Physical Activity 2016: Progress and Challenges

Scaling up physical activity interventions worldwide: stepping up to larger and smarter approaches to get people moving

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The global pandemic of physical inactivity requires a multisectoral, multidisciplinary public-health response. Scaling up interventions that are capable of increasing levels of physical activity in populations across the varying cultural, geographic, social, and economic contexts worldwide is challenging, but feasible. In this paper, we review the factors that could help to achieve this. We use a mixed-methods approach to comprehensively examine these factors, drawing on the best available evidence from both evidence-to-practice and practice-to-evidence methods. Policies to support active living across society are needed, particularly outside the health-care sector, as demonstrated by some of the successful examples of scale up identified in this paper. Researchers, research funders, and practitioners and policymakers in culture, education, health, leisure, planning, and transport, and civil society as a whole, all have a role. We should embrace the challenge of taking action to a higher level, aligning physical activity and health objectives with broader social, environmental, and sustainable development goals.

Published **Online** July 27, 2016 http://dx.doi.org/10.1016/S0140-6736(16)30728-0

This paper forms part of the Physical Activity 2016 Series

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See **Online/Comment** http://dx.doi.org/10.1016/S0140-6736(16)31070-4, http://dx.doi.org/10.1016/S0140-6736(16)30960-6, http://dx.doi.org/10.1016/S0140-6736(16)30929-1, and http://dx.doi.org/10.1016/S0140-6736(16)30881-9

See **Online/Articles** http://dx.doi.org/10.1016/S0140-6736(16)30370-1, and http://dx.doi.org/10.1016/S0140-6736(16)30383-X

See **Online/Series** http://dx.doi.org/10.1016/S0140-6736(16)30581-5

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Background

Since the publication of the first *Lancet* Series on physical activity in 2012—which recognised physical inactivity as a global pandemic and urged all sectors of governments and societies to take immediate action—the demand for effective strategies to increase population physical activity levels has grown.[1,2] A substantial body of evidence resulting from decades of research in the fields of exercise physiology, public health, epidemiology, and the behavioural sciences has shown that physical activity has broad economic and health benefits[1] and that under scientifically controlled circumstances, behaviour change is achievable for increasing physical activity in diverse groups.[3] Until 2010, most of this evidence came from high-income countries (HICs),[3] but during the past 5 years, the number of interventions developed, implemented, and assessed in low-income and middle-income countries (LMICs) has grown substantially.[4]

Despite the many convincing arguments and global calls for action to reverse the physical inactivity pandemic,[1] practitioners and policy makers have restricted access to knowledge about existing physical activity programmes that can be effectively implemented at scale. So-called effective physical activity interventions have too often been done only in small, controlled settings.[2] However, a few efforts to bring these findings into real-world programmes have been made. In fact, the scientific literature contains abundant examples of researcher-led translation and dissemination trials, implementing evidence-based physical activity interventions in a variety of real-world settings.[3] Unfortunately, these initial translation attempts have usually not thrived in the real world (ie, in becoming embedded in a system) once the research funds for translation have expired. Further expansion to reach more people and places (scaling up) and achieve programme maintenance and sustained health benefits requires extensive knowledge of strategies for implementation, adoption, and sustainability.[5,6]

Some well-known examples of fast-growing programmes have arisen from the real world, such as open streets, Academia da Saúde, and bike sharing programs) often reflecting common civic sense. These forms of practice-based evidence are often implemented at scale and replicated in many settings around the world. Often there is no budget for assessment, but in the best of cases, these programmes are later assessed by researchers to estimate their effectiveness in promoting physical activity.[3,4,7] However, an exhaustive inventory of these cases is not available to researchers, practitioners, and stakeholders, and the internal and external validity of the evaluations have been questioned.[3,4,7]

In our view, scaling up is not simply achieved by researchers leading the implementation of a translated programme at a larger scale (eg, at city or state level), although in some cases this type of scale-up could represent the first step. When an intervention outgrows the research setting and becomes embedded in a system, thereby ensuring maintenance and sustainability of its health benefits, only then can successful scale-up be considered to have been achieved. Likewise, in some cases, practice-based evidence can also outgrow its local context to improve external validity and be embedded in its local system. Although other researchers have used varying definitions for scalability and scale-up, our approach is pragmatic and responsive to the urgent call to action to reverse the pandemic of inactivity. In essence, by seeking effective strategies for scaling up physical activity interventions around the world, we aim to find ways of reintegrating active living into the realms of government and society where it used to reside:

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Key messages

- The existing scientific literature has identified several key factors required for the scaling up of physical activity interventions: proven efficacy in controlled settings, partnerships beyond the health sector, and institutionalisation early in programme development
- Drawing on input from researchers and stakeholders across the world, more than 50 unique physical activity interventions were identified that have been scaled up but not reported in the peer-reviewed literature
- Not every intervention implemented at scale is effective in increasing population physical activity levels, and not every effective, researcher-led intervention is scalable
- Greater numbers of studies that are more rigorous and have more useful scalability are needed: researchers, research funding agencies, and scientific journals should prioritise studies for assessing the impact of real-world physical activity interventions
- An action-oriented framework will help researchers to focus on the most important factors in the scale-up process, and will aid policy makers and practitioners in understanding its staged nature
- International organisations (eg, UN, WHO, and World Bank) should provide leadership for scaling up evidence-based physical activity interventions worldwide, by setting targets and indicators for countries
- Ministries of health should have a multilevel and multisectoral plan to increase population physical activity levels
- Physical inactivity should become an actively monitored risk factor in clinical medical practice and in national and regional surveillance systems, and health-care systems should provide physical activity counselling and support for the prevention and treatment of chronic diseases
- More graduate-level programmes to train researchers in physical activity and public health are desperately needed worldwide, especially in low-income and middle-income countries
- Sectors outside of health are essential to scaling up (eg, schools, urban planning, transportation, sports and recreation, the environmental sector); to reach these sectors fully, medical and public health practitioners need to highlight and emphasise the benefits beyond health effects (eg, economic benefits, quality of life)
- Policy makers, stakeholders, and city and state planners should focus on scaling up approaches with the highest face validity:
  - Ministries of education should adopt whole-of-school approaches for promoting physical activity among children and adolescents
  - Sports authorities should prioritise sports-for-all approaches and harness the potential co-benefits of sport participation
  - Environmental policies should be linked to the promotion of active living to maximise their opportunities for adoption, implementation, and scale-up
  - Urban planning and transportation policies should prioritise actions that promote safe, equitable, and environmentally friendly active mobility and leisure options for all citizens
- Civil society should demand improved policies, programmes, systems, and places to enable people to lead more active lives
- Greatest progress is likely to occur through interventions that are effective in promoting physical activity, implemented at scale, regularly assessed, and fully embedded in a system

