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# The Bogota Ciclovía-Recreativa and Cicloruta Programs: Promising Interventions to Promote Physical Activity, and Social Capital in the City of Bogota

Andrea D. Torres

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# **The Bogota Ciclovía-Recreativa and Cicloruta programs: Promising interventions to promote physical activity, and social capital in the City of Bogota**

## **Abstract**

**Background:** The Ciclovía program (60.3 miles of streets temporarily closed to motorized vehicles and open to pedestrians) and the Ciclorutas (186.4 miles bicycle paths network) represent two policy and built environment approaches that have been implemented in Bogota, Colombia to increase access to recreational and physical activity (PA) opportunities and promote active transportation. Both programs have other potential public health outcomes such as quality of life and social capital. Both physical activity and social capital have been demonstrated to be strongly related with health. The purpose of this study was to describe and compare the participants from Ciclovía and Cicloruta and to explore how program usage relates to public health outcomes including, physical activity, social capital and equity.

**Methods:** Analysis based on secondary data obtained from two surveys, one conducted in the Ciclovía and the other in the Ciclorutas in Bogota, Colombia. First, the general characteristics of the users of both programs were described and compared using the Pearson chi-square test. Second, a principal component analysis (PCA) was conducted to reduce the number of SC variables from the Ciclovía survey, by using a varimax (orthogonal) rotation method. A binary logistic regression adjusted model was developed to examine the relationship between frequency of participation on the Ciclovía and perceived SC levels. In addition, two adjusted multivariate logistic regression models were conducted to examine associations between meeting the PA recommendations with the characteristics of program use/participation.

**Results:** The majority of the Ciclovía participants reported meeting the PA recommendation in leisure time (59.5%), whereas near all Cicloruta participants reported to meet the recommendations by cycling for transportation (70.5%). The safety perception was higher among Ciclovía users with 51.2% of those surveyed having reported feeling safe at the Ciclovía with respect to traffic and accidents and 42.4% with regard to crime. Results from the logistic regressions showed that participants who reported more frequent participation in the Ciclovía program were more likely to have a higher SC perception (OR=2.0, 95%CI=1.4-2.8), those who reported regular participation in the program had increased odds of meeting the PA recommendation in leisure time (OR=1.7, 95%CI=1.1-2.4), as well as those who reported to perform vigorous (OR=4.9, 95%CI=2.5-9.2) and moderate (OR=1.9, 95%CI=1.2-3.0) physical activity during the Ciclovía. For the Ciclorutas males (OR=1.94, 95%CI=1.2-3.2), regular Cicloruta users (OR=10.18, 95%CI=6.1-16.8), and Cicloruta users who reported participation in the Ciclovía over the last 12 months (OR=1.6, 95%CI=1.1-2.2), were more likely to meet the PA recommendation by cycling for transportation.

**Conclusions:** The Ciclovía program and Cicloruta system represent two policy and environmental approaches that have the potential to equitably promote physical activity and provide a mobility alternative in complex urban settings such as the city of Bogota. Specifically the Ciclovía program also provides enhanced social environments in which the program users also feel safer.

**THE BOGOTA CICLOVIA-RECREATIVA AND CICLORUTA PROGRAMS:  
PROMISING INTERVENTIONS TO PROMOTE PHYSICAL ACTIVITY, AND  
SOCIAL CAPITAL IN THE CITY OF BOGOTA IN COLOMBIA.**

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A Thesis Submitted to the Graduate Faculty of Georgia State University in Partial Fulfillment of  
the Requirements for the Degree

Master of Public Health

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2011

The Bogota Ciclovia-Recreativa and Cicloruta programs: Promising interventions to promote physical activity, and social capital in the City of Bogota in Colombia.

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## **Dedication**

This accomplishment is dedicated to the love of my life: my husband for being my permanent support and for always standing by my side to help me achieving this very important goal for my life. I love you Tito.

To my mom for her love and for giving me everything I needed in my life to be a good person and to be able to achieve all I want in my personal and professional life.

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Last but not least, my thesis and graduation were possible due to the encouragement and constant support of those who I consider more than my team and mentors, my second family since I came to the US: Mike Pratt, who believed in me and gave me the opportunity to work in this wonderful country 5 years ago; Becky Lanckenau and Tom Schmid my permanent supporters, thanks so much for all your patience and flexibility and for all your valuable advice and guidance; and Madita my dear friend, who has always been there for me in all my ups and downs, thanks for your love and support, you know what you mean to me. Words cannot really express my love, respect and appreciation to all of you.

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- Isabela C. Ribeiro, **Andrea Torres**, Diana C. Parra, Rodrigo Reis, Christine Hoehner, Thomas L. Schmid, Michael Pratt, Luiz R. Ramos, Eduardo J. Simões, and Ross C. Brownson. Using Logic Models as Iterative Tools for Planning and Evaluating Physical Activity Promotion Programs in Curitiba, Brazil. *Journal of Physical Activity and Health*, 2010, 7(Suppl 2), S155-S162
- Isabela C. Ribeiro, Diana C. Parra, Christine M. Hoehner, Jesus Soares, **Andrea Torres**, Michael Pratt, Branka Legetic, Deborah C. Malta, Victor Matsudo, Luiz R. Ramos, Eduardo J. Simoes and Ross C. Brownson. School-based physical education programs: evidence-based physical activity interventions for youth in Latin America. *Global Health Promotion*, 2010, 1757-9759; Vol 17(2): 05–15; 365231
- Ciclovía Recreativa Implementation and Advocacy Manual. The Pan American Health Organization’s Regional Council on Healthy Eating and Active Living and Non-Communicable Disease Unit, La Via RecreActiva of Guadalajara, the Schools of

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- Mosquera M Janeth, **Torres Andrea**, Gómez LF, Parra D, D Lucumí. “Understanding walking patterns among elderly population in Bogotá- Colombia: a qualitative approach”.
- Ribeiro Isabella , Parra Diana, Hoehner Christy, Soares Jesus, **Torres Andrea**, Pratt Michael, Legetic Braka, Carvalho DM, Matsudo V, Ramos LR, Simões EJ, Brownson RC. “School-based physical education programs: evidence-based physical activity interventions for youth in Latin America”.
- Ribeiro Isabella, **Torres Andrea**, Parra Diana, Reis R, Hoehner C, Thomas Schmid, Pratt M, Ramos R, Simoes E, Brownson R: Using Logic Models as Iterative Tools for Planning and Evaluating Physical Activity Promotion Programs in Curitiba, Brazil. Third International Congress on Physical Activity and Public Health, May 5-8, 2010 in Toronto, Canada.

