete streets" movement. Complete streets are designed to facilitate pedestrians, bicyclists, motorists, and transit riders through urban planning policies that require safe, secure, and comfortable travel. In such a design, all transportation modes are treated equally to ensure safe access. Transportation agencies across several cities in America have already latched onto the coalition's ideals by redesigning their existing roads, as opposed to developing entirely new communities.

6. Survey and Results

A general survey questionnaire was conducted around the University of Delaware campus during the summer of 2013. Approximately 300 surveys were hand distributed. A total of 45 respondents answered the questions, with a response rate of 15%. The intent of this investigation was to gather insights into the beliefs and wants of ordinary people living in the modern built environment. Establishing a direct correlation between the design of a community and the health of its residents is difficult. Many external factors such as air, water, and soil pollution, as well as the presence of such toxins as asbestos, radiation, and radon gas, etc. need direct measurements to quantify. Internal factors such as smoking, drinking, diet, genetic predispositions, psychological health, and many others that are private and confidential may not be easily quantified as well. That is why as part of this research report; I instead tried to determine what it is that people would like to have – what they prefer. Do they care about having communities in which they can walk and bike for recreational purposes, commute to work, or visit entertainment and shopping centers? The survey questionnaire is designed to analyze the preferences of the respondents starting with the immediate vicinity of where the respondent lives, progressing to include work and school-related trips, and finishing with questions regarding major shopping malls and other recreational facilities. Stem-and-leaf displays as well as minimum values, maximum values, count (number of respondents per question), measures of central tendency, and measures of spread are provided for each question.

Frequency tables for select questions were created to singularly display the behaviors of the respondents.

Table 1: Question 1 Data

Code	*Value*	*Frequency*	*Percent*
1	Disagree strongly	0	0
10	Agree strongly	25	55.6

Question 1: "Do you believe that physical activity (walking, bicycling, etc.) is a major contributor to your overall health and well-being? Please circle.

The frequency table indicates that 25 of the 45 total respondents (or 55.56%) to this question agree strongly that physical activity is indeed a major contributor to one's overall health and well-being. Also, none of the respondents disagree strongly with such notion, indicating that the majority share similar convictions regarding physical activity and its effects on the human body.

Table 2: Question 3 Data

Code	*Value*	*Frequency*	*Percent*
1	No I don't	3	12
10	Yes I do	16	64

Question 3: "If you don't [have accessible safe, and secure pedestrian and bicycling facilities near where you live],

would you like to have accessible, safe, and secure pedestrian and bicycling facilities **near where you live**?

The frequency table reveals that 16 of the 25 total respondents (or 64.00%) to this question would like to have accessible, safe, and secure pedestrian and bicycling facilities near where they live. Only 3 of the 25 total respondents (or 12.00%) do not want to have accessible, safe, and secure pedestrian and bicycling facilities near where they live. Because such a vast percentage shares the common belief that pedestrian and bicycling facilities are important elements of a functioning development, the 3 respondents that provided negative responses are likely outliers in the distribution.

Table 3: Question 5 Data

Code	*Value*	*Frequency*	*Percent*
1	*No I don't*	*1*	*3.45*
10	*Yes I do*	*19*	*65.52*

Question 5: "If you don't [have accessible, safe, and secure walking and bicycling routes to schools for school children in your community], would you like to have accessible, safe, and secure walking and bicycling **routes to schools for school children in your community**?

The frequency table shows that 19 of the 29 total respondents (or 65.52%) to this question would like to have accessible, safe, and secure walking and bicycling routes to schools for school children in their community. Only 1 of the 29 total respondents (or 3.45%) does not want to have accessible, safe, and secure walking and bicycling routes to schools for school children in he or she's community. This is a likely outlier in the distribution.

Table 4: Question 7 Data

Code	*Value*	*Frequency*	*Percent*
1	No I don't	1	3.12
10	Yes I do	20	62.50

If you don't [have accessible, safe, and secure walking and bicycling routes to places where you do your grocery shopping, local libraries, community centers], would you like to have accessible, safe, and secure walking and bicycling routes to **places where you do your grocery shopping, local libraries, community centers, etc.**?