city planning, transport, education, culture, leisure, environmental sustainability, and, of course, health. Scalable interventions in these wider areas of public policy will probably be needed to shift societies towards a more active way of life.

In this Series paper, we provide an overview of factors that could help to increase the ratio of success to failure in scaling up physical activity interventions around the world. We have four aims: (1) to summarise the available peer-reviewed, scientific evidence on scaling up physical activity interventions; (2) to integrate the knowledge and experience of senior researchers and key stakeholders on the factors influencing the scalability of physical activity interventions in HICs and LMICs; (3) to identify case studies of scaled-up physical activity interventions from around the world; and (4) to develop a framework to guide researchers, practitioners, policy makers, and civil society in selecting, implementing, and assessing scaled-up physical activity interventions.

What can be learnt about scaling up physical activity interventions from the scientific literature?

We did a systematic review of the peer-reviewed, English-language literature to summarise the available scientific evidence on scaling up physical activity interventions. An intervention was defined as a set of actions with a coherent objective to bring about change or produce identifiable outcomes.[8,9] Therefore, the review included not only traditional researcher-driven interventions proven to be efficacious in increasing physical activity in a controlled research setting (evidence-based practice),[10] but also programmes, strategies, policies, or initiatives that originated outside the scientific realm, but have been assessed by researchers and shown to be effective (practice-based evidence).[11,12] We searched PubMed and Scopus databases without any restriction on date of publication, given the anticipated dearth of sufficiently detailed accounts of the scale-up process in the literature. We reviewed publications with a scalability search term—from

an extended list based on that used by Milat and colleagues[9] in a similar review for scaled-up public health interventions—in the title, and a physical activity term in the title or abstract. The search terms used to define scalability were centred around the objective of identifying truly scaled-up interventions, defined for this study as those that had outgrown research dependency and become embedded into a system. Therefore, we purposely excluded search terms reflecting researcher-driven and researcher-funded translational studies (see appendix for a full list of search terms and criteria).

Publications were eligible for further abstraction if they reported an intervention implemented at scale and embedded in a system, for which physical activity was an intended outcome, and if they included sufficient detail of the scaling-up process. We used an adapted version of the External Validity Assessment Tool (EVAT)[7] developed by Project GUIA (Guide for Useful Interventions for Physical Activity in Brazil and Latin America).[13] Interventions were classified by theme, using the seven investments that work for physical activity outlined in the Toronto Charter for Physical Activity,[14,15] and by scalability category, using WHO's ExpandNet framework for scaling up.[16] When available, information was abstracted on any process assessment, key actors and partnerships, and cost-effectiveness of scaling up. We also abstracted information on the geographical setting (country, world region, and World Bank income category[17]), the target population, and whether the scaled-up intervention was an example of evidence-based practice or practice-based evidence. Further details of the review methods are available in the appendix.

The search yielded 547 unique articles. Among these, 18 peer-reviewed articles were identified in which physical activity was either the main outcome or a co-benefit of a scaled-up intervention, and for which sufficient detail of the scalability process was reported.[18–35] 16 unique scaled-up physical activity interventions were identified (with more than one publication for some interventions), of which 14 were from HICs,[18–30,32,34,35] one was from a middle-income country (MIC; Brazil)[31] and one was from a low-income country (LIC; Uganda).[33] 13 of the cases represented evidence-based practice.[18–22,24–30,32,34,35] Two of the three practice-based evidence cases were from LMICs.[31,33] 14 of the cases described an intervention that fitted into one of the seven categories of investment in physical activity (figure 1), with the most frequently represented categories being those of community-wide programmes (n=6),[20,22,24,31,32,34] whole-of-school programmes (n=3),[23,26–28,30] and physical activity promotion or NCD prevention integrated into primary health-care systems (n=3).[18,25,29] No cases relating to the categories of transport systems prioritising active travel, or urban design policies and infrastructure, were identified. The remaining cases involved public health education delivered by telephone or text message.[19,21] Six cases described interventions targeting children or youth,[18,23,25–28,30,33] four focused on adults,[19,24,29,35] one on older adults (aged 65 years or older),[32] and another one on both adults and older adults.[34] Two cases related to all age groups[21,22] and two were not specific about age groups.[20,31]

