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Urban environment interventions linked to the promotion of physical activity. A mixed methods study applied to the urban context of Latin America

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Abstract

This study summarizes the evidence from quantitative systematic reviews that assessed the association between urban environment attributes and physical activity. It also documents sociopolitical barriers and facilitators involved in urban interventions linked with active living in the ten most populated urban settings of Latin America. The synthesis of evidence indicates that several attributes of urban environments are associated with physical activity, including land-use mix and cycling infrastructure. The documentary analysis indicated that despite the benefits and opportunities provided by the programs and existing infrastructure in the examined cities, an overall concern is the rising inequality in the coverage and distribution of the initiatives in the region. If these programs and initiatives are to achieve a real population level effect that helps to

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reduce health disparities, they need to examine their social and spatial distribution within the cities so they can reach underserved populations and develop to their full potential.

Keywords

Latin America; physical activity; urban environments

INTRODUCTION

There is compelling evidence on the benefits of physical activity, including a lower risk of cardiovascular disease, diabetes mellitus, and some cancers (Jeon, Lokken, Hu, & van Dam, 2007; Monninkhof et al., 2007; Sattelmair et al., 2011; Teychenne, Ball, & Salmon, 2008). Physical inactivity is responsible for 9% of global premature mortality (Lee et al., 2012) and is estimated to be the sixth and eighth major risk factor contributing to the burden of disease in Central and Andean Latin America, respectively (Lim et al., 2012).

To face this growing public health challenge, there is a need to undertake interventions that have a broader impact at the population level (e.g. policy and environmental changes), instead of relying on individual counseling alone (Brownson, Haire-Joshu, & Luke, 2006). There are many studies, mostly conducted in high-income countries, which have established a relationship between urban environment attributes and physical activity (O Ferdinand, 2012; McCormack & Shiell, 2011). While the urban environmental characteristics examined in these studies may have an important impact on physical activity levels in North America and other affluent countries, there is uncertainty about the applicability of this evidence in low- and middle-income countries. Latin America is one of the most urbanized regions in the world ranging from 57% in Central American countries to 89% in the Southern Cone (Chile, Argentina and Uruguay). Even Brazil and Mexico, the most populated countries of the region, have urbanization rates of 87% and 77%, respectively. (ONU-HABITAT, 2012). The aims of the present study are twofold: 1) to summarize the evidence from quantitative systematic reviews and meta-analysis that assessed the associations between urban environment attributes and physical activity; and 2) to conduct a documentary analysis of the socio political facilitators and barriers involved in the interventions identified in the review of the urban context of Latin America.

A BRIEF OVERVIEW OF URBAN PROCESSES IN LATIN AMERICA

The current patterns of physical activity among the different socioeconomic strata and other social conditions in Latin America are closely related with the urban processes of the region. These processes have been characterized by a prevalence of social and environmental inequalities, unplanned and disorganized growth, and underlying convergence of political and socioeconomic factors (Chant & Mcilwaine, 2009; ONU-HABITAT, 2012; Sabatini, 2003). The migration from rural to urban areas was influenced by different internal and external factors, such as globalization, the implementation of Import Substitution Industrialization (ISI) policies, structural adjustment plans (SAPs), and land conflicts in rural areas. In the 1950s, ISI policies were implemented as a trade and economic strategy aimed at reducing dependence on foreign manufacture goods by investing in local industry

in larger cities of the region (Baer, 1972). ISI policies further exacerbated the large socioeconomic inequalities between rural and urban areas observed today in Latin America because they were accompanied by profound changes in the modernization of agricultural production and rapid urbanization (Baer, 1972). As a consequence, most Latin American countries experienced a massive and unprecedented migration from rural to urban settings during 1950-1980 (ONU-HABITAT, 2012).

The internal migration caused by these social and economic changes has contributed to the creation of massive metropolitan areas with 10 million or more inhabitants, such as Greater México City, São Paulo, Rio de Janeiro and Buenos Aires (ONU-HABITAT, 2012). The relatively small industrial growth and the lack of state intervention were unable to meet the job demands of this new population. As such, these new migrants have usually resorted to employment in informal economic activities as street vendors, porters, handymen, and other odd jobs in public spaces such as sidewalks, pedestrian bridges, parks and plazas located in commercial areas, (Gherssi, 1997; Portes, 2005). The magnitude of this problem is quite large and in 2007, it was estimated that 57% of the employment in urban areas of the region came from the informal sector, such as street vendors (Inter-American-Development-Bank, 2011; Perry, 2007).

In most cases, these new migrants to Latin America's megacities are not only part of the informal labor economy; they are also usually settled in informal housing developments. The pace of informal settlement creation has increased and abetted by land speculation, political corruption, and inappropriate land regulations (Clichevsky, 2000). These informal settlements are known as “favelas,” “tugurios”, “pueblos jóvenes”, “comunas”, and “zonas marginales” depending on the country of the region. Usually, these areas are divided into plots by “pirate urban developers” and are acquired by the newcomers who usually build their own dwellings (Chant & Mcilwaine, 2009; ONU-HABITAT, 2012; UN-HABITAT, 2008). These settlements have important deficits, not only in dwelling quality and public services, but also in recreational spaces, public transportation, and urban safety which are all linked with physical activity patterns (ONU-HABITAT, 2012). Due to their informal nature, many are located in geologically vulnerable areas, increasing the exposure to natural disasters. Moreover, governments do not have the capacity to address housing needs for the constant flow of migrants, thus high risk zones that have been previously evacuated are occupied again by new waves of newcomers (ONU-HABITAT, 2012).

In countries that have experienced internal armed conflicts, like Colombia, this process has been accompanied by a large migration of nearly 6 million internally displaced people (IDPs) (Victimas, 2013). Colombia has the highest number of IDP in the world followed by Sudan and Congo. Guatemala, Mexico, and Perú are other Latin American countries that have also suffered from forced displacement, but at a smaller scale (Centre, 2013).