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# CHAPTER 1

## Introduction

### **1.1 Background: Physical activity and health in Bogota, Colombia, and the broader international context**

The health benefits of regular physical activity (PA) have been extensively documented<sup>1</sup>, especially as a protective behavior for the prevention of chronic diseases and risk factors such as obesity, lipid disorders and hypertension<sup>2</sup>. Strong evidence indicates that physically active individuals have a lower risk of premature death compared to their sedentary counterparts<sup>3</sup>, even if they engage in moderate intensity activity. Furthermore, higher levels of activity provide greater effects.<sup>4</sup> The World Health Organization (WHO) emphasized the relevance of physical activity for public health globally by recognizing physical inactivity as the fourth leading risk factor for death in all income level countries, especially in middle income countries, such as the Latin American countries<sup>5</sup>.

The growing prevalence of physical inactivity and non-communicable diseases (NCDs) that Latin America has faced as a result of the epidemiological transition and globalization<sup>6</sup>; is also affecting an important percentage of the population in Colombia<sup>7</sup>. In fact, research conducted in Bogota, the capital of Colombia, found that NCDs related with atherosclerosis and vascular system diseases are the first cause of premature death among adults 45 to 59 years old, and the first cause of death for older adults in the city<sup>8</sup>. Importantly, the findings suggest that the majority of these deaths could be attributed to physical inactivity<sup>8</sup>. Recent data from the National Survey of the Nutritional Situation in Colombia<sup>9</sup> showed that 42.2% of the adults in Bogota did not meet the physical activity recommendations for health; only 18.3% met the recommendations doing activity on leisure time, 4.3% cycling for transportation, and 40.5%

walking for transportation. Furthermore, 70% of the children between 5 to 12 years old, and 77% between 13 to 17 years old were exposed to two hours or more of TV watching (sedentary time) per day. TV watching and levels of overweight increased for these age groups from 2005 to 2010. Overweight and obesity levels also increased in adults in Bogota<sup>9</sup>.

The good news is that even fairly small increases in PA can generate valuable positive health impacts at the population level<sup>10, 11</sup>. This is also true for the population in Bogota<sup>8</sup>. Consequently, it is imperative to continue to focus attention on the promising community-wide interventions to increase PA, such as environmental and policy interventions. Evidence suggests that the implementation of strategies to enhance built and social environments are essential to effectively increase PA and to improve health and quality of life at the population level<sup>12,13</sup>. In addition, the comprehensive nature of this strategies, could have relevant indirect impacts at the social level, such as promote social capital, safety and equity<sup>12,14,15</sup>. Indeed, the city of Bogota has been recognized for the implementation of policies, programs and built environment changes that have increased access to recreational facilities and programs, and have promoted public transportation and active commuting<sup>16</sup>. Two of the most acknowledged approaches that the city has implemented since the late 90's to increase leisure time and transportation PA are the Ciclovía program and the Ciclorutas (Bicycle paths) network<sup>16</sup>.

The Ciclovías program is a community-based program in which streets are temporarily closed to motorized vehicles to exclusively allow access to pedestrians, cyclist, rollerbladers, and others for active recreational activities<sup>17</sup>. Currently, a circuit of 97 km (60.3 miles) of main avenues is closed in Bogota for the Ciclovía<sup>18</sup>, almost every Sunday and holiday of the year (72 events per year, from 7am to 2pm). The estimated participation of the program ranges from 600,000 to 1,000,000 people per Sunday along the 60-mile circuit, which also offers a variety of

complementary physical activities such as aerobics and biking classes<sup>17</sup>. The Bogota Ciclovía was found to be a cost-beneficial program for the city<sup>19</sup> and was recognized by the Guide for Useful Interventions for Activity (GUIA) systematic review in Latin America as a promising intervention for PA promotion for the region within the category of “community-wide policies and planning”<sup>6</sup>.

The Cicloruta is the most extensive bicycle path network in Latin America<sup>20</sup> with 300 km (186.4 miles) of cycling paths. The network of paths connects with public transportation and provides access to several destinations in the city including schools, recreational facilities, and worksites<sup>16</sup>. The characteristics of the Ciclorutas in Bogota and the socio-economic context of the city make this cycling network a promising approach for future public health impact. Besides, if the use of Ciclorutas for transportation increased, they could be an alternative to improve the mobility issues of the city and other social and environmental outcomes could also be achieved.

Both initiatives, the Ciclovía as a recreational program and Ciclorutas as a transportation program, have strong potential to increase PA levels in Bogota<sup>17,21</sup>; however this potential should be analyzed for two separate PA domains: leisure time PA (LTPA) for Ciclovías and transportation (utilitarian) PA for Ciclorutas; Each domain is influenced by different environmental and policy determinants<sup>22</sup>. Other critical public health co-benefits that could be related with both programs include quality of life, health, social capital, equity and air quality<sup>17,21,23,24</sup>. Unfortunately, specific evidence on the association that Ciclovías and Ciclorutas have with PA and other health-related outcomes is limited<sup>16, 17,18</sup>. Furthermore, few articles have described characteristics of the Bogota Ciclovía and Cicloruta programs on health-related outcomes.

Nonetheless, the exponential growth of Ciclovias around the world (especially in the Americas) and the strong evidence on the impact of Ciclorutas internationally should be acknowledged. In fact, both programs were recognized as promising interventions to increase PA and prevent Non-Communicable diseases at the population level by the World Bank<sup>25</sup>. Similarly a systematic review conducted in 2008 found 57 Ciclovía programs in the Americas, from which 38 were active programs that met the inclusion criteria, 24 had been launched over the two last decades, and 9 had been carried out in the US, which indicates the expansion of this programs beyond Latin America<sup>17</sup>. In addition the Ciclovias have been documented as programmatic interventions that could promote cycling at the population level<sup>26</sup> for transportation. Equally important is the evidence that shows how the provision of separate cycling paths along the roads (Ciclorutas) have been significantly associated with increasing cycling for transportation in European and American cities<sup>26</sup>. Other studies have shown the same positive association in other developed countries such as Australia<sup>27</sup> and Canada<sup>28</sup>.

This context emphasizes both the opportunity and need to learn more about these two promising approaches for PA and health promotion in the city of Bogota, which could also provide other benefits to the population. This is especially important considering the potential that PA for transportation has in Bogota, and the need to increase LTPA<sup>9</sup> among all age groups.

## **1.2 Purpose of the Study**

The purpose of this study was to describe the characteristics of the participants from Ciclovía and Cicloruta, compare program participation frequencies, and general demographic characteristics. In addition, we explored how program usage relates to public health outcomes including, physical activity, safety perception, social capital and equity.

### **1.3 Research Questions:**

1. What are the main differences between the characteristics of the Ciclovía and Cicloruta participants with respect to socio-demographics, physical activity behavior and social capital perception?
2. What are the characteristics of the Ciclovía users that are related with meeting the PA recommendations in leisure time?
3. Is the level of Social Capital perception associated with the frequency of participation in the Ciclovía program?
4. What are the characteristics of the Cicloruta users that are related with meeting the PA recommendations by cycling for transportation?

