



# Assessing the effect of physical activity classes in public spaces on leisure-time physical activity: “Al Ritmo de las Comunidades” A natural experiment in Bogota, Colombia



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## ABSTRACT

The Recreoivia program provides free physical activity (PA) classes in public spaces in Bogota, Colombia. The purpose of this study was to assess the effectiveness of the Recreoivia program in increasing PA among users of nine parks in Bogota. This study was a natural experiment conducted between 2013 and 2015 in Bogota. Community members and park users living nearby three groups of parks were compared: Group 1 were parks implementing new Recreoivias ( $n = 3$ ), Group 2 were control parks ( $n = 3$ ) without Recreoivias, and Group 3 were parks with existing Recreoivias. Individuals in the “intervention” group were exposed to newly implemented Recreoivia programs in parks near their homes. Measurements were collected at baseline and 6–8 months after the intervention started. A total of 1533 participants were enrolled in the study: 501 for the existing Recreoivias (included in a cross-sectional assessment) and 1032 participants (from the new Recreoivias and control parks) included in the cross-sectional and pre-post study. Most participants were low income females. Twenty-three percent of the intervention group started participating in the program. Users of existing Recreoivias were significantly more active and less likely to be overweight/obese compared to new Recreoivia users at baseline. No changes on PA were found when comparing the intervention and control groups. Recreoivias may have potential for increasing PA at the population level in urban areas given their rapid scalability, the higher levels of PA observed among program users, and its potential to reach women, low-income, less educated populations, and the overweight and obese.

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## 1. Introduction

The pandemic of physical inactivity is a major driver of non-communicable disease morbidity and mortality (Lee et al., 2012; Kohl et al., 2012). Researchers and practitioners are implementing and assessing community-based interventions to promote physical activity (PA) around the world (Hoehner et al., 2008; The Community Guide, n.d.). Community-based interventions for PA are feasible, cost-effective and more efficient than individually-focused approaches, especially among socioeconomically disadvantaged populations (Bauman and Craig, 2005; Mummery and Brown, 2009; Luten et al., 2015). Brazil and Colombia are noted for implementing and evaluating innovative community-based interventions to promote PA (Hoehner et al., 2008; Díaz Del Castillo et al., 2011). One of these interventions is the provision of

physical activity classes in community settings (PA classes) (Hoehner et al., 2008; Hoehner et al., 2013). PA classes are free exercise classes, mostly government subsidized, conducted by trained instructors and offered in existing public spaces (Paez et al., 2015).

PA classes have been identified as promising and innovative for promoting PA at the community-level (Hoehner et al., 2008; Hoehner et al., 2013). Promising, given their expansion in the Americas (Paez et al., 2015), sustainability, and ability to reach inactive populations including women and vulnerable socioeconomic groups (Paez et al., 2015; Reis et al., 2014a). Innovative due to their utilization of social support strategies and public infrastructure (Paez et al., 2015).

One of the best known PA classes programs is the Recreoivia in Bogota, Colombia. The Recreoivia was initiated in 1995 by the Bogotá Institute for Sports and Recreation (IDRD). It provides free PA classes in public spaces (parks, malls, and community centers) (Díaz Del Castillo et al., 2017). The classes are conducted by trained instructors, and are offered every day of the week including holidays (Díaz Del Castillo et

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al., 2017). The *Recreovia* is offered at 41 hubs in 95% of the city's districts (75% in low-middle income neighborhoods) (Díaz Del Castillo et al., 2017). In 2015, program participation was 641,956 (Díaz Del Castillo et al., 2016). Cross-sectional studies suggest that women who participate report more vigorous PA than non-participants (Rios et al., n.d.).

PA classes hold promise for improving social equity as well as increasing PA (Paez et al., 2015; Reis et al., 2014b; Simoes et al., 2009). However, published evaluations of PA classes are limited to cross-sectional studies from Brazil (Reis et al., 2014a; Reis et al., 2014b; Simoes et al., 2009; Reis et al., 2010). Further studies are required to provide evidence on the effectiveness of PA classes for increasing PA and improving health equity (Hoehner et al., 2013; Paez et al., 2015). The purpose of this study is to assess the effectiveness of the *Recreovia* in increasing PA among users of nine parks in Bogota, Colombia. This study is a natural experiment in which individuals in the “intervention” group are community residents and park users exposed to newly implemented *Recreovia* programs in parks near their homes. This natural experiment also incorporates a traditional control (parks with no *Recreovia*) and a naturally-occurring comparison group (existing *Recreovias*) as a post-intervention control (Ogilvie et al., 2006) to account for outcomes that are the result of 20 years of implementation of a real community program.

## 2. Methods

Data were collected in Bogota, Colombia between July 2013 and September 2015. Bogota has a population of 7,940,120 (Secretaría Distrital de Planeación - Alcaldía Mayor de Bogotá, n.d.) and high levels of socioeconomic inequality (Social Panorama of Latin America, 2011). Women and lower income residents in Bogota have disproportionately high prevalence of overweight (Instituto Colombiano de Bienestar Familiar - ICBF, 2010) and physical inactivity in leisure-time (Instituto Colombiano de Bienestar Familiar - ICBF, 2010; González et al., 2014). This study was approved by Los Andes University ethics committee and by Georgia State University's Institutional Review Board (IRB H16202).