These urban areas experienced increasing crime and violence in the 1980's when a deep economic and social crisis occurred in Latin American. Much of this has been closely linked to illegal drug trade (Montoya, 2004). The failed demobilization processes of illegal armed forces in Latin America has contributed to the growth of crime and violence due to many former combatants being recruited by urban gangs and post-conflict mafias (Pearce, 1999;

Rozema, 2008). The evidence of violence perpetrated by these groups is reflected in the homicide rates where nine out of the ten cities worldwide with the highest rates were in Latin America, including Ciudad Juárez, San Pedro de Sula, and Caracas (Inter-American-Development-Bank, 2011). Studies in some Brazilian cities suggest that this situation could negatively impact physical activity during both leisure time and active transportation (Reis, 2013; Reis, 2014; Rech, 2014; Salvador, 2009). It is important to note that even considering the complexity of violence and crime in the Latin American context, many may walk simply due to a lack of alternative options, regardless of safety concerns (Reis, 2014).

Despite the overall trend of economic growth and the remarkable reduction of inequality in the last decade, Latin America is by far the most unequal region in the world. Among the cities with the highest Gini coefficient (a measure commonly used to assess inequality based on income distribution) are São Paulo, Rio de Janeiro (0.62 respectively), Bogotá (0.61), and Belo Horizonte (0.60) (ONU-HABITAT, 2012; United Nations Development Programme, 2013). Such pronounced social inequalities are not only observed in the income distribution, but also in access to adequate dwellings, public spaces, and educational and health services (ONU-HABITAT, 2012).

According to data available for Bogotá, São Paulo, and Belo Horizonte, the poorest areas of these cities have the lowest index of green areas and public space per inhabitant (Bonduki, 2011). In addition, the population is affected by inadequate transport causing individuals to travel long distances from home to work. As a consequence of these urban environmental inequalities, human development and quality of life have substantially decreased (PNUD, 2008; Moraes-Pereira, 2011).

Although these statistics paint a gloomy scenario, the socioeconomic and urban conditions of Latin American have improved since 2000, with a slow reduction in the number of people living under the poverty line in the past 10 years (UN-HABITAT, 2008). In the past two decades the proportion of inhabitants living in slums or substandard dwellings has decreased from 33 to 24%; however, in absolute values the number increased from 106 to 111 million in the same period (ONU-HABITAT, 2012).

Together, these urban processes have had an impact on the urban densities and other urban attributes. While the urban densities in Latin American have somewhat diminished in the last decade (ONU-HABITAT), they are still higher compared to North American and lower than those observed in China, India, and Pakistan. There are variations in the region, however, with Bogotá being the most dense urban area (16,600 inhabitants per square kilometer) in contrast to Rio de Janeiro which has the lowest density among the 10 most populated cities (5,800 inhabitants per square kilometer) (Demographia, 2014).

In the last two decades Latin American cities have undertaken urban interventions, motivated by the need to increase economic competitiveness, as part of neoliberal reforms. These changes included improvements in public transit, urban development, sanitation, and utilities infrastructure. In this manuscript we review these efforts with a focus on those that are related to increasing physical activity. The objective of this study is the presentation of a

summary and description of not only urban interventions that are similar to other regions, but also novel interventions that have originated from Latin America.

METHODS

A mixed methods study with embedded design was conducted which included two methodological components (Cresswell, 2007). This approach is recommended when different research questions require the use of different data sets in order to be resolved. The first component was a synthesis of evidence from systematic reviews and meta-analyses conducted to document the effectiveness of urban environment interventions linked with the promotion of physical activity. The second component was a narrative documentation of some socio political barriers and facilitators linked with physical activity in urban Latin-American contexts (Riessman, 2008).

For the purpose of this study, urban environment was defined as a set of human activities which involve complex social interactions within the urban space and comprises social, political, and organizational processes (Galea, Freudenberg, & Vlahov, 2005). This definition embraces a comprehensive and integral vision pertaining to the links of urban environments and health that are the main focus of this paper.

Methods Used in Synthesis of Evidence

Search strategy—A structured search of 9 electronic databases (The Cochrane Library, PubMed, Scielo, Scopus, JTOR, ISI-WEB, EBSCO-HOST, Science Direct, EMBASE) was carried out, including systematic reviews and meta-analyses published from January 2000 up to November 2013, in English, Spanish, and Portuguese. These limits were defined by considering the few original studies about urban environments, physical activity, and travel behavior published previously to 2000. In accordance, only three systematic reviews published before 2000 were included in this study (McCormack & Shiell, 2011; Yang, Sahlqvist, McMinn, Griffin, & Ogilvie, 2010; Anderson, 2009). Both relevant MeSH and free text terms were used in the search with the Boolean operator “OR”. MeSH terms included “physical activity”, “exercise”, “bicycling”, “walking”, “leisure activities” and “sports”. Free text terms used were: inactivity, cycling, active transport, active transportation, and biking. In addition, the terms “systematic review” and “meta-analysis” were added in the query using the Boolean operator “AND”. This general search procedure intended to favor sensitivity and reduce the risk of omitting relevant systematic reviews or meta-analysis. For this reason, we did not include terms in the search syntax, such as built environment, urban environment, or urban policies. Moreover, a manual search was carried out on the following journals: American Journal of Preventive Medicine, Social Science & Medicine, British Medical Journal, Preventive Medicine, International Journal for Behavioral Nutrition and Physical Activity, American Journal of Public Health, American Journal of Health Promotion, and *Medicine and Science in Sports and Exercise*. Finally, an external researcher with experience in the area was contacted in order to verify the existence of other systematic reviews or meta-analysis not included in our study. There were no search limits on study design or study population.

Study selection and inclusion criteria—The inclusion criteria for the synthesis of the evidence were: a) quantitative systematic reviews and meta-analysis about urban environment interventions that were linked with physical activity promotion, b) studies published in any language, c) studies conducted in any age group, and d) studies carried out in any social urban context.

This search included a wide spectrum of quantitative studies such as: a) observational studies aimed at establishing the potential relations between different attributes of urban environments and physical activity patterns, and b) experimental or quasi-experimental studies that establish the potential effect or impact of urban interventions on active transportation or leisure time physical activity. This decision was made given the absence of empirical evidence from robust effectiveness evaluations, and the availability of cross-sectional studies and other quantitative designs that are useful to guide policymakers in the process of making decisions (Wang, Moss, & Hiller, 2006). In addition, the economic restrictions and logistic challenges do not always allow conducting controlled trial evaluations (Hoehner, 2013).

During the eligibility process the following exclusion criteria were considered: reviews of reviews, narrative reviews, qualitative systematic reviews, and reviews that did not include urban environments, as well as physical activity as outcome variables. These exclusion criteria were supported by the fact that we were interested in analyzing meta-analysis and systematic reviews based on original studies. In addition, qualitative systematic reviews were not considered because the scope of this study component was focused on quantitatively assessing the potential associations between urban environment attributes and physical activity. Finally, we did not include meta-analysis of systematic reviews in which outcome variables were exclusively centered on obesity or other indicators, in order to gain accuracy in our analysis.

