Vehicle 4 Change: Health Implications of the Capital Bikeshare Program

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Table of Contents

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Executive Summary

This report was undertaken to examine the health effects of membership in the Capital Bikeshare program. Methods of analysis include a review of major research and scholarly works within the transportation field and other pertinent issue areas such as health and economic policy. In addition to analyzing prior survey data of Capital Bikeshare members, we developed and, working closely with Capital Bikeshare staff, administered a new survey that allowed us to better understand the health benefits, both realized and unrealized, of the four-year-old program.

Although the survey results suggest Capital Bikeshare members tend to be healthier than the population at-large and would therefore not be expected to derive substantial health benefits from the program, we pinpointed several promising findings in the response data. These together constitute a framework for exploring the program's potential for making a more far-reaching impact on the health of existing members as well as the larger metropolitan community. Important findings included:

- The areas utilizing the Capital Bikeshare program the least (Wards 7 and 8) could potentially have the most to gain in terms of health benefits.
- Although Capital Bikeshare members are somewhat homogenous in terms of education and income levels, their motivations for joining are quite varied and offer some important insight for the program moving forward.
- Many respondents reported an increase in the amount of time per week spent performing moderate to strenuous physical activities, which suggests the program has a notable (and beneficial) effect on health.

Major Recommendations include:

- **Health grants**. Utilize our finding that program participation tends to increase beneficial health activities. And, as a result, seek both private and public health-related grants as a means of increasing outreach and program participation in lower-income communities that are not actively participating in the existing Capital Bikeshare program.
- **Health impact assessment**. Consider applying a formal health impact assessment tool in order to better evaluate the health impacts of the program.
- **Survey non-members**. A survey of individuals who are not already program participants would almost certainly underscore many of the major reasons program utilization is low in some areas of the city and region.
- **Annual health survey.** Repeating the health survey annually will serve to measure changes in member health better than asking members to evaluate their health a year ago (as opposed to today).

It is our hope that this project will serve as an informative and useful underpinning for further exploration of the issue.

Introduction/History: Launched in August 2008, Capital Bikeshare became the first jurisdiction-wide bike sharing system in North America. Capital Bikeshare was originally founded as SmartBike D.C. with only 120 bikes and 10 stations throughout downtown Washington, D.C. Due to the increasing popularity of the program, 1,600 people joined SmartBike D.C. during its first two years of inception (Capital Bikeshare 1, 2012). Around this same time, Arlington, VA also started to launch its own bike sharing system and subsequently entered into a partnership with Washington, D.C. to create the "Capital Bikeshare" program in 2010. Capital Bikeshare was formed as an affordable, convenient and accessible alternative to owning a bicycle in the D.C. metropolitan area.

Over the next two years, Arlington, VA and Washington, D.C. established Capital Bikeshare throughout the National Capital Region and built over 175 stations with over 1,670 bicycles (Capital Bikeshare 2, 2012). The program now has over 18,200 annual and monthly members and another 8,000+ daily/short-term members. The program is growing rapidly as the D.C. metro area increases in population and as cycling becomes a more popular mode of transportation for commuting to work, sightseeing and visiting family and friends. In August 2012 Alexandria, VA also launched an expansion of Capital Bikeshare infrastructure into the city and environs. Capital Bikeshare now serves all eight wards of the District of Columbia, Arlington and Alexandria and continues to have the highest number of annual members of any bikeshare program in the United States (Malouff, 2012).

Problem: In the fall of 2011, Capital Bikeshare submitted a survey to members on the benefits of the bikeshare program, members' reasons for participation in Capital Bikeshare, and members' demographics. Since the survey did not include many questions on health, there was

a need to gather data on whether people take part in Capital Bikeshare for health reasons and whether Capital Bikeshare has helped them lead a healthier lifestyle.

Without this health and wellness data, Capital Bikeshare is unable to adequately seek out funding opportunities to expand the program based on health and exercise factors. This data may be especially relevant to low-income communities, which various studies have shown tend to have higher rates of obesity than their same city higher income counterparts (Black and Macinko, 2008). If the data points to a connection between bikeshare and healthy living, the Capital Bikeshare program may have a greater platform to apply for health and wellness grants. These grants may allow the program to expand into underrepresented communities and enable Capital Bikeshare to conduct more health-oriented outreach, marketing, and advertising in areas which may know little about Capital Bikeshare or may not utilize the program at a very high rate, compared to other areas of Washington, D.C.

Objectives: The primary objective of this project is to study the relationship between health and Capital Bikeshare membership. Through the examination of data from past Capital Bikeshare membership surveys as well as the implementation of our own health survey, we hope to explore the health benefits, if any, pertaining to membership. Further, through this study we plan to look at whether people joined Capital Bikeshare for exercise purposes (i.e. to become healthier) or if they did so for other reasons. If health concerns are not the primary motivation for joining, we hope to capture whether members have become healthier nonetheless as a result of their membership. Using the survey data, we intend to create a profile of current members' health that can then be used as a point of comparison with future

iterations of our health survey. Finally, we will look at other bikeshare programs to determine if there are any best practices in terms of health that Capital Bikeshare could employ.

Capital Bikeshare may utilize the results of our analysis to conduct future outreach initiatives targeted at low-income and currently underrepresented communities. Should the study provide clear linkages between Capital Bikeshare membership and improved health, the client, at their discretion, may also employ the findings to enhance efforts at obtaining higher levels of program funding through public-private partnerships as well as local, state and federal grants. Overall, the information obtained in the study may provide the staff at Capital Bikeshare with the data necessary in order to reach out to underrepresented and underserved communities

Research Questions: Major research questions for this project were designed to explicate the health effects members may derive, either from Capital Bikeshare or similar programs elsewhere. Some of the questions we attempted to answer during the course of our project included:

- What are the *potential* health implications of the Capital Bikeshare program?
- What are the *actual* health benefits (as reported by members) of Capital Bikeshare and how can our data be used to grow the membership base to include greater numbers of people in underrepresented communities?
- What are other programs doing to improve the health of their members and are there any practices used by other programs that could improve the Capital Bikeshare program?