### 2.1 Park selection

The study was a natural experiment conducted in 9 public parks. Parks were classified as: Group 1 parks implementing new *Recreovias* in 2013 ( $n = 3$ ), Group 2 control parks ( $n = 3$ ) without *Recreovias*. Control parks were selected randomly from a list of parks previously matched by SES, size, type of park, and potential PA target areas. Group 3 consisted of parks with existing *Recreovias* of at least 12 years' duration ( $n = 3$ ). These *Recreovias* will be examined to provide perspective on the long term effects on health and behavioral factors that might be expected with sustained implementation.

### 2.1. Study participants

Eligible participants were adults aged 18 and above, residents of Bogotá, and reported not having participated in a *Recreovia* in the past 6-months (for the new *Recreovia* and control groups). In the new *Recreovia* and control groups, subjects were selected systematically from three settings: parks (60%), households (22%), and community groups (18%). Parks were divided into target segments and every fourth adult passerby was invited to participate. For the households every fourth household within a radius of 500 m around the park was selected, moving in a clockwise direction. Every fourth eligible subject in each household was recruited. For the community groups, individuals were recruited during their meetings by inviting every fourth attendee, moving in a clockwise direction. Participants from the existing *Recreovias* were approached during the Sunday classes, and every fourth person was selected.

### 2.2. Exposure to the *Recreovia* (natural intervention)

Individuals from the parks with new *Recreovias* were exposed to the PA classes offered at a nearby park. The instructors offered 45-min classes, every Sunday from 8:00 am to 12:00 pm. Individuals were only informed and invited to participate in the classes, either by phone, email, or personally. However, participation in the *Recreovia* was voluntary, and not required to participate in the study. This design was selected to increase external validity by maintaining the normal conditions for participation in the *Recreovia*.

### 2.3. Measurement

At baseline, all participants ( $N = 1533$ ) completed a questionnaire and body mass index (BMI) was computed from objective weight and height measurements. Follow up occurred 6–8 months after implementation of the new *Recreovias*, only in the new *Recreovias* and control groups ( $N = 1032$ ). A random subsample of 396 subjects was selected to wear an accelerometer: 66 individuals at each of the three parks with new *Recreovias*, 33 participants from each of the control parks, and 33 from each of the parks existing *Recreovia*.

The 65 item questionnaire was administered by trained interviewers. Questions included: (1) characteristics of participation in the *Recreovia* (type of classes attended, frequency of attendance, time attending the *Recreovia*, transportation to the *Recreovia* (walking, cycling/skating, public transportation, or motorized vehicle), and travel time to *Recreovia* (minutes); (2) self-reported PA; and (3) sociodemographic information.

### 2.4. Primary outcome measures. Self-reported leisure time PA (LTPA)

Only the LTPA section of the International Physical Activity Questionnaire (IPAQ) was used in this analysis since the focus was on LTPA in the *Recreovia* (International Physical Activity Questionnaire, n.d.). We used a continuous score of total weekly minutes of leisure-time-moderate-to-vigorous PA (MVPA) including walking (by adding total minutes of moderate-PA + vigorous-PA + walking), and total minutes of MVPA per week excluding walking (total minutes of moderate + vigorous PA). We also classified individuals as meeting/not meeting the PA recommendation in leisure time (accumulation of 150 min or more of moderate-intensity PA, or 75-min for vigorous-intensity-PA per week excluding walking in bouts of at least 10 min each time), based on the PA guidelines for Americans (Physical Activity Guidelines, n.d.).

### 2.5. Accelerometer-based PA

PA was measured objectively using Actigraph GT3X accelerometers. Participants were instructed to wear the monitors for seven days during waking hours, on the right hip. Accelerometers were programmed to record 60-s epochs (i.e., counts per minute). Participants were trained at home on the use of the accelerometer and received two phone calls to ensure protocol compliance. After 8 days, participants were visited to validate wear time. When valid time was not completed, participants were asked to wear the accelerometer for 7 additional days. Valid wear time was defined as four or more days with at least 10 h per day, and had to include one valid Sunday. Nonwear time was defined as 60 or more consecutive zeros (1 h). Data were scored using Freedson's counts thresholds for adults (Freedson et al., 1998). Data was processed with R software 3.2.3 using a previously described methodology (Salvo et al., 2014).

Minutes of MVPA were calculated for the week and for the weekend only. MVPA within bouts of at least 10 min was calculated for Sunday (day in which the *Recreovia* is implemented). Bouts were defined as continuous MVPA, having a duration of 10 min or more, with a maximum break-time below the MVPA threshold of 20% of the total bout length (i.e., 3-min of break time in a 15 min bout) (Salvo et al., 2014).

