The Physical Inactivity Matrix: Lessons from the classification of physical inactivity interventions

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Dot points for the paper:

- The Physical Inactivity Matrix (PIM) was developed to synthesise the research literature and thereby inform policy and research needs.
- Most studies identified (80%) were individually focused; only 4% targeted the physical environment.
- The findings support the call for greater investment in policies, interventions, and research addressing transport and the physical environment by way of reducing physical inactivity.

Abstract

Physical inactivity (PI), a leading modifiable cause of disease and injury, is endemic in industrialised nations. Although considerable research has been undertaken in this field, we lack a system to synthesise the research literature to inform policy and identify research needs. The aims of this study were to (1) develop a system to classify physical inactivity intervention studies, (2) examine the distribution of PI interventions published in the peer-reviewed health literature using the developed system, and (3) consider implications for future research. We developed the Physical Inactivity Matrix (PIM), with 12 intervention points, created by the intersection of two dimensions: the intervention target (individual, physical environment, and social/cultural environment) and the activity focus (transport, work/school, leisure, and consumer). A formal search of the health research literature identified 529 eligible studies and each study was classified into one of the 12 cells of the PIM. Nearly all the identified studies were categorised as: Individual-Leisure (68%), Individual-Work/School (12%), or Social/Cultural environment-Leisure (13%). Only 4% targeted the physical environment. The findings of this initial application of the PIM support the call for greater investment in policies, interventions, and research that focus on the relationship between the environment and PI, and transportation, in particular. There would be merit in establishing the inter-rater reliability of the PIM and applying it to a wider variety of studies, including those published in the transportation and urban planning literatures. The PIM could be a useful tool for monitoring trends in research directions and funding levels over time and across countries.

Introduction

Physical inactivity (PI) is a leading cause of morbidity [1], and decreasing its prevalence is a priority [2]. There is widespread agreement on the need for action [3], and recognition of the considerable social and economic forces acting against the health of the public with respect to PI [4]. Many researchers share the view expressed by Sallis et al., that a "lack of conceptual models and the inherent difficulties of evaluation have hampered research on environmental and policy interventions. Further research is needed, and practitioners and researchers should work together to evaluate programs." [5] (p.379). Although considerable research has been undertaken in this field, we lack a system to synthesise the research literature to inform policy and identify research needs.

The aims of this study were to (1) develop a system to classify PI intervention studies, (2) examine the distribution of the peer-reviewed health literature using the developed system, and (3) consider implications of the findings for future research.

Methods

Development of a classification system

This study adapted the Haddon Matrix [6], an exhaustive set of mutually exclusive intervention points used extensively in injury prevention, to assist understanding of the physical inactivity problem. Haddon improved on the standard public health model, in which the epidemiological factors are represented in terms of the individual, agent/vehicle, and environment, by framing intervention points according to the temporal phase of the injury event—pre-event, event, and post-event—to produce a matrix.

For the purposes of this study, the authors reframed Haddon's universe of intervention points contextually rather than temporally. We classified the targets for PI interventions as the individual, the physical environment, and the social/cultural environment. In addition, we identified four mutually exclusive activity types: transport, work/school, leisure, and consumer activity. These are types of activity which occur daily or weekly for most people and they occur in locations and settings which are potentially regulable via public policy. Table 1 presents the Physical Inactivity Matrix (PIM) resulting from the combining of the three intervention targets and the four activity types.

Table 1. The Physical Inactivity Matrix (PIM): a taxonomy of interventions to reduce physical inactivity*

Activity focus	*Intervention target*		
	Individual	Physical environment	Social/cultural environment
Transport	What can we change about the commuter to increase active transport?	How can we change infrastructure, to promote active transport?	What laws, policies, rules or social norms can we change to promote active transport?
Work/School	What can we change about the worker to increase energy expenditure during work/school hours?	How can we change work/study environments to increase energy expenditure in the workplace/school?	What organisational policies, rules or social norms can we change to increase energy expenditure in the workplace/school?
Leisure	What can we change about the person to increase energy expenditure in leisure time?	How can we change neighbourhoods to promote energy expenditure in leisure time?	What laws, policies, rules or social norms can we change to promote energy expenditure in leisure time?
Consumer	What can we change about the consumer to increase energy expenditure during consumer activities?	How can we change environments to increase energy expenditure during consumer activities?	What laws, policies, rules or social norms can we change to increase energy expenditure during consumer activities?