Literature Review: It is well documented that the US population is not active enough to maintain good health. In 2005, the percentage of adults who engaged in moderate physical activity ranged from 33% to 62% across states in the US (Cradock et al., 2009, p.39). Some studies have shown that less than 10% of adults in the US get the recommended amount of moderate-to-vigorous physical activity per day (Rodriguez, 2009, p.1). This level of inactivity comes at a high cost both in terms of actual health and health care costs. Cradock et al. reported in their 2009 study that the estimated annual direct medical costs associated with physical inactivity were at $24 billion with an additional $70 billion from obesity. This accounted for 94% of US health care expenditures (Cradock et al., 2009, p.62) and these costs do not appear to be declining. One Minnesota study predicted that by 2020, the cost of treating an obese person in Minnesota will skyrocket to 61% more than that of an average-weight person ("Obesity and Future"2008, p. 2).

Obesity is particularly worrisome given that 35.7% of adults and 16.9% of children and adolescents in the US were considered obese in 2009-2010 (Ogden et al., 2012). Obesity can lead to many other health problems such as cardiovascular disease, diabetes, and certain types of cancer. Obese youth are especially at risk as 70% have additional risk factors for cardiovascular disease like hypertension or high cholesterol (Frieden et al., 2010, p. 357). This is a huge burden on individuals and society at large.

Obesity can be very difficult to address. For one thing, much data on obesity rates is derived from self-reports in which people tend to overestimate the time and intensity of their physical activity; one study purports that 40% of adults claim to engage in enough activity to improve health but less than 4% actually do (Frieden et al, 2010, p.359). Another complicating

component to addressing obesity is its complex causes. According to the Congressional Research Service, obesity is caused by interacting genetic, behavioral and environmental factors (Corby-Edwards, 2010, p.10). Programs designed to impact obesity rates therefore need to be built on accurate data and need to target both individual behavioral change and more expansive socioeconomic changes such as poverty and education initiatives.

A series of more targeted policy interventions in areas such as transportation (including biking) can also make a big difference. Physical activity has declined in part due to the design of neighborhoods (e.g., lack of sidewalks, bike lanes, and traffic congestion), but changes "to the built environment are unlikely to increase activity levels without complementary strategies that address determinants of physical activity behavior" (Frienden et al., 2010, p. 360). Programs such as Capital Bikeshare along with targeted outreach could be one mechanism to induce these necessary behavioral changes.

Across the literature there was general agreement that physical activity is correlated with better health and currently, Americans do not engage in enough physical activity. Studies have shown that physical activity is associated with decreases in mortality and morbidity (Erikssen et al. , 1998; Macera et al., 2003; and Cavill & Davis, 2012, p.16) More specifically, inactive persons have a greater chance of coronary disease, primary and secondary diabetes, and arthritis (Macera et al[1], 2003, p.125). Literature further suggests that bicycling improves health. One study found that 12.28 deaths were avoided as a result of using Barcelona's bikesharing program, Bicing (Rojas-Rueda et al., 2011, p.1). A longitudinal cohort study found that those who did not cycle to work experienced a 39% higher mortality rate (Cavill & Davis,

[1] The Macera et al. study was a comprehensive review of the literature.

2007, p. 26). Additionally, Cavill & Davis[2] cited a number of randomized trial studies showing that bicycling for one's commute was sufficient to improve fitness and health, increased measured fitness more than walking, and led to physiological changes such as decreased cardiovascular load, increased use of fats as energy, and an increase in HDL cholesterol (2007, p. 27).

Other benefits of biking include societal benefits such as reduced health care costs and increased productivity. One study estimated about $24 million per year in reduced health care costs in Minnesota as a result of biking (Barnes, 2004, p.29-30). A cost-benefit analysis of the health benefits of investments in bicycling infrastructure in Portland showed $388 to $594 million in health care cost savings and $7 to $12 million in savings in value of statistical lives (Gotschi, 2011, p. 49-50). Oja et al. conducted a systematic review of sixteen studies on the health benefits of cycling and found "strong evidence for cardiorespiratory fitness benefits in adults" and "moderate evidence for benefits in cardiovascular risk factors in adults"; but "inconclusive evidence for reduction in all-cause mortality, in CHD morbidity or mortality, in cancer risk, and in overweight and obesity in adults" (Oja et al., 2011, p. 12). This study thus differs from others in not finding a conclusive correlation with bicycling and mortality. The authors advise that more intervention research is needed.

Within the physical activity literature, we found a number of studies on active commuting which is defined as walking or bicycling as part of your commute. One study concludes that people can get in their recommended levels of physical activity through their commute even if that commute entails using public transportation (Rodriguez, 2009). More

[2] The Cavill & Davis report does not indicate the strength of the studies they cite.

specifically, “29 percent of those who use transit were physically active for 30 minutes or more each day, solely by walking to and from public transit stops” (Rodriguez, 2009, p.2). This led to saving money and better health.

Table 1: Summary of Active Commuting Literature

Paper	Authors	Date	Methodology	Limitations	Conclusions
"Active Commuting and Cardiovascular Disease Risk: The Cardia Study"	Gordon-Larsen et al.	2009	Cross-sectional study with those enrolled in the Coronary Artery Risk Development in Young Adults program	Low rates of active commuting; self-selection bias	"Active commuting was positively associated with fitness in men and women and inversely associated with BMI, obesity, triglyceride levels, blood pressure, and insulin level in men"
"The joint associations of occupational, commuting, and leisure-time phsyical activity, and the Framingham risk score on the 10-year risk of coronary heart dissease"	Hu et al.	2007	Cohort study using five independent cross-secitonal population surveys in four geographic areas of Finland in 1972, 1977, 1983, 1987, and 1992	Self-reporting of physical activity; recording physical activity only once at the baseline	Significant inverse association in women between active commuting and 10 year risk of coronary events; moderate or high levels of occupational or leisure-time physical activity for men and womenwas associated with a reduced 10-year risk of cornary hear disease events
"Health benefits of cycling: a systematic review"	Oja et al.	2011	Literature review	More intervention research is needed	Decline in active commuting; commuter cycling of a few kilomerters' single-trip distance substantially improves cardiorespiratory performan of low-fitness adults; significant but less substantial improvement for medium-and high-fitness adults
"Walk or Bike to a Healthier Life: commuting Behavior and Recreational Physical Activity"	Terzano,K. & Morckel, V.C	2011	Survey of faculty and staff at Universities in Columbus Ohio, Youngstown, Ohio, and Washington, DC	Representativeness of Sample	Significant relationship between the modes of transit used in commuting for work and amount of time a person engages in recreational physical actiivty outside of their commute

Across the literature there seemed to be general agreement that active commuting can be beneficial to health. Table 1 above summarizes the active commuting literature. Terzano and Morckel (2011) found a significant relationship between one’s mode of transportation for their commute and the amount of time spent engaged in recreational physical activity (p. 492-496). The Gordon-Larsen et al. (2009) and Hu et al. (2007) studies both evaluated the health benefits from active commuting. These studies differ in their estimates of the impact of active commuting for men and women. The Gordon-Larsen et al. (2009) study found greater benefits for men in terms of BMI, obesity, triglyceride levels, blood pressure and insulin while the Hu et al. (2007) study found that only in women was there a significant relationship between active

commuting and 10 year risk of coronary events (p. 492). Oja et al. (2011) found a significant relationship between commuter cycling and cardiorespiratory performance. The improvement was progressive and more substantial for low-fitness adults (p. 12).