The frequency table indicates that 20 of the 32 total respondents (or 62.50%) to this question would like to have accessible, safe, and secure walking and bicycling routes to places where they do their grocery shopping, local libraries, community centers. Similar to previous questions that contained anomalous respondents, only 1 of the 32 total respondents (or 3.13%) does not want to have accessible, safe, and secure walking and bicycling routes to places where he or she does his or her grocery shopping, local libraries, community centers.

Table 5: Question 9 Data

Code	*Value*	*Frequency*	*Percent*
1	No I don't	1	3.33
10	Yes I do	21	70.00

Question 9: If you don't [have accessible, safe, and secure walking and bicycling facilities to your place of work, major shopping malls, movie theaters, and other recreational areas], would you like to have accessible, safe, and secure walking and bicycling facilities to your **place of work, major shopping malls, movie theaters, and other recreational areas**?

The frequency table reveals that 21 of the 30 total respondents to this question would like to have accessible, safe, and secure walking and bicycling facilities to their place of work, major shopping malls, movie theaters, and other recreational areas. Similar to previous questions that contained anomalous respondents, only 1 of the 30 total respondents would not like to have accessible, safe, and secure walking and bicycling facilities to his or her place of work, major shopping malls, movie theaters, and other recreational areas.

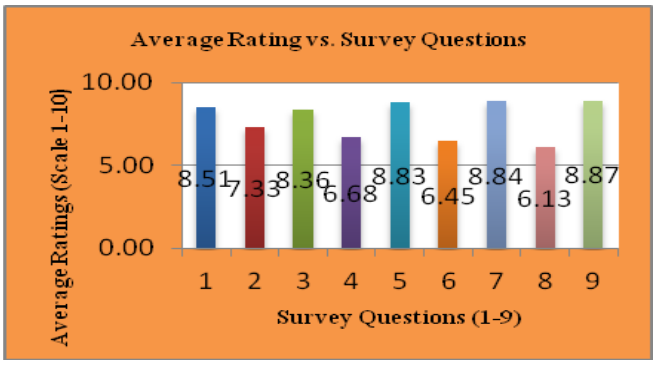

Figure 1: Average Rating vs. Survey Questions

The average rating vs. survey questions display is spread from a low value 6.13 to a high value 8.87. The median of the distribution is 8.36. The distribution is not skewed towards any particular side. There are no apparent modal peaks. Questions 1, 3, 5, 7, and 9 all had average rate values that were greater than 8, indicating strong respondent approval.

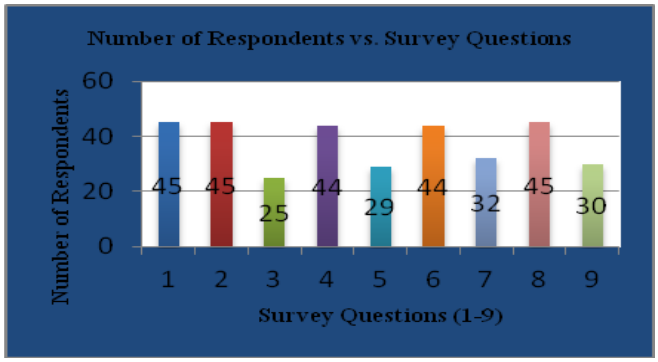

Figure 2: Number of Respondents vs. Survey Questions

The number of respondents vs. survey questions display is spread from a low value of 25 to a high value of 45. The median of the distribution is 44. The distribution is not

skewed towards any particular side. There are no apparent modal peaks. Evidently, respondents favored questions 1, 2, 4, 6, and 8. Questions 3, 5, 7, and 9 seemed unfavorable to respondents, for they had the lowest response rates.

