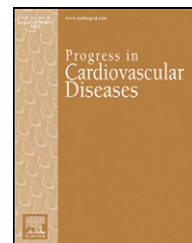


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Can Population Levels of Physical Activity Be Increased? Global Evidence and Experience

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ABSTRACT

Physical inactivity is one of the most important contributors to the global burden of disease and has become a global public health priority. We review the evidence on physical activity (PA) interventions, actions, and strategies that have the greatest potential to increase PA at the population level. Using the socio-ecological framework to conceptualize PA interventions, we show that PA can be targeted at multiple levels of influence and by multiple sectors outside the health system. Examples of promoting PA on a national scale are presented from Finland, Canada, Brazil, and Colombia. A strong policy framework, consistent investment in public health programs, multi-sectoral support and actions, and good surveillance characterize each of these success stories. Increasing PA globally will depend on successfully applying and adapting these lessons around the world taking into account country, culture, and context.

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Physical inactivity accounts for more than five million premature deaths each year, making it one of the most important contributors to the global burden of disease.¹ Public health policy is beginning to be informed by this fact. Physical activity (PA) is prominently featured in the World Health Organization's Global Action Plan for the Prevention and Control of Non-Communicable Diseases (NCDs) 2013–2020 and the targets and indicators within a global monitoring framework for NCDs.^{2,3} Many countries have national public health plans with specific objectives that support and encourage physical activity, including the United States (US), United Kingdom, Brazil, Colombia,

Australia, and India.^{4–9} The ubiquity of inactivity as a public health challenge was made clear in The Lancet series on PA in 2012.^{1,10–14} Nearly one third of adults are inactive worldwide¹⁰ and there is a growing evidence-base on the correlates and determinants of physical activity¹¹ and effective interventions to increase PA¹². However, substantial gaps in the evidence remain, especially related to interventions in low and middle-income countries (LMICs) and interventions at a scale beyond the community-level.¹³

In this paper we critically review the evidence on PA interventions, actions, and strategies that have the greatest

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Abbreviations and Acronyms

LTPA = leisure time physical activity

LMICs = low and middle-income countries

NCD = non-communicable diseases

PA = physical activity

SEM = socio-ecological model

US = United States

potential to increase PA at the population level. We will first define a framework for understanding ways to change population levels of PA, then summarize the published systematic reviews on PA interventions, highlight four examples of promoting PA at a national scale, and finally synthesize recommendations for public health policy, research, and

practice given our current understanding of the field.

Increasing PA at the population level depends on several factors: the efficacy and effectiveness of the chosen public health and clinical interventions; supportive policy, environments, and planned actions in sectors other than public health and medicine; the population reach of these actions; continuity; scalability; secular trends in key domains such as the economy, technology, and politics; and country, culture, and context.¹³ In other words, PA promotion is a true public health activity fitting well within classic definitions such as those from Last's *A Dictionary of Public Health*¹⁵ ("An organized activity of society to promote, protect, improve, and, when necessary, restore the health of individuals, specified groups, or the entire population."¹⁶), and the Institute of Medicine report *The Future of Public Health*¹⁷ ("Public Health is organized community efforts aimed at the prevention of disease and promotion of health. Its mission is the fulfillment of society's interest in assuring conditions in which people can be healthy."¹⁷).

Successful PA promotion is also characterized by a balance between a strong science base (i.e., evidence-based reviews) and artful application of that science. This blending of the science and art of PA promotion relies on scientific studies, quantitative data, qualitative data, professional judgment, and timing. Again, matching nicely with our understanding of how evidence-based public health ("the process of integrating science-based interventions with community preferences to improve population health"¹⁸) should guide modern public health policy and practice. A key concept in each of these definitions is that public health is population health. A seemingly obvious corollary to this is that global public health must of necessity be especially focused on understanding how to best deliver public health strategies addressing the most important causes of disease and disability to large populations. In reality, this is often not the case. Global public health has been slow to adapt to the triple transition (epidemiologic, demographic, and lifestyle) that has shifted the center of gravity of the global burden of disease to NCDs in LMIC.^{19–21} Until quite recently this has also been the case for public health research and programs for physical activity, with the bulk of the evidence and most of the best examples of national plans and policies for PA coming from a handful of high-income countries.^{4,5,8,13,14} However, as we will see from recently published evidence-based reviews and our four case

studies, research, policy, and programs for PA are also becoming a priority in middle-income countries.

Evidence-based reviews

There is a large and growing body of evidence on the effectiveness of PA interventions. Systematic reviews have been conducted using a variety of evidence-based constructs, and these reviews themselves were recently reviewed and summarized in *The Lancet*¹². We will briefly summarize the results of the key evidence-based reviews and attempt to place them in a socio-ecological framework in order to better understand the totality of the evidence for effectiveness of PA interventions. The United States *Guide to Community Preventive Services*²² ("the *Community Guide*" <http://www.thecommunityguide.org>), the *Guide to Clinical Preventive Services*²³ ("the *Clinical Guide*" <http://www.ahrq.gov/professionals/clinicians-providers/guidelines-recommendations/guide/>), and the United Kingdom National Institute for Health and Care Excellence (NICE)²⁴ (<http://www.nice.org.uk/>) have been among the most comprehensive review processes to date^{25–28}. The clinical interventions reviewed in the *Clinical Guide* and community-based and health system-based interventions reviewed by the *Community Guide* have been used by researchers and practitioners to guide health promotion and disease prevention efforts in both clinical and community settings. In recent years, the *Community Guide* process has been culturally adapted to review PA promotion and obesity prevention interventions in Latin America. The *Guide for Useful Interventions for PA in Brazil and Latin America* (Project GUIA)²⁹ synthesized the evidence for PA interventions in Latin America (<http://www.projectguia.org/en/>), and the *Guide to Obesity Prevention in Latin America and US* (Project GOL)³⁰ synthesized the evidence for diet and PA interventions for obesity treatment or prevention among Latinos in the US and Latin America (<http://www.sdprc.net/research/other-projects/project-gol/>). Both collaborations evaluated interventions based on criteria from the *Community Guide*.