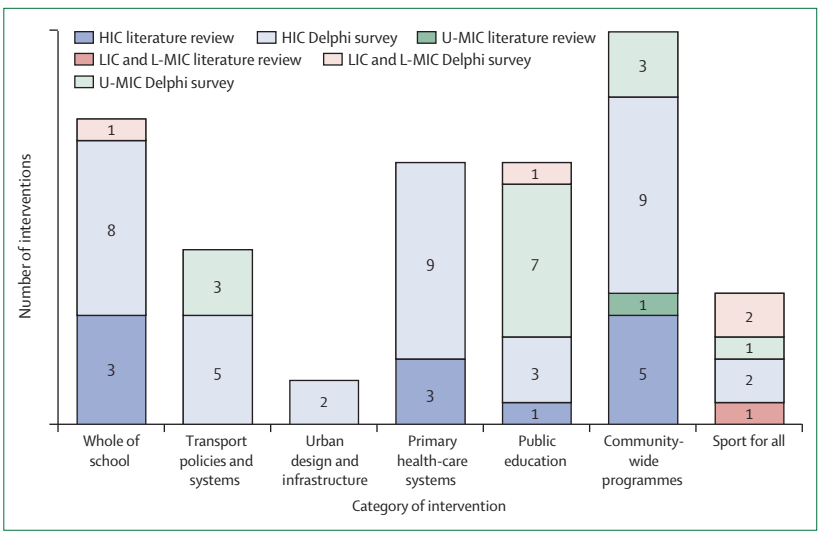

Figure 1: **Number of scaled-up physical activity interventions identified in the literature review and in the Delphi study**
HIC=high-income countries. LIC=low-income countries. L-MIC=lower-middle-income countries. U-MIC=upper-middle-income countries.

See **Online** for appendix

Scalability was most commonly defined exclusively as extending the reach of an intervention by replicating it in other localities, cities, or states (horizontal scale-up)[16] (n=6),[20,24,25,30,34,35] as institutionalising the intervention at government level so it could reach all citizens within a given jurisdiction (vertical scale-up)[16] (n=5),[22,23,29,31,32] or as a combination of horizontal and vertical scale-up (n=4).[18,19,21,26–28] Most of the monitoring and assessment activities pertaining to scalability assessed whether the programme was reaching the specified target population and whether the intervention was being properly implemented, with several cases reporting deficiencies in these regards. Public or private health-sector entities were the most commonly reported key actors, whereas partnerships with other sectors (schools, urban planning, sports and recreation, or academia) were reported in over half of cases. Further details of the 18 scientific publications, representing 16 unique scaled-up physical activity interventions found in the peer-reviewed literature, are available in the appendix.

The review provides important insights into the processes, key actors, and partnerships involved in scaling up physical activity interventions. Demonstrated efficacy in controlled settings, partnerships beyond the health sector, and institutionalisation from an early stage of programme development emerged as key factors for success. However, the exercise also highlighted some shortcomings of the evidence in this area. First, we found little information in the scientific literature—only 18 publications, representing 16 unique interventions—outlining the steps and processes involved in successful

scale-up of physical activity interventions. Second, the great majority of this literature relates to interventions being taken to scale in HICs. Third, we found few examples of practice-based evidence. Fourth, we found no examples corresponding to transport systems or urban design policies and infrastructure, two of the seven best investments for physical activity.

Drawing from the knowledge and experience of key researchers and stakeholders from around the world

To complement the literature review in building a fuller picture of the factors influencing the scalability of physical activity interventions, we sought to integrate the knowledge and experience of senior researchers and key stakeholders from all continents. We used an adapted Delphi method[36,37] combining email and telephone contacts, as this hybrid approach has been shown to outperform the traditional paper-based Delphi design.[37,38] We recruited participants from the Global Observatory for Physical Activity (GoPA), comprised of key researchers and practitioners from around the world. Among the country contacts of the GoPA network with full contact information available, at least one person per country (its primary contact listed in the network database) was invited to take part. This entailed completing a two-round online survey using the Qualtrics platform.

For the **Global Observatory for Physical Activity** see http://globalphysicalactivityobservatory.com

For the **Qualtrics platform** see http://www.qualtrics.com

After testing all electronic contacts, 139 eligible participants (each from a different country) were identified. Among them, 45·0% were from HICs (n=62), 28·6% were from upper-middle-income countries (U-MICs; n=40), 20·0% were from lower-middle-income countries (L-MICs; n=28), and 6·4% were from LICs (n=9). Of these, 74 (36 from HICs, 17 from U-MICs, and 21 from L-MICs or LICs) responded to the first round of the survey, which included open-ended questions on key factors that should be considered when deciding to scale up a physical activity intervention, as well as examples of any such intervention that had been scaled up in their country or region. Further details on the questionnaire and sample characteristics are available in the appendix. Following our definition of scalability, we identified 56 unique interventions that were cited as having been scaled up in the participants' own regions and were not found in our literature search (figure 1; appendix). A search for information on content, reach, effectiveness, and scalability was done for each regional intervention cited by the key informants, on the basis of published references and web-links provided, and through targeted internet searches based on the country, setting, and programme name (appendix). Scaled-up interventions were more frequently cited by key informants from HICs (38 interventions) than by their counterparts (14 from U-MICs, four from L-MICs or LICs). The most frequently reported categories of intervention were those of community-wide programmes (n=12) and public education (n=11), whereas those of urban design policies and infrastructure (n=2) were the least frequent. Examples of all seven categories of the best investments for physical activity were cited by HIC informants, whereas examples of urban design policies and infrastructure and of primary health-care systems were not cited by any of our U-MIC, L-MIC, or LIC informants.

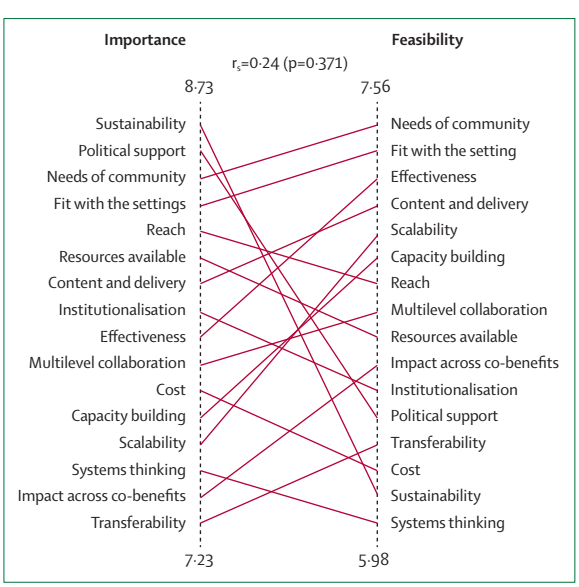

Figure 2: **Pattern matches for importance and feasibility of scalability factors for physical activity interventions among key informants[39]**