## CHAPTER 2

### Literature Review

#### 2.1 Physical Activity Recommendations for Health

Physical Activity (PA) was originally defined as “any bodily movement produced by skeletal muscles that results in energy expenditure”<sup>29</sup>. This definition differentiated PA from exercise and fitness, and allowed the beginning of a new field in public health: physical activity and public health, which is concerned with the incorporation of physical activity as part of the daily life of the individuals, for achieving health benefits and preventing disease. One key consequence of the evolution of the PA concept globally has been the development of PA recommendations or guidelines directed to entire populations. The WHO, in an effort to provide a unified message around the world and reach low and middle income countries, recently published the Global Recommendations on PA for Health<sup>30</sup>, which are consistent with the 2008 PA Guidelines for Americans<sup>31</sup>. The recommendations provide guidance on the minimum amount of physical activity that any person should do to obtain health benefits and prevent diseases, and how it can be incorporated into daily life. The guidelines recommend that adults accumulate at least 150 minutes of moderate intensity aerobic activity throughout the week or 75 minutes of vigorous activity, both in bouts of at least 10 minutes each time<sup>30</sup>. Table 1 summarizes the recommendations by age group.

**Table 1. Summary of the WHO Global Recommendations on Physical Activity for Health by age group<sup>30</sup>.**

Age	Recommendation
<b>Children and youth aged 5–17</b>	<ul style="list-style-type: none"> <li>• Accumulate at least 60 minutes of moderate- to vigorous intensity physical activity a day.</li> <li>• Amounts of physical activity greater than 60 minutes provide additional health benefits.</li> <li>• Most of the daily activity should be aerobic.</li> <li>• Vigorous-intensity activities should be incorporated</li> <li>• Muscle and bone strengthening activities at least 3 times per week.</li> </ul>
<b>Adults 18-64</b>	<ul style="list-style-type: none"> <li>• Accumulate at least 150 minutes of moderate or 75 minutes of vigorous intensity aerobic activity throughout the week, performed in bouts of at least 10 minutes duration.</li> <li>• Additional health benefits can be accomplished by increasing moderate-intensity activity to 300 minutes per week, or engaging in 150 minutes of vigorous activity per week, or an equivalent combination of both.</li> <li>• Muscle-strengthening activities should be performed on 2 or more days a week.</li> </ul>
<b>Older Adults 65 and above</b>	<ul style="list-style-type: none"> <li>• Follow the recommendations for adults</li> <li>• Adults of this age group, with poor mobility, should perform physical activity to enhance balance and prevent falls on 3 or more days per week.</li> <li>• Muscle-strengthening activities should be done involving major muscle groups, on 2 or more days a week.</li> <li>• When adults of this age group cannot do the recommended amounts of physical activity due to health conditions, they should be as physically active as their abilities and conditions allow.</li> </ul>

## **2.2 Environment and policy interventions to promote physical activity**

Increasing evidence suggests that built environment policies influence PA behaviors and are important contributors to comprehensive efforts to effectively increase PA at the population level<sup>13</sup>. People who live in communities with environments that encourage them to engage in recreational or transportation physical activity are more likely to be active<sup>14</sup>. The Community

Guide systematic review identified two evidence-based environmental and policy approaches that can increase PA at the community level<sup>32</sup>:

- Community-scale urban design and land use regulations, policies, and practices, which include policies to promote mixed land use, safe and appealing neighborhoods and routes, and street connectivity.
- Street-scale urban design and land use approaches, which target smaller geographic areas, include street lighting, and other safety features and improved aesthetics of streets.

Both approaches were positively associated with higher levels of PA both in the leisure and transportation domains<sup>32</sup>. Nonetheless, it is important to analyze each domain separately, because they are influenced by different environmental and policy determinants<sup>22</sup>.

### **2.3 Environmental and policy approaches and leisure time physical activity**

Researchers have explored the relationship of environment and policies on leisure time physical activity (LTPA), with special emphasis on walking, which is the most common type of physical activity for adults<sup>12</sup>. Evidence suggests that LTPA has a stronger correlation with intrapersonal and neighborhood attributes<sup>33</sup>. A review showed that positive perceptions of the neighborhood environments were associated with higher levels of LTPA. Stronger associations were observed for access-proximity to facilities, opportunities to be active and aesthetic characteristics of the neighborhood. The relationship with safety was in the same direction but was not as strong<sup>34</sup>. Hoehner et, al., also found that LTPA had a positive association with access to recreational facilities (e.g. parks, recreational areas, trails) and neighborhood aesthetics, including maintenance and presence of trees<sup>22</sup>. Similarly, studies conducted in Latin America have shown that environmental attributes are related with LTPA. Parra, et al., found that people

reporting high accessibility to trails, or any other recreational facility had increased odds of being active in leisure time and meeting the PA recommendation<sup>31</sup>. Higher safety perception and good perception of the quality of the pedestrian space was associated with meeting the overall PA recommendation (transportation and leisure)<sup>35</sup>.

More specifically, research in Bogota indicated that adults living in neighborhoods with higher park density and presence of TransMilenio stations (Bus Rapid Transit-BRT system) had higher levels of walking during leisure time; but those living in neighborhoods with slopes higher than 4% were less likely to be active in leisure time<sup>36</sup>. In another study examining the Ciclovía, the lack of female participation and lack of intention to lose weight were associated with being inactive in leisure time<sup>37</sup>. Sarmiento et al, explored the association of environmental characteristics and Health Related Quality of Life (HR-QOL) among adults in Bogota. Their findings suggested that mixed land-use and park density was positively associated with HR-QOL<sup>38</sup>.

## **2.4 Environmental and policy approaches and transportation physical activity**

In contrast, physical activity for transportation has been found to have a stronger influence from physical environment characteristics. It is suggested that cycling for transport is mainly associated with number of destinations along the routes, access to public transportation, access to bike lanes, higher numbers of active people in the neighborhood<sup>22</sup>, not having a car at home, and perception of behavioral control over cycling<sup>33</sup>. Two comparative studies of active travel, one between the US and Germany<sup>39</sup>, and the other between the US and Canada<sup>28</sup> demonstrated that active transportation was positively associated with meeting the PA recommendations. The authors indicated that the higher prevalence of active transportation in

Germany and Canada compared to the US, has been a result of the implementation and enforcement of policies to enhance safety and convenience for active commuters, including, car-free zones and bike trail networks<sup>39,28</sup>. Other research has shown positive associations between active commuting and health outcomes including, lower levels of obesity and diabetes<sup>40</sup>, reduction of air pollution and noise level; and enhancement of quality of life and social capital<sup>21</sup>.