Across the existing models for evaluating PA interventions, there are several major categories for conceptualizing intervention approaches, including behavioral and social, campaigns and informational, health-care based, as well as environmental and policy approaches. In a recent review in *The Lancet*, these approaches were found to be effective at increasing PA across various ages, social groups, communities, and countries.¹²

Classifying interventions based on the approach applied to increase PA is useful for evaluating similar interventions; however, this method of conceptualization is not based on any theoretical framework. In fact, few reviews of strategies for promoting health behaviors use a theoretical framework for conceptualizing interventions. To address this gap, we organized the aforementioned approaches for PA promotion within the theoretical framework of the socio-ecological model (SEM), which posits that behavior is influenced by factors that co-exist and interact at multiple levels³¹. The key levels of influence include the intrapersonal (individual), interpersonal, community/organizational, and environmental/policy levels (Fig 1). The notion behind the SEM is that because factors that influence behavior do not act alone, a multilevel

approach is deemed to be more effective at behavior change than one that targets only one level.^{31,32}

We searched for reviews of PA interventions published until June 2014 including *Community Guide*, *Project GUIA*, *Project GOL*, *NICE*, and the *Cochrane Collaboration*, and attempted to conceptualize the interventions reviewed according to the SEM. Details of the reviews can be found elsewhere^{27,33,28,34–38}.

The results of our review show sufficient to strong evidence for interventions targeting at least one level of influence of the SEM (Table 1). At the intrapersonal level, individually-adapted health behavior interventions were effective at increasing PA levels among overweight/obese Latino adults, pointing to the potential of these interventions for obesity treatment among this population group when combined with dietary improvement efforts. Healthcare-based interventions delivered by health professionals (e.g., counseling) also had positive effects on increasing PA among patients,²⁶ indicating that primary care practitioners have an important role in promoting PA at the individual level. Professional advice or counseling can also be enhanced with additional education and support from community-based and healthcare-system based programs to assist practitioners in meeting the health needs of their patients.

At the interpersonal level, there was strong evidence for recommending nonfamily social support strategies for promoting PA among adults in high-income settings (i.e., US, Canada, and Australia) but there was little evidence to support its effectiveness in LMIC.

At the community/organizational level, several interventions that applied a combination of approaches (e.g., informational, behavioral, and environmental) were found to be effective (Table 1). School- and workplace-based interventions, in particular, had the strongest and most consistent evidence for PA interventions combining several approaches for behavior change. For example, strong evidence for recommendation was found for school-based interventions that involved exercise groups, enhanced social support and self-esteem, active commuting campaigns, increased time spent in moderate/vigorous PA during physical education classes and decreased screen time, and the involvement of parents. These interventions were conducted in high- and low-and-middle-income countries and among culturally and socio-economically diverse populations. Workplace-based interventions with strong evidence for recommendation involved PA education, discounts to fitness centers, motivational sessions, supervised sessions, and policy support measures. These interventions were only studied in high-income countries (i.e., US, Australia, and New Zealand). Community-wide campaigns involving multiple approaches (social support, health education, etc.) and several community sectors were also found to be effective in high-income countries but there was insufficient evidence to evaluate its effectiveness in Latin America.

At the physical/policy environmental level, the following strategies showed sufficient to strong evidence for recommendation: point of decision prompts, creation of or enhanced access to places for physical activity combined with activities in informational outreach, community-scale urban design and land-use policies and practices, street scale urban design and land use policies and practices, community-wide policies and planning, workplace-based, school-based physical education, mass media campaigns, physical activity classes in community settings, family-based social support, nonfamily social support, delivery of short physical activity-related messages, individually adapted health behavior change, classroom-based health education, college-based physical education/health education, and healthcare-based.

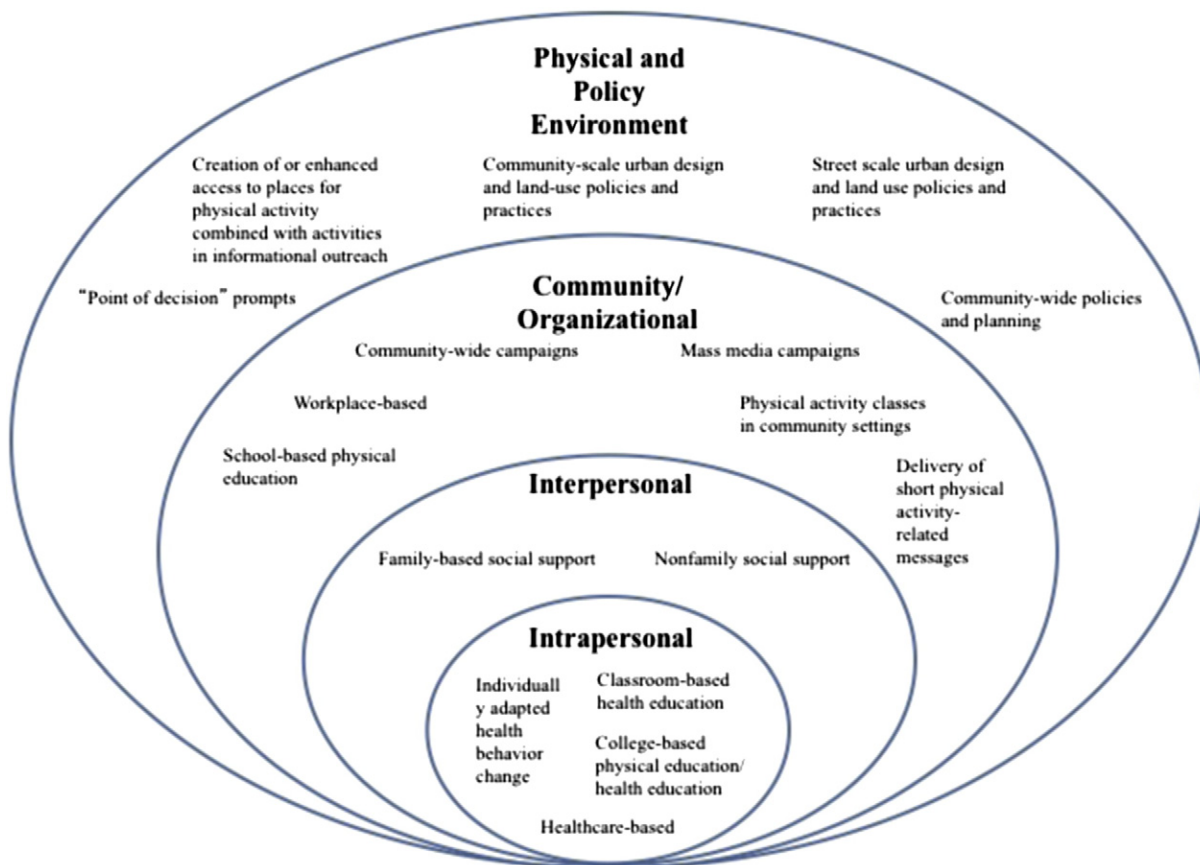


Fig 1 – Mapping physical activity intervention strategies on the socio-ecological model.