We identified a variety of factors regarded as important for scaling up physical activity interventions. 94 statements were provided and grouped by similarity into 16 unique factors. To assess the relative importance and feasibility of these factors, we invited all 74 initial respondents to complete the second round of the survey, of whom 67 did so. They were asked to rate each factor for importance and feasibility relative to the other factors on a 10-point scale (from 1, relatively unimportant or infeasible, to 10, extremely important or feasible). We also did pattern matching, which creates a series of graphs representing clusters in the data in order of importance or feasibility, or both (according to the average rating of the statements in each cluster). We used pattern matching to assess the correlation between importance and feasibility among our key informants (figure 2), between researchers and practitioners (appendix), and by country income level (appendix). We also assessed the correlation between groups using Spearman's rank correlation.

Overall, the scores attributed to importance were higher (median 8·27, IQR 8·00–8·35) than those attributed to feasibility (median 6·82, IQR 6·64–7·12; figure 2), suggesting that it remains a notable challenge to put what is considered to be important into practice. This mismatch was confirmed by the low and non-significant correlation of the importance and feasibility scores (r_s=0·24; p=0·37). However, the needs of the community and the fit with the setting showed relatively high scores for both importance and feasibility, suggesting that these categories might be

particularly important to consider when prioritising actions for scale-up. The large number of responses citing community-based interventions reinforces the importance of adapting and localising an intervention within a community setting. Conversely, the most important factors (sustainability and political support) had relatively low scores for feasibility, indicating a gap that might impede taking effective action. Previous research has found differences between responses from key informants from research and practice backgrounds in rating priorities for action on physical activity,[40,41] which our data support (appendix). However, the pattern of mismatch did not change when comparing responses from key informants with practice and research backgrounds, suggesting that our overall findings might be fairly consistent regardless of the background of the participants. Finally, in analysis stratified by country income level, sustainability emerged as being equally important regardless of the country income level, whereas content and delivery and multilevel collaboration seemed to be more important in L-MICs and LICs than in their higher-income counterparts. However, these factors—along with capacity building—were given lower feasibility scores by L-MIC and LIC informants (appendix).

Scale-up and effectiveness of strategies: lessons in finding balance

Our mixed-methods approach included a traditional systematic literature search complemented by an adapted qualitative Delphi process to obtain comprehensive information on scaled-up interventions worldwide. With this approach, we examined where, why, and how physical activity interventions are being scaled up around the world, and confirmed that the science of scalability in the realm of physical activity interventions remains a nascent field of research. The fact that the adapted Delphi process yielded 56 examples of scaled-up interventions, which were not found through the systematic review of the peer-reviewed literature, highlights the importance of searching both peer-reviewed and grey literature to achieve a better understanding of the types of physical activity interventions being scaled up around the globe. This mixed-methods approach also allowed us to identify case studies covering a variety of geographical and country-level income settings, and a range of strength of evidence of effectiveness.

In terms of where this evidence-based practice is taking place, our findings suggest that it seems to be mainly a practice of HICs, and is also the predominant type of scaled-up intervention reported in the peer-reviewed literature. Apart from reflecting the obvious—that evidence is more likely to be used for policy development in more highly developed nations—these results could also reflect the substantially larger research capacity available in HICs to undertake and publish studies documenting all steps of the knowledge-to-practice process.[42,43] A good example of a study that documents all these steps is the Coordinated Approach To Child Health (CATCH; panel 1), which followed a clear linear progression from a controlled efficacy trial,[47] to researcher-led dissemination efforts,[28] to showing effectiveness in researcher-led translation trials,[26] to achieving institutionalisation in more than half of Texas schools plus several other areas of the USA.[44,46] Despite its success, the case of CATCH also serves to highlight how long it takes for knowledge to become available to the population at large through real-world programmes—over 20 years have elapsed since the first efficacy trial of CATCH.

It seems that LMICs seldom rely on the evidence-based practice approach for scaling up physical activity interventions. In addition to absence of (or only emerging) research capacity,[42] the dearth of examples of effective physical activity interventions appropriate to the context of these settings could help to explain why evidence-based practice is not implemented in LMICs. Interventions designed, implemented, and assessed in LMICs have only fairly recently (ie, within the past 6 years) appeared in the peer-reviewed literature.[4] As for how the scale-up of physical activity interventions has occurred, scale-up efforts in LMICs have primarily emerged from the real world, with practice moving faster than research.[43] In these settings, the low levels of knowledge or local applicability of existing evidence, together with the urgent need for streamlined solutions to large-scale problems, seem to be important in moving practice agendas forward, as such factors are more highly valued than measures of effectiveness. These large-scale problems are not exclusive to health issues. Rather, the need to alleviate traffic congestion, air pollution, environmental injustice, social inequalities, and other societal challenges is resulting in the scaling up of interventions that might promote physical activity as a co-benefit.[43] Initial scaling up generally occurs with little consideration of the potential effectiveness of these programmes for increasing physical activity in populations.[43] In some instances in U-MICs, researchers are catching up to practice by producing well-designed evaluation studies of practice-based interventions such as bus rapid transit (BRT) systems (panel 2).[53,55,56,59] In L-MICs and LICs, competing priorities and scarce resources, and in some cases research capacity, have resulted in few rigorous assessments of scaled-up interventions, exemplified by the case of Sports for Development (S4D; panel 3). There is insufficient evidence to deem S4D as either effective or ineffective in increasing physical activity, but the few available studies point out that the programmes could be failing to reach those most in need (ie, the most inactive)[33] despite their popularity and widespread adoption in African nations and other regions worldwide.[61,62,65]

Not every intervention implemented at scale is effective for increasing physical activity in populations, and not every effective, researcher-led intervention is scalable. This highlights the need for more high quality research, and calls into question the role that the research community should play if we are serious about reversing the global pandemic of inactivity. Is continuing to do

Panel 1: **Scaled-up interventions from around the globe: Coordinated Approach To Child Health (CATCH)**

Overview
The Coordinated Approach To Child Health (CATCH) is a multilevel programme, based on the US Centers for Disease Control and Prevention's Whole School, Whole Community, Whole Child model.[44,45] The programme is designed to promote a healthy school environment through five modules: physical education, nutrition and cafeterias, the classroom, families and communities, and sun protection.