Evidence on PA for transportation is more limited in Latin America<sup>41</sup>; although some research has been conducted in Brazil and Colombia. Data from Brazil indicated that cycling for transportation was significantly associated with the number of nearby destinations<sup>35</sup>. A population-based study in Bogota indicated that 16.7% of the adults reported cycling for transportation; higher prevalence was reported by those having close access to Ciclorutas (bike paths); and those who reported living in a neighborhood with flat terrain and participating in the Ciclovía programs. The use of bike for transport was lower among women and people with college education<sup>41</sup>.

## **2.5 The relationship between Social Capital and Health**

The concept of Social Capital (SC) was introduced by Pierre Bourdieu in the 80's but has been widely explored over the last decade<sup>42</sup> to explain how social environments influence every aspect of our lives, including health. One of the first, currently used definitions of SC was proposed by Putnam, who described SC as “features of social organization, such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit”<sup>43</sup>. Other components of SC have been documented including, shared values, mutual support, cooperation<sup>44</sup>, social participation<sup>45</sup>, social cohesion and collective efficacy<sup>46</sup>.

There has been growing evidence on the relationship between the levels of social capital and different health-related outcomes and well-being<sup>42, 44</sup>. Individuals can obtain health benefits by being connected with specific social networks and collectively health benefits could be a result of living in neighborhoods with higher social interaction<sup>15</sup>. A study conducted in Los Angeles County using data from the “Los Angeles Family and Neighborhood Study” (LAFANS), showed that lower levels of collective efficacy (a combination of trust in a social group and willingness to help other community members for a common good<sup>46</sup>) measured among adults in several neighborhoods in LA had a significant association with increased odds of being overweight or at risk of being overweight<sup>47</sup>.

A recent cohort study conducted in Thailand indicated that poor self-reported and physiological health was associated with low levels of two social capital components: trust and social support<sup>48</sup>. These associations may be true in other middle income countries. A review of literature from research conducted in Latin America concluded that there is incipient evidence that high SC has been associated with better mental health and lower prevalence of trauma<sup>49</sup>. There has only been one study that explored SC and health in Colombia and the authors found that cognitive social capital (perception of trust and reciprocity) and membership to associations were related to a better self-reported overall health<sup>50</sup>.

Research focused on built environment and SC has demonstrated that living in neighborhoods with more parks is strongly associated with higher collective efficacy<sup>15</sup>. Moreover, parks with higher social capital levels have shown better safety perceptions, more users and higher levels of physical activity<sup>51</sup>. A study conducted in Japan indicated that higher levels of the cognitive dimension of social capital (trust) were significantly associated with lower odds of physical inactivity<sup>52</sup>. Likewise, Lindstrom, et al., found social participation measured

at the individual level to be strongly related with higher levels of LTPA. The neighborhoods with more participative communities had increased PA levels compared to the ones with lower levels of social participation<sup>45</sup>.

High levels of SC have also been associated with prevention of crime and as buffers of socioeconomic inequalities<sup>53</sup>. Income inequalities are associated with low SC, poor health, and less socially cohesive environments, which often generate higher crime rates. Higher collective efficacy and overall social capital can play an important role in protecting the health of those living in conditions of disadvantage<sup>54</sup> and also in decreasing crime rates that are frequent under such living conditions<sup>53</sup>.

These findings are relevant to this current study, and represent an opportunity to start exploring how two approaches that provide free access to facilities for transportation and recreation such as the Ciclovias and Ciclorutas, could be related with SC and equity in a context of high socioeconomic inequalities such as the city of Bogota.

In sum, there is strong evidence on the impact that the implementation of comprehensive policies and environmental interventions may have to promote leisure time and transportation PA and other health-related and social benefits at the population. Both the Ciclovias and Ciclorutas in Bogota are examples of these type of interventions in Latin America, and have become role model for many cities in the region. Nonetheless, few studies have explored the potential outcomes of these interventions in the city and none have compared the characteristics of the users of the two programs to better understand how they function, how they influence various aspects of the city, and how they can be enhanced. This study will describe the users of the two programs and analyze their PA, and social capital characteristics.

## CHAPTER 3

### Methods

#### 3.1 Study Setting:

The data for this study was collected in Bogota the capital of Colombia. The city is located in the Andes Mountains, 8,500 ft above the sea level, with an average temperature of 57 °F varying from 37 to 77 °F throughout the day. Dry and rainy seasons alternate during the year. The city has 6,778,691 inhabitants<sup>55</sup>, and is divided in a six level socioeconomic strata (SES) index, which classifies the households based on their location, surrounding areas and physical characteristics. SES 1 is the lowest and 6 the highest level<sup>56</sup>. Bogota is a city with important safety issues. Data from a safety report in Bogota showed that the main safety problems that the city faced during the first semester of 2010 included: homicides (801 cases), interpersonal violence (21,292 cases) and traffic death (253 cases), in which 3 out of 5 victims were pedestrians. Robbery with 8042 reported cases and automobile theft with 2281 reported cases represent an additional safety challenge for the city<sup>57</sup>.

#### 3.2 Data Sources

Data for this study was obtained from a survey designed and conducted in Bogota, Colombia by researchers of the Schools of Engineering and Medicine from Los Andes University in October to December 2009. The study was originally approved by the Research Ethics Committee from the University. The principal investigators approved the use of the data for the current study. The surveys were de-identified and analyzed in a secondary analysis that was approved by the Georgia State University Institutional Review Board (IRB) on March 28,

2011. The data were gathered using two intercept surveys: one performed on Ciclorutas and one during Ciclovias. The methods for each one are described as follows:

**3.2.1 The Cicloruta Survey:** This survey was conducted among 1000 adult cyclists who were intercepted on the Cicloruta (bike paths network). The bike paths network was divided into five zones, in which the six SES levels were represented. Two interception points were selected per zone based on the density of cyclists in the area: one with low and one with high density of cyclist. A total of 10 interception points were selected.

Table two shows the distribution of interception points and surveys conducted per zone.

The survey was conducted on every third adult crossing each of the previously mentioned interception points, until completing 1000 surveys.

**Table 2. Cicloruta Survey Interception points, SES distribution and total number of surveys conducted.**

<b>Zone</b>	<b>Density</b>	<b>Interception Point</b>	<b>SES</b>	<b>Total #surveys</b>
South-East	<b>High</b>	Ciclo-Parqueo (Banderas)	3 - 4	184
	<b>Low</b>	Calle 6- K.19	3	67
South-West	<b>High</b>	Ciclo-Parqueo (Americas)	2	159
	<b>Low</b>	Av. C. de Cali- Calle 58 S	2	29
Downtown	<b>High</b>	Calle 26- K 94	3-4	155
	<b>Low</b>	K.30- Calle 72	3 - 4	120
North-West	<b>High</b>	Calle 80- K. 78	3	126
	<b>Low</b>	Av. Boyacá- Calle 170	5	22
North-East	<b>High</b>	Calle 127- AK. 19	5 - 6	108
	<b>Low</b>	K.11- Calle 92	6	30
				1000

**Target Study Population:**

The survey was conducted on 1000 adults 18 years old and over who were using the Cicloruta.