There are some definite limitations to studying physical activity and its health impacts. Macera et al. (2003) discuss some of the difficulties in linking health and physical activity. First, physical activity is measured in various ways throughout the literature thus making comparisons more difficult. Second, the types and intensities of physical activity vary depending on the health outcome. Last, the physiologic changes that may result from physical activity do not all become apparent immediately (p.123).

An additional problem in determining health impacts of physical activity develops due to the variances in the recommended amount of physical activity needed for healthy living. The World Health Organization (WHO) recommends 30 minutes of physical activity a day, either all at once or in 10-15 minute increments (Cavill & Davis, 2007, p. 22). The Centers for Disease Control and Prevention (CDC) recommend 2 ½ hours of moderate-intensity aerobic activity every week and muscle-strengthening activities on two or more days. The CDC agrees that this can be reached incrementally (CDC, 2011). The benefits derived from incremental exercise are particularly pertinent for bikeshare programs as the trips are mostly within these shorter timeframes.

Methodology: Our first step was to review the literature on existing bikeshare programs, physical activity, cycling, and active commuting. We then developed a series of survey questions informed by the literature to explore potential program health benefits. The survey consisted of 44 questions and covered a broad range of lifestyle and health issues, including:

- Motivations for joining Capital Bikeshare;
- How often members take advantage of the program;
- Whether members use Capital Bikeshare primarily for health and fitness reasons rather than convenience or cost;
- Extent to which Capital Bikeshare is the main mode of exercise for members; and
- Levels of physical activity before and after joining Capital Bikeshare.

A major area of inquiry for our study concerned the extent to which the program is attracting individuals who are already healthy and active. We also attempted to determine whether the program is contributing to an increase in physical activity for its members, regardless of prior health condition.

The survey took place over a two-week period and provided data that allowed us to expound upon our preliminary examination of the issue. We also analyzed existing survey data from Capital Bikeshare's annual membership survey and made comparisons with Census data. Using the survey data provided by Capital Bikeshare staff, we applied quantitative and qualitative analysis techniques to explore potential correlations between ridership levels and health of members. The data can be further utilized by Capital Bikeshare in the future to establish demographic associations with ridership levels.

Survey Details & Potential Obstacles: Although an inadequate survey response rate would have posed a serious problem for our project, a sufficient number of members responded to ensure validity for a variety of statistical analyses.

- Total sample size: 13,886.
- Total finished survey: 2,830 (20% response rate)

During the course of our project we dealt with several important obstacles, which are summarized here.

- **Selection bias.** Our survey was distributed only to Capital Bikeshare members, which created the possibility of a sample that is unrepresentative of the entire population as well as the Capital Bikeshare population itself. Bikeshare members may have had a preexisting interest in biking; may inherently lead healthier lifestyles; and may be so different demographically from lower-income nonmembers so as to render predictions on population-wide impacts impossible. We minimized the risk of selection bias by analyzing data from a prior Capital Bikeshare survey and with U.S. Census data.
- **Survey fatigue**. Capital Bikeshare sent out an extensive survey to its membership in the fall of 2011, raising the possibility that members could be less inclined to participate in the health survey. To minimize the likelihood that survey fatigue would adversely impact our project, Capital Bikeshare randomly selected half of its distribution list to receive the health survey. The other half received the 2012 annual membership survey.
- **Time limitations**. In order to reduce the probability that the limited timeframe of the project would negatively impact the quality of our work, we maintained a relatively narrow project scope. We also allocated our time judiciously, conducting much of our data analysis during the survey response period, which allowed us to focus exclusively on health survey results and comparative data analysis once the survey period ended.
- **Data compromise**. One major issue that we dealt with was the unintentional editing of a survey question that occurred as the survey was open. Survey responses recorded prior to the edit were not reflected in the final response totals. The question was not related

to the potential health benefits of the program. Thus, although the data loss was undesirable, it did not affect our findings.

Goals for Analysis of Findings: In order to answer the major research questions posed by our project, we employed a methodologically eclectic approach that minimized the potential obstacles already discussed but also increased the likelihood of generating results of both statistical and practical significance. Initial analysis of survey results applied simple statistical methods such as frequency counts and distributional breakdowns. Other statistical techniques utilized in our analysis included cross tabulations and various graphical techniques. Finally, qualitative scrutiny interspersed throughout our discussion of quantitative results provided a crucial analytical component for the client.

Analysis of Findings: In analyzing the results from our health survey, we first looked at demographics and how a typical Capital Bikeshare member compared with the general population in the Washington Metropolitan area. According to our survey, a majority of Capital Bikeshare members are Caucasian (76.3%), males (59.5%), aged 25-34 (54.8%) who are living in the District of Columbia (77.7%). Capital Bikeshare members are highly educated with 41.2% having obtained a 4 year college degree, 40.2% a Master's degree, and 13.3% a Doctoral Degree. Nearly 90% of Capital Bikeshare members are employed full-time and 41.5% had a total household income of between $50,000 and $124,999 last year. In Table 2 below, we compared Census data with our survey data in areas where we saw divergences. It is important to note that there is no direct comparison, as the data for Washington-Arlington-Alexandria Metro Area also includes parts of West Virginia.