2.6. Data analysis

First, descriptive analyses were conducted on the socioeconomic characteristics and the baseline PA outcomes of participants stratified by the three groups of parks. BMI and PA outcomes were compared statistically using Pearson  $\chi^2$  and *t*-test as appropriate. The group of new Recreoivia was sub-stratified into those who started participating in Recreoivia and those who did not 6 months after the intervention started. Second, the median differences (pre-post) and interquartile range (IQR) of self-reported and objective PA outcomes, were calculated and compared using the Wilcoxon Signed Rank Test. This nonparametric statistical test was used due to the skew of the distribution of the differences. Frequency statistics on the characteristics of participation among Recreoivia users were also computed and compared between users of new and existing Recreoivias using the Pearson  $\chi^2$  test. Third, two general linear mixed models (Hayat and Hedlin, 2012; Diggle et al., 2002) were developed to assess the effects of the Recreoivia program on self-reported PA, using the difference on MVPA in leisure time excluding walking for leisure as the dependent variable. The first was a bivariate and the second a multi-variable model, respectively. Both models included park ID as a random effect. The level of significance was set a priori at  $\alpha = 0.05$ . The intraclass correlation coefficient was calculated at level 2. Analysis were conducted using SAS version 9.2 software (SAS Institute Inc., Cary, NC).

2.7. Fixed effects

The fixed effects in the models included: (1) Sociodemographic characteristics: gender, age group (18–24 years, 25–60 years, or  $\geq 60$  years),

occupation (not remunerated, remunerated), education (less than middle school, high school, bachelor's and above), marital status (single, widowed, or divorced; married or living with a partner) car/motorcycle in the household (yes, no), and socioeconomic status (SES). SES was assessed with a standardized scale used in Bogotá to classify neighborhoods on the basis of income, location, and urban characteristics. The scale ranges from 1 to 6 and is classified as follows: low SES (categories 1 and 2), low-to-middle (3), middle-to high (4), and high SES (5–6) (Departamento Administrativo Nacional de Estadística (DANE), n.d.). (2) Objectively measured distance from household to Recreoivia (Geocoded distance using ArcGIS 9.3 (ESRI Inc); and (3) intervention group status (parks with new Recreoivias and control parks).

2.8. Random effects

A variable identifying each of the 9 parks was included as a random effect to account for within-subject correlation among participants in each park given the multilevel structure of the data.

3. Results

3.1. Participation

A total of 1533 participants were enrolled in the study: 501 for the cross-sectional evaluation of the existing Recreoivias and 1032 participants for the pre-post study (509 at the new Recreoivias and 523 at the control parks). Of the 509 participants enrolled in the parks with new Recreoivias, 23% participated in the program. (See Fig. 1.)

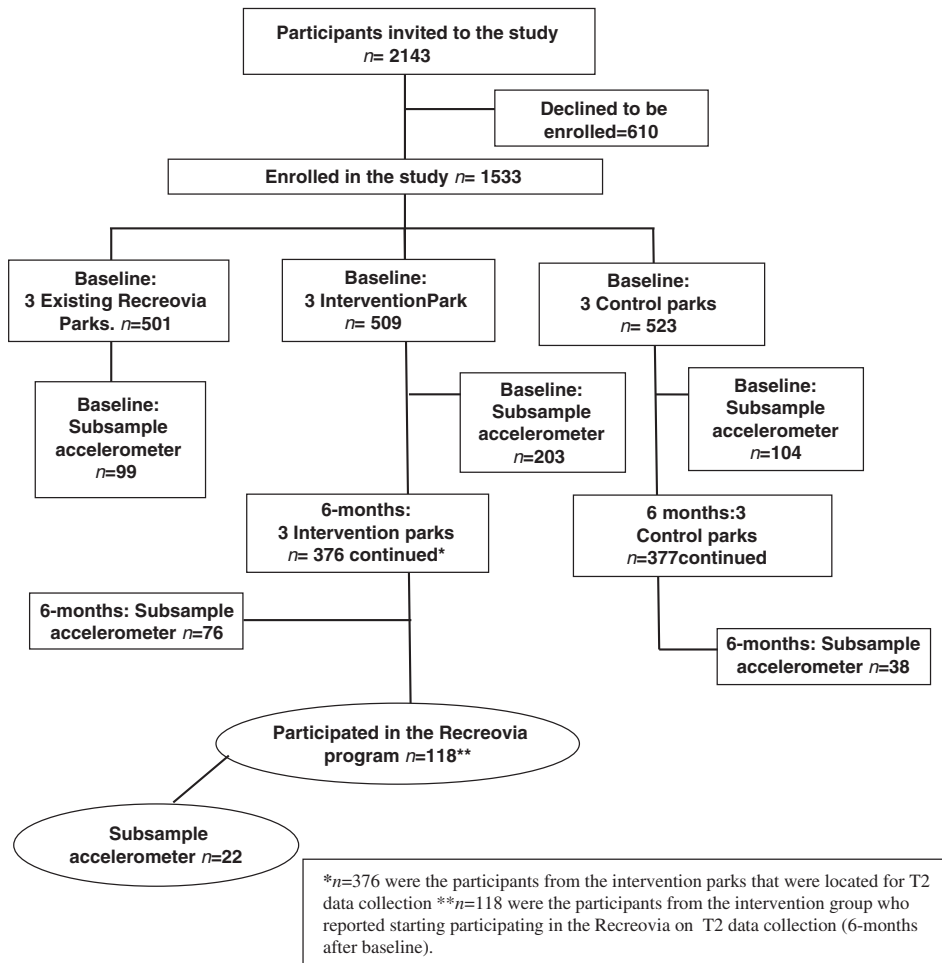


Fig. 1. Study flow chart “Al Ritmo de las Comunidades” a natural experiment in Bogota, Colombia, 2013–2015.