## **Study Measures**

### **Outcome variable:**

#### **Physical Activity:**

The long version of the International Physical Activity Questionnaire (IPAQ)<sup>58</sup> was used to assess the physical activity levels for the leisure time and transportation domains. For the Ciclorutas' analysis only the transportation domain was considered, specifically cycling for transportation<sup>59</sup>. Individuals were classified as meeting the PA recommendation (those who reported accumulating at least 150 minutes of cycling for transportation, in bouts of at least 10 minutes each time) and not meeting the PA recommendation (<150 minutes of transportation PA ).

#### **Independent Variables:**

**Socio-demographic factors:** The socio-demographic variables included, sex, age, occupation, income, education, marital status, car in the household and socio-economic Status (SES). The SES classifies the households based on their location, surrounding areas and physical characteristics in a range of 1 to 6: 1 being the lowest and 6 the highest and more advantaged level<sup>56</sup>. The classification of the socio-demographic variables is presented in Table 1.

**Cicloruta use characteristics:** frequency of use (Infrequent: at least once a year-once a week, frequent: 2-4days/week , regular: 5-7 days/week, Safety Perception-Accidents (In general, how safe from do you feel in the Cicloruta from road and traffic accidents?): unsafe, neutral, safe, Security perception–Robbery (In general, how safe from do you feel in the Cicloruta from crime and robbery?): unsafe, neutral, safe.

### **Ciclovia use factors among Cicloruta users:**

Use of Ciclovia over the last 12 months: (Yes, No).

**3.2.2 The Ciclovia Survey:** This survey was conducted among a thousand adults who were intercepted at the Ciclovia. The total distance of the Ciclovia was divided into 16 equidistant interception points to represent the entire circuit. The survey was conducted on 3 consecutive Sundays to every third adult crossing the interception points.

### **Target Study Population:**

The survey was conducted to 1000 adults 18 years old and over who were participating at the Ciclovia.

### **Study Measures**

#### **Outcome variables**

##### **-Physical Activity:**

For the Ciclovias analysis only the leisure time domain (LTPA) from the IPAQ was considered and calculated by adding up the minutes expended on leisure time activities from any of the following three categories: moderate intensity PA, vigorous intensity PA (multiplied by 2 due to the double credit of the intensity) and walking; based on the LTPA categories suggested at the IPAQ scoring protocol<sup>58</sup>. Individuals were classified as meeting the PA recommendation (those who reported accumulating at least 150 minutes of LTPA, in bouts of at least 10 minutes each time) and not meeting the PA recommendation (those who did not meet the previously mentioned criteria).

**-Social Capital:** The SC questions were selected and adapted from existing international questionnaires including: The general social survey 2008 (GSS)<sup>60</sup> from the University of Chicago, The European Social Survey 2004/2005<sup>61</sup>, the World Bank Social Capital

Integrated Questionnaire (SOCAP IQ)<sup>62</sup>, and specific questions design for Ciclovias and Ciclorutas. Ten SC questions were asked to evaluate the respondent's perception of the level of different SC components in the Ciclovía environment including trust, collective efficacy, mutual support, and shared values. Response options were likert scales ranging from 1 to 5, in which the lowest value indicated the respondent strongly disagreed with the positive SC statement and 5 indicated that the respondent strongly agreed.

### **Independent Variables:**

**Socio-demographic factors:** The same socio-demographic factors considered for the Cicloruta Survey were used and are described in table 1.

**Ciclovía use factors:** frequency of participation (Infrequent: at least once-year-once per month, Frequent: 2-3 days/month, Regular: 4 days-month-always), type of activity performed during the Ciclovía (cycling, other wheels, walking/jogging), intensity of the activity performed at the Ciclovía (vigorous, moderate, low) and safety perceptions for accidents and crime as previously described for the Ciclorutas Survey (Table 1).

### **Cicloruta use factors among Ciclovía users:**

Use of Cicloruta over the last 12 months: (Yes, No), frequency of use/participation (Infrequent: once per week- at least once-year, Frequent: 2-4 days/week, Regular: 5-7 days-week), type of activity performed during the Ciclovía (cycling, other wheels, and walking/jogging).

## **3.3 Data Analysis**

The statistical analysis was carried out using SAS 9.2 software. First, the general characteristics of the Ciclovía and Cicloruta users were described and compared using the Pearson chi-square test. Second, a principal component analysis (PCA) was conducted to reduce

the number of SC variables from the Ciclovía survey, by using a varimax (orthogonal) rotation method<sup>63</sup>. Questionnaire items and corresponding factor loadings are presented in table 3.

Three factors displayed eigenvalues greater than one; however the scree plot suggested that only one of them was meaningful. Therefore, only the first factor was retained, which accounted for 22.3% of the total variance. Five items (questions) had loadings greater than .57 for the first factor. The five questions were summed and then labeled as Social Capital level. The SC variable was subsequently dichotomized and categorized into two levels: high (scores above the mean: 17.4) and low (scores below the mean). A binary logistic regression model was developed to examine the relationship between frequency of participation on the Ciclovía and perceived SC levels; the model was adjusted by sex and monthly income.

In addition, two multivariate logistic regression models were conducted to examine associations between meeting the PA recommendations with the characteristics of program use/participation. The first model was carried out for Cicloruta users. The following variables were included as independent variables: motorized vehicle at home, frequency of use, safety perception, and participation in Ciclovía over the last 12 months. The model was also adjusted by including all the socio-demographic variables previously mentioned (sex, SES, monthly income). The outcome variable was meeting the PA recommendation by cycling for transportation-yes or no- based on previously described criteria. The independent variables used for the Ciclovía model included: frequency of participation, type of activity performed, intensity of the activity performed, and safety perceptions. The model was also adjusted for the socio-demographic variables. The outcome for the Ciclovía model was meeting the LTPA recommendation yes or no.