Table 2: Demographic Information Comparison Chart					
	Bikeshare Annual Membership Survey 2011	Bikeshare Health Survey 2012	DC Census (2010)	DC-VA-MD-WV Metro Area Census (2010)	National Census 2010
Race:					
% Caucasian	75.19%	76.3%	42.4%	54.8%	74.1%
% African American	3.15%	3.5%	50.7%	25.8%	12.6%
Gender:					
% Women	42.59%	39.8%	52.7%	51.3%	56.7%
Income:					
Less than $14,999	4.11%	3.2%	15.8%	6.6%	13.6%
$15,000 to $34,999	6.3%	4.3%	16.1%	11%	22%
$35,000 to $49,999	11.86%	9.9%	11.8%	9.4%	13.9%
$50,000 to $74,999	18.54%	16.2%	15.6%	15.9%	18%
$75,000 to $99,999	14.69%	12.8%	11.1%	13.6%	11.7%
$100,000 to $149,000	N/A	19.9%	12.8%	19.8%	12.1%
$150,000 +	15.99%	18.4%	16.8%	23.6 %	8.7%
Age:					
Age 25-34	51.71%	54.8%	19.5%	15.5%	13.3%
Age 35-44	18.63%	19.4%	14%	14.8%	13.1%
45-54	8.98%	9.6%	12.8%	15.1%	14.3%
55-64	3.88%	4.7%	55-59: 5.8%; 60-64: 4.8%	55-59: 6.2%; 60-64: 5.3%	55-59: 6.5%; 60-64: 5.7%
Sources: Capital Bikeshare 2011 Survey, Capital Bikeshare Survey 2012, and US Census Bureau: http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml					

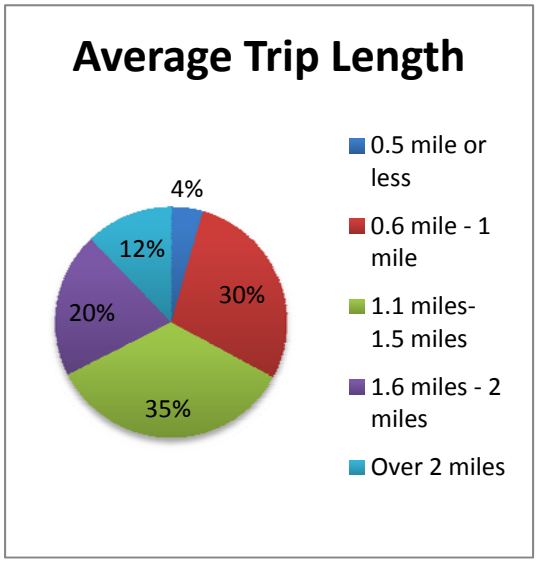
The percentage of African Americans participating in Capital Bikeshare is very low (3.5%) compared to the overall percentage of African Americans in Washington, DC (50.7%) and in the DC Metro Area (25.8%). Similarly, lower income persons are underrepresented within Capital Bikeshare. This leaves a largely untapped constituency of lower income people and minorities that are not currently using Capital Bikeshare. Mainly this market exists in wards 7 and 8 which only make up .8% and .4% of the membership respectively. Lower income areas such as these are associated with higher obesity rates (Black and Macinko, 2008) and thus could gain the most health benefits from joining Capital Bikeshare. This is consistent with the Oja et al. (2011) study which found that cardiorespiratory improvement from cycling was greater in low-fitness adults (p. 12). Additionally, the short trips could incrementally add up to the daily amount of

physical activity recommended by the WHO which would improve health for those in these areas.

Although the current membership of Capital Bikeshare is somewhat homogenous, the motivations they have for joining are quite varied. We asked survey respondents to rate each motivation on a scale from 1 to 5 with 1 being a “not at all important” and 5 being “very important”. The highest rated response was “get around more easily, faster, shorter time” for which 1,920 people (71.3%) rated 5 and had an average response rate of 4.60. Other highly rated motivations included “access to other form of transportation, new travel option” with an average rating of 4.30; “like to bike, fun way to travel” with an average rating of 4.17 rating; and “exercise, fitness” with an average rating of 3.62. 735 people (27.3%) rated “exercise, fitness” as a very important motivation and 262 people rated “health concerns” as such.

While health and fitness concerns are not the highest motivation for joining Capital Bikeshare, they are still an important element for members. In our question assessing the primary types of trips Capital Bikeshare members make, 21% rated “exercise, recreation” as a 4 or 5. Although not a top response, members are still using it as a mechanism for fitness in some cases and are likely receiving health benefits. The top responses for motivation in joining included “going to or from work” and “going to or from Metro, carshare, train, airport,” which indicates that many members use bikeshare to actively commute. The higher usages of Capital Bikeshare for commuting and to get to and from public transportation options suggests that the health advantages of active commuting for members could be applied here (as is suggested in the literature review).

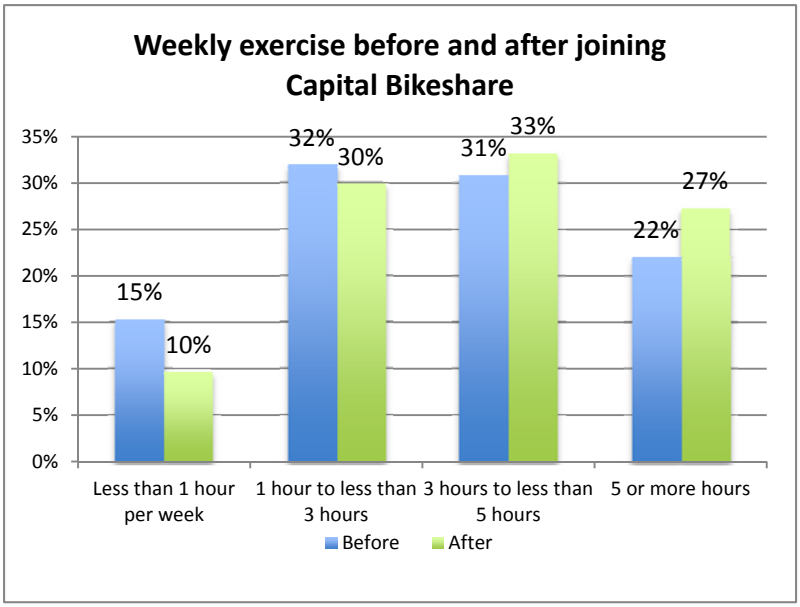
The additional data from the Health Implications survey was consistent with this idea; we saw that Capital Bikeshare members engage in quite a bit of exercise on a weekly basis, both through cycling and other outside physical activities. This is consistent with the Terzano & Morckel (2011) study which suggested that those who actively commute may engage in higher levels of physical activity outside of their commute. Although the typical Capital Bikeshare member only utilizes the program for 15-30 minutes (most likely due to the fact that bikes must be returned within 30 minutes to not incur a fee), many members take trips that are one mile or more in length when they rent a bike. As seen in the chart above, 28.5% of Capital Bikeshare members ride for 0.6 to 1 miles, 34.6% of members ride for 1.1 miles to 1.5 miles, 20.3% of members ride for 1.6 miles to 2 miles, and 12.2% of members ride over 2 miles on a typical Capital Bikeshare trip. In the aggregate, this means that over 67% of Capital Bikeshare members are riding at least one mile or more on average when they rent out a Capital Bikeshare bike.