### 3.2. Sociodemographic characteristics and body mass index

Characteristics of all study participants at baseline are shown in Table 1. Participants from the new Recreovias and control parks were similar in their sociodemographic characteristics: Over 60% were age 25-to-60 and female, approximately 60% lived in a low SES community (SES categories 1–2) and had lower educational attainment (high school or less), 97% reported not having a car /motorcycle at home, and lived nearby the assessed parks (mean distance 1.6 and 1.5 km respectively). Participants from the existing Recreovias reported living in low-middle SES (47%) and middle-to-high SES (9%), having a higher educational attainment (54% bachelor's/above), and having a car/motorcycle at home (37%).

The majority of participants (65% in the new Recreovias and 59% in the control parks) were overweight or obese; including those from the new Recreovias who started participating in the program (65% were overweight/obese). In contrast, participants from the group of existing Recreovias were less likely to be overweight (near 50% had normal weight).

### 3.3. Cross-sectional analysis comparing parks with Recreovia with those with no Recreovia at baseline

Users from existing Recreovias were significantly more active in all the accelerometer measures compared to those from the parks with new Recreovias at baseline (i.e., before the program). Users from existing Recreovias had significantly higher vigorous activity (16 min a week  $\pm$  40), were more active on the weekend (79 min of MVPA  $\pm$  49) and on Sunday (20 min of MVPA in bouts). In contrast, before becoming users of the program, new Recreovia users had lower levels of vigorous activity (5 min  $\pm$  16,  $p = 0.003$ ), and were less active on the weekend (45 min of MVPA  $\pm$  33,  $p = 0.005$ ) and on Sunday (6 min of MVPA in bouts,  $p = 0.007$ ). The users from existing Recreovias were also significantly more active in all the accelerometer measures, when compared to all the parks with no Recreovia at baseline (new Recreovias and control groups grouped together) (Data not shown). Users from existing Recreovias also had higher self-reported and accelerometer-measured activity compared to participants from control parks, however this difference was not significant (Table 1).

**Table 1**  
Sociodemographic and baseline physical activity characteristics of study participants from communities with new Recreovia parks, control parks, and parks with existing Recreovias (with 10 to 20 years of implementation). "Al Ritmo de las Comunidades" A natural experiment in Bogota, Colombia, 2013–2015.