**Table 3. Social Capital Principal Components Analysis<sup>a</sup> and matrix of rotated correlations for Ciclovía participants.**

Items	Factor 1 <sup>†</sup>	Factor 2 <sup>**</sup>	Factor 3 <sup>**</sup>
Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?	0.14	0.80	0.11
Do you think most people would try to take advantage of you if they got a chance, or would they try to be fair?	0.11	0.78	0.7
Would you say that most of the time people try to be helpful, or that they are mostly just looking out for themselves?	0.32	0.52	0
Most people in the Ciclovía are willing to help if you need it.	<b>0.69*</b>	0.20	0.4
Most people in the Ciclovía get along with each other	<b>0.71*</b>	0.19	0.15
Most people who use the Ciclovía can be trusted.	<b>0.60*</b>	0.28	0.30
Most people who use the Ciclovía share the same values.	<b>0.57*</b>	0.5	0.49
Most people who use the Ciclovía know each other.	0.17	-0.7	0.78
Would you trust someone at the Ciclovía to take care of your bike for 40 minutes or more?	-0.15	0.33	0.58
Do you think that if you fell at the Ciclovía someone would help you to get up?	<b>0.62*</b>	0.2	-0.18
Percentage of explained variance	22.3	17.9	13.4

<sup>a</sup> Varimax rotation and <sup>†</sup>Eigen value > 1 (3.1).

\*>0.56

\*\* Eigen values marginally >1 (1.06 and 1.1)

## CHAPTER 4

### Results

#### 4.1 Socio-demographic and program participation differences characteristics among the Ciclovía and Cicloruta users in Bogotá.

**Table 4. Socio-demographic and program participation differences characteristics among the Ciclovía and Cicloruta users in Bogotá**

Variables	Ciclovía		Cicloruta		Chi-square test	
	n	%	n	%	$\chi^2$	P-value
<b>Sex</b>						
Female	299	29.9	123	12.3	93.03	<.0001
Male	701	70.1	877	87.7		
<b>Age</b>						
18-29	362	36.2	310	31	17.1	0.002
30-49	407	40.7	499	49.9		
>= 50	231	23.1	191	19.1		
<b>Marital Status</b>						
Single/Widow/Divorced	533	53.3	956	95.7	472.6	<.0001
Living with partner/married	467	46.7	43	4.3		
<b>Education level</b>						
Less than Middle School	111	11.1	269	27.0	240.3	<.0001
Middle to High School	404	40.0	558	56.0		
Bachelor's and above	483	48.4	170	17.0		
<b>Occupation<sup>a</sup></b>						
Not remunerated	74	7.4	93	9.3	43.8	<.0001
Remunerated	816	82.0	865	86.6		
Student	103	10.3	41	4.1		
<b>Monthly Income*</b>						
\$ 0-195 USD	99	11.0	141	14.8	166.6	<.0001
\$ 196-487 USD	422	47.0	666	69.8		
>=488 USD	384	42.0	147	15.4		
<b>Socio-economic status (SES)</b>						
1,2	279	28.0	531	53.1	144.9	<.0001
3,4	642	64.0	488	44.8		
5 y 6	77	8.0	21	2.1		
<b>Car or other motorized vehicle at home</b>						
Yes	339	33.9	171	17.1	74.2	<.0001
No	661	66.1	829	82.9		

\*Converted to USD exchange rate 2009

<sup>a</sup> Remunerated=Employer/employee/own-account worker, Non-remunerated=Unpaid family/ worker/ Unemployed/

Variables	Ciclovia		Cicloruta		Chi-square test	
	n	%	n	%	$\chi^2$	P-value
<b>Meeting PA Recommendation by cycling for transportation<sup>b</sup></b>						
Yes	174	17.4	705	70.5	572.3	<.0001
No	826	82.6	295	29.5		
<b>Meeting PA Recommendation in leisure time<sup>c</sup></b>						
Yes	595	59.5	403	40.3	54.4	<.0001
No	405	40.5	597	59.7		
<b>Frequency of use/participation</b>						
Infrequent	202	20.2	101	10.1	72.7	<.0001
Frequent	276	27.6	198	19.8		
Regular	522	52.2	701	70.1		
<b>Safety Perception (Accidents)</b>						
Unsafe	166	16.7	295	29.5	48.5	<.0001
Neutral	321	32.2	247	24.7		
Safe	510	51.2	458	45.8		
<b>Security perception (Crime)</b>						
Unsafe	253	25.3	450	45.0	99.5	<.0001
Neutral	323	32.3	297	29.7		
Safe	424	42.4	253	25.3		
<b>Factors mostly related with safety perception</b>						
Crime or robbery	290	29.2	535	53.6	132.3	<.0001
Traffic/roads quality/ vehicles	703	70.8	463	46.4		

<sup>b</sup> Yes=>150 min, No<=150 min.

<sup>c</sup> Yes=150 min or more of moderate /75 min vigorous activity/week.

Participants of both programs were primarily males (70.1% in Ciclovia and 87.7% in Ciclorutas), within 30-49 years of age (40.7% and 49.9% respectively), and regular participants/users of the program (52.2% in Ciclovia and 70.1% in Ciclorutas). Cicloruta users were more likely to be living in SES categories of 1-2 (53.1%), have lower education attainment (27% less than middle school), and most did not own a car at home (82.9%). They were also less likely than Ciclovia users to having an income at or above 488 USD a month (15.4%), report being a student (4.1%) and fewer were living in SES categories of 5-6 (2.1%). In contrast, most Ciclovia participants

reported living in SES categories of 3-4 (64%), and having a higher education attainment (48.4% Bachelor's degree and above). In addition more Ciclovía participants reported living in SES categories of 5-6 (8% vs. 2% of the Cicloruta users), and having a car at home (33.9% vs. 17.1% of the Cicloruta users).

The PA characteristics (Table 1) significantly differed between the two groups of users. The majority of the Ciclovía participants reported meeting the PA recommendation in LTPA (59.5%), whereas near all Cicloruta participants reported to meet the recommendations by cycling for transportation (70.5%).

The safety perception was higher among Ciclovía users with 51.2% of those surveyed having reported feeling safe at the Ciclovía with respect to traffic and accidents and 42.4% with regard to crime. On the contrary, more Cicloruta users reported feeling unsafe: 29.5% with regard to traffic and 45% with regard to crime.

The SC perception differences between the two programs are presented in Table 2. A higher proportion of Ciclovía participants reported to agree with the five positive components of SC in the program. The participants especially agreed with the following three items: the willingness of the Ciclovía participants to help each other (62.4%), to get along with each other (61.4%), and to help in specific situations like fix a flat tire or help someone get up if another user fell (73.2%). The only SC component from which more than 50% of the Cicloruta users reported to agree with was the willingness of the Cicloruta users to help each other (56.3%).