* The text in each cell is a guide to identifying the intervention point for physical inactivity programs and policies

For the purposes of this system, we decided that *transport* would include mechanisms by which people move between home, work, shops, and places of leisure, where the primary purpose is utilitarian rather than pleasure or exercise. We also decided that *Work/School* could be paid or unpaid and included all levels of education, housework, self-care and yard work (e.g., gardening). In addition we defined *Leisure* to include all non-work, non-consumer, and non-transport activities whose primary goal is pleasure or improved health (e.g., watching television, and running for exercise). *Consumer activities* were those whose primary purpose was to obtain goods and services (e.g., grocery shopping, visiting a mall, and on-line commerce). This category excludes consumption of physical activity services (e.g., use of a gymnasium), which are classified as leisure.

For example, an individual cycles to school (transport), attends classes (work) and plays sport during breaks (leisure). She then catches a bus to the mall (transport), shops for clothes (consumer), attends soccer practice (leisure), takes a bus home (transport), does her homework (work), watches television (leisure), and washes the dishes (work).

Arguably the cycle to school could be classified as *leisure* activity. We categorised it as transport having decided that the primary purpose of the journey was getting from one point to another, and because the trip would typically occur in a recognised transport corridor (e.g., a public road).

Using the PIM to classify PI interventions

To demonstrate the use of the PIM, we conducted a three-stage literature review:

(1) search of the PubMed database using the following terms and Boolean logic: *physical activity* AND (*intervention* OR *strategy* OR *policy*) AND (*trial* OR *evaluation* OR *effectiveness*)
(2) review of the selected abstracts and exclusion of studies not examining health or behavioural effects of a PI intervention
(3) addition of studies from reference lists in recent review papers [7–13].

The review was not restricted to primary studies; review papers and commentaries were eligible for inclusion. We then classified interventions on the basis of their abstracts. Full papers were obtained when there was insufficient information in the abstract to enable classification. Where two or more abstracts referred to a single study, the intervention was classified only once.

Results

We judged 529 papers (436 from the formal literature search and 93 from the reference lists of review papers) suitable for classification using the PIM. A list is available from the authors on request.

Table 2 presents the distribution of the reviewed abstracts across the PIM. It shows a predominance of reports of PI interventions targeting the individual. Eighty-two percent fell into this category, while only 4% examined interventions targeting the physical environment, and 15% targeted the social/cultural environment. There was a similar disparity across activity types: leisure (83%), work/school (16%), consumer (1%), and transport (1%).

Table 2. Distribution of identified reports of interventions in the Physical Inactivity Matrix (n=529)

Activity focus	*Intervention target*			
	Individual	Physical environment	Social/cultural environment	
Transport	1%	0%	0%	**1%**
Work/School	12%	2%	2%	**16%**
Leisure	68%	2%	13%	**83%**
Consumer	1%	0%	0%	**1%**
	82%	**4%**	**15%**	

Discussion

The application of the PIM highlighted the predominant focus of PI intervention studies on individuals as the agents of change and leisure activity as the context of intervention. Although others have decried the lack of literature on environmental and policy PI interventions [5,14], this is the first study to classify PI interventions according to the agent of change and the context of activity and to quantify the imbalance in research focus in this field.

Increased motor vehicle transport and the accompanying road infrastructure have displaced active transport and diminished opportunities for physical activity [15]. Behavioural theory and empirical findings from other disciplines (e.g., injury prevention) show that physical and social environments are major drivers of behaviour [16]. Furthermore, population-based interventions can be more effective and sustainable than those targeting high-risk individuals [17]. Further research exploring the relationship between the environment and PI is needed if we are to maximise the potential public health benefits.

A probable reason for the predominance of individual and leisure-time focused interventions is their amenability to evaluation via research designs that permit strong inference of effectiveness. The randomised controlled trial can be unsuited to the scale, complexity, and practical constraints presented by interventions that target the physical environment (infrastructure) and policy [18]. Alternative evaluation methods are urgently needed.

Progress on PI interventions focusing on large-scale environmental change is also limited by the cost of implementing and evaluating them. In addition, measures to improve the environment to make it more conducive to participation in physical activity may be perceived to be curtailing individual choice and politically unpalatable, particularly in the areas of urban design and transportation [5].

This study only included journals indexed by PubMed. Institutional reports and papers in unindexed journals were excluded, although the quality of those studies is expected to be lower, on average, than those included. In addition, studies published in the urban design, transportation and engineering literature were not captured. The proportion of evaluations of transport and the physical environment focused interventions may therefore be understated. It is now important to establish the inter-rater reliability of the PIM and to broaden the scope of the literature to which it is applied.

The term ‘exercise’ was not used in the search criteria because we did not want to include laboratory studies examining physiological outcomes. These were deemed *a priori* to be of a different nature to the population focussed interventions we were seeking to examine. If they had been included, the proportion of studies on transport, work/school and the physical or social/cultural environment would probably be even lower than reported here, given that laboratory studies are usually sporting activity (i.e. leisure) and individual focused.