Table 1 – Review of strategies for increasing physical activity by level of influence of the socio-ecological model.

Level of Influence and Strategy	Description	Sources	Target Population and Setting	Findings (No. Studies Included)
Intrapersonal Individually adapted health behavior change	Education on behavioral skills: goal setting and monitoring of progress, building social support, behavioral reinforcement, problem solving, prevention of relapse into sedentary behavior, etc.	1. Kahn et al., 2002 ²⁷ 2. Hoehner et al., 2008 ³³ 3. Holub et al., 2013 ³⁵	1.1. Adults in the US and Australia 2.1. N/A 3.1. Overweight/ obese Latino adults in the US 3.2. Overweight/ obese adults in Mexico & Brazil 3.3. Latino children in the US and Latin America	1.1.1. Strong evidence for recommendation (n = 18) 2.1.1. Insufficient evidence from Latin America for recommendation (n = 0) 3.1.1. Strong evidence to recommend interventions combining PA and healthy eating/nutrition for obesity treatment (n = 14) 3.2.1. Sufficient evidence to recommend interventions combining PA and healthy eating/nutrition for obesity treatment (n = 9) 3.3.1. Insufficient evidence to recommend interventions focused on PA alone for obesity prevention (n = 2) or treatment (n = 0) 3.3.2. Insufficient evidence to recommend interventions combining PA and healthy eating/ nutrition for obesity prevention (n = 2) or treatment (n = 8)
Classroom-based health education focused on providing information	Education on skills development for adopting healthier behaviors; topics vary	1. Kahn et al., 2002 ²⁷ 2. Hoehner et al., 2008 ³³ 3. Biddle, Braithwaite, & Pearson, 2014 ³⁸	1.1. Children & adolescents in the US 2.1. Children & adolescents in Brazil and US–Mexico border 3.1. Young girls in the US and other countries	1.1.1. Insufficient evidence for recommendation (n = 10) 2.1.1. Insufficient evidence for recommendation (n = 3) 3.1.1. Recommended interventions targeting girls only and those that used educational (n = 9) and multicomponent strategies (n = 9) based on small but significant effects
Classroom-based education focused on reducing television viewing and video game playing	Education on reducing screen time (e.g., TV)	1. Kahn et al., 2002 ²⁷ 2. Hoehner et al., 2008 ³³	1.1. Children & adolescents in the US 2.1. N/A	1.1.1. Insufficient evidence for recommendation (n = 3) 2.1.1. Insufficient evidence from Latin America for recommendation (n = 0)
College-based physical education/health education	Didactic and behavioral education on setting long-term behavioral patterns for physical activity	1. Kahn et al., 2002 ²⁷ 2. Hoehner et al., 2008 ³³	1.1. Young adults in the US 2.1. N/A	1.1.1. Insufficient evidence for recommendation (n = 2) 2.1.1. Insufficient evidence from Latin America for recommendation (n = 0)
Healthcare-based	Interventions to improve PA among patients in the primary care or health clinic setting; interventions	1. NICE, 2006 ²⁶ 2. Orrow et al., 2012 ³⁷	1.1. Adults in Australia, New Zealand, US, UK, & Canada 2.1. Adults and older populations	1.1.1. Recommended based on evidence showing moderate increases in PA (n = 11) 2.1.1. Recommended based on small to medium positive

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Table 1 (continued)

Level of Influence and Strategy	Description	Sources	Target Population and Setting	Findings (No. Studies Included)
	are delivered by health professionals (e.g., psychologist, licensed nutritionist, licensed dietician, and physician)	3. Holub et al., 2013 ³⁵	in the UK, New Zealand, US, Canada, Switzerland, Australia, & Netherland 3.1. Overweight/ obese children in Brazil & Mexico 3.2. Overweight/ obese children in the US 3.3. Adults in the US and Latin America	intervention effects at follow up (n = 13); insufficient evidence to recommend exercise referral schemes over advice or counseling interventions (n = 3) 3.1.1. Sufficient evidence from Latin America to recommend interventions combining PA and healthy eating/nutrition for obesity treatment in children (n = 3) 3.2.1. Insufficient evidence from the US to recommend interventions combining PA and healthy eating/nutrition for obesity treatment in children (n = 2) 3.3.1. Insufficient evidence from the US (n = 5) and Latin America (n = 1) to recommend interventions combining PA and healthy eating/nutrition for obesity treatment in adults 3.3.2. Insufficient evidence to recommend interventions focused on PA alone for obesity prevention (n = 1) or treatment (n = 1)
Interpersonal Family-based social support	Joint (with family) or separate education on health, goal-setting, problem solving, family behavioral change	1. Kahn et al., 2002 ²⁷ 2. Hoehner et al., 2008 ³³ 3. Holub et al., 2013 ³⁵	1.1. Families in the US & Greece 2.1. N/A 3.1. Latino children in the US and Latin America 3.2. Latino adults in the US and Latin America	1.1.1. Insufficient evidence for recommendation (n = 11) 2.1.1. Insufficient evidence for recommendation from Latin America (n = 0) 3.1.1. Insufficient evidence to recommend interventions combining PA and healthy eating/nutrition for obesity prevention (n = 3) or treatment (n = 4) among children 3.1.2. Insufficient evidence to recommend interventions focused on PA alone for obesity prevention (n = 0) or treatment (n = 0) among children 3.2.1. Insufficient evidence to recommend interventions combining PA and healthy eating/nutrition for obesity prevention (n = 3) or treatment (n = 1) among adults 3.2.2. Insufficient evidence to recommend interventions focused on PA alone for obesity prevention (n = 0) or treatment (n = 0) among adults

Table 1 (continued)