Based on titles and abstracts, the first (LFG) and second (RS) authors compiled a list of potentially relevant studies. During the entire screening process, eligibility of publications was discussed with the third (MFO) author until consensus was reached.

Quality Assessment—The quality of the systematic reviews was assessed using the checklist designed by the Support Unit for Research Evidence (SURE) from Cardiff University (Support Unit for Research Evidence (SURE), 2010).

Based on this instrument, two domains of internal validity were determined: a) methods used to identify the studies and b) methods used to analyze the findings. The first considered aspects such as criteria used for deciding the original studies, comprehensiveness of search, grade of update of search, and assessment of bias. The second domain focused on assessing the reliability of the reported results and methods used to analyze the findings. Those articles that were graded as having fatal flaws were excluded.

Documentary analysis of the socio political barriers and facilitators of urban interventions linked to physical activity in the Latin American context—A documentary analysis was conducted in order to identify sociopolitical barriers and

facilitators to implement urban interventions similar to those found in the synthesis of evidence. To fulfill this purpose this analysis focused on the ten most populated metropolitan areas of the region which include: Mexico City, São Paulo, Buenos Aires, Rio de Janeiro, Lima, Bogotá, Santiago de Chile, Belo Horizonte, Guadalajara, and Caracas. Urban policies and social movement initiatives that took place in each city were documented, in particular, those that may have a potential link with active transportation and leisure time physical activity. For this purpose, a literature search of peer-reviewed literature including analytical essays, case studies, geographic studies, and policy analysis was conducted in the selected cities. Searches were carried out using the following electronic databases: Pubmed (117 hits), Proquest (225 hits), and Scientific Electronic Library Online (203 hits) for the period from 1990 to December 2013. The search strategy included the terms “public space”, “Ciclovía”, “bicycle”, “bike-lane”, “bike-sharing”, “parks”, “public transport”, “public transportation”, “active transport”, “active transportation”, “urban expansion”, “motorization” and “uses of land”. For this search the Boolean operator “OR” was used. In addition, researchers and public officials related with urban issues as well as leaders of social movements involved with active transportation or recreational activism were contacted in each city in order to access local government documents related with urban planning issues or advocacy processes. Finally, technical reports from NGOs, bilateral, and multilateral organizations were reviewed, including UN-HABITAT, GIZ-SUTP, IDP, Global NGOs such as ITDP and EMBARQ, and also local-level NGOs like Bicivilizate (Chile), Transporte Ativo (Brazil), and Despacio (Colombia). We restricted this broad search to studies or documents published in Spanish, Portuguese or English. A total of 41 articles and documents were retrieved once duplicates were excluded. Thirty-two were finally deemed relevant for the documentary analysis.

RESULTS FROM THE SYNTHESIS OF EVIDENCE

General Characteristics of the Systematic Reviews

Figure 1 shows an overview of the search procedures using the PRISMA approach. After excluding duplicates and papers based on titles and abstracts, twenty studies remained. Once full texts were reviewed, six of these studies were excluded because they did not comply with the inclusion criteria nor had important methodological limitations (see appendix I). There were no meta-analyses found for inclusion in the synthesis of evidence.

Table 1 shows the principal characteristics of the 8 systematic reviews that were included in this manuscript. All of these studies, except one (Anderson et al, 2009), included studies that were carried out in high-income countries, mainly in the United States, Australia and England. Three systematic reviews were exclusively conducted on adults and one in children and adolescents, while the other four included studies conducted among different age groups. The range of studies included in each systematic review was from ages four to 70.

Main Findings of the Systematic Reviews

Rissel et al. (2012) reported the links between objectively measured physical activity levels and use of public transportation. This review included only original studies conducted in adults and published from 2002-2012. Different means of public transport such as buses,

ferries, trains, trams, and light rail were included. Conclusions revealed a range of 8 – 33 minutes of additional walking might be attributable to the use of public transport (Rissel, Curac, Greenaway, & Bauman, 2012).

Van Holle et al. (2012) conducted a systematic review that included 70 European studies published between 2000 and 2011. Thirty-nine of these studies were from the United Kingdom, Belgium, and The Netherlands. The authors found convincing evidence of 5 environmental factors associated with physical activity in adults: walkability, access to shops, services or work facilities, urbanization levels, quality of environment, and safety from traffic. The first 4 factors were mainly associated with walking and cycling for transportation while the last factor associated with leisure time physical activity (Van Holle et al., 2012).

The systematic review of Durand assessed the links between Smart Growth principles with physical activity and obesity. Smart Growth principles have been proposed by non-profit and government institutions to guide sustainable urban planning in the United States (Smart Growth Online, 2012). Forty-four studies were included in this review, which were published between 2000 and 2010. Thirty of them were conducted in North America, nine in Australia and five in Europe. An association was found with walking for transportation mainly in the following aspects: a) range of housing opportunities and choices (5 of 9 studies), b) mix land uses (32 of 61 studies), and c) compact building design (10 of 18 studies) (Durand, Andalib, Dunton, Wolch, & Pentz, 2011).

Chillon et al included 14 intervention studies published up to January 2010 conducted in children ages 5 to 12 years. These interventions included advocacy initiatives for urban policies that either affected active transportation to schools or undertook actions to remove urban barriers for physical activity, such as sidewalks, road safety improvements and traffic control projects. Ten of the studies showed positive changes on active transportation to school, but only 3 of them had large or very large size effects and included other multilevel intervention components, which involved school and parents (Chillon, Evenson, Vaughn, & Ward, 2011).

Two systematic reviews about cycling were identified. In the first one, 11 out of 21 included studies found significant and positive associations between some environmental factors and higher rates of cycling, including: exclusive cycle routes (on and off road), 'Safe Routes to School' initiatives, short distance of trip, separation from traffic, short distance to a cycle path, and presence of green space or recreational land. Conversely, traffic danger, steep terrain, and long trip distance were negatively associated (Fraser & Lock, 2011). The second systematic review of cycling initiatives included 25 controlled before and after either experimental or observational interventions. Six interventions designed primarily to promote cycling had a positive association with cycling for transportation. These included actions such as educational campaigns, improvements of cycling infrastructure, cycle training, free bike hire, and ride to work day. In addition, sixteen of the reviewed studies assessed marketing strategies that encouraged bicycling and public transportation. They reported an average net effect of 8 additional cycling trips per person per year in the target population (Yang, Sahlqvist, McMinn, Griffin, & Ogilvie, 2010).