Capital Bikeshare members also engage in quite a bit of physical activities outside the program. In a typical week, 29.9% of Capital Bikeshare members will exercise or engage in moderate to strenuous physical activities for about 1 hour to 3 hours. Further, 33.2% of Capital Bikeshare members engage in moderate to strenuous physical activities for 3 to 5 hours per week and another 27.3% of members engage in moderate to strenuous physical activities for 5 or more hours per week. This means that approximately 90% of all Capital Bikeshare members

engage in at least one hour or more of moderate to strenuous physical activities or exercise per week outside of bikeshare.

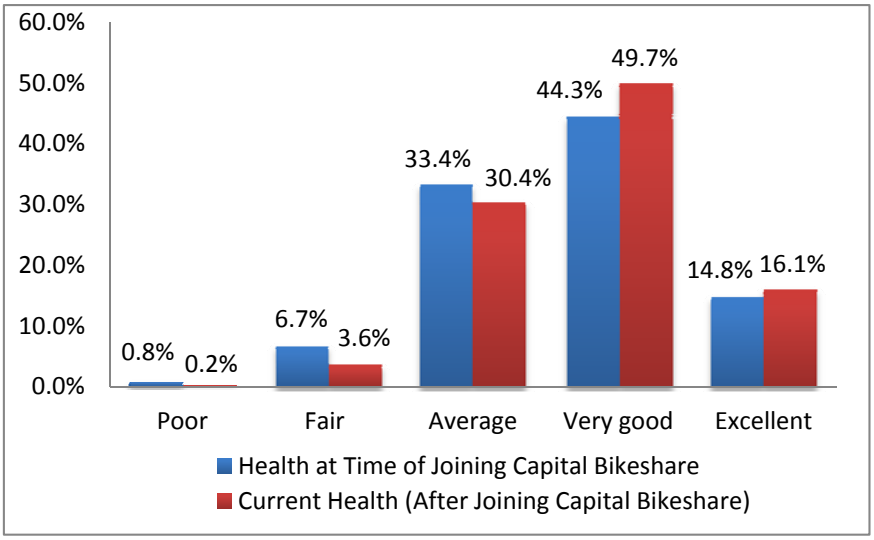
The data also showed that the time members spent being physically active has increased since joining Capital Bikeshare. Many respondents reported an increase in the amount of time per week spent performing moderate to strenuous physical activities. The percentage of individuals exercising the least (less than one hour per week) declined by 5 percent, while the percentage of individuals exercising the most (five or more hours per week) increased by 5 percent. Similarly, the "1 to 3 hours" category declined by 2 percent while the "3 to 5 hours" category increased by 2 percent. Thus, total hours per week spent exercising appears to have increased for most respondents after joining Capital Bikeshare.



In terms of types of exercise that members engage in each week, the top two answers to our survey were shown to be walking and jogging/running at 59.1% and 57.7% respectively. The third and fifth most frequent types of exercise that members engage in on a weekly basis are bicycling through Capital Bikeshare at 47.5% and bicycling in general at 39.6%. These statistics indicate that almost half of Capital Bikeshare members participate in the program for exercise benefits each week and utilize the program for this purpose. Furthermore, strength

training/weights (47.3%), fitness classes/aerobics (31.4%), and sports teams (17.5%) all ranked highly as well for types of exercise that members engage in each week. This means that although Bikeshare does provide exercise benefits for some members, many are engaging in a wide plethora of physical activities outside of the program on a weekly basis.

In terms of the general health of Capital Bikeshare members, we found that the average member tends to be in very good (49.7%) or excellent health (16.1%). As the chart indicates, members describing themselves as being in average, fair and poor health decreased from the time of joining Capital Bikeshare until now. A greater percentage of members now consider themselves in very good to excellent health than when they joined the program (whereas the opposite is found for members who consider themselves in average, fair, and poor health). Other health improvements reported include: reduced stress (31.5%), improved stamina (26.7%), increased energy (21.8%), and increased aerobic capacity (20.6%). Some members also reported changes in weight since joining. Over 30 percent of respondents indicated they had lost weight since joining, 60 percent reported no change, and 6 percent reported weight gain. Approximately 5 percent chose not to answer. Over one-quarter of respondents said their personal physique was “somewhat better” or “much better” since joining Capital Bikeshare.



The commuting and travel patterns of Capital Bikeshare members are also very revealing. Prior to joining Capital Bikeshare, members on average took a bicycle to get to work about 1.75 days a week. However, after joining the program, members now take a bicycle to get to work 3.08 days per week on average. Further, before joining Capital Bikeshare, members on average took public transportation 4.17 days per week. However, after joining the program, members on average now take public transportation about 3.5 days per week. After analyzing the data, it appears many members are now commuting more days per week via Capital Bikeshare or by riding their own personal bicycle than are taking public transportation.

Table 3	**Male**	**Female**
Concern with fitness, exercise (average importance on a scale of 1 to 5)	3.53	3.75
Use of Capital Bikeshare to go to/from Metro, carshare, train, airport (average importance on a scale of 1 to 5)	3.01	2.85
Most common trip length	15 minutes or less	16-30 minutes
Improvement in personal physique (percent indicating “somewhat better” or “much better” change)	28%	25%
Percent reporting weight loss since joining	32%	29%

Examining the response data according to certain demographic characteristics provide further insight into the Capital Bikeshare members. Notable discrepancies are provided and summarized in table 3.

Recommendations:

Recommendation 1: Health-Related Grants: Our first recommendation for Capital Bikeshare is to pursue more health-related grants in order to increase outreach to lower income communities. We saw in our research that lower income communities have higher rates of obesity and therefore could possibly have the most health benefits to gain. Our survey

indicated that this is currently an underrepresented market and from our contacts at Capital Bikeshare, we know that they would like to expand their presence in such communities. Many other bikeshare programs in the US are funded in part by health insurance companies or state and local health agencies. Kaiser Permanente has provided Denver's bikesharing program with $450,000 over three years and Blue Cross, Blue Shield provided NiceRide Minnesota with $1,000,000 (Farber et al., 2012, p.22). In addition, Blue Cross, Blue Shield of North Carolina is the primary sponsor of Charlotte B-cycle (Bethea, 2012) and Nashville B-cycle is funded by the Communities Putting Prevention to Work federal grant which is administered by the Metro Public Health Department (Schlesinger, 2012). It seems that there is an interest by health agencies and health care providers to fund bikeshare projects in order to encourage active and healthier lifestyles.