**Table 5. Social Capital perception differences among the Ciclovía and Cicloruta users in Bogotá**

Variables	Ciclovía		Cicloruta		Chi-square test	
	n	%	n	%	$\chi^2$	P-value
<b>Users of the program are willing to help each other</b>						
Agree	623	62.4	563	56.3	9.14	0.0103
Neutral	238	23.8	258	25.8		
Disagree	138	13.8	179	17.9		
<b>Users of the program get along with each other</b>						
Agree	614	61.4	472	47.2	46.2	<.0001
Neutral	257	25.7	309	30.9		
Disagree	129	12.9	218	21.8		
<b>Users of the program can be trusted</b>						
Agree	410	41	319	31.9	34.6	<.0001
Neutral	353	35.3	330	33		
Disagree	236	23.7	351	35.1		
<b>Users of the program share values</b>						
Agree	339	33.9	424	42.4	22.700	<.0001
Neutral	339	33.9	296	29.6		
Disagree	321	32.2	280	28		
<b>Users of the program would help you to fix flat tire/get up if you fell</b>						
Agree	730	73.22	280	28	481.5	<.0001
Neutral	152	15.25	176	17.6		
Disagree	115	11.53	544	54.4		

#### **4.2 Characteristics associated with meeting LTPA recommendation among Ciclovía**

**participants.** Results from the logistic regression analysis assessed what variables were associated with meeting the LTPA recommendations in Ciclovía participants. These results are shown in Table 3. Those who reported regular participation in the program had increased odds

of meeting the LTPA recommendation (OR=1.7, 95%CI=1.1-2.4), as well as those who reported to perform vigorous (OR=4.9, 95%CI=2.5-9.2) and moderate (OR=1.9, 95%CI=1.2-3.0) activity during the Ciclovía. Walking/jogging (OR=1.3, 95%CI=0.8-1.9) and using other wheels during the Ciclovía (OR=1.7, 95%CI=0.7-3.5) were also positively associated with meeting the LTPA recommendation, however, the association was not significant.

**Table 6. Characteristics of Ciclovía participation related with meeting LTPA recommendation.**

Variable	OR	95% CI
<b>Frequency of participation<sup>a</sup></b>		
Regular	<b>1.7</b>	<b>1.1-2.4<sup>†</sup></b>
Frequent	1.1	0.8-1.6
Infrequent**		
<b>Type of activity performed</b>		
Walking/Jogging	1.3	0.8-1.9
Other wheels	1.7	0.7-3.5
Cycling**		
<b>Intensity of the activity</b>		
Vigorous	<b>4.9</b>	<b>2.5-9.2<sup>†</sup></b>
Moderate	<b>1.9</b>	<b>1.2-3.0<sup>†</sup></b>
Low**		
<b>Safety Perception (Accidents)</b>		
Safe	1	0.6-1.6
Neutral	0.7	0.4-1.5
Unsafe**		
<b>Security perception (Crime)</b>		
Safe	1	0.6-1.5
Neutral	1	0.6-1.4
Unsafe**		

<sup>a</sup> Regular: 4 days-month/always, Frequent: 2-3 days/month, Infrequent: at least once-year/once per month

\*150 min of moderate intensity or 75 minutes of vigorous intensity

\*\*Referent group

Model adjusted by sex, age, marital status, education level and SES

<sup>†</sup> P-value <0.0001

### 4.3 Characteristics associated with meeting PA recommendation by Cycling for transportation among Cicloruta participants.

Table 4 shows the results of the multivariate analysis for meeting the PA recommendation in cycling for transport among Cicloruta users. Males (OR=1.94, 95%CI=1.2-3.2), regular Cicloruta users (OR=10.18, 95%CI=6.1-16.8), and Cicloruta users who reported participation in the Ciclovía over the last 12 months (OR=1.6, 95%CI=1.1-2.2), were more likely to meet the PA recommendation by cycling for transportation. Similarly, users living in low SES (OR=1.5, 95%CI=0.4-4.9), having an education level between middle and high school (OR=1.4, 95%CI=0.8-2.2), and not having a car at home (OR=1.5, 95%CI=1-2.3) had an increased probability of meeting the recommendation though cycling for transport, nonetheless, the relationship was not statistically significant.

**Table 7. Characteristics of Cicloruta use related with meeting the physical activity recommendation through cycling for transportation.**

Variable	OR	95% CI
<b>Sex</b>		
Male	<b>1.94</b>	<b>1.2-3.2<sup>†</sup></b>
Female**		
<b>Age</b>		
>=61	1.6	0.6-4.2
25-60	1.3	0.8-2.0
18-24**		
<b>Marital Status</b>		
Single/Widow/Divorced	0.9	0.4-2.0
Living with partner/married**		
<b>Education level</b>		
Less than Middle School	1.1	0.6-2.2
Middle to High School	1.4	0.8-2.2
Bachelor's/Post-graduate degree**		
<b>Occupation</b>		
Non-remunerated	1.1	0.4-3.2
Remunerated	1.4	0.5-3.5
Student**		

<b>Variable</b>	<b>OR</b>	<b>95% CI</b>
<b>SES</b>		
1-2	1.5	0.4-4.9
3-4	1.3	0.4-4.1
5-6**		
<b>Motorized vehicle at home</b>		
No	1.5	1-2.3
Yes**		
<b>Frequency of Cicloruta use<sup>a</sup></b>		
Regular	<b>10.18</b>	<b>6.1-16.8<sup>†</sup></b>
Frequent	1.7	1.0-3.0
Infrequent		
<b>Safety perception (Accidents)</b>		
Safe	0.9	0.5-1.4
Neutral	1	0.6-1.7
Unsafe**		
<b>Security perception (Crime)</b>		
Safe	1	0.6-1.6
Neutral	0.8	0.5-1.3
Unsafe**		
<b>Participation in the Ciclovía over the last 12 months</b>		
Yes	<b>1.6</b>	<b>1.1-2.2<sup>†</sup></b>
No**		

<sup>a</sup>Regular: 5-7 days/week, Frequent: 2-4days a week, Infrequent: at least once-year/once per week

<sup>†</sup> P-value <0.0001

\*150 min accumulated per week in bouts of at least 10 min each

\*\*referent group

#### 4.4 The Ciclovía and Social Capital

Table 5 shows the results of the by-variate regression for SC levels and frequency of participation in the Ciclovía program. Those participants who reported more frequent participation were more likely to have a higher SC perception of the Ciclovía: (OR=2.0, 95%CI=1.4-2.8) for regular compared to infrequent participants of the program. Frequent

participants were also more likely to have a higher SC perception compared to infrequent ones (OR=1.7, 95%CI=1.2-2.6), both associations were statistically significant.

**Table 8. Association between participation in the Ciclovía and Social Capital**

<b>Variable</b>	<b>OR</b>	<b>95% CI</b>	<b><i>P</i></b>
<b>Frequency of Ciclovía use<sup>a</sup></b>			
Regular	<b>2.0</b>	<b>1.4-2.8</b>	<b>0.001</b>
Frequent	<b>1.7</b>	<b>1.2-2.6</b>	<b>0.001</b>
Infrequent**			

<sup>a</sup>Regular: 4 days-month/always, Frequent: 2-3 days/month  
 Infrequent: at least once-year/once per month

Model adjusted by sex, and income

## CHAPTER V

### Discussion and Conclusions

#### 5.1 Discussion

The results of this study indicate that the participants of the Ciclovía and Cicloruta programs are a diverse group of the population in Bogotá, with important differences in their PA characteristics, safety and SC perceptions. Regarding PA we found that more than half of the Ciclovía's participants met the LTPA recommendation, and they were the more regular users and those who reported to perform a more intense PA during the Ciclovía. In contrast, our results suggest that over 70% of the Cicloruta users met the PA recommendation by cycling for transportation, and they were mainly males, more regular users, and those who reported that they had also participated in the Ciclovía over the last 12 months. Finally we found that being a regular user of the Ciclovía was associated with a higher perception of Ciclovía-based SC.