Where did the intervention originate?
California, Louisiana, Minnesota, and Texas, USA (high income)

How has the intervention been scaled up?
Through horizontal (replication) and vertical (institutionalisation) scale-up. Over 10 000 sites worldwide have adopted CATCH, mostly in the USA.[46] In Texas, researchers led dissemination efforts by engaging health and education authorities and subsidising initial distribution of materials for schools.[28]

Did the intervention originate from the research world or from the real world?
CATCH originated from the research world via the first trial in the early 1990s: the Child and Adolescent Trial for Cardiovascular Health.[47] The intervention was later renamed for translation, implementation, and scale-up in the real world,[28] which has been facilitated by the CATCH Global Foundation, a charitable organisation founded in 2014.[46]

Which of the seven investments for physical activity does it fit best?
Whole-of-school programmes.

Is physical activity promotion the main purpose of the intervention, or is it a co-benefit?
Physical activity is one of its main intended outcomes, along with healthy eating and preventing obesity.

Has the scaled-up intervention been adopted by target staff, settings, or institutions?
Education and health authorities at various levels from school to state across the USA have provided legislative, economic, organisational, and administrative support for CATCH,[28,44] but not all sites that could benefit have adopted it.

How has the scaled-up intervention been implemented?
Variably. In some cases (eg, Dallas School District, TX, USA), CATCH has become institutionalised, with strong multisectoral involvement (including principals, teachers, physical educators, administrative and catering staff, parents, and the wider community) in schools.[46] Elsewhere, discontinuous funding, or the lack of institutionalisation or a local champion, have impeded optimal implementation.[27,28]

Does the scaled-up intervention reach the target population?
CATCH is currently used in centres run by the Young Men's Christian Association in 32 USA states and more than half of Texas schools, but access varies by region.[46]

Is the scaled-up intervention effective?
Yes. A substantial body of evidence shows that CATCH is effective in increasing physical activity in school-age children, both in controlled trials and in real-world studies.[26,47]

Have the effects of the scaled-up intervention been maintained over time?
In controlled trials the effects have been maintained for up to 3 years,[48] and investigations in some real-world settings (eg, NJ, USA) also report maintained health effects.[49–51] Evidence also shows that CATCH is cost-effective for preventing childhood obesity.[52]

To what extent is CATCH an example of successful scaling up?
CATCH is one of few good examples of the successful translation, dissemination, and scaling up of an evidence-based (research tested) physical activity programme that is institutionalised and given full school, health, and other governmental support. CATCH also exemplifies the time taken for the first scientific evidence, published over 20 years ago, to be widely translated into practice.

randomised controlled trials in HICs necessary to show that positive changes in health behaviour are achievable in small, selected samples under controlled conditions? More evidence of effective, contextually appropriate strategies is needed in LMICs, so should research funds be allocated if no clear potential for rapid, cost-effective scale-up is shown? Should we not be learning more about scaling up successful ventures, and how opportunities for dissemination can be strategically brokered to reduce the lag in scaling up evidence-based practice? How could we improve understanding of the policy processes involved across varying settings, contexts, and political systems to facilitate streamlining of adoption and implementation of evidence-based practice? Much of the evidence describing the scale-up process of physical activity interventions, and in some cases of their impacts on population health, lies in government databases, reports, or websites, and not in the scientific peer-reviewed literature. This shortage of evidence in the peer-reviewed literature raises important questions about the methodological rigour and internal and external validity of such evidence. Why does the research community not focus more on systematic documentation and investigation of already scaled up innovations from around the world, using the best available methods to assess their reach and effectiveness, and why are there still so few opportunities for funding and publishing natural experimental studies of innovations that are being scaled up without clear evidence of effectiveness?

Panel 2: **Scaled-up interventions from around the world: bus rapid transit (BRT) systems**

Overview
BRT systems provide high-speed, mass public transport, using buses running on segregated lanes and stopping at stations spaced further apart than traditional bus stops.[53,54]

Where did the intervention originate?
Curitiba, Brazil (upper-middle income).

How has the intervention been scaled up?
Through horizontal scale-up (replication in other settings). Over 150 cities worldwide have BRT systems,[53] most in middle-income countries.

Did the intervention originate from the research world or from the real world?
BRT originated from the real world of transport planning.

Which of the seven investments for physical activity does it fit best?
Transportation systems that promote walking, bicycling, or public transit use.

Is physical activity promotion the main purpose of the intervention, or is it a co-benefit?
Physical activity is a co-benefit of BRT systems,[55] which were primarily designed to improve mobility and reduce carbon emissions in cities, more economically than by building metrorail or light-rail systems.[53,54]

Has the scaled-up intervention been adopted by target staff, settings, or institutions?
City mayors in several middle-income countries have provided strong political, economic, and structural support for BRT, which offers high-capacity, fast, modern, and environmentally sustainable public transport.[55] Nonetheless, not all cities that could benefit have adopted BRT.