Recommendation 2: Health Impact Assessment Tool: Our second recommendation is that Capital Bikeshare uses a health impact assessment tool to better evaluate the health impacts of the program. Health impact assessments tend to be "applied to decisions made outside the health sector—for example, those concerning urban land use and transportation planning and permit issuing; energy and environmental regulating and permit issuing; and social policies such as providing a state energy assistance program or setting minimum wage requirements—where important health effects might be overlooked or ignored" (Wernham, 2011, p.948). In the area of transportation planning, health impact assessments could be particularly useful and could provide a more comprehensive picture of the health impacts of Capital Bikeshare.

A major impediment to conducting health impact assessments, however, is the time and cost involved (Wernham, 2011, p. 952). Potential solutions include collaboration with other agencies that would be capable of sharing the costs, both in terms of time and dollars as well as federal grant initiatives that provide monetary support to regional and local planning. Capital Bikeshare should explore these collaboration opportunities.

Recommendation 3: Surveys of Non-members: Our data is able to show general trends regarding the level of fitness and health of current members, but because of selection bias it is unable to show a correlation between membership and health improvements generally. A survey of those in underrepresented communities that evaluates the differences between members and non-members would better show the impacts of Capital Bikeshare membership. Additionally, a survey to non-members may point to the reasons why people aren't using the service, including: safety, neighborhood layout, access to sidewalks, and cultural pressures. If Capital Bikeshare wants to increase their presence in underrepresented communities, they will need to expand their understanding of the environment in these communities.

Recommendation 4: Annual Health Survey: Repeating the health survey annually will serve to measure changes in member health better than merely asking members to evaluate their health a year ago as opposed to today. Perhaps even more importantly, future surveys will measure the impact of health related outreach both generally and in the targeted communities. This is useful in terms of evaluating efficiency and effectiveness and could possibly be used in grant reports and requests.

Conclusion: By examining the available literature and surveying the current Capital Bikeshare membership, we found evidence that physical activity and active commuting can lead to health improvements. Capital Bikeshare members overall are rather healthy and take part in high levels of physical activity both through Capital Bikeshare and outside of it. From our data collection, there were member reports citing improvements in health, changes in physique, and weight loss since joining the program. Additionally, the average lengths of trips indicate that Capital Bikeshare is helping people meet their daily recommended levels of exercise.

By comparing demographic information from the membership survey and that from the 2010 Census, however, we found that Capital Bikeshare members are inherently different from the general population in DC, primarily along the lines of age, gender, income, and race. Given these differences and Capital Bikeshare's desire to increase usage in underrepresented communities, we recommend that Capital Bikeshare survey non-members, perform a health impact assessment, and repeat the health survey annually. These activities will better detail the exact health benefits of the program for all and will help gather the reasons why people aren't using bikeshare in these communities already. Capital Bikeshare would then be able to target their outreach more effectively. We also recommend that Capital Bikeshare pursue grants and other types of funding from health agencies and health care providers. This is a common practice among other bikeshare programs across the US and could help fund both outreach initiatives and the health impact assessment tool.

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Appendix A: Client Liaisons

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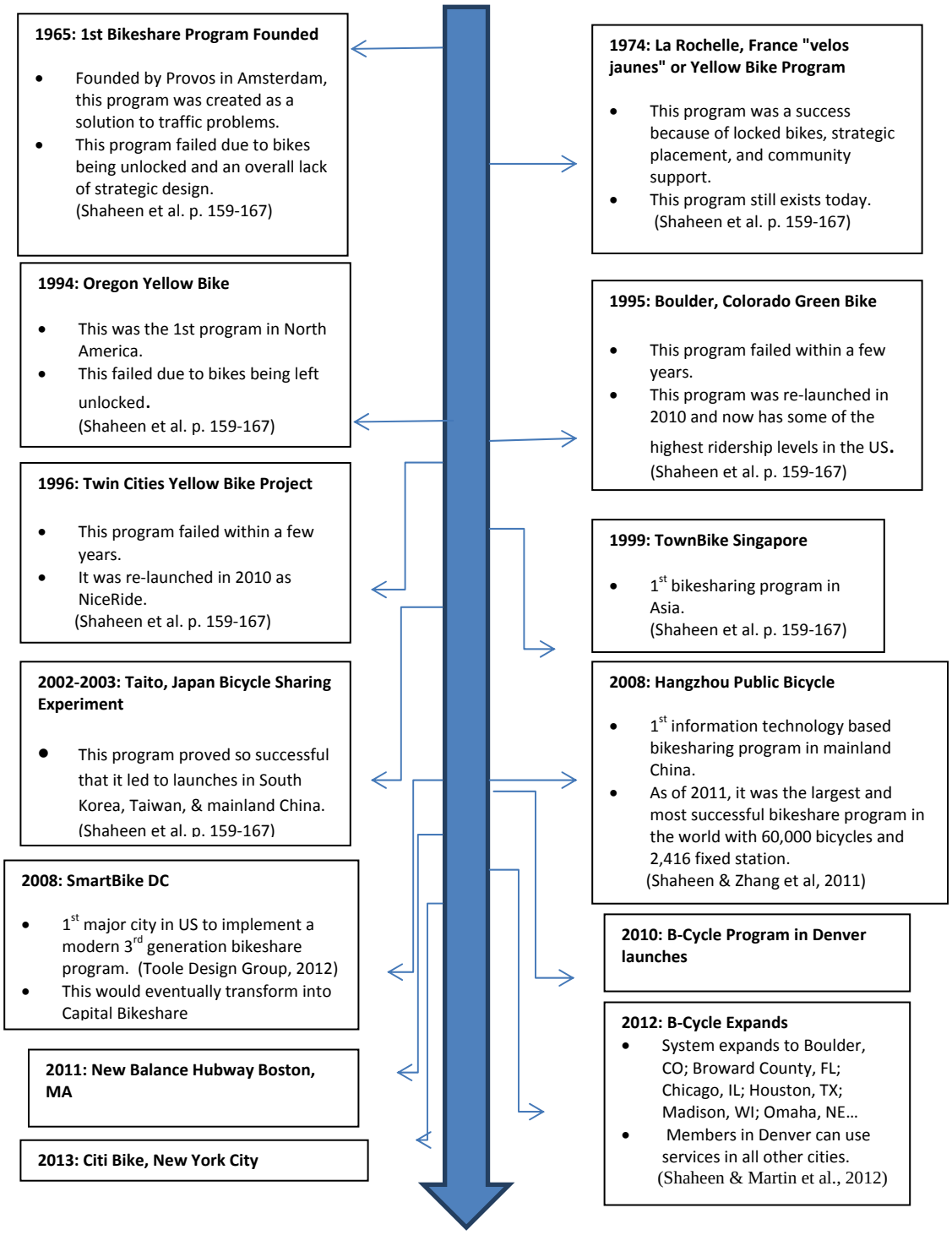
Appendix B: Abridged History of Bikesharing Programs