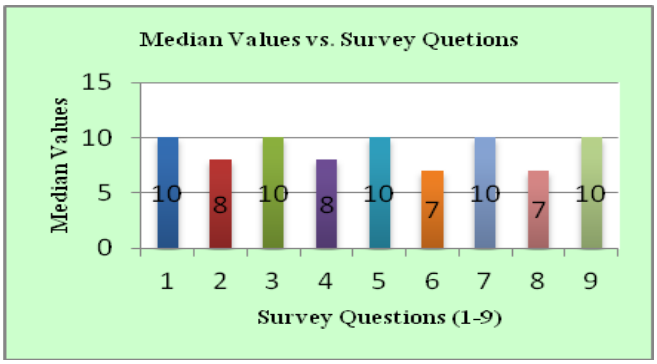

Figure 3: Median Values vs. Survey Questions

The median values vs. survey questions display is spread from a low value of 7 to a high value of 10. The median of the distribution is 10. The distribution is not skewed towards any particular side. There are no apparent modal peaks. Questions 1, 3, 5, 7, and 9 had median response values of 10, indicating very strong respondent approval.

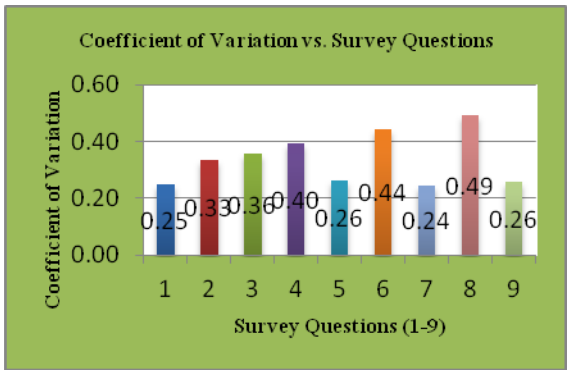

Figure 4: CV vs. Survey Questions

The coefficient of variation (CV) is the ratio of the standard deviation to the mean. Essentially, the CV measures the percentage of the results that equals the mean value of the entire data set. It is an effectual measure of distirbution variability. CV values less than 1 indicate a low variance distribution. The coefficient of variation vs. survey questions display is spread from a low value of 0.24 to a high value of 0.49. As shown above, each survey question (1-9) possesses a CV value that is less than 1. This indicates that the data collected have low variance. The median of the distribution is 0.33. The distribution is not skewed towards any particular side. There are no apparent modal peaks.

7. Summary, Conclusions, Recommendations

This research project provides a comprehensive analysis of the association between the built environment and human health. An overview of salient diseases that have had a profound impact on human development is reported. Illnesses reviewed include: heart disease, cancer, lung disease, obesity, and diabetes mellitus. Notable statistics, causes, symptoms, and treatment options for each disease are conveyed. Following this examination, the project discusses the connection between the onset of such diseases and physical activity, providing specific information and data for each illness. For instance, the American Cancer Society recommends that adults perform at least one hundred fifty minutes of mild to intense physical activity each week. Subsequently, a history of the modern built environment is presented. Since the advent of World War II, the built environment has profoundly affected human health. Relatively inexpensive automobiles and favorable government policies in regards to housing development and zoning are contributable factors to the urban sprawl movement and the development of the built environment. Results from complementary research reports regarding urban design, illness, and physical activity are also included to support the correlation between the built environment and human health. Other urban design approaches, such as the "new urbanism" movement and transit oriented development (TOD, are investigated to provide possible alternatives that promote walkability and interconnectedness of communities, thus rendering them favorable to pedestrians and bicyclers. Moreover, the results of a survey questionnaire administered around the University of Delaware campus are provided. Statistical data, frequency tables, and bar charts are completed for most questions. Analysis of the results is provided, which convey respondent preferences and sentiments towards the built environment and human health. Results indicate that respondents believe that there is a clear shortage of safe and secure walking and bicycling facilities in most modern developments, and that the built environment is a major contributor to one's overall health. Additionally, the majority of respondents would like to have safe and secure pedestrian and bicycling facilities near their homes, places of work, grocery stores, areas of recreation, school communities and major entertainment centers.

The objectives for this research report included:

A. Conduct a survey of literature about the most common diseases in the United States
B. Understand how and why physical activity can abridge or even obviate these diseases, through reading and studying the most relevant literature
C. Conduct a survey of literature on how and why our built environment has been shaped the way it is i.e. unfriendly to walkers and bicyclists
D. Conduct a random survey of residents in different communities in and around the University of Delaware campus to understand their preferences with regards to walking and bicycling

A. The research project provides a thorough analysis of the most common diseases in the United States. Illnesses that are reviewed include: heart disease, cancer, lung disease, obesity, and diabetes mellitus. Several sources of both literature and digital media were utilized to fully support the claims provided.
B. A discussion of the connection between the onset of these diseases and physical activity is conveyed. Specific information regarding each disease was gathered through a thorough reading of digital publications and literature.