How has the scaled-up intervention been implemented?
In some cities (eg, Bogotá, Colombia), BRT implementation has been accompanied by new supportive infrastructure including improved routes for pedestrians and cyclists, and full integration with other transit systems (eg, feeder bus systems).[56] In other settings (eg, Istanbul, Turkey), station and bus overcrowding, poor integration with other urban transit systems, or scarce supporting infrastructure around some stations, might have restricted the overall benefits by rendering active travel less attractive or safe.[57]

Does the scaled-up intervention reach the target population?
Studies assessing BRT's reach are scarce, and indicators vary between cities. In Cali, Colombia, for example, BRT is more accessible to residents of middle-income neighbourhoods than to those in high-income or low-income neighbourhoods.[58] In Delhi, India, BRT has increased the accessibility of destinations that were previously difficult to reach without a car.[59] In Cambridge, UK, there is no evidence of a socioeconomic gradient in use of a new BRT.[60] Further analysis is needed to establish the extent to which BRT reaches those at highest risk for inactivity.

Is the scaled-up intervention effective?
Emerging evidence suggests that BRT can promote physical activity through transport: living closer to BRT is associated with higher levels of physical activity in adults in Bogotá, Colombia, and Curitiba, Brazil,[55,56] and with shifting from car use towards active transit in Cambridge, UK.[60]

Have the effects of the scaled-up intervention been maintained over time?
Stable or increasing prevalence of BRT use indicate potential for sustained effects, but further and more rigorous studies are needed to establish if any physical activity benefits are maintained over time.

To what extent is this an example of successful scaling up?
Although BRT exemplifies the complexity involved in scaling up innovative urban public transport systems, it has been successfully scaled up in some settings (eg, Bogotá, Colombia). Key factors for success have included having a committed champion (often the mayor), providing supportive infrastructure as outlined above, and implementing complementary measures to restrict car use.[55]

Tying it all together: developing a framework for scaling up physical activity interventions

Taken together, the analytical steps described above suggest that successfully scaled-up physical activity interventions should not just be those that are implemented at a large scale, but also those that are effective in increasing physical activity levels of a population, and that become fully embedded into a system. To further advance this field and improve efforts to develop, implement, and assess such interventions, we have developed a framework for action.

The scaling up of physical activity interventions can be better understood and enhanced by the use of systematic planning frameworks, logic models, and theory.[66] The main purpose of a planning framework is to map the key linkages, stages, and conditions that are likely to affect scaling up and on which inferences about effectiveness could be made. A framework can help ensure that researchers focus on the most important factors in the scaling-up process, and that policy makers and practitioners understand its staged nature—eg, that effectiveness is a prerequisite for sustainment.

We used a two-step process to develop the framework. We searched for existing frameworks. We then reviewed these together with the results of the literature review and Delphi survey, with the aim of either identifying one or more existing frameworks that could be adapted to create a scalability framework, or building one from scratch if necessary.

We identified more than 60 possible frameworks for translational research,[9,67–69] many of which could

Panel 3: Scaled-up interventions from around the globe: Sport for Development (S4D)

Overview
S4D is an umbrella term for a variety of programmes that promote sport participation as a vehicle for development—understood broadly to include outcomes such as gender equity, economic development, access to education, health improvement (eg, HIV prevention), and peace.[61]

Where did the intervention originate?
The idea can be traced back centuries, and the date of the first S4D programme is unclear.[62] Several S4D programmes emerged in (mostly low-income) African nations in the 1990s, facilitated by financial and logistical support from high-income countries (HICs) and international humanitarian organisations.[62]

How has the intervention been scaled up?
Mostly through replication (horizontal scale-up), and sometimes also through institutionalisation (vertical scale-up).[63] The UN has contributed to recent accelerated expansion through the establishment of its own S4D office in 2001.[64]

Did the intervention originate from the research world or from the real world?
From the real world, mainly through humanitarian efforts in disadvantaged settings.

Which of the seven investments for physical activity does it fit best?
Sports systems and programmes that promote sport for all.

Is physical activity promotion the main purpose of the intervention, or is it a co-benefit?
Mostly a co-benefit, in that most S4D programmes have prioritised other outcomes as outlined above.

Has the scaled-up intervention been adopted by target staff, settings, or institutions?
Worldwide, S4D programmes have been adopted by governments and non-governmental organisations (NGOs): mostly by those in HICs to aid development in low-income or lower-middle-income countries, but sometimes fully based in higher-income countries.[65] The UN's adoption of S4D in 2001 has enhanced the credibility, and probably the scaling up, of these initiatives.[61,64]

How has the scaled-up intervention been implemented?
Mainly through international partnerships between an international or HIC government or agency (eg, the UN) and a local NGO for delivery.[65,63] So-called top-down approaches with funder-led programme design and implementation are common, but have been criticised for being paternalistic and not accounting for local nuances.[63] Other programmes have used a more horizontal approach with substantial local involvement and autonomy.[63] For the most part, comparative evidence from process assessment is absent.[33]

Does the scaled-up intervention reach the target population?
Rigorous analysis is scarce, and reach probably varies by setting. For example S4D in Gulu, Uganda, was found to reach mostly those who were already sufficiently active, owing to its voluntary enrolment policy.[33]

Is the scaled-up intervention effective?
There is insufficient evidence to support S4D's effectiveness, or lack of effectiveness, for increasing populations' physical activity levels.[33] More rigorous investigation is needed.

Have the effects of the scaled-up intervention been maintained over time?
This is not known.