| Variable  | New Recreovias                                     |                                  |                        | Control                |  | Existing Recreovias              |                          |                        |
|---|--|----------------------------------|------------------------|------------------------|--|----------------------------------|--------------------------|------------------------|
|   | Continued in the study to T2 <sup>a</sup><br>N (%) | T1 <sup>c</sup><br>only<br>N (%) | Users<br>N (%)         | Non-users<br>N (%)     | Continued in the study to T2 <sup>a</sup><br>N (%) | T1 <sup>a</sup><br>only<br>N (%) | Recreovia users<br>N (%) |                        |
| Age group   | 18–24  | 23 (6)                           | 35 (27)                | 3 (3)                  | 14 (8)   | 59 (15)                          | 35 (24)                  | 93 (19)                |
|   | 25–60  | 267 (71)                         | 85 (64)                | 92 (78)                | 105 (61)   | 225 (60)                         | 100 (68)                 | 381 (76)               |
| Sex   | > = 61   | 87 (23)                          | 12 (9)                 | 23 (19)                | 53 (31)  | 93 (25)                          | 11 (8)                   | 27 (5)                 |
|   | Male   | 79 (21)                          | 43 (33)                | 23 (19)                | 41 (24)  | 131 (35)                         | 61 (42)                  | 137(27)                |
| SES <sup>b</sup>  | Female   | 298 (79)                         | 89 (67)                | 95 (81)                | 131 (76)   | 246 (65)                         | 85 (58)                  | 364(73)                |
|   | 1 & 2  | 249 (66)                         | 80 (60)                | 91 (77)                | 72 (42)  | 223(59)                          | 67 (46)                  | 222 (44)               |
| Education   | 3  | 126 (33)                         | 51 (39)                | 27 (23)                | 98 (57)  | 154 (41)                         | 78 (53)                  | 235 (47)               |
|   | 4&5  | 2 (1)                            | 1 (2)                  | 0                      | 2 (1)  | 0                                | 1 (1)                    | 44 (9)                 |
| Marital status  | Less than middle school                            | 87 (23)                          | 21 (16)                | 21 (18)                | 37 (21)  | 114 (30)                         | 22 (15)                  | 43(9)                  |
|   | High-school  | 149 (40)                         | 63 (48)                | 46 (39)                | 67 (39)  | 147 (39)                         | 63 (43)                  | 187(37)                |
| Occupation <sup>c</sup>                                   | bachelor's- above                                  | 141 (37)                         | 48 (36)                | 51 (43)                | 68 (40)  | 116 (31)                         | 61 (42)                  | 271(54)                |
|   | Single widow divorced separate                     | 148 (39)                         | 59 (45)                | 42 (36)                | 66 (38)  | 162 (43)                         | 70 (48)                  | 273 (55)               |
| Car/motorcycle in the household                           | Married living with partner                        | 229 (61)                         | 73 (55)                | 76 (64)                | 106 (62)   | 215 (57)                         | 76 (52)                  | 228 (45)               |
|   | Not remunerated                                    | 183 (49)                         | 51 (39)                | 51 (44)                | 88 (51)  | 166 (44)                         | 52 (36)                  | 130 (26)               |
| Distance home-park  | Remunerated  | 194 (51)                         | 79 (61)                | 67 (57)                | 84 (49)  | 211 (56)                         | 94 (64)                  | 371 (54)               |
|   | Mean distance in km                                | 1.5 (2.4) <sup>†</sup>           | 6 (5)                  | 2 (2)                  | 5 (3)  | 13 (3)                           | 5 (3)                    | 185 (37)               |
| BMI kg/m <sup>2</sup>                                     | Yes  | 9 (1)                            | 126 (95)               | 116 (98)               | 167 (97)   | 364 (97)                         | 141 (97)                 | 316 (63)               |
|   | No   | 368 (99)                         | 2.5 (4.8) <sup>†</sup> | 1.6 (2.3) <sup>†</sup> | 1.4 (2.1) <sup>†</sup>                             | 1 (1.6) <sup>†</sup>             | 1.7 (3.7) <sup>†</sup>   | 3.1 (1.9) <sup>†</sup> |
| Baseline physical activity                                | Underweight-normal                                 | 126 (33)                         | 53 (40)                | 41 (35)**              | 84 (33)  | 142 (38)                         | 70 (48)                  | 247 (49)**             |
|   | Overweight   | 153 (41)                         | 56 (43)                | 46 (39)**              | 106 (41)   | 168 (45)                         | 49 (34)                  | 180 (36)**             |
| Accelerometer   | Obese  | 98 (26)                          | 23 (17)                | 31 (26)**              | 67 (26)  | 67 (18)                          | 26 (18)                  | 74 (15)**              |
|   | MVPA/week  | 276 (194) <sup>†</sup>           | 216 (167) <sup>†</sup> | 271 (164) <sup>†</sup> | 235 (206) <sup>†</sup>                             | 246 (163) <sup>†</sup>           | 225 (188) <sup>†</sup>   | 305 (189) <sup>†</sup> |
| Self-report   | VPA/week   | 8 (22) <sup>†</sup>              | 5 (18) <sup>†</sup>    | 5 (16)**               | 8 (28) <sup>†</sup>                                | 6 (17) <sup>†</sup>              | 8 (35) <sup>†</sup>      | 16 (40)**              |
|   | MVPA/weekend                                       | 56 (54) <sup>†</sup>             | 46 (42) <sup>†</sup>   | 45 (33)**              | 52 (57) <sup>†</sup>                               | 55 (58) <sup>†</sup>             | 48 (47) <sup>†</sup>     | 79 (67)**              |
| Meeting PA guidelines in LT excluding walking for leisure | Bouted MVPA Sunday                                 | 11 (20) <sup>†</sup>             | 8 (19) <sup>†</sup>    | 6 (13)**               | 9 (18) <sup>†</sup>                                | 9 (21) <sup>†</sup>              | 8 (15) <sup>†</sup>      | 20 (37)**              |
|   | Total minutes of LTPA excluding walking            | 278 (247) <sup>†</sup>           | 264 (319) <sup>†</sup> | 245 (212) <sup>†</sup> | 268 (269) <sup>†</sup>                             | 228 (240) <sup>†</sup>           | 189 (171) <sup>†</sup>   | 274 (360) <sup>†</sup> |

<sup>a</sup> T1 refers to all measures taken at baseline and T2 to all measures taken 6-months after the beginning of the program at the communities with new Recreovias.

<sup>b</sup> SES categories: 1&2 (low), 3 (low-middle), 4–5 (middle-to-high).

<sup>c</sup> Occupation: not remunerated (unemployed, student, or unpaid family worker), remunerated (employee, employer, own-account worker).

<sup>†</sup> Mean (SD), otherwise N (%).

\*\*  $p < 0.05$  comparing new vs. existing Recreovia participants compared using Pearson  $\chi^2$  and  $t$ -test as appropriate.

### 3.4. Differences in physical activity outcomes

Overall, there was no differences relative to baseline for self-reported PA for participants in the new Recreovias (median difference 0, IQR-140, 140), nor for those in the control parks (median difference 0, IQR-140, 100), 6 months after implementation of the new classes (Table 2). By contrast, individuals from the parks with new Recreovias who started participating in the program had a marginally significant ( $p = 0.06$ ) median increase in total minutes of self-reported MVPA including walking for leisure of 30 min (IQR -180, 180) compared to non-participants whom had a median decrease of 90 min (IQR -120, 210). Similarly, those who stated participating in the program had a median increase excluding walking of 15 min (IQR -180, 120), compared to non-participants (median difference of 0, IQR -120, 63). Yet, this difference was not significant. We found no statistically significant differences on accelerometer measures (Table 2).

### 3.5. Multilevel associations with MVPA for new Recreovias and control parks

Results of bivariate and multivariable general linear mixed models are shown in Table 3. We failed to find statistically significant fixed effects, except for marital status. Being single, widowed, or divorced was associated with a greater increase in minutes of self-reported MVPA (median difference -71, CI -138.69, -3.11), compared to being married/living with partner. This association was no longer significant in the adjusted model. However, having a non-remunerated occupation became significantly associated with lower self-reported MVPA on the adjusted model (median difference 103.9, CI 30.96, 176.85). No park-level effect was found when considering the random effect for parks. For that reason, we did not develop additional models with park-level variables.