Bikesharing is emerging as a solution to a number of problems facing urban environments in the US. The literature describes it as a means to reduce traffic congestions, improve the environment, and improve the health of city residents by encouraging higher levels of physical fitness. A look at the history shows the development of bikesharing and its increasing prevalence in the United States.



Appendix C: Survey Questionnaire

1. Are you currently a member of Capital Bikeshare? If so, what membership level are you?
    a. Annual (Go to Q5.)
    b. Monthly (Go to Q5)
    c. 3 –day (Go to Q5.)
    d. 24-hour (Go to Q5)
    e. No longer member/former member of Capital Bikeshare (Go to Q2)
    f. Never used Capital Bikeshare (Go to Q3)

2. Why are you no longer a member of Capital Bikeshare? (Skip to end)
    a. Cost was too high
    b. Not convenient for traveling to my intended destination(s)
    c. Riding Capital Bikeshare was too strenuous and I would prefer to drive or take public transit
    d. I bought my own bike and now I do not need to take Capital Bikeshare
    e. Docks were not available when I needed them
    f. Bikes were not available when I needed them
    g. Moved out of the area
    h. Other _____

3. I haven't used Capital Bikeshare because: (Please select any that apply) (goes to Q4)
    a. I don't know how to ride a bike
    b. Riding a bike in the street seems too dangerous
    c. I don't know how Capital Bikeshare works
    d. I don't have a credit card for registration
    e. I don't have a bicycle helmet
    f. The stations are not in locations that are useful to me
    g. I have health issues that prevent me from riding
    h. I prefer to walk
    i. I prefer to ride my own bike
    j. I prefer to take a bus or train
    k. I would rather drive a car
    l. Other _____

4. I might try using Capital Bikeshare if: (please select any that apply) (Skip to end)
    a. I felt safer riding a bike on the street
    b. I knew more about how Capital Bikeshare worked
    c. The cost to use Capital Bikeshare was lower
    d. There was help for me to improve my bicycling skills
    e. There were more bike lanes on the street
    f. There were more off street bike paths
    g. There was a station closer to my home
    h. There was a station closer to my office or school
    i. There was a station closer to my bus or rail stop
    j. There were stations near where I shop or do errands
    k. Other _____

5. When did you join Capital Bikeshare?
    a. Aug-Dec 2010
    b. Jan-Mar 2011
    c. Apr-Jun 2011
    d. Jul-Sept 2011
    e. Oct-Dec 2011
    f. Jan-Mar 2012
    g. Apr-Jun 2012
    h. Jul-Oct 2012

6. What was your motivation for joining Capital Bikeshare? (Please rate each individually on a scale of 1 to 5, with 1 being a not at all important motivation and 5 being very important motivation)
    a. Save money on transportation ___
    b. Get around more easily, faster, shorter time ___
    c. Like to bike, fun way to travel ___
    d. Exercise, fitness ___
    e. Reduce carbon footprint, concerned about environment ___
    f. Health concerns ___
    g. Access to another bike / back-up bike ____
    h. Access to other form of transportation, new travel option/one-way travel option ___
    i. Other _____

7. In the past month, about how many Capital Bikeshare trips did you make?
    a. No trips
    b. 1 – 2 trips
    c. 3 – 5 trips
    d. 6 – 10 trips
    e. 11 – 15 trips
    f. 16 – 25 trips
    g. 26 or more trips

8. What are the primary types of trips for which you use Capital Bikeshare? (Please rate each individually on a scale of 1 to 5, with 1 meaning you never use Capital Bikeshare for this type of trip and 5 meaning you very often use Capital Bikeshare)
    a. Go to or from work ___
    b. Go to or from school ___
    c. Go to a meeting ___
    d. Social/ entertainment/ visit friends ___
    e. Restaurant / meal ___
    f. Exercise, recreation ___
    g. Shopping ___
    h. Errands, personal appointments ___
    i. To or from Metro, carshare, train, airport ___

9. How long is your average trip on Capital Bikeshare?
    a. 15 minutes or less
    b. 16- 30 minutes
    c. 31 minutes - 1 hour
    d. Over 1 hour

10. How far is your average trip on Capital Bikeshare?
    a. .5 mile or less
    b. .6 mile – 1 mile
    c. 1.1 miles – 1.5 miles
    d. 1.6 miles – 2 miles
    e. Over 2 miles

11. In a typical week, about how many total hours do you spend riding a Capital Bikeshare bike?
    a. Less than 1 hour per week
    b. 1 hour to less than 3 hours
    c. 3 hours to less than 5 hours
    d. 5 or more hours

12. In a typical week, how many hours do you exercise or engage in moderate to strenuous physical activities?
    a. Less than 1 hour per week
    b. 1 hour to less than 3 hours
    c. 3 hours to less than 5 hours
    d. 5 or more hours

13. Outside of Capital Bikeshare, how many hours a week do you exercise or engage in moderate to strenuous physical activities?
    a. Less than 1 hour per week
    b. 1 hour to less than 3 hours
    c. 3 hour to less than 5 hours
    d. 5 or more hours

14. What types of physical activities do you do for exercise? (check all that apply)
    a. Jogging/ running ___
    b. Walking
    c. Bicycling (Capital Bikeshare) ___
    d. Bicycling (other than Capital Bikeshare) ___
    e. Sports teams (e.g., baseball, soccer, etc)___
    f. Fitness classes / aerobics ___
    g. Swimming ___
    h. Strength training / weights ___
    i. Other _____

15. Before you joined Capital Bikeshare, how many hours a week did you exercise or engage in moderate to strenuous physical activities?
    a. Less than 1 hour per week
    b. 1 hour to less than 3 hours
    c. 3 hours to less than 5 hours
    d. 5 or more hours