Level of Influence and Strategy	Description	Sources	Target Population and Setting	Findings (No. Studies Included)
Nonfamily social support	Building, strengthening, and maintaining social networks that support PA behavior change (e.g., buddy system and walking groups)	1. Kahn et al., 2002 ²⁷ 2. Hoehner et al., 2008 ³³	1.1. Adults in the US, Canada, & Australia 2.1. Adults in Colombia & US–Mexico border	1.1.1. Strong evidence for recommendation (n = 9) 2.1.1. Insufficient evidence for recommendation (n = 2)
Community/ Organizational				
School-based physical education	Enhanced school physical education (PE): improvements to the curriculum to increase amount spent in moderate or vigorous PA during PE classes	1. Hoehner et al., 2008 ³³ 2. Lavelle, Mackay, & Pell, 2012 ³⁶ 3. Holub et al., 2013 ³⁵ 4. Lonsdale et al., 2013 ³⁴	1.1. Children in Brazil, Chile, & US–Mexico border 2.1. Children in Europe, US, Thailand, China, India, Singapore, Australia, Egypt 3.1. Latino children in the US 3.2. Children in Mexico, Brazil, & Chile	1.1.1. Strong evidence for recommendation (n = 5) 2.1.1. Recommended interventions focused on PA alone or in combination with dietary change to reduce body mass index (n = 34) 3.1.1. Sufficient evidence to recommend interventions combining PA and healthy eating/nutrition for obesity prevention (n = 8) but insufficient evidence for obesity treatment (n = 4) 3.2.1. Sufficient evidence to recommend interventions focused on PA alone for obesity prevention (n = 3) but insufficient evidence for obesity treatment (n = 2)
Workplace-based	Interventions at the worksite focused on increasing PA among employees (e.g., reduced gym membership fees, supervised exercise, and motivational/ educational sessions)	1. Conn et al., 2009 ⁵⁴ 2. Holub et al., 2013 ³⁵	4.1. Children in the US, UK, Belgium, & Australia 1.1. Adults in the US, Australia, & New Zealand 2.1. Latino adults in the US 2.2. Adults in Latin America	4.1.1. Strong evidence for recommendation (n = 14) 1.1.1. Evidence inconsistent but some interventions showed improvements in PA (n = 138) 2.1.1. Insufficient evidence from US to recommend interventions focused on PA alone for obesity prevention (n = 0) or treatment (n = 0) among Latino adults 2.1.2. Insufficient evidence from US to recommend interventions combining PA and healthy eating/nutrition for obesity prevention (n = 1) or treatment (n = 1) among Latino adults 2.2.1. Insufficient evidence from Latin America to recommend interventions focused on PA alone for obesity prevention (n = 1) or treatment (n = 0) 2.2.2. Insufficient evidence from Latin America to recommend interventions combining PA and healthy eating/nutrition for obesity prevention (n = 1) or treatment (n = 1)

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Table 1 (continued)				
Level of Influence and Strategy	Description	Sources	Target Population and Setting	Findings (No. Studies Included)
Community-wide campaigns	Multicomponent informational approaches (e.g., social support, health education) involving many community sectors	1. Kahn et al., 2002 ²⁷	1.1. Adults in the US, Sweden, Denmark, Australia, Scotland, Wales	1.1.1. Strong evidence for recommendation (n = 10)
		2. Hoehner et al., 2008 ³³	2.1. Adults in Brazil	2.1.1. Insufficient evidence for recommendation (n = 1)
PA classes in community settings	Regular, structured exercise group classes that involve some educational component	1. Hoehner et al., 2008 ³³	1.1. Adults in Brazil and Chile	1.1.1. Insufficient evidence for recommendation (n = 5)
Mass media campaigns	Delivery of messages on PA via mass media (newspapers, radio, TV, websites, etc.)	1. Kahn et al., 2002 ²⁷	1.1. Adults in the US and Australia	1.1.1. Insufficient evidence for recommendation (n = 3)
		2. Hoehner et al., 2008 ³³	2.1. N/A	2.1.1. Insufficient evidence from Latin America for recommendation (n = 0)
Delivery of short physical activity-related messages	Delivery of short physical activity-related educational and motivational messages	1. Hoehner et al., 2008 ³³	1.1. Women in Brazil	1.1.1. Insufficient evidence for recommendation (n = 1)
Physical and policy environment				
“Point of decision” prompts	Motivational signs placed in/near stairwell or base of elevators to encourage stair use	1. Kahn et al., 2002 ²⁷	1.1. Individuals in the US, England, & Scotland	1.1.1. Sufficient evidence for recommendation (n = 6)
		2. Hoehner et al., 2008 ³³	2.1. Individuals in the US-Mexico border	2.1.1. Insufficient evidence for recommendation (n = 1)
Creation of or enhanced access to places for PA combined with activities in informational outreach	Changing local environment to provide opportunities for PA (e.g., walking trails and building exercise facilities)	1. Kahn et al., 2002 ²⁷	1.1. Adults in the US	1.1.1. Strong evidence for recommendation (n = 10)
		2. Hoehner et al., 2008 ³³	2.1. N/A	2.1.1. Insufficient evidence from Latin America for recommendation (n = 0)
Community-scale urban design and land-use policies and practices	Changing physical environment of urban areas to support PA (e.g., proximity of residential areas to stores/school/work/recreational areas, connectivity of sidewalks, and aesthetics of environment)	1. Heath et al. 2006 ²⁸	1.1. Adults in the US and Canada	1.1.1. Sufficient evidence for recommendation (n = 12)
		2. Hoehner et al., 2008 ³³	2.1. N/A	2.1.1. Insufficient evidence from Latin America for recommendation (n = 0)
Street scale urban design and land use	Changing physical environment of small geographic	1. Heath et al., 2006 ²⁸	1.1. Adults in the US, England, Canada,	1.1.1. Sufficient evidence for recommendation (n = 6)

Table 1 (continued)

Level of Influence and Strategy	Description	Sources	Target Population and Setting	Findings (No. Studies Included)
policies and practices	areas to support PA(e.g., building codes, roadway design standards, improved street lighting, and use of traffic calming approaches)	2. Hoehner et al., 2008 ³³	Australia, Belgium, & Germany 2.1. N/A	2.1.1. Insufficient evidence from Latin America for recommendation (n = 0)
Community-wide policies and planning	Multicomponent approaches to remove environmental/institutional barriers to physical activity; may involve many community sectors	1. Hoehner et al., 2008 ³³ 2. NICE, 2008 ²⁵	1.1. Women in Colombia 2.1. Adults in the US, Germany, Netherlands, & Finland	1.1.1. Insufficient evidence for recommendation (n = 1) 2.1.1. Evidence found suggesting positive association between PA and national policies on health and physical activity, transport, and planning (n = 3)

Abbreviation: PA, physical activity.

outreach, community-scale urban design and land-use policies and practices, and street scale urban design and land use policies and practices. With the exception of one intervention in Colombia, all the environmental interventions reviewed were conducted in high-income countries, pointing to a large gap in understanding of the effectiveness of such interventions in LMIC.