The systematic review conducted by McCormack et al. (2011) included 33 studies published up to September 2010 conducted in adults. The authors found that three built environment attributes were consistently associated with higher physical activity levels even after controlling for neighborhood self-selection: land use mix, composite walkability indices, and neighborhood type. Moreover, the built environment was found to be more supportive of walking and cycling for transportation in comparison with other physical activity patterns (McCormack & Shiell, 2011).

Finally, the WHO summary report by Anderson et al. (2009) examined urban policies aimed at reducing barriers to physical activity or increasing space for recreational activity such as Ciclovía programs. They revealed those interventions were positively associated with active transportation and leisure time physical activity (Anderson, 2009; Anderson, 2009).

Documentary analysis of the sociopolitical barriers and facilitators of urban interventions linked to physical activity in the Latin American context—Based on the evidence obtained from the synthesis previously described, Table 2 shows the urban initiatives and attributes positively associated with physical activity, as well as its main facilitators and barriers or challenges in relation to similar interventions conducted in the selected urban areas of Latin America. Appropriate documentation was found with respect to experiences linked with public transportation, public spaces for recreational activity, and cycling infrastructure. No documentation was found regarding compact building development, walkability, or urban environments that support active transportation to school.

One of the most remarkable initiatives identified in the documentary analysis that is positively associated with walking for transport in the region is the construction of Bus Rapid Transit systems (BRT). BRT is characterized by segregated lanes and off-board fare collection (Wright & Hook, 2007; Parra, Gómez, Pratt, Samiento, Triche, Mosquera, 2007). This transport system has been implemented in six out of the 10 cities selected for this analysis, with the exception of Buenos Aires, Belo Horizonte, São Paulo and Caracas. These last 4 cities have either planned or implemented lower specification bus improvement systems that do not qualify as BRT. A cross-sectional study conducted in Bogota found positive associations between the presence of BRT stations in neighborhoods and meeting physical activity recommendations through walking for transportation (Cervero, 2009). If these links are established in longitudinal studies, it could have important public health relevance in the selected cities due to the large quantity of people who use BRT.

The promotion and expansion of BRT in Latin America has largely been due to its fast implementation, capacity to transport a large numbers of passengers, and relative low cost compared to other transportation systems (i.e. rail)(Hidalgo, 2013). Despite this rapid expansion, there have been some criticisms of the system. First, some motor vehicle users have negative perceptions towards BRT because they believe it reduces the road capacity of private vehicles. Second, high occupancy rates of BRT vehicles (more than 6 people per square meter) have generated protests from users, which have been particularly severe in Bogota (Lewin, 2012). Third, there have been logistical and financial challenges to operate the system in several cities which threaten the future sustainability of the BRT (Hidalgo,

2013). Fourth, the design of BRT stations and their surroundings may lack adequate user safety from oncoming motor vehicles if they are required to cross busy roadways to arrive at or leave stations (Quistberg 2013). Finally, in cities like Bogota and Lima the BRT has had difficulties in becoming part of the integral transport system due to the lack of inter-modality. Cyclists that use BRT systems in the cities of Santiago, Belo Horizonte, and Caracas for part of their trips have limited access to bicycle racks or secure places to store their bicycles. Transfers between BRT and non-BRT bus routes are complicated by a lack of integration and shared fares between them due to being operated by competing private companies. This has affected its capacity to satisfy travel demand and dissuade motorcar users to change their travel patterns (Hidalgo, 2013). However, the development of these BRT systems has been a decisive improvement for public transport service, coverage, and access in many cities. Further BRT provides a less expensive mode of transport and is quicker to construct than other mass transit systems (Hidalgo et al., 2007).

Another internationally recognized urban initiative linked with leisure time and physical activity is the Ciclovía Program. This program closes specific streets on Sundays and Holidays to motor vehicles in order to provide exclusive access for cyclists, runners, and pedestrians. This program has been implemented in 9 of the 10 studied cities of this study, with the exception of Buenos Aires. Social engagement groups have had an important role in the implementation of this program, mainly in Bogotá, Lima and São Paulo (Diaz Del Castillo et al., 2011). São Paulo has two coexisting programs: 1) the “Ruas de Lazer”, founded by a community grassroots movement in 1976 and 2) the “Ciclofaixa de Lazer” that was founded by a public-private partnership in 2009 (Sarmiento et al., 2010).

Several studies have observed health and social benefits of Ciclovía programs (Montes et al., 2012; Torres, Sarmiento, Stauber, & Zarama, 2013), with their growing popularity likely due to several factors. One possibility is that the appropriation of public streets in urban contexts characterized by relatively low and unequal availability of public recreation facilities may improve cultural and social environments. Another is that the program may temporarily reduce sociospatial segregation due to the greater access to public spaces in the city through an extended network of roads with exclusive use by non-motorized modalities (Ciclovías-Recreativas., 2013).

Despite the significant advances in Ciclovía Programs, not all have an appropriate geographic coverage and distribution in the selected cities. For instance, the Ciclovía Programs in México City, Lima and Santiago typically are only sponsored in wealthier areas of these cities. In addition, there is opposition from motorists demanding the right to circulate during Ciclovía (Diaz Del Castillo et al., 2011; OIMC, 2008; Sarmiento et al., 2010). Finally, some formal commercial business located in the Ciclovía corridor have claimed a significant decrease in sales (Diaz Del Castillo et al., 2011), though other studies demonstrate an increase in sales and productivity using non-traditional analysis (Wright & Hook, 2007).

Several of the studied cities have implemented other policies and programs aimed at promoting the bicycle as a means of transport. These include the construction and development of bike paths and bike lanes, bike parking facilities, and bike sharing programs.