Both programs had a similar SES distribution of their participants, which was also representative of the SES distribution in the city of Bogotá, where 51% of the population lives on SES categories 1-2, 43.2% on SES categories 3- 4, and only 4.2% on SES categories 5-6<sup>64</sup>. These findings suggest that the Ciclovía and Cicloruta programs provide equal and free opportunities for PA, recreation and commuting for all the Bogotá's inhabitants. Other research had shown the relevance of providing equitable access to recreational facilities<sup>65</sup>. Moore, et al., found that in three States of the US the amount and quality of recreational facilities were not equitably distributed; and that lower income and minority areas were less likely to have access to recreational facilities where they could be physically active with no extra-cost and not necessarily practicing sports<sup>65</sup>.

In Latin America, the need to implement policies that provide solutions to the lack of sustainable transportation systems, inequalities and recreational facilities that the rapid urbanization has brought to the region has also been documented<sup>18, 66</sup>. Important to this study is the fact that more than 50% of the Cicloruta users live in SES categories 1-2, and over 80% of them do not have a car at home. This result suggests that the Cicloruta represents a key mobility alternative that is accessible to a vulnerable population of the city; which may be especially important when considering that in Bogota only 22% of the households have a private automobile<sup>67</sup>.

Other key findings of this study were the striking differences in the safety and SC perceptions among the participants of the two programs. It is especially important to find that the Cicloruta users had even lower safety perceptions related to crime, than the overall perception of the Bogota inhabitants, which is already low<sup>62</sup>. According to a city-wide perception survey, 38% of the Bogota inhabitants feel unsafe in the city and 32% in their neighborhood<sup>68</sup>. This result may imply the need to implement strategies to enhance the safety level of the Ciclorutas and their users. Enhancing safety in the Ciclorutas may increase their use for transportation, taking into account that the current prevalence of Cicloruta use in Bogota is only 2%<sup>67</sup>.

In contrast, we found that the Ciclovía users feel considerably safer in the program on Sunday (42.4%) and also had higher SC perceptions, which could be explained by the presence of more people on the streets (instead of cars), engaging in positive activities such as exercise and recreation. This finding is consistent with previous international research that had found higher safety perceptions among users of parks and other recreational facilities<sup>51, 69</sup>. Other studies had

also found that the users of these facilities who had higher safety perceptions also had higher SC perceptions<sup>51</sup>.

The higher SC perceptions of the regular users for the Ciclovía are relevant to the context of inequality and unsafe environments in Bogotá. City statistics had shown that 41% of the citizens in Bogotá perceived that most inhabitants in the city are not willing to help each other<sup>70</sup>. Similarly, 86% perceived that in Bogotá low SES people are discriminated against, and 45% considered that most people in the city do not have proper behaviors in public spaces<sup>68</sup>. In this environment a program that becomes provides a social group to which the participants belong may explain the higher SC perception in the Ciclovía. This is very significant considering previous research has shown strong association between higher social capital perception and well-being as well as perceived health<sup>71,44</sup>.

Additional studies have documented the positive association between social capital and physical activity level<sup>45,51</sup>, which indicates that the Ciclovía could also provide encouraging social environments to the Bogotá's inhabitants to be more physically active and to feel better, and therefore promote better health and quality of life. Furthermore, based on previous studies it could be implied that the high levels of perceived Ciclovía-based collective efficacy could provide the city with opportunities to buffer social inequalities and even decrease crime rates<sup>53,54</sup> during each day in which the program is implemented. International studies have indicated that SC could encourage positive social norms and help minimize antisocial behaviors that make individuals feel unsafe<sup>72</sup>. Additional studies have shown that increased pedestrian traffic can enhance neighborhood safety by generating natural surveillance<sup>73</sup>. Such evidence may be an alternative explanation as to why Ciclovía users feel safer in the streets that are closed for the program.

As it relates with meeting the PA recommendations, our findings for the Cicloruta users were consistent with previous international studies in which exclusive bike lanes were positively associated with increased levels of cycling<sup>28,26, 74</sup> at the population level. In addition, results from a previous study conducted in Bogota found that being a male and reporting use of Ciclovía were two of the factors that increased the likelihood of using bicycle for transportation<sup>41</sup>. Another study in Bogota also found that participation in the Ciclovía was associated with meeting the LTPA recommendations in women<sup>37</sup>. This result is important taking into account that only 18% of the inhabitants in Bogota meet the LTPA recommendation<sup>9</sup>, suggesting the Ciclovía program has the potencial of increasing LTPA among them. Finally our findings could support the importance of analyzing PA levels by domain, according to the type of intervention that is being examined. In this case, the participants of a recreational program showed increased levels of LTPA and low levels of transportation PA, and the users of a transportation program, increased levels of cycling for transportation and low levels of LTPA.

The main limitations of this study are its cross-sectional design and the lack of control groups of non-users/participants of the two programs examined. In addition, since to our knowledge SC had not been explored before in this type of programs, our study relied on self-reported measures adapted from validated international instruments. Future studies should address these limitations.

Nonetheless, this study has strengths as well, including: it is the first study to our knowledge to illustrate the importance of two programs such as Ciclovía and Cicloruta in promoting better social environments and equitable opportunities for recreation, socialization and PA in a large population. The sample size for each survey was representative of the number of users of the program, and it is the first time that the two programs are thoroughly described

and compared. For this reasons this study represents an important initial effort to better understand these programs and their potential public health outcomes such as PA and SC that could be the base for future studies. Our findings also support the importance of implementing recreation, public space usage and transportation policies, as well as built environment changes such as Ciclovía and Ciclorutas in urban settings to have a population based impact in various aspects of public health such as PA, SC safety and equity.

## **5.2 Conclusion**

The Ciclovía program and Cicloruta network represent two policy and environmental approaches that have the potential to equitably promote physical activity and provide a mobility alternative in complex urban settings such as the city of Bogotá. Additionally, the Ciclovía program provided enhanced social environments in which the program users also feel safer. The Ciclovía and Ciclorutas are important health promotion interventions that should be considered as potential multi-level, large-scale approaches to address social and environmental determinants of health-related behavior at the population level.

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