Several limitations of our review should also be mentioned. First, most strategies reviewed were evaluated in the short-to medium term pointing to the need for long-term assessments for greater understanding of sustained impacts of these interventions. It is also important to note that most of the evaluated interventions were conducted in high-income countries, thus recommendations reported here may not be generalizable to other contexts. Nevertheless, our review shows that there is emerging evidence from countries in Latin America that have experienced the triple transition and are now focusing public health efforts and research on increasing PA.²¹ In addition, our findings are consistent with those described in the review in *The Lancet* on evidence-based PA interventions from around the world¹² and a review by the Cochrane Collaboration synthesizing systematic reviews and meta-analyses of randomized controlled trials for increasing PA levels.³⁹ Using the socio-ecological framework to conceptualize PA interventions, we show that PA can be targeted at multiple levels of influence and by multiple sectors outside the health system (e.g., education, workplace, and urban planning) in various countries. Most of the impact on PA will come from sectors outside of health. Much more research is needed to better understand how to scale up evidence-based

interventions, especially in the complex reality of LMIC. However, several countries have been reasonably effective at taking PA promotion to a national scale. In the following section, using brief case studies, we will describe how this occurred in Canada, Finland, Brazil, and Colombia. These descriptions point not only to the “what” (e.g., evidence of effective intervention approaches) of PA promotion but the “how” (e.g., mobilizing action, political will) of achieving change on a large-scale.

Country case studies

Canada

Canada developed an early policy focus on PA, starting with the Fitness and Amateur Sport Act in 1961. A decade later, the national PA focused program ParticipACTION was launched.⁴⁰ This initiative was initially a public–private partnership, with subsequent Government engagement. It provided a consistent health communication around PA for four decades, and created a clear ParticipACTION ‘brand.’ This program achieved very high population rates (70%–85%) of message recall, understanding, and credibility among adult Canadians.⁴⁰ ParticipACTION developed many national and regional worksite programs and youth sport and activity programs, and conducted serial mass media campaigns encouraging PA, sport participation, and ‘active living’. Canada had introduced the concept of lifestyle-related ‘active

living' in 1986, years ahead of most other developed nations. ParticipACTION became so associated with PA in Canada that it was the most commonly attributed source of the first Canadian PA Guidelines in 2002, even though ParticipACTION had not developed the guidelines, and the initiative was in abeyance between 2001 and 2005.⁴⁰ Although de-funded by Health Canada in 2001, ParticipACTION was revived in 2005, and developed a strong social marketing approach to promoting children's physical activity.⁴¹ Unfortunately, in July 2014, ParticipACTION underwent a large funding cut from the Federal Government, with the recommendation that it should return to its private sector funding roots, with support from the Provincial governments.

In the period from the 1970s until around 1990, there were several national policy initiatives in Canada, with a good understanding of the cross-sectorial nature of PA action, usually involving partnerships between the health, sport and recreation sectors. In addition, the complex nature of Federal, Provincial, municipal and non-government sector responsibilities for PA was often beneficial. For example, when the national government effort was quiescent, other agencies or levels of government would implement effective PA strategies. Funding for PA was at its peak in the mid 1980s⁴², the period during which PA rates increased in Canada⁴³.

Since 2000, due to fiscal restraint and changes in government policy, there was less funding devoted specifically to PA. There were developments from 2005 through the Pan-Canadian Healthy Living Strategy, advocacy co-ordination through the Coalition for Active Living, ongoing and diverse PA programs in the Provinces,⁴² and possibly implementation of an ineffective children's fitness tax credit scheme⁴⁴. Nonetheless, this devolution of implemented PA work resulted in a plateau of, and then slight decline in population PA levels in children and adults.⁴² The current partnership around the Active Canada 20/20⁴⁵ strategy (<http://www.activecanada2020.ca/>) has been developed to address this, but needs to obtain sustainable funding and Government support.

A key strength throughout this period was an ongoing PA monitoring system, through the Canadian Fitness and Lifestyle Research Institute⁴⁶, this measured not only PA levels, but also policies at the school, workplace, and municipality levels, as well as the built environment (<http://www.cflri.ca/>). Such long-term monitoring systems were useful in identifying the successful population-level increases in PA in Canada from around 1980 to 2000,⁴³ and subsequent lack of improvements thereafter.

Finland

Experience in Finland provides an interesting contrast to that from Canada. Leisure time PA levels in both countries increased over a period of 20 or more years and this appears to be the result of favorable public policies and consistent investment in infrastructure and programs.^{47,48} In addition, both countries have had ongoing surveillance of PA, thus allowing an assessment of trends in population levels of PA. In Finland, as in Canada, public policy has provided a strong and stable base for developing national and community PA programs. However, the nature of the programs in Canada and Finland has been quite different. Finland developed a series of national policy

statements on the importance of PA for health between 1970 and 2002 in the education, sport, transport, and health sectors.⁴⁷ Three sequential national PA initiatives followed from 1991 to 2005 with flexible funding for community programs as a key element. The emphasis of these initiatives was on building an infrastructure of parks, trails, sports and recreational facilities, and community centers coupled with funds for local programming driven by grass roots community engagement. There has been relatively little emphasis in Finland on mass media to promote PA, perhaps in part because of the already strong social value of sport and PA.⁴⁷ As of 2004 Finland had more than 30,000 sites for sports and recreation (one for every 176 citizens). More than 90% of Finns report using the extensive network of paths and trails for either recreation or transport. Several surveys show increases in leisure time PA (LTPA) among Finnish adult men and women between the 1970s and 1980s and 2000.^{47,48} The proportion of both men and women reporting regular PA increased from approximately 40% to 60%.⁴⁷ In East Karelia a series of six surveys between 1972 and 1997 showed declining sedentary time and increasing LTPA for both men and women.⁴⁸ It appears that LTPA has plateaued for Finish adults since about 2000 while occupational and transport activity continue to gradually decline. In summary, Finland has been able to substantially increase LTPA over a period of decades through strong multisectoral public policy, consistent investment in community infrastructure and programs, and attention to local needs and culture. It is interesting to note that even with near optimal public policy, infrastructure, and programming only a bit more than half of the adult population is regularly physical active during leisure time.

Brazil

Health has been a constitutional right in Brazil since 1988.⁴⁹ Following that legal landmark a unified public health system was created, providing access to health care for the entire population, and with an explicit focus on health promotion.^{7,49} In the late 1990's a new PA promotion model was initiated in Brazil: *Academia da Cidade*, a community intervention that started in the city of Recife, a state capital in the Northeast of Brazil. *Academia da Cidade* is characterized by free daily PA classes in early mornings and late afternoons led by trained physical educators. An important environmental component of the program is the re-engineering of public parks or plazas, often in poor and dangerous neighborhoods. This creates safe public space for PA with good equipment and supervision. A close connection with the public primary health care system is integral to *Academia da Cidade*, allowing for easy referrals for prevention and treatment of NCD.