The most well-known initiatives have been implemented in Rio de Janeiro, México City, Buenos Aires, Bogotá, and Santiago de Chile. For example, Bogota built approximately 300 kilometers of bike paths from 1998 to 2000, increasing the share of bicycle trips from 0.58% to 2.2% during 1996-2002 (Pardo, 2013; Pucher, Dill, & Handy, 2010) and later to more than 3% in 2012 (Bogotá, 2011). However, during 2004-2011 all the bikeway management staff were removed and no significant efforts were undertaken in this city in terms of physical infrastructure and social recognition of cyclists (Pardo, 2013). Paradoxically, this was the period in which the city had a significant growth of social activism movements committed to the promotion of cycling. These groups may have helped avoid a decrease in the mode-share proportion of bicycle users (Pardo, 2013). In another example, Rio de Janeiro has 200 kilometers of bike paths, most of which are outside the North Zone, the poorest region of the city (SETRANS, 2014). Lima has a patchy network of bike paths that run throughout some its municipal districts making commuting outside a municipality difficult (Defensoría del pueblo de la República de Perú, 2008).

Half of the 10 cities have developed bike-sharing programs (Mexico City, Rio de Janeiro, São Paulo, Buenos Aires and Santiago de Chile) that have shown a significant increase in the number of cyclists (Antunes-Dias, 2010; Pardo, 2012). Other cities have developed smaller-scale systems (like the bike-sharing system within some of the BRT stations) and others have only built pilot systems that lasted a brief period (e.g., Bogota's BiciBog system that lasted two weeks and had four stations) (Espacio, 2014). Despite the promising results of these programs, they are mainly located in middle to upper-class neighborhoods, with no current plans for expansion into low-income areas in the near future. This could be a result of serving private partner interests over the public good in deciding where to locate the bike stations. In addition, there are social barriers in its implementation that have been mainly documented in the car dependent urban districts of Polanco and La Condesa in Mexico city where some groups of neighbors argue loosing parking areas located in public spaces due to the new bike sharing program stations (ECOBICI). Moreover, they also claim the value of their properties may go down due to the bikers and street vendors that visit the area (Perez-Lopez, 2013).

Bogota and Belo Horizonte offer good examples of cities that have increased the area, security conditions and social appropriation of public park facilities. From 2001 to 2003, the city administration of Bogota undertook an ambitious effort to increase the number of public parks and improve its maintenance, resulting in an increase of 1.6 m² of green space per inhabitant (Parra, Gómez, Pratt, Samiento, Triche, Mosquera, 2007). However, this indicator has not significantly increased in the last decade (Bogotá., 2009) and it is still far below the recommended level of green space per inhabitant (Gómez, 2012). Since 2003, the city of Belo Horizonte has developed several initiatives to revitalize public parks, including mobilization programs to increase social appropriation of these urban spaces and involvement of private sectors to maintain public green spaces and sport facilities (Silveira & Silva, 2010). In contrast, it is estimated that between 1984-2001, Rio de Janeiro had a reduction of 29.5% in public green space per inhabitant due to population growth and urban expansion of the city, mostly in favela areas (Lissardy, 2012). A similar situation has been documented in Lima from 1970-2013, which witnessed a decrease in green space from 16 to 3.9 m² (Vidal, 2007).

Urban inequalities in the distribution of public park areas in several of the studied cities are striking. For example, in Rio de Janeiro there is a high availability of public park areas in middle and middle-upper class neighborhoods such as Floresta da Tijuca and Jardim Botânico, but in contrast there is a complete absence of park areas in popular sectors located in the low-income areas of the city (Lissardy, 2012). This same situation is evident in São Paulo, Bogota, Lima, Caracas, and Santiago de Chile (ONU-HABITAT, 2010, 2012; Reyes, 2010, Bogota., 2009; Alcaldía Metropolitana de Caracas, 2012). In the latter city, the average of public green area per inhabitant is 3.2 m². In contrast with the most affluent areas (6.7 – 18.8 m²) the poorest “comunas” (urban districts) only have a green space range of 0.4 to 2.9 m² (Reyes, 2010). Although São Paulo has 12.5 m² of public green area per inhabitant, more than 50% of the green space is located in the low-income, rural district of Parelheiros which has only 1.2% of the city population (Redes Nossa São Paulo, 2014). In Lima, several grassroots community movements in recent years have attempted to stop or modify the municipal government redevelopment megaprojects, since they lack input from local residents and only benefit private corporations (Strauch et al, 2014). While these projects have included plans for public spaces, they displace low-income residents to other areas of the city without adequate compensation rather than finding solutions to maintain the integrity of their communities.

The cities under study have engaged several urban processes that are potentially linked with physical inactivity. Several have reduced urban density, while expanding their suburban areas. This process has been especially evident in the cities of Mexico, Santiago de Chile, São Paulo, and Buenos Aires (Heinrich, 2009; ONU-HABITAT, 2012; Suarez, 2006; Unit, 2010). In the first case, the city grew from 75.000 hectares in 1970 to 160.000 hectares in 2000 and its urban density decreased from 120 to 100 inhabitants per hectare in the same period (Suarez, 2006). This urban expansion has been closely linked with growing motorization that can be illustrated in the paradigmatic case of the urban district of Santa Fe in Mexico City. This outskirt area has experienced accelerated urban growth with the construction of housing developments for an affluent population, corporate offices, shopping malls, and education institutions without an appropriate physical infrastructure for pedestrians (Suarez, 2006). This process has been partially due to the lack of coordination between different government agencies and the interests of some sectors of the real estate and motor vehicle industry (ITDP-Mexico, 2013). In Belo Horizonte, this accelerated motorization process has been accompanied by a significant reduction in travel demand of public transportation (González-Guzmán, 2013; Governo do Estado de Minas Gerais, 2013).

DISCUSSION

This mixed analysis describes evidence of relationships between urban environments and physical activity, while also providing insight regarding the sociopolitical challenges of promoting active transportation and active recreation in the context of the largest urban settings of Latin America. This analytical approach not only allows the characterization of some urban inequalities linked with physical activity patterns, but also provides insight regarding the social construction of inequalities in this region (Schlosberg, 2007). This study further illustrates that encouraging active transport and leisure time physical activity in Latin America is a complex process. The current urban conditions are a consequence of historical,

political, and socioeconomic factors that have directly neglected the needs of marginalized populations.

The primary findings of this review can be summarized in three aspects: (i) the importance of improving attributes of urban environments to promote physical activity, (ii) the unequal distribution of supportive urban environments in Latin American countries, and (iii) the unknown effects of social and cultural environments during the implementation of urban interventions.