16. Since joining Capital Bikeshare, has your amount of physical activity changed?
    a. Greatly decreased
    b. Somewhat decreased
    c. No change, stayed the same
    d. Somewhat increased
    e. Greatly increased

17. In general, how would you rate your general health?
    a. Poor
    b. Fair
    c. Average
    d. Very good
    e. Excellent

18. How would you rate your general health at the time you joined Capital Bikeshare?
    a. Poor
    b. Fair
    c. Average
    d. Very good
    e. Excellent

19. Has your health improved in any of the following ways since you joined Capital Bikeshare? (Check all that apply)
    a. Improved stamina ___
    b. Weight loss ___
    c. Improved overall health ___
    d. Reduced stress ___
    e. Increased energy ___
    f. Increased aerobic capacity ___
    g. Improved muscle tone ___
    h. None of these changes ___
    i. Other _____

20. Has your weight changed since you joined Capital Bikeshare?
    a. Lost 1 to 5 pounds
    b. Lost 6 to 10 pounds
    c. Lost 11 to 15 pounds
    d. Lost 16 to 20 pounds
    e. Lost more than 20 pounds
    f. No change in weight
    g. Gained 1 to 5 pounds
    h. Gained 6 to 10 pounds
    i. Gained 11 to 15 pounds
    j. Gained 16 to 20 pounds
    k. Gained more than 20 pounds
    l. Prefer not to answer

21. What is your approximate weight? (Optional)

22. What is your approximate height? (Optional)

23. Has your personal physique changed since you joined Capital Bikeshare?
    a. It is much worse now
    b. It is somewhat worse now
    c. It has not changed
    d. It is somewhat better now
    e. It is much better now

24. How would you characterize your eating habits? (a “healthy diet” features a **high** consumption of fruits and vegetables, whole grains, and protein primarily from fish and dairy products; and a **low** consumption of red meat, fatty foods, processed foods, sugar, coffee and other caffeinated beverages).
    a. I eat very healthy all of the time
    b. I eat healthy most of the time
    c. I eat healthy some of the time
    d. I don’t eat very healthy most of the time
    e. I never eat healthy

25. If you smoke cigarettes, how much do you smoke?
    a. I never smoke cigarettes
    b. I smoke occasionally / socially
    c. A few cigarettes a week
    d. 1 to 10 cigarettes per day
    e. 11 to 19 cigarettes per day
    f. 1 pack or more per day
    g. Prefer not to answer

26. If you drink alcohol, how much do you drink in a week?
    a. I never drink alcohol
    b. 1 drink or less per week
    c. 2 to 3 drinks per week
    d. 4 to 6 drinks per week
    e. 7-13 drinks per week
    f. 14 or more drinks per week
    g. Prefer not to answer

27. Do you have a family history of any of the following conditions? (Please check all that apply).
    h. Heart disease ___
    i. Heart attacks ___
    j. Strokes ____
    k. Diabetes ____
    l. None of these conditions____
    m. Prefer not to answer ____

The remaining questions are for classification purposes only.

28. Are you currently employed, either full-time or part-time?
    a. Yes, employed full-time
    b. Yes, employed part-time
    c. Not employed (SKIP TO Q34)
    d. Prefer not to answer (SKIP TO Q34)

29. About how many miles is it from your home to you usual work location?

30. In a typical week, how many days do you use each of the following types of transportation to get to work? If you use more than one type on a single day, such as walk to a bus stop then ride a bus, report the type you use for the longest distance part of your trip.
    a. Bicycle
    b. Walk
    c. Ride public transit (bus, Metrorail, or commuter train)
    d. Drive alone
    e. Ride in a carpool or vanpool
    f. Taxi
    g. Telework (count only days you work at home All DAY)

31. In the past year, did you make any of the following changes in how you travel to work? (Please select all that apply)
    a. Started riding a bike to work; ride a bike more often
    b. Started walking to work; walk more often
    c. Started riding public transit to work; ride transit more often
    d. Started carpooling or vanpooling to work; carpool or vanpool more often
    e. Started teleworking; telework more often
    f. No changes

32. Before you made this change, how many days in a typical week did you use each of the following types of transportation to get to work?
    a. Bicycle
    b. Walk
    c. Ride public transit (bus, Metrorail, or commuter train)
    d. Drive alone
    e. Ride in a carpool or vanpool
    f. Taxi
    g. Telework (count only days you work at home All Day)

33. What is your work Zip Code?

34. What is your home Zip Code?

35. In which of the following jurisdictions do you live?
    a. District of Columbia
    b. City of Alexandria
    c. Arlington County
    d. Fairfax County
    e. Loudoun County
    f. Montgomery County
    g. Prince George's County
    h. Prince William County
    i. Other _____

36. In which Ward do you reside in Washington, D.C.?
    a. Ward 1
    b. Ward 2
    c. Ward 3
    d. Ward 4
    e. Ward 5
    f. Ward 6
    g. Ward 7
    h. Ward 8
    i. I don't know
    j. Prefer not to answer

37. Are you male or female?
    a. Male
    b. Female
    c. Prefer not to answer

38. What is your age?
    a. 16-17 years old
    b. 18-24
    c. 25-34
    d. 35-44
    e. 45-54
    f. 55-64
    g. 65 years or older
    h. Prefer not to answer

39. Approximately what was your total household income last year?
    a. Less than $10,000
    b. $10,000 - $14,999
    c. $15,000 - $24,999
    a. $25,000 - $34,999
    b. $35,000 - $49,999
    c. $50,000 - $74,999
    d. $75,000 - $99,999
    e. $100,000 - $124,999
    f. $125,000 - $149,999
    g. $150,000 - $199,999
    h. $200,000 or more
    i. Prefer not to answer

40. How many people reside in your household?
    a. 1 (Just myself)
    b. 2
    c. 3
    d. 4 or more

41. What is the highest level of education you have completed? Less than high school
    a. High school diploma / GED
    b. Some college
    c. 2 year college degree
    d. 4 year college degree
    e. Masters degree
    f. Doctoral degree
    g. Prefer not to answer

42. What of the following best describes your racial or ethnic background?
    a. Asian/Pacific Islander
    b. Black/African-American
    c. Caucasian
    d. Hispanic
    e. Other/Multi-Racial
    f. Prefer not to answer

43. If you'd like to be entered into a drawing for a free [Prize – Kindle Fire?], please enter your information below. (Optional)
    a. Name _____
    b. Email Address _____
    c. Phone Number _____

44. Comments:

Thank you for completing this survey. We value your input!