Given the demonstrated bias toward individual, leisure targeted interventions in the scientific health literature, and the increasing incidence of PI related diseases, policy makers, researchers and intervention designers urgently need guidance to inform the

development of environmental countermeasures with limited evidence of effective interventions. The precautionary principle with its central element of 'taking preventive action in the face of uncertainty' [19] (p.1351), offers such a framework.

At present, an evidence-based approach to PI prevention will lead to the continued funding of individually focused, leisure based interventions at the expense of promising yet untested environmental approaches. Until there is sufficient research evidence on what (if any) modifications of the physical environment bring about health benefits, there is justification for investment in reasoned experimentation and evaluation of these types of interventions by health, transport, and urban planning authorities, possibly at the expense of individually focused, leisure-based programs.

Conclusion

The findings of this initial application of the PIM support the call for greater investment in policies, interventions, and research that focus on the relationship between the environment and physical activity, and transportation in particular. There would be merit in applying the PIM to a wider variety of studies, including those published in the transportation and urban planning literatures. The PIM could be a useful tool for monitoring trends in research directions and funding levels over time and across countries.

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References

1. World Health Organization. *The World Health Report 2002, Reducing Risks, Promoting Healthy Life*. Geneva: WHO, 2002:1-248.
2. Bauman AE, Bellew B, Vita P, Brown W, Owen N. *Getting Australia active : towards better practice for the promotion of physical activity*. Melbourne: National Public Health Partnership, 2002.
3. National Health and Medical Research Council. *Acting on Australia's weight: a strategic plan for the prevention of overweight and obesity. Summary report*. Canberra: NHMRC/AGPS, 1997.
4. Roberts I, Owen H, Lumb P, MacDougall C. *Pedalling health: health benefits of a model transport shift*. Adelaide: SA Department of Transport, 1996.
5. Sallis JF, Bauman A, Pratt M. Environmental and policy interventions to promote physical activity. *Am J Prev Med* 1998;15(4):379-97.
6. Haddon W, Jr. The changing approach to the epidemiology, prevention, and amelioration of trauma: The transition to approaches etiologically rather than descriptively based. *American Journal of Public Health* 1968;58(8):1431-8.
7. Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, et al. The effectiveness of interventions to increase physical activity. A systematic review. *Am J Prev Med* 2002;22(4 Suppl):73-107.

8. Timperio A, Salmon J, Ball K. Evidence-based strategies to promote physical activity among children, adolescents and young adults: review and update. *Journal of Science and Medicine in Sport: Physical Activity Supplement* 2004;7(1):20-29.

9. Cyarto EV, Moorhead GE, Brown WJ. Updating the evidence relating to physical activity intervention studies in older people. *Journal of Science and Medicine in Sport: Physical Activity Supplement* 2004;7(1):30-38.

10. Shilton TR, Brown WJ. Physical Activity among Aboriginal and Torres Strait Islander people and communities. *Journal of Science and Medicine in Sport: Physical Activity Supplement* 2004;7(1):39-42.

11. Marshall AL. Challenges and opportunities for physical activity in the workplace. *Journal of Science and Medicine in Sport: Physical Activity Supplement* 2004;7(1):60-66.

12. Miller YD, Dunstan DW. The effectiveness of physical activity interventions for the treatment of overweight and obesity and type 2 diabetes. *Journal of Science and Medicine in Sport: Physical Activity Supplement* 2004;7(1):52-59.

13. McCormack G, Giles-Corti B, Lange A, Smith T, Martin K, Pikora TJ. The effectiveness of physical activity interventions for the treatment of overweight and obesity and type 2 diabetes. *Journal of Science and Medicine in Sport: Physical Activity Supplement* 2004;7(1):81-92.

14. King AC, Jeffery RW, Fridinger F, Dusenbury L, Provence S, Hedlund SA, et al. Environmental and policy approaches to cardiovascular disease prevention through physical activity: issues and opportunities. *Health Educ Q* 1995;22(4):499-511.

15. British Medical Association. *Road transport and health*. London: British Medical Association, 1997.

16. Christoffel T, Gallagher SS. *Injury Prevention and Public Health, Practical Knowledge, Skills, and Strategies*. USA: Aspen Publishers Inc., 1999.

17. Rose G. *The strategy of preventive medicine*. Oxford: Oxford University Press, 1992.

18. Bauman AE. Updating the evidence that physical activity is good for health: An epidemiologic review. *Journal of Science and Medicine in Sport: Physical Activity Supplement* 2004;7(1):6-19.

19. Kriebel D, Tickner J. Reenergizing public health through precaution. *Am J Public Health* 2001;91(9):1351-5.