The results of this synthesis of evidence indicate that although there are some varied results, several attributes of urban environments are associated with physical activity. Among them, the most relevant are the availability of public transportation, land-use mix, bicycle infrastructure, short distance of trips, availability of public recreational facilities, and traffic safety. Although the heterogeneity of methods used in the different systematic reviews do not allow quantitative comparisons, the aforementioned urban environment attributes tend to be more supportive of active transportation. Promising evidence was also found regarding the policies to increase public spaces for recreational physical activity.

The documentary analysis of the 10 Latin American cities found several initiatives developed in Latin America that seem to positively influence physical activity. Some of the most relevant and commonly implemented programs in this current study are the Ciclovía Program and the implementation of BRT projects.

Of the urban interventions found in this study, BRT has been highly prioritized compared to increasing and improving public parks, green areas, bike sharing programs, bike paths, or Ciclovía programs. This is potentially due to the strategic value placed on BRT as a public transport system, which increases productivity and economic competitiveness of the cities. However, as reported in the documentary analysis, this transport system faces logistic challenges. Among them, the limited modal integration between BRT and bicycle use may have a deleterious effect on active transportation in some of the largest Latin American cities. This can dissuade persons who usually have long trips and would use a bicycle if they had access to bicycle parking in the BRT stations and buses. In addition, the urban expansion and reduction of urban density that occurred in the majority of metropolitan areas may affect the geographic accessibility of public transportation while increasing the acquisition of motorcycles and motor vehicles (ITDP-Mexico, 2013). These facts highlight the need to harmonize the agendas of public transportation with urban development in order to achieve the highest benefits on physical activity levels.

Less value has been placed on strategies that increase quality of life and improve options for leisure time activities. The Ciclovía program is an innovative urban intervention that is anchored in the social and cultural environment of most of the examined 10 Latin American cities and may offset urban inequalities existing in public green areas. There are several aspects of this program, however, that need improvement to increase physical activity at population level. First, several cities (Greater México, Lima, and Santiago) described in this study face important challenges implementing the Ciclovía program because the routes are limited to specific areas and do not connect the different socioeconomic groups across the

cities. In addition, the overall reduction of public green space through formal and informal processes in some of these cities might increase social and environmental inequalities.

The findings of the study's documentary analysis suggest some initiatives to promote active living require a strong civil society leadership. In this context, physical activity advocates should establish alliances with other social sectors to promote and support urban sustainability agendas. This is especially relevant since the majority of urban interventions reviewed in this study may have political motivations that are not necessarily related with an explicit discourse on physical activity promotion. These could include the improvement of the urban mobility, reduction of air pollutants, enforcement of land use regulations aimed at curbing sprawl, provision of recreational facilities to improve social cohesion, or provision of an appropriate context for investing and economic activities, among other social motivators.

Despite the benefits and opportunities provided by the programs and existing infrastructure, there are many concerns regarding the rising inequality of the coverage and distribution of these initiatives. Among these are the widespread violence and insecurity in Latin American cities that can affect physical activity patterns of those populations, especially in deprived areas. If these programs and initiatives are to achieve a complete population level effect that reduces health disparities, their social and spatial distribution within the city need closer examination so they reach underserved populations and can develop to their full potential.

Several limitations can be identified in this study. First, despite the promising evidence, the majority of the studies included in the systematic reviews were conducted in high-income countries (mainly USA, Australia and the United Kingdom) which have different urban processes from the ones experienced in Latin America. There is some evidence that urban and built environment interventions evaluated in high income settings may work differently in low and middle-income settings and may even have the opposite effect intended. Thus, while these interventions may be associated with increased physical activity in high income settings, they may not have the same impacts in low and middle-income settings (Adams et al., 2013; Cervero, 2009; Gomez, Sarmiento, et al., 2010). Second, several studies documenting relationships between urban environments and physical activity in Latin America published in the last 10 years have yet to be included in systematic reviews (Adams et al., 2013; Cervero, 2009; Ding et al., 2013; Gomez, Parra, et al., 2010; Gomez, Sarmiento, et al., 2010; Gómez, 2010; Hino, Reis, Sarmiento, Parra, & Brownson, 2011; Parra, Gomez, Fleischer, & David Pinzon, 2010; Parra, Hoehner, et al, 2011; Parra, McKenzie, et al., 2010; Gómez et al., 2013; Torres et al., 2013). Third, we did not find enough documentation of urban processes linked with the aims of this study for the city of Caracas, which limits the reach of our conclusions. Fourth, the complexity of the issues addressed in this study did not allow the coverage of all aspects related with urban environments and physical activity. For example, there are additional factors that can play a role in the decision to engage in active transportation or physical activity during leisure time. Fifth, the synthesis of evidence did not identify relevant urban attributes, which have been shown to influence physical activity in Latin America, such as road safety and personal security conditions (Gómez, 2010). Finally, because sociopolitical processes in medium and small urban settings may significantly differ from those found in large urban cities, the policy analysis is restricted to

the cities included in this study. Therefore, this study should be assumed as one of the first approximations on the topic and by no means a conclusive compilation of evidence. Future studies should seek to better understand the challenges of promoting physical activity in urban settings of the region. Such studies may consider a comprehensive theoretical approach to gain a deeper understanding of the hidden connections of urban interventions and physical activity in Latin America.

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Appendix I

Systematic reviews and meta-analysis excluded of the umbrella reviewed due to fatal flaws based on SURE. Ordered by publication date.

Review or meta-analysis	Reasons for exclusion
Ferdinand AO et al 2012	No quality assessment of the included studies. Heterogeneity makes difficult the approach to the bias. There was language bias, no contact with authors/expert. Not clear if the screening was made by 2 authors..
Van Cauwenberg J et al 2011.	No assessment for bias in the results analysis. Not clear if there was an independent review of the articles by different authors in the screening or full text phases. Language bias, no excluded studies list provided. No/poor examination of the specific factors that might explain differences in the results of the included studies
Wong BY et al 2011.	No assessment of risk of bias. not clear how many authors participate in the screening of full text articles, no list of excluded studies provided. language bias, no contact with authors/experts. No explicit selection criteria. No type of studies listed. There was not a sensible method used to explore the extent to which key factors explains heterogeneity
Faulkner G et al, 2008.	No clear assessment for bias in the results analysis. Language bias, no authors/experts contact, no excluded studies list provided. No type of study included specified. Not clear if there was an independent review by different authors
Wendel-Vos W et al 2007.	No assessment of the risk of bias. Language bias, no contact with authors/experts, no reference lists in included articles checked. No list of excluded studies provided. Not reasonably up-to-date. There was not a sensible method used to explore the extent to which key factors explains heterogeneity
Duncan MJ et al, 2005.	No assessment of risk of bias. Vague explanation of the inclusion criteria: search criteria not explicit, type of population, age and type of study not described. Screening of full text by 1 reviewer, no list of excluded studies provided. No explicit selection criteria. There was not a sensible method used to explore the extent to which key factors explains heterogeneity