### 3.6. Characteristics of participation among Recreovia users

Significant differences were found in the characteristics of participation between users of new and existing Recreovias (Appendix 1). Most users (80%) of new Recreovias reported participating in the program for >3-months and engaged in cardiovascular classes (aerobics/dance), and almost all (97%) reported walking to the Recreovia. Additionally, 29% reported attending the Recreovia weekly and 43% attending the Ciclovía monthly. The majority of users of existing Recreovias (64%) reported having participated in the classes for over 6 months and of those, 40% had participated for >2 years. Most of them reported weekly attendance (71%), engaging in cardiovascular classes (84%), and walking (73%) or cycling/public transport (18%) to the classes. One out of four users from existing and new Recreovias indicated they would have been at home indoors, watching TV, or using the computer if the program was not offered on Sundays.

## 4. Discussion

Our study is the first in the 20 years of the Recreovia to assess whether the program increases LTPA. It is also the first natural experiment conducted to assess a real community-based intervention to increase PA in Latin America with a three-way comparison (intervention parks, pre-intervention control parks and post-intervention control parks) (Ogilvie et al., 2006). This type of natural experiment has been used in studies that examine health effects of existing transportation initiatives and is intended to increase the value of the cross-sectional study and to strengthen the explanatory power of the longitudinal study (Ogilvie et al., 2006). Consistent with the complexity of our real-world study design, our findings incorporate aspects beyond what is normally included in an intervention vs control design. The cross-sectional comparison with existing Recreovias provides a long term view of community uptake of the PA classes.

We found no significant changes in PA when comparing the intervention and control groups after 6 months of implementation. However, our findings suggest that Recreovia is a promising program to increase MVPA in leisure time for the following reasons. We found a significant increase in MVPA including walking, among those who became users of the new Recreovias compared to non-users. These findings suggest that Recreovia could impact walking behavior in addition to the activity directly related with the PA classes. Previous studies on PA classes in Brazil had found a positive association between program participation and leisure-time walking (Simoes et al., 2009) and MVPA in leisure-time including walking (Reis et al., 2014a).

In the cross-sectional analysis we found that users of existing Recreovias were significantly more active, specifically during the weekend and on Sunday (day in which most people attend the Recreovias) and were significantly less likely to be overweight/obese compared to non-users of Recreovia. Previous studies found that PA classes were associated with increased LTPA at the communities where they were implemented (Reis et al., 2014b; Simoes et al., 2009; Mendonça et al., 2010). Also, a high proportion of users from the existing Recreovias had participated regularly in the program for >2 years, indicating the program promotes high level of adherence which is a challenge in PA promotion programs and is associated with greater health benefits (Allen and MC, 2010). The inclusion of existing Recreovias in the study is crucial to provide insights into program history and sustainability (Sekhon and Titunik, 2012; Green, 2006). History shows that the integration of Recreovia within the communities is a long process that requires years of regular implementation (Díaz Del Castillo et al., 2017). As a result, significant improvements in MVPA might not be observed among users in the parks with new Recreovias until the program becomes an “accepted practice” in the community (Overview of the Stages of Implementation SISEP: State Implementation and Scaling-up Evidence-based Practices Center, n.d.; Brownson et al., 2012; Fixsen et al., n.d.).

Another promising finding is the high community reach particularly to population groups that are more likely to be inactive such as women

**Table 2**

Differences (Pre- Post) on Physical Activity Outcomes among all participants and among the accelerometer subsample Data given as Median Difference and IQR 25th–75th. “Al Ritmo de las Comunidades” A natural experiment in Bogota, Colombia, 2013–2015.

| Self-reported physical activity on leisure time    |                                 |                          |          |  |  |          |
|--|---------------------------------|--------------------------|----------|--|--|----------|
| Variable   | New Recreovias                  | Control                  | <i>p</i> | Users of new Recreovias                  | Non-users of new Recreovias                  | <i>p</i> |
| Total minutes MVPA excluding walking               | 0 (−140, 140)                   | 0 (−140, 100)            | 0.653    | −15 (−180, 120)                          | 0 (−120, 180)                                | 0.426    |
| Total minutes MVPA including walking               | 0 (−150, 180)                   | 0 (−180, 120)            | 0.04     | −30 (−180, 180)                          | 90 (−120, 210)                               | 0.068    |
| Participants from the accelerometer subsample only |                                 |                          |          |  |  |          |
|  | New Recreovias ( <i>n</i> = 75) | Control ( <i>n</i> = 36) | <i>p</i> | Users of new Recreovias ( <i>n</i> = 22) | Non-users of new Recreovias ( <i>n</i> = 35) | <i>p</i> |
| Total minutes MVPA                                 | −16 (−142, 63)                  | −44 (−116, 35)           | 0.87     | 11 (−119, 98)                            | −11 (−102, 63)                               | 0.58     |
| MVPA/weekend                                       | −8 (−43, 21)                    | −20 (−37, 17)            | 0.54     | −3 (−24, 10)                             | 5 (−43, 38)                                  | 0.48     |
| Bouted MVPA Sunday                                 | 0 (−13, 8)                      | 0 (−17, 0)               | 0.27     | 0 (−10, 0)                               | 0 (−17, 9)                                   | 0.76     |