To what extent is S4D an example of successful scaling up?
S4D exemplifies how the real world can be driven by factors other than evidence-based practice. Despite weak evidence of effectiveness for physical activity, S4D has become very popular worldwide and therefore extremely successful in terms of being scaled up to multiple settings, and becoming embedded in systems. Rigorous outcome and process assessment could assess S4D's impacts on physical activity and other outcomes, and contribute important learning on how other interventions might be scaled up.

potentially apply to scaling up physical activity interventions.[9] A small number of published frameworks exist for scaling up public health programmes and policies.[6,70–74] After our three-step process, the RE-AIM framework emerged as the one that best framed the core elements. RE-AIM takes a staged approach to measure reach, efficacy and effectiveness, adoption, implementation, and maintenance.[75] In RE-AIM, reach refers to the participation rate within the target population and the characteristics of participants versus non-participants—ie, does the scaled-up intervention reach people at highest risk for inactivity? Effectiveness refers to the impact of an intervention on specified outcomes—ie, does the scaled-up intervention increase population physical activity levels? Adoption applies at the system level and refers to the percentage and representativeness of organisations that will adopt a given programme or policy—eg, for a school-based intervention, how many states within a country, municipalities within a state, school districts within a municipality, and schools within a school district, adopted the intervention as an official school programme to be implemented within their jurisdiction? Implementation refers to intervention integrity, or the quality and consistency of delivery when the intervention is replicated in real-world settings—ie, is the real-world, scaled-up version of the intervention being delivered properly? Finally, maintenance describes the long-term change at both individual and system or organisational levels, which are fundamental concepts for scaling up—ie, have all of the implementation activities of the intervention been maintained fully throughout the years, thus ensuring that the health

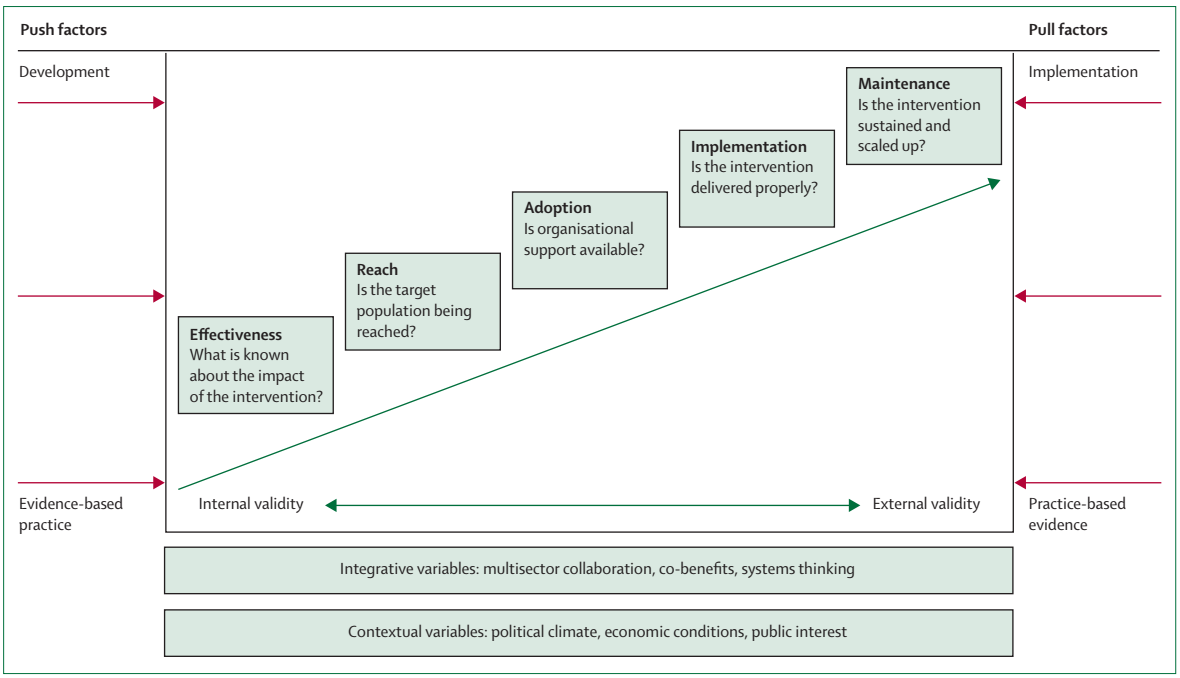

Figure 3: **Framework for scaling up physical activity interventions**

benefits of the intervention continue to occur through time? RE-AIM has been applied across numerous risk factors, diseases, and settings.[76] Its usefulness in assessing the impact of public health policies and physical activity scale-up efforts has also been documented.[77–79] In figure 3, concepts from RE-AIM are supplemented by two additional frameworks: the ExpandNet framework for scaling up,[74] and the framework for disseminating evidence-based health promotion practices.[80]

In addition, our framework accounts for the importance and relevance of both evidence-based practice (the push, interventions developed and tested through research that might be scaled up[81]) and practice-based evidence (the pull, real-world practitioner experience to inform intervention approaches[12]) in informing the scaling up of physical activity interventions. Therefore, this framework can be used both by people in the research world and in the real world (including public-health practitioners, stakeholders, and policy makers) to optimise the scaling-up process in many stages across the research-to-practice or practice-to-research spectra. For instance, it can be used by stakeholders and policy makers to select a contextually appropriate intervention for scaling up, which has been proven to work at scale in similar settings in reaching the target population and in promoting physical activity. In such cases, the framework stresses that for successful scale-up, assessment of adoption, implementation, and maintenance is needed. Similarly, our framework can be used by researchers to study innovative strategies implemented at scale, without sufficient existing evidence to show one or more of the stages of RE-AIM.

Conclusions

Despite facing a global pandemic of similar proportions to that of smoking,[1,2] our response to the public health challenge of inactivity has not been as strong as is needed.[1,2] The successful scaling up of interventions that result in increased levels of physical activity is challenging but feasible, across varying cultural, geographical, social, and economic settings. We should draw on the best available evidence from both the traditional evidence-to-practice pathway and the practice-to-evidence route. Using a mixed-methods approach, we have comprehensively examined both researcher-led and practice-based insights into the factors affecting scalability around the world. Active policies across society—particularly outside the health-care sector—are urgently needed, as shown by some of the successful examples of scale-up identified in this Series paper. Researchers, research funding agencies, practitioners in public health, transport, leisure, recreation, and other sectors, policymakers, and civil society should embrace the challenge of taking action to a larger and more sustainable level.