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- Most research on physical activity and the environment was in high income countries
- Urbanization and planning are unequal in Latin American cities examined
- Poor safety in low income areas may lessen the effect of physical activity programs
- The Ciclovía program and bus-rapid transit are successful, popular programs
- Strong civil society leadership is needed for sustainable policy and programs

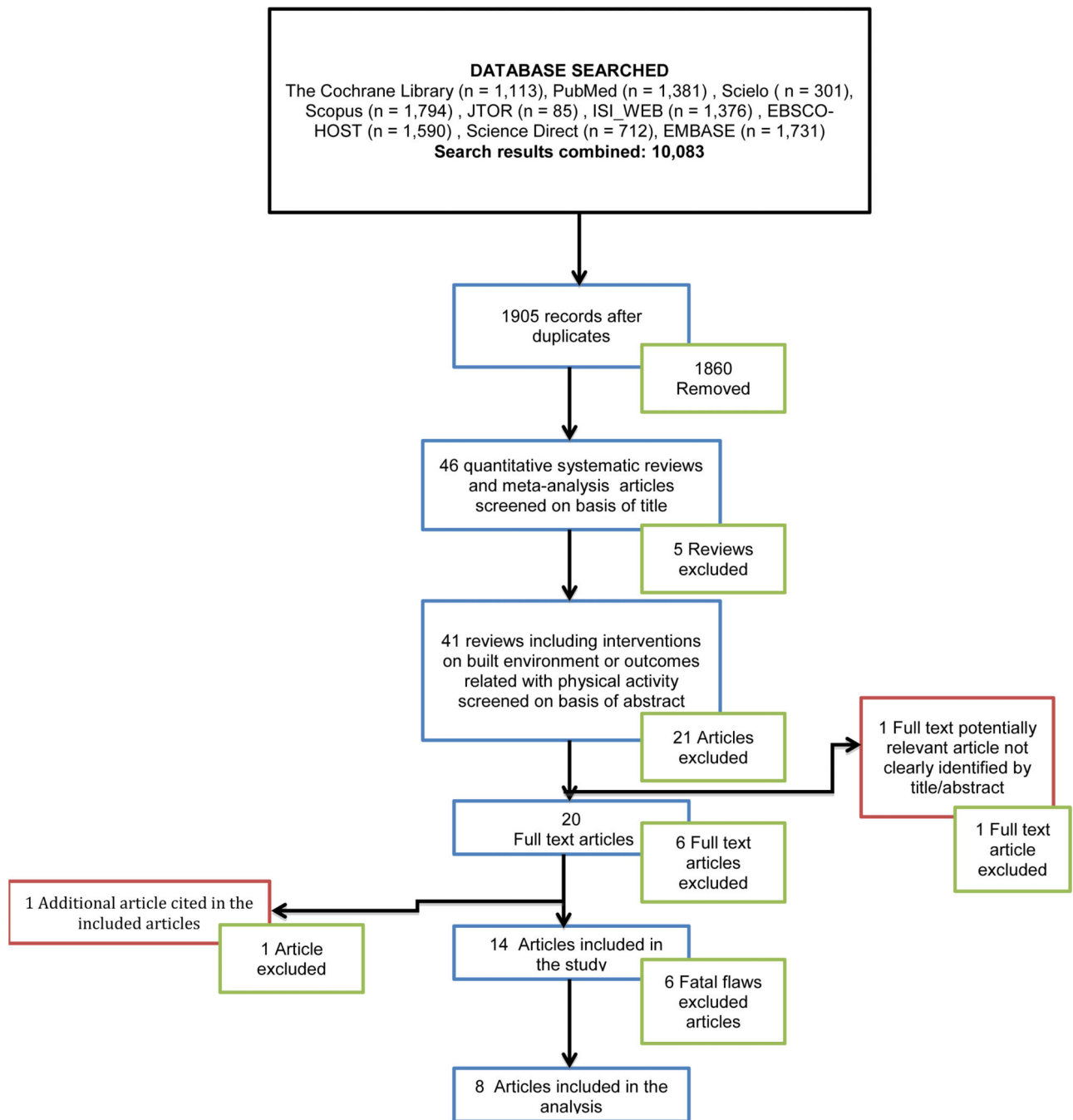


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow-chart of study selection.

Table 1
Systematic reviews of urban interventions linked with physical activity promotion. Ordered by publication date.

Review or meta-analysis	Number of studies*	Countries	Study population	Study designs	Reviewed topic	Main findings	Rate of the methods used	
							Identification and assessment of studies	Methods to analyse the findings
Rissel C et al 2012	9	6 in USA 2 in United Kingdom 1 in Australia	Adults	7 cross-sectional studies 2 cohort follow-up without control group.	Time spent in physical activity among adults using public transport	Using public transport adds 8 – 33 minutes walking per day with several papers reporting 12 – 15 minutes of additional physical activity per day.	Important limitations. There was no a clear analysis for the risk of bias, language bias, no contact with authors/experts.	Reliable
Van Holle V et al 2012	70	17 in United Kingdom 13 in Belgium 9 in The Netherlands 5 in Sweden 3 in Spain 3 in Portugal 3 in Czech Republic 3 in Austria 1 in France 1 in Greece 1 in Denmark 1 in Croatia 1 Poland 1 in Italy 8 Multinational	Adults aged between 18 – 65 years	69 cross-sectional studies 1 repeat cross-sectional study without control	Relationships between different attributes of the physical environment and diverse domains of physical activity in Europe	In Europe adults: walkability was positively related to total physical activity, transportation walking and transportation cycling. Access to shops/services/work was positively related to general active transportation and transportation cycling. Safety from traffic showed a positive association with recreational walking/cycling. Urbanization degree revealed a positive relationship with transportation cycling and a negative relationship with total physical activity. Quality of the environment was positively related to total physical activity.	Important limitations. Full text review by 2 authors was only made for doubtful articles. Language bias, no contact with authors/experts. No excluded studies list provided.	Reliable