**Table 3**  
General Linear Mixed Model of the Difference on Self-Reported Total Minutes Per Week of Moderate-to-Vigorous Physical Activity (Excluding walking) with Sociodemographic Variables among study participants from communities in the parks with new Recreovias and Control Parks. †“Al Ritmo de las Comunidades” A natural experiment in Bogota, Colombia, 2013–2015.

| Independent variable† |   | Bivariate |                    |         | Multivariable |                  |         |
|-----------------------|---|-----------|--------------------|---------|---------------|------------------|---------|
|                       |   | Estimate  | 95% Ci             | p value | Estimate      | 95% Ci           | p value |
| Intervention group    | Control vs. parks with new Recreovias       | 14.78     | (– 52.56, 82.13)   | 0.666   | 12.18         | (– 57.11, 81.48) | 0.72    |
| Age                   | 18–24                                       | 36.24     | (– 86.22, 158.55)  | 0.19    |               |                  |         |
|                       | 25–60                                       | – 51.13   | (– 125, 22)        |         |               |                  |         |
|                       | > = 61                                      |           |                    |         |               |                  |         |
| Sex                   | Male  | 35.04     | (– 35, 105)        | 0.32    | – 5.45        | (– 81.37, 70.46) | 0.88    |
|                       | Female                                      |           |                    |         |               |                  |         |
| Education             | None-primary                                | 8.73      | (– 78, 95.54)      | 0.31    |               |                  |         |
|                       | High-school bachelor's-postgraduate degree  | – 49.15   | (– 128.5, 30.2)    |         |               |                  |         |
| Occupation            | Unemployed or unpaid family worker, student | – 51.2    | (– 108.2, 5.8)     | 0.07    | 103.91        | (30.96, 176.85)  | 0.005   |
|                       | Employee, employer, own-account worker      |           |                    |         |               |                  |         |
| SES <sup>a</sup>      | 1 & 2                                       | – 0.49    | (– 67.28, 66.71)   | 0.98    | 26.75         | (– 42.05, 95.57) | 0.44    |
|                       | 3, 4 & 5                                    |           |                    |         |               |                  |         |
|                       |   |           |                    |         |               |                  |         |
| Marital status        | Single widow divorced separated             | – 70.9    | (– 138.69, – 3.11) | 0.04    | – 58.67       | (– 126.53, 9.18) | 0.08    |
|                       | Married/living with partner                 |           |                    |         |               |                  |         |
| Distance home-park    | Measured in km                              | – 14.01   | (– 33.51, 5.48)    | 0.13    | – 13.59       | (– 33.52, 6.34)  | 0.18    |

† Models include park as random effect.

<sup>a</sup> SES categories were combined for modeling purposes; however, they are described in three categories on Table 1 for conceptual purposes.

and overweight/obese. Our results indicate that 23% of individuals from the parks with new Recreovias choose to participate. Program reach is challenging for community-based PA interventions (Reis et al., 2014b; Merzel and D'Afflitti, 2003; Koorts and Gillison, 2015; Reis et al., 2010). From a public health perspective having such strong community reach without any additional outreach activity is remarkable. Furthermore, most of the Recreovia users were lower SES and less educated women. Previous studies also found that PA-classes programs provide opportunities for PA in disadvantaged populations in Latin America (Paez et al., 2015; Reis et al., 2014a). Thus, the Recreovia program may be well suited for cities like Bogota, characterized by high levels of insecurity and socioeconomic inequalities (Interactivo cómo vamos en localidades Bogotá Cómo Vamos, n.d.; Bogotá C de C de. Balance de la seguridad, n.d.; Boletin\_Resultados\_Encuesta\_Multiproposito\_2014.pdf, n.d.) and low levels of LTPA, especially among vulnerable populations (Instituto Colombiano de Bienestar Familiar - ICBF, 2010; Gomez et al., 2010). The substantial participation of women suggests that this program can contribute to decreasing gender disparities in LTPA (Torres et al., 2013; Gomez et al., 2005).

## 5. Limitations

Limitations include: (1) a small sample size and low follow-up rate for the accelerometer subsample, leaving the study potentially underpowered for detecting changes in PA. A reliance on the IPAQ self-reported data subject to recall bias, over-reporting, and potentially not sufficiently sensitive for detecting changes in PA (Bauman et al., 2009; Rzewnicki et al., 2003). Nonetheless, IPAQ has been extensively used for population-based studies worldwide with acceptable validity and reliability (Reis et al., 2014b; Craig et al., 2003; Hallal et al., 2010). (2) Our sample may have been subject to selection bias, limiting the generalizability of our findings for the following reasons (a) most (78%) of our sample was recruited at parks or community groups, which make them more likely to be active before the study, and (b) loss to follow-up (27%). (3) The short follow-up period of 6 months may be insufficient for a community-based program to become established and lead to changes in PA (Brownson et al., 2012; Fixsen et al., n.d.).