Academia da Cidade in the city of Recife has been evaluated with a combination of quantitative and qualitative research studies. A population-based phone survey showed that both current and former participants were more likely to be active than community members who had never participated in the program.⁵⁰ Less direct sources of exposure, such as having heard about the intervention or having seen classes, were also associated with higher levels of PA.⁵⁰ A study using direct observation showed that individuals using public spaces with *Academia da Cidade* units were more active than those

visiting similar locations without the program.⁵¹ Other studies indicated a high-level of satisfaction of both users and instructors with the intervention.⁵²

A key limitation of most existing PA interventions worldwide is that few have been scaled-up to national or state level. This is not the case for *Academia da Cidade*. Several cities in Brazil adapted the model based on its popularity and success. Based on the careful evaluation of the program in Recife and public demand, the state government of Pernambuco decided to expand the program to all 185 municipalities in the state.⁵¹ Preliminary findings suggest that the magnitude of the increase in PA is even greater than was observed in single-city studies. *Academia da Cidade* has also been exported and adapted for Latino communities in the US.⁵³ However, the most promising development has been a massive national expansion of the *Academia da Cidade* program.⁵⁴ The Federal Government has funded over 2000 cities in Brazil to deliver *Academia da Cidade* (now named *Academia da Saúde*—Healthy Gym) to the population. To date, more than 400 cities have built the program infrastructure and are delivering community PA classes.

Colombia

The National Constitution of 1991 established sports and recreation as a right for all Colombians. Funding and promotion for sports and recreation were also defined as responsibilities of the state.⁵⁵ However, Colombia's emphasis on PA as a public health issue is relatively new. A number of city programs began in the 1990s, spawning a national physical activity network by 2002. An intersectoral government commission for PA was created in 2008, and in 2009 the Colombian congress passed a national obesity law⁵⁶ that included strategies for improving environments, policies, and programs for PA. The National Development Plan 2010–2014 included PA promotion as a priority, with specific ten-year plans for sports, recreation, physical education, and public health.⁹ Stimulated by both supportive policies and local programs the national sports institute (Coldeportes) launched a national PA program in 2003 and expanded it to healthy lifestyles in 2011.⁵⁷ The national program focuses on training public health and PA professionals from each of the 32 departments in Colombia to deliver community-based programs modeled on successful municipal programs such as *Por su Salud Muévase Pues* in Medellín, *Risaralda Activa*, and *Muévete Bogota*, and the *ciclovías* of Bogotá, Medellín, and Cali (open streets programs).^{58–60} Free PA classes in public parks, plazas, and community centers similar to those in Brazil, and a network of 67 open streets programs (*Vías Activas y Saludables*) are key components of the national program. Evaluation of the *Ciclovía* and *Recreovia* (community classes) programs conducted as part of international partnerships suggests that these programs are effective at increasing the proportion of the population meeting PA recommendations and are also cost beneficial.^{61,62} National nutrition and health surveys conducted in 2005 and 2010 showed an increase in overall PA among adults in Colombia from 50.1% to 53.5%. In contrast to data from high-income countries, walking for transport increased (24.2% to 33.8%), biking for transport was unchanged (6.4% to 5.6%), and the prevalence of PA in leisure time decreased

(24.3% to 19.9%).⁶³ Colombia demonstrates the feasibility of implementing a national PA promotion program in a LMIC, but it is not yet clear whether the increases in PA prevalence are a result of public health, sport, and recreation programs or changes in the urban environment and public transport.

Conclusions

In summary, we have made a case for PA promotion as a classic population health endeavor. Substantial evidence for effective interventions exists at the community level, and a handful of cases suggest that effective interventions can be scaled up to the national level. Based on these examples one may ask, what combination of planned public health interventions, partnerships, and actions in various sectors is most likely to result in population level increases in PA? There are a number of common characteristics that emerge from the evidence-based reviews and the experiences in Canada, Finland, Brazil, and Colombia. Large scale programs for PA promotion and NCD prevention appear to evolve much more from community need and political will with some guidance from the evaluation of pilot programs than from synthesis, adaptation, and implementation of research findings. A focus on action with good evaluation guiding further investment is evident in the cases of *ParticipACTION* in Canada, the *North Karelia Project* in Finland, community PA classes in Brazil, and the *ciclovía* in Colombia. In order to deliver a sufficient dose of intervention to change behavior it seems that the balance must skew towards action and reach. When research is the primary goal of community projects, evaluation may become so much the priority that it consumes the resources required to deliver sufficient intervention. Nevertheless, solid evaluation is also essential. We know that the programs in Canada, Finland, Brazil, and Colombia were effective because in all cases there was a combination of targeted evaluation and continuous national surveillance systems that included consistent measures of PA allowing for an assessment of change over time. It is also worth noting that some aspects in the scaling-up of these four country cases differ markedly. While Brazil and Colombia built their national programs around scaling up well-evaluated large city programs, Finland's success seems more a matter of high cultural value of PA and a steady flow of supportive programs and initiatives. Canada used sustained mass media promotion of PA in a uniquely effective manner.

Despite the differences in approach, size and diversity of populations, geography, income, and culture, several other common factors emerge from the cases of these four countries. PA and sport are highly valued in the culture, for rich and poor, and generally for both genders. Evidence-based strategies for promoting PA were effectively adapted to the social norms, culture, and context of each country. Public space and public facilities also played key roles in each country. In Finland and Canada, community centers and robust systems of parks and trails created an excellent infrastructure for PA. In Brazil and Colombia, challenging, crowded, chaotic, often dangerous urban areas have led to a special emphasis on utilizing selected public streets, plazas, and parks to provide secure and attractive areas where people can congregate for PA and social activity. It is intriguing to note

that the success stories for national PA promotion come from either countries with a high degree of social equity (Finland and Canada) or countries that are focused on PA as a strategy to explicitly address social inequity (Brazil and Colombia). The themes of public good and public space appear to be integral to successful large-scale PA promotion.