Review or meta-analysis	Number of studies [*]	Countries	Study population	Study designs	Reviewed topic	Main findings	Rate of the methods used	
							Identification and assessment of studies	Methods to analyse the findings
Durand CP et al 2011.	44	1 in Portugal 1 in Sweden 1 in Belgium 2 in England 3 in Canada 9 in Australia 27 in USA	Children, adolescents and adults.	39 cross-sectional studies. 3 cohort follow-up without control group. 2 controlled cohort studies.	Association between Smart Growth attributes and physical activity.	Several features of the built environment associated with smart growth planning may promote physical activity (open space preservation) and walking (range of housing choices, mixed land use, development toward existing communities and compact building design).	Important limitations. No clear assessment for bias in the results analysis. Language bias, no authors/experts contact.	Reliable
Chillon P et al 2011.	14	9 in USA 1 in United Kingdom 3 in Australia 1 in England	Children and adolescents.	10 controlled cohort studies. 1 cohort follow-up without control group. 2 randomized controlled trial (individual). 1 cluster randomized controlled trial.	Assessment of interventions aimed at promoting active school transport.	Interventions that work toward a specific goal, in this case: increasing active transportation; involvement of school, parents and community seemed to be more effective than those that were broader in focus and with involvement of one or two of the actors.	Reliable, only minor limitations. There was language bias, no contact with authors/expert.	Reliable
Fraser SD et al, 2011	21	14 in USA 3 in Australia 2 in England 1 in Canada 1 in Netherlands	Children, adolescents, adults and older adults.	17 cross-sectional studies. 2 controlled repeat cross sectional studies. 1 repeat cross sectional studies without control. 1 Qualitative.	Associations between the built environment and cycling.	There are associations between objectively measured environmental factors and cycling, such as cycle routes or paths, population density, short trip distance, proximity to a cycle path or greenspace and	Reliable, only minor limitations. Language bias, no authors/experts contact, no list of excluded articles.	Important limitations No clear explanation on how they classify the studies.

Review or meta-analysis	Number of studies [*]	Countries	Study population	Study designs	Reviewed topic	Main findings	Rate of the methods used	
							Identification and assessment of studies	Methods to analyse the findings
Yang et al, 2010	25	13 in England, 4 in Australia, 3 in USA, 1 in Sweden, 1 in Netherlands, 1 in Denmark, 1 in Germany, 1 in Scotland.	Children and adults	1 randomized controlled trial (individual). 1 cluster randomized controlled trial. 20 controlled repeat cross sectional studies. 3 Controlled cohort studies.	Effectiveness of interventions to promote cycling.	safe routes to school, safe routes to school, Interventions applied at population level to promote cycling such as: Improvement to infrastructure for cycling, cycle training, free bike hire, Ride to work Day, educational and promotional campaigns had net increases of prevalence cycling or bicycle trips up to 3.4 percentage points.	Reliable, only minor limitations. Full text screening made only by 1 author.	Reliable
McCormack GR et al, 2010.	33	29 in USA, 1 in Australia, 1 in England, 1 in Netherlands 1 in Canada.	Adults aged 18 years and over	20 cross-sectional studies. 6 cohort follow-up without control group. 5 controlled cohort studies. 2 repeat cross sectional studies without control.	Associations between the built environment and physical activity despite neighborhood self-selection	Higher physical activity levels are associated with land use mix, composite walkability indices and neighborhood type even after controlling for neighborhood self-selection..	Important limitations. No clear assessment for bias in the results analysis. Language bias, no authors/experts contact, no excluded studies list provided.	Reliable
Anderson et al, 2009	4	1 in Australia 1 in Finland and Germany 1 in USA 1 in Colombia	Children, adolescents and adults.	2 cross-sectional studies. 2 repeat cross sectional studies.	Effectiveness of diverse interventions on physical activity.	Policies targeting the built environment (policies that reduce barriers to physical activity, transport policies and policies to increase space for recreational activity) showed positive a effective results.	Important limitations. Language bias, no excluded studies list provided. The information from grey literature is incomplete. Is not clear if there was an independent review by different authors	Reliable, only minor limitations. Not clear if there was an independent review by different authors

* Number of studies linked with urban interventions to promote physical activity. Some systematic reviews included several types of interventions and this number may be a subset of the total studies.

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Table 2

Urban attributes and interventions positively associated with physical activity and their potential facilitators and barriers or challenges for implementation in the selected Latin American cities.

Urban attributes and interventions	Systematic reviews	Physical activity modes	Examples in the selected Latin American cities.	Facilitators	Barriers and challenges
Public transportation	Rissel et al 2012	Walking for transportation	Bus rapid transit system implemented in 7 of 10 cities, with the exception of Buenos Aires, Belo Horizonte, São Paulo and Caracas.	Low cost in comparison with rail systems. Fast implementation. Political support at local, national and regional levels.	High occupancy rates due to excess demand of users. Limited modal integration with bicycle. Logistic and financial challenges to operate the system. Difficulties in becoming part of an integral transport system.
Public spaces for recreational activity**	Anderson et al 2009.	Leisure time physical activity.	Ciclovia Program implemented in 9 of 10 cities, with the exception of Buenos Aires.	Social engagement groups committed. Political support in the cases Bogotá, Sao Paulo and Guadalaajara. Reduction of socio spatial segregation due to the greater access to public space.	Not all Ciclovia Programs cover urban areas of different socioeconomic status. Criticisms from some local commercial business nearby.
Cycling infrastructure	Fraser et al 2011, Yang et al 2010.	Cycling for transport.	Bike paths and bike lanes implemented in 5 of 10 cities (Rio de Janeiro, México City, Buenos Aires, Bogotá and Santiago de Chile).	Social activism movements committed to the promotion of bicycling.	Limited connectivity between the bike-lane networks.
Compact building development and walkability*	Durand et al 2011; McCormack et al 2011.	Walking for transportation.	There were no documented large scale experiences in the selected cities which have been implemented using urban policies.		
Urban environments that support active transportation to school	Chillon P et al 2011.	Walking and cycling for transportation.	There were no documented experiences in the selected cities.		

* Combination of commercial floor, space, connectivity, residential density and land use mix.

** This urban attribute or intervention includes the Ciclovia program in which some of the main roads of the cities are closed to motor vehicles for seven daylight hours on Sundays and holidays and opened exclusively to pedestrians and cyclists.