The limitations noted should be considered in the context of natural experiments, which must contend with inherently messy, complex, real-world conditions, that provide challenges for evaluation (Brownson et al., 2012). These “trade-offs” between maximizing internal validity while also trying to have substantive relevance have been documented before (Sekhon and Titiunik, 2012; Brownson et al., 2012). Natural experiments may sometimes offer the only opportunity

to study real-world interventions that have been implemented for years like Recreovia (Ogilvie et al., 2006). There is emerging evidence on the need to shift research efforts from designing and testing small-scale interventions towards expanding the evidence on strategies for scaling up effective real-world practice such as Recreovia that could increase PA levels in populations (Reis et al., 2016; Brownson, 2014).

Strengths of this study include that it is the first to assess the effectiveness of PA classes in public spaces for PA in Latin America with a study design including pre and post data with multiple comparison groups, and objective assessment of PA (Mercer et al., 2007). The study also had a multilevel design that accounted for park-level clustering effects. Our study has high external validity since we assessed a real-world intervention in actual communities. Neither incentives, nor additional strategies were provided to encourage participation and adherence to the Recreovia. The high external validity contributes to bridging the gap between research and practice (Mercer et al., 2007), making these results relevant for practitioners and future policies.

### 5.1. Recommendations for future studies on PA classes in public spaces

Future studies should increase the follow-up period to a minimum of one year and strengthen efforts to increase participation from inactive individuals. This will require a collaborative approach with the program administrators (IDRD) who could expand recruitment efforts to reach a broader community audience (Fixsen et al., n.d.). Additional strategies such as the provision of incentives, or behavioral approaches such as creation of “buddy systems” for social support, individual goal setting, or reinforcement through text messaging or newsletters, educational activities and policy and environmental changes could be implemented to enhance participation (The Community Guide, n.d.; Reis et al., 2014b). These strategies could also decrease the loss-to-follow up. Future studies should also increase the sample size for the objective measurement of PA and implement strategies to increase protocol compliance. Finally, transport PA might be incorporated into future evaluations as most Recreovia participants reported walking to the classes.

## 6. Conclusions

We were not able to document significant overall increases in PA among those exposed to the community-based PA classes, perhaps because of the methodological challenges previously noted. However, Recreovias may have potential for increasing PA at the population level in urban areas given their rapid and large scale spread, the higher

**Appendix 1**

Characteristics of participation in the PA-classes among study participants from communities with the new and existing Recreovias. “Al Ritmo de las Comunidades” A natural experiment in Bogota, Colombia, 2013–2015.

| Variables                                | Users from new Recreovias, no. (%)<br>n = 118 | Users from existing Recreovias, no. (%)<br>n = 501 | p*      |
|--|---|--|---------|
| Time participating at the Recreovia      |   |  |         |
| <3 months                                | 24(20)  | 47(9)  | <0.0001 |
| 3–6 months                               | 36(31)  | 133(26)  |         |
| 6 months - 2 years                       | 58(49)  | 119(24)  |         |
| >2 years                                 | 0   | 201(40)  |         |
| Frequency of attendance                  |   |  |         |
| At least 1 day/year                      | 11(9)   | 11 (2.41)  | <0.0001 |
| 1–2 days per month                       | 73(62)  | 120 (26.26)  |         |
| 1 or more days per week                  | 34 (29)                                       | 324 (70.90)  |         |
| Type of class attended                   |   |  |         |
| Psychophysics/maintenance gymnastics     | 14 (12)                                       | 29(6)  | 0.8820  |
| Joint movement                           | 2(2)  | 28 (6)   |         |
| Force stimulation                        | 2(2)  | 25 (5)   |         |
| Folk dance                               | 8(7)  | 120 (24)   |         |
| Aerobics                                 | 85(73)  | 269(54)  |         |
| Rhythmic activities for kids             | 6(5)  | 30(6)  |         |
| Time traveled to the Recreovia (minutes) |   |  |         |
| 0–10                                     | 75 (64.10)                                    | 195 (39)   | <0.0001 |
| 11–15                                    | 12 (10.26)                                    | 85 (17)  |         |
| 16–30                                    | 28 (23.93)                                    | 143 (29)   |         |
| 31–120                                   | 2 (1.71)                                      | 74 (15)  |         |
| Transport used to the Recreovia          |   |  |         |
| Walking                                  | 111 (97.37)                                   | 368 (73)   | <0.0001 |
| Bicycling/skating                        | 0   | 52 (10)  |         |
| Public transportation                    | 0   | 42 (8)   |         |
| Motorized vehicle                        | 2(2)  | 21 (4)   |         |
| Other                                    | 1 (0.88)                                      | 18 (4)   |         |
| Participates in the Ciclovía             |   |  |         |
| No                                       | 45(38.14)                                     | 166 (33.13)  | 0.2435  |
| At last once a year                      | 22(18.64)                                     | 90 (17.96)   |         |
| > 1 time per month                       | 51 (43.22)                                    | 245 (48.90)  |         |
| Alternative activity <sup>a</sup>        |   |  |         |
| Indoors/TV/computer                      | 28 (25)                                       | 121 (25)   |         |
| Other physical activity                  | 90 (75)                                       | 377 (75)   |         |

<sup>a</sup> Survey question “what would you do if the Recreovia classes did not exist”.

\* Chi-square test was conducted.

levels of PA observed among program users, and its potential to reach women, low-income, less educated populations, and the overweight and obese. Enhanced and longer term evaluation will be required to answer this question.

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