While PA as a public health discipline is still in the early stages of evolution, some recommendations may be reasonably drawn from research and global experience. Evidence-based interventions are necessary but not sufficient for large-scale public health efforts. Adaptation of these strategies to country, culture, and context is critical. An important part of this process will involve tailoring of strategies based on social norms related to PA and sport, realities of public space and infrastructure, and issues of equity and security. Favorable actions in sectors outside of public health and medicine (e.g., urban planning and transportation) are essential for large-scale PA promotion. Public investment in walkable city centers and public transport with attention to pedestrians and cyclists, parks, and public safety may be driven by concerns related to economic development, climate change, or urban quality of life, but will have major impacts on PA. An isolated public health strategy for PA is unlikely to be successful as many of the necessary actions occur in sectors other than public health and because sustained funding is nearly impossible without the broader political support associated with strong partners and constituencies. High-quality, ongoing PA surveillance is also essential as it is impossible to judge success at the national level without it. Increasing PA globally will depend primarily on successfully applying these lessons in LMIC that account for approximately 90% of the world population. The experience of the last decade in Latin America suggests that this is feasible, but the situation may differ substantially in Asia, Africa, and the Middle East. It is likely that the concepts we have summarized will hold, but how they are operationalized may differ. Safety from crime and traffic, congested unplanned urban conglomerations, climate, and less social desirability of sport and PA are likely to be especially challenging in these regions. Research on determinants, correlates, and intervention effects specific to countries in Asia, Africa, and the Middle East is needed to guide public health strategies for PA. However, as we have seen in Canada, Finland, Brazil, and Colombia, the real key to population level impact may be government commitment and implementation of major new programs accompanied by selective, focused, high quality evaluation.

Statement of Conflict of Interest

The authors report no conflicts of interest.

REFERENCES

1. Lee IM, Shiroma EJ, Lobelo F, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet*. 2012;380(9838):219-229.
2. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013–2020. Geneva: World Health Organization. 2013.
3. World Health Organization. 2008–2013 Action plan for the global strategy for the prevention and control of noncommunicable diseases. Geneva: World Health Organization. 2009.
4. Bornstein DB, Pate RR, Pratt M. A review of the national physical activity plans of six countries. *J Phys Act Health*. 2009;6(Suppl 2):S245-S264.
5. Pate RR. A national physical activity plan for the United States. *J Phys Act Health*. 2009;6(Suppl 2):S157-S158.
6. Goenka S, Ajay VS, Jeemon P, Prabhakaran D, Varghese C, Reddy KS. Powering India's growth. New Delhi: Initiative for Cardiovascular Health Research in the Developing Countries; Centre for Chronic Disease Control; World Health Organization, Country Office, India; and Public Health Foundation of India. 2007.
7. Ministério da Saúde, Secretaria de Vigilância em Saúde, Secretaria de Atenção à Saúde. Brazil national policy of health promotion 2nd ed. 2007. [Brasília].
8. Bull FC, Milton K, Kahlmeier S. National policy on physical activity: the development of a policy audit tool. *J Phys Act Health*. 2014;11(2):233-240.
9. Departamento Nacional de Planeación. Plan Nacional de Desarrollo 2010–2014: Prosperidad para todos. 2011.
10. Hallal PC, Andersen LB, Bull FC, et al. Physical activity levels of the world's population: surveillance progress, gaps and prospects. *Lancet*. 2012;380(9838):247-257.
11. Bauman AE, Reis RS, Sallis JF, et al. Correlates of physical activity: why are some people physically active and others not? *Lancet*. 2012;380(9838):258-271.
12. Heath GW, Parra DC, Sarmiento OL, et al. Evidence-based intervention in physical activity: lessons from around the world. *Lancet*. 2012;380(9838):272-281.
13. Pratt M, Sarmiento OL, Montes F, et al. The implications of megatrends in information and communication technology and transportation for changes in global physical activity. *Lancet*. 2012;380(9838):282-293.
14. Kohl III HW, Craig CL, Lambert EV, et al. The pandemic of physical inactivity: global action for public health. *Lancet*. 2012;380(9838):294-305.
15. Last JM. A dictionary of public health. , vol. 13 New York: Oxford University Press Oxford. 2007.
16. Last JM. A dictionary of public health. , vol. 13 New York: Oxford University Press Oxford. 2007:306.
17. Institute of Medicine. The future of public health. Washington, DC: National Academy Press. 1988.
18. Kohatsu ND, Robinson JG, Torner JC. Evidence-based public health: an evolving concept. *Am J Prev Med*. 2004;27(5):417-421.
19. Pratt M, Lamarre M-C. The new world of global health. *Glob Health Promot*. 2013;20(Suppl 4):3-5.
20. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380(9859):2224-2260.
21. Pratt M, Brownson RC, Ramos LR, et al. Project GUIA: a model for understanding and promoting physical activity in Brazil and Latin America. *J Phys Act Health*. 2010;7(Suppl 2):S131-S134.
22. The guide to community preventive services. <http://www.thecommunityguide.org/>. [Updated August 15, 2014. Accessed June 30, 2014].
23. The guide to clinical preventive services. <http://www.ahrq.gov/professionals/clinicians-providers/guidelines-recommendations/guide/>. [Accessed June 30, 2014].