C. Multiple research reports, journals, and digital publications were utilized to effectively demonstrate how and why our build environment has been inauspicious to pedestrians and bicyclists.
D. A random survey of residents in and around the University of Delaware was partially accomplished. More methods of randomness could have been implemented in the survey distribution process to ensure the accuracy of the data.

Results of the literature search and survey questionnaire indicate that the majority of respondents strongly believe that there is a correlation between the modern built environment and human health. 55.56% of respondents agreed strongly that physical activity was a major contributor to one's well being. None of the respondents disagreed with such notion. Additionally, 64.00% of respondents indicated that they would like to have safe, secure, and accessible walking and bicycling facilities near where they lived. This clear majority reveals that areas of close proximity, such as one's abode, are lacking basic pedestrian walkways and bicycling lanes. Interestingly, 65.52% of respondents stated that they would like to have accessible, safe, and secure walking and bicycling routes to schools for school children in their community. In a society that values child safety, why must there be a privation of walking and bicycling facilities to schools? As the younger generation relinquishes its own physical capabilities in favor of cars and other modes of transportation, obesity levels will surge to pandemic levels. Further analysis reveals that locations relatively far from where respondents live, such as areas of grocery shopping, local libraries, and community centers, are also lacking accessible, safe, and secure walking and bicycling facilities. 62.50% of respondents claimed that they would like to have such facilities near the aforementioned locations. Lastly, with respect to locations that were generally far from where respondents lived, such as major shopping malls, movie theaters, and other recreational centers, 70.00% of respondents indicated that they would like to have accessible, safe, and secure walking and bicycling facilities near these locations. Such a high statistic is indicative of one conclusion: there is an obvious disregard for walking and bicycling facilities. In a mechanized and auto-dependent society, public policy has favored major automotive and housing industries at the expense of human health. Respondents from each question demonstrated their sentiments regarding this community development structure, and the results point to one profound conclusion: there exists a correlation between physical activity and overall health.

Seeking to gather the personal sentiments and preferences of people regarding physical activity and the built environment, this research report draws conclusions from a uniquely designed survey questionnaire. Each question has been designed to garner specific information from the respondents. For example, questions 2 and 3 addresses the immediate vicinity of where the respondent lives, while questions 8 and 9 address locations that are far from the respondent's abode. Extensive statistical analysis is provided for each question, effectively quantifying the preferences of the respondents. Additionally, comprehensive review major diseases, physical activity's connection to the onset of such diseases, and the development of the built environment is presented. Several reputable journal publications are used to corroborate these findings. Lastly, the author of this report, a high school senior, provides a distinctive viewpoint into modern suburban design and the built environment. As a member of the "generation Z", the author delivers some personal insights into road design surrounding his community, and the factors that impelled him to investigate the correlation between the built environment and human health.

The homogeneity of the respondent population could have skewed results, for the survey was conducted in and around the University of Delaware campus, where individuals come from similar economic and socioeconomic backgrounds. More methods of randomization could have been implemented in the survey distribution process to ensure accuracy of data as well. Also, with a sample size of 45 participants, the statistical results of this project may not be applicable or representative of the true data.

Research and the results from this project show that there is a direct link between our built environment and human health. Readers should actively participate in mild to intense physical exercise each week, as the level of one's physical activity is a major contributor to overall health. Depriving society of the very necessary facilities required to nurture its overall health and well-being does not bode well. Drastic changes must be implemented, for a rising pandemic of disease will have dire implications. Society should seek other forms of urban design and community development to counteract the effects of the built environment. Alternatives include the "new urbanism" movement and the complete streets movement, both of which de-emphasize auto dependency and promote walkability of pedestrian friendly streets. Furthermore, future survey distributions should implement necessary randomization techniques to ensure a heterogeneous population of respondents, and represent larger sample sizes to ensure the relevancy of the results.

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Author Profile

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