The research community should shift the balance of its efforts from designing and testing small-scale interventions to change individual behaviour towards expanding the evidence on strategies for translating, disseminating, implementing, and scaling up effective policy and practice for physical activity promotion worldwide. In LMICs, new evidence is needed on effective interventions that are contextually appropriate. The science of scalability will be greatly advanced by research that systematically identifies the key steps and processes needed for successful scale-up of interventions. Although

this might require more robust and standardised measures and indicators for tracking, assessing, and reporting all stages of scale-up—many of which might be developed at comparatively low cost using geographical information systems—it will also entail examining how political, cultural, and economic contexts influence the potential to adopt and scale up evidence-based practices. Researchers from all regions of the world should do more programme analysis studies to strengthen the global practice-based evidence base, which can be achieved by using rigorous research methods to establish the impact of real-world scaled-up interventions of which the reach and effectiveness remain unknown.

However, the success of these proposed actions for the research community is highly dependent on existent and future mechanisms for research funding, particularly for the rapid investigation of natural experiments. Research funding agencies should provide fast and flexible mechanisms to allow researchers to develop practice-based evidence through natural experimental studies or studies of programmes that have already been scaled up. The complexity of these research projects is likely to require transdisciplinary teams, sometimes with expertise in fields such as systems science, network analysis, or policy analysis. For LMICs in which more evidence on effective interventions is needed, funding agencies should prioritise the assessment of projects with clear potential for fast and cost-effective scale-up. Likewise, scientific journals should facilitate and prioritise the dissemination of this type of research.

Although increasing the amount and strength of research is important, public health action in the face of a global pandemic responsible for over 5 million deaths each year should not wait for the outcomes of future studies. We urge all sectors of government and society to take immediate, bold actions to help make active living a more desired, affordable, and accessible choice for all population groups. Getting people moving should become a priority of all sectors—not just health—in all entities and countries. In light of the scarce scientific evidence of what works at scale and how to scale up most strategies, we encourage governments and society to adopt and adapt strategies already used to address other public health issues such as smoking and sugar-sweetened beverage consumption.[82,83] International organisations such as the UN, WHO, and the World Bank should provide strong leadership for accelerating the scale-up of evidence-based physical activity interventions worldwide by setting targets and indicators for tracking countries' progress. Governments should integrate active living into policies across sectors. National policies and action plans are particularly important to overcome scalability challenges in countries in which decentralisation of power has led to devolved authority. Ministries of health should have a multilevel and multisectoral physical activity plan, with specific strategies to scale up physical activity interventions. Physical inactivity should become an actively monitored risk factor in clinical medical practice and in national and regional surveillance systems, and health-care systems should provide physical activity counselling and support for the prevention and treatment of chronic diseases. Ministries of education should adopt whole-of-school approaches for promoting physical activity among children and adolescents. More graduate-level programmes to train researchers in physical activity and public health are urgently needed worldwide, and especially in LMICs. Sports authorities should prioritise sports-for-all approaches and harness the potential co-benefits of sport participation. Similarly, environmental policies should be linked to the promotion of active living to maximise their opportunities for adoption, implementation, and scale-up. Urban planning and transportation policies should prioritise actions that promote safe, equitable, and environmentally friendly active mobility options for all citizens, including improved infrastructure for walking and cycling for transport and recreation, and accessible and convenient public transport. Civil society should demand improved policies, programmes, systems, and places that enable people to lead more active lives. We encourage practitioners, policy makers, and researchers to consider our framework and the catalogue of examples of scaled-up interventions from around the globe presented here (appendix) for selecting contextually appropriate, evidence-based strategies for scaling up, prioritising evaluation across all RE-AIM stages. Likewise, we encourage them to use our framework to guide the analysis of scaled-up interventions that are already in place, using the findings to modify programme delivery as needed to optimise the health benefits.

Unilateral efforts will not be enough to shift populations to a more active way of life even if taken to scale. A shift in the focus of researchers will not help if funding agencies do not facilitate this type of research, and an increase in the quality of evidence to support scaling up will achieve nothing if it is not translated into practice and effectively scaled up by policy makers and practitioners in multiple sectors. Large-scale problems require large-scale solutions, and we need the committed and joint efforts of all sectors of government and society to tackle the global public health challenge of inactivity.

Contributors

All authors contributed equally to the paper.

Declaration of interests

RSR is supported by The Brazilian National Council for Scientific and Technological Development–CNPA (grant number 308979/2014-1). DS is supported by the Michael and Susan Dell Foundation through a postdoctoral research fellowship at the Michael and Susan Dell Center for Healthy Living, which is part of the School of Public Health (Austin Regional Campus) of the University of Texas Health Science Center at Houston, and by the National Institute of Diabetes and Digestive and Kidney Diseases (grant number 3R01DK101593-03S1). DO is supported by the Medical Research Council (Unit Programme number MC_UU_12015/6). SG is supported by the Bernard Lown Scholars in Cardiovascular Health Program, Harvard School of Public Health (2015–17). RCB is supported by the National Cancer Institute at the

National Institutes of Health (grant numbers 1R01CA124404-01 and P30 CA09184), the National Institute of Diabetes and Digestive and Kidney Diseases (grant number 1P30DK092950), and Washington University Institute of Clinical and Translational Sciences (grant numbers UL1 TR000448 and KL2 TR000450) from the National Center for Advancing Translational Sciences. We declare no other competing interests.

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Acknowledgments
We thank Jessica Mason, Anna Porter, and Sarah Bentley for their assistance in data abstraction for the literature review, under the supervision of DS; Adalberto Lopes and Claudia Alberico for the assistance with the online survey, under the supervision of RSR; and Andrea Ramirez for the assistance with the compilation of the Global Physical Observatory contacts.

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