24. National Institute for Health and Care Excellence (NICE). <http://www.nice.org.uk/>. [Accessed June 30, 2014].
25. National Institute for Health and Clinical Excellence (NICE). Physical activity and the environment. UK: National Institute for Health and Clinical Excellence. 2008.
26. National Institute for Health and Clinical Excellence (NICE). Four commonly used methods to increase physical activity. UK: National Institute for Health and Clinical Excellence. 2006.
27. Kahn EB, Ramsey LT, Brownson RC, et al. The effectiveness of interventions to increase physical activity: a systematic review. *Am J Prev Med.* 2002;22(Suppl 4):73-107.
28. Heath GW, Brownson RC, Kruger J, et al. The effectiveness of urban design and land use and transport policies and practices to increase physical activity: a systematic review. *J Phys Act Health.* 2006;3(Suppl 1):S55-S76.
29. Project GUIA (Guide for Useful Interventions for Physical Activity in Brazil and Latin America). <http://www.projectguia.org/en/>. [Accessed June 30, 2014].
30. Project GOL (Guide to Obesity Prevention in Latin America and US). <http://www.sdprc.net/research/other-projects/project-gol/>. [Accessed June 30, 2014].
31. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q.* 1988;15(4):351-377.
32. Stokols D. Translating social ecological theory into guidelines for community health promotion. *Am J Health Promot.* 1996;10(4):282-298.
33. Hoehner CM, Soares J, Parra Perez D, et al. Physical activity interventions in Latin America. *Am J Prev Med.* 2008;34(3):224-233.
34. Lonsdale C, Rosenkranz RR, Peralta LR, Bennie A, Fahey P, Lubans DR. A systematic review and meta-analysis of interventions designed to increase moderate-to-vigorous physical activity in school physical education lessons. *Prev Med.* 2013;56(2):152-161.
35. Holub CK, Elder JP, Arredondo EM, et al. Obesity control in Latin American and U.S. Latinos: a systematic review. *Am J Prev Med.* 2013;44(5):529-537.
36. Lavelle HV, Mackay DF, Pell JP. Systematic review and meta-analysis of school-based interventions to reduce body mass index. *J Public Health (Oxf).* 2012;34(3):360-369.
37. Orrow G, Kinmonth AL, Sanderson S, Sutton S. Effectiveness of physical activity promotion based in primary care: systematic review and meta-analysis of randomised controlled trials. *Br Med J.* 2012;344:e1389, <http://dx.doi.org/10.1136/bmj.e1389>.
38. Biddle SJ, Braithwaite R, Pearson N. The effectiveness of interventions to increase physical activity among young girls: a meta-analysis. *Prev Med.* 2014;62:119-131.
39. Foster C, Hillsdon M, Thorogood M, Kaur A, Wedatilake T. Interventions for promoting physical activity. *Cochrane Database Syst Rev.* 2005;1.
40. Bauman A, Madill J, Craig CL, Salmon A. ParticipACTION: this mouse roared, but did it get the cheese? *Can J Public Health.* 2004;95(S2):S14-S19.
41. Craig CL, Bauman A, Gauvin L, Robertson J, Murumets K. ParticipACTION: a mass media campaign targeting parents of inactive children; knowledge, saliency, and trialing behaviours. *Int J Behav Nutr Phys Act.* 2009;6(88), <http://dx.doi.org/10.1186/1479-5868-6-88>.
42. Craig CL. Evolution and devolution of national physical activity policy in Canada. *J Phys Act Health.* 2011;8(8):1044-1056.
43. Craig CL, Russell SJ, Cameron C, Bauman A. Twenty-year trends in physical activity among Canadian adults. *Can J Public Health.* 2004;95(1):59-63.
44. Spence J, Holt N, Dutove J, Carson V. Uptake and effectiveness of the Children's Fitness Tax Credit in Canada: the rich get richer. *BMC Public Health.* 2010;10(1), <http://dx.doi.org/10.1186/1471-2458-10-356>.
45. Active Canada 20/20. <http://www.activecanada2020.ca/>. [Accessed August 10, 2014].
46. Canadian Fitness and Lifestyle Research Institute. <http://www.cflri.ca/>. [Accessed August 15, 2014].
47. Vuori I, Lankenau B, Pratt M. Physical activity policy and program development: the experience in Finland. *Public Health Rep.* 2004;119(3):331-345.
48. Barengo NC, Nissinen A, Tuomilehto J, Pekkarinen H. Twenty-five-year trends in physical activity of 30- to 59-year-old populations in eastern Finland. *Med Sci Sports Exerc.* 2002;34(8):1302-1307.
49. Paim J, Travassos C, Almeida C, Bahia LJM. The Brazilian health system: history, advances, and challenges. *Lancet.* 2011;377(9779):1778-1797.
50. Simoes EJ, Hallal P, Pratt M, et al. Effects of a community-based, professionally supervised intervention on physical activity levels among residents of Recife, Brazil. *Am J Public Health.* 2009;99(1):68-75.
51. Parra DC, Hoehner CM, Hallal PC, et al. Scaling up of physical activity interventions in Brazil: how partnerships and research evidence contributed to policy action. *Glob Health Promot.* 2013;20(4):5-12.
52. Hallal PC, Tenório MC, Tassitano RM, et al. Evaluation of the Academia da Cidade program to promote physical activity in Recife, Pernambuco State, Brazil: perceptions of users and non-users. *Cad Saude Publica.* 2010;26(1):70-78.
53. Larsen BA, Pekmezi D, Marquez B, Benitez TJ, Marcus BH. Physical activity in Latinas: social and environmental influences. *Womens Health (Lond Engl).* 2013;9(2):1-10.
54. Malta DC, da Silva JB. Policies to promote physical activity in Brazil. *Lancet.* 2012;380(9838):195-196.
55. República de Colombia. Constitución Política de Colombia. 1991.
56. Congreso de la República de Colombia. Ley 1355. 2009. [Colombia].
57. Social MdlP, Departamento Administrativo del Deporte IR, la Actividad Física y el Aprovechamiento del Tiempo Libre, Coldeportes. Hábitos y Estilos de Vida Saludable. Tomo 1: Documento técnico con los contenidos para el mejoramiento de la gestión territorial de los referentes departamentales, en la promoción de hábitos de vida saludable, con énfasis en alimentación y prevención del. 2011. [Bogotá].
58. Sarmiento O, Torres A, Jacoby E, Pratt M, Schmid TL, Stierling G. The Ciclovía-Recreativa: a mass-recreational program with public health potential. *J Phys Act Health.* 2010;7(Suppl 2):S163-S180.
59. Torres A, Sarmiento OL, Stauber C, Zarama R. Ciclovía and Cicloruta programs: promising interventions to promote physical activity and social capital in Bogotá. *Am J Public Health.* 2013;103(2):e23-e30, <http://dx.doi.org/10.2105/AJPH.2012.301142>.
60. Gámez R, Parra D, Pratt M, Schmid TL. Muévete Bogotá: promoting physical activity with a network of partner companies. *Glob Health Promot.* 2006;13(2):138-143.
61. Montes F, Sarmiento OL, Zarama R, et al. Do health benefits outweigh the costs of mass recreational programs? An economic analysis of four Ciclovía programs. *J Urban Health.* 2012;89(1):153-170.
62. Paez DC, Reis RS, Parra DC, et al. Bridging the gap between research and practice: an assessment of external validity of community-based physical activity programs in Bogotá, Colombia, and Recife, Brazil. *Transl Behav Med.* <http://dx.doi.org/10.1007/s13142-014-0275-y> (in press).
63. González SA, Sarmiento OL, Lozano O, Ramírez A, Grijalba C. Niveles de actividad física en la población colombiana: desigualdades por sexo y condición socioeconómica. *Biomedica.* 2014;34(3), <http://dx.doi.org/10.7705/biomedica.v34i3.2258>.
64. Conn VS, Hafsdahl AR, Cooper PS, Brown LM, Lusk SL. Meta-analysis of workplace physical activity interventions. *Am J Prev Med.* 2009;37(4):330-339.