

Physical activity mass media campaigns and their evaluation: a systematic review of the literature 2003-2010.

Leavy JE¹, Bull FC¹, Rosenberg M², Bauman A.³

¹ Center for the Built Environment and Health, School of Population Health, University of Western Australia WA 6009 Australia

² School of Sport Science, Exercise and Health, University of Western Australia, Perth, WA 6009 Australia.

³ Sydney School of Public Health, University of Sydney, Sydney, NSW 2006 Australia

Corresponding author:

Justine Leavy
School of Population Health
University of Western WA 6009 Australia
Phone: + 618 6488 1575
Facsimile: + 618 6488 1199
Email: justine.leavy@uwa.edu.au

Abstract

Internationally, mass media campaigns to promote regular moderate-intensity physical activity have increased recently. Evidence of mass media campaign effectiveness exists in other health areas, however the evidence for physical activity is limited. The purpose was to systematically review the literature on physical activity mass media campaigns, 2003-2010. A focus was on reviewing evaluation designs, theory used, formative evaluation, campaign effects and outcomes. Literature was searched resulting in 18 individual adult mass media campaigns, mostly in high-income regions and two in middle-income regions. Designs included: quasi experimental (n=5); non experimental (n=12); a mixed methods design (n=1). One half used formative research. Awareness levels ranged from 17% to 95%. Seven campaigns reported significant increases in physical activity levels. The review found that beyond awareness raising, changes in other outcomes were measured, assessed but reported in varying ways. It highlighted improvements in evaluation, although limited evidence of campaign effects remain. It provides an update on the evaluation methodologies used in the adult literature. We recommend optimal evaluation design should include: (1) formative research to inform theories/frameworks, campaign content and evaluation design; (2) cohort study design with multiple data collection points; (3) sufficient duration; (4) use of validated measures; (5) sufficient evaluation resources.

Background

Insufficient physical activity remains an important public health issue contributing to a range of chronic diseases [1-3]. One component of a comprehensive approach to promoting participation in regular physical activity is to raise community awareness about regular moderate-intensity physical activity using mass media communication campaigns [4-7].

These campaigns focus on population-wide reach usually using the mass-reach communication channels of television, radio and print media [3, 6].

Mass media campaigns aim to raise community awareness, inform and change attitudes towards being active, and ultimately, to influence physical activity behaviour [3, 8, 9]. Mass media can be used to communicate many and varied physical activity-related messages to large audiences, or to targeted segments of the community.

Historically, mass media efforts aimed at physical activity date back to the early 1970s, when ParticiP ACTION was launched in Canada; this overarching campaign and brand ran for thirty years [10]. Similar campaigns, although not on this scale, have been run in the United States, New Zealand and elsewhere with a significant increase in this field during the 1990s.

Marcus [11] reviewed the literature on media interventions published between 1983-1997 inclusive. Their results showed that although audience recall of mass-media messages generally was high, there was little demonstrated impact on physical activity behaviour [11]. A later, more comprehensive review, covered campaigns published between 1970-2003. This review also reported high levels of campaign awareness but again few studies reported any population level increases in physical activity [5]. Cavill and Bauman [5] critiqued the evaluation methods being applied and concluded there was a need for improved campaign evaluations using reliable and valid physical activity measures [5]. Furthermore, they recommended that efforts should be continued to develop and use valid and reliable measures of physical activity [12]. This limited evidence base on effectiveness for physical activity contrasts with the stronger evidence showing that mass media campaigns have been effective

in addressing other lifestyle behaviours, notably tobacco and alcohol use, and sun protection [9, 13-17].

Given the recent resurgence in interest and investment in physical activity mass media campaigns in Australia and internationally, it is timely to review the evidence and specifically assess if stronger evaluation methods are being used, and do these suggest greater campaign effectiveness. We identified a set of evaluation criteria that might form an ‘optimal’ evaluation design for assessing campaign effects. These are: (1) use of formative research to inform conceptual theory/frameworks, campaign content and evaluation design; (2) a cohort study design with multiple data collection points; (3) sufficient campaign duration; (4) use of valid measures; and (5) sufficient and dedicated evaluation resources.

Using this set of criteria, the aim of this study was to undertake a systematic review of the literature on physical activity mass media campaigns from 2003-2010 and to assess progress and quality of [i] campaign evaluation design and sampling [ii] use of theory and formative research in campaign development and [iii] evidence of campaign effects including proximal, intermediate and behavioural outcomes.

Methods

Search strategy

To identify published articles on physical activity mass media campaigns, a literature search was conducted using the following databases: Medline; Embase; PsychInfo; Web of Science; Current Contents; CINAHL plus, SPORTDiscus with full text, SPORTDiscus (Figure 1).

The search strategy consisted of a key word searching using either ‘mass media’, ‘mass media campaign’, ‘social marketing’, ‘television campaign’, ‘public health education’, ‘public health communication’, ‘health campaign’ ‘AND’ physical activity (Figure 1). Titles were identified using: a basic ‘in topic’ field search or; an advanced ‘keyword’ search with the option ‘map term to subject heading’ chosen or; a basic field search using ‘Boolean phrase and apply related terms’ database dependent. The search was repeated using the same keywords listed above, in the same order using AND fitness, then subsequently AND exercise in the title field.

Criteria for inclusion

Articles that met the following criteria were included: published in English between 2003 and week 6, 2010, peer reviewed, full text; adult focus; population level focus; a clear mass media and/or social marketing component that relates specifically to physical activity OR fitness OR exercise; paid or unpaid media or a combination of both; primary prevention; evaluation methodology described; and post evaluation design as a minimum. Articles that focused on clinical populations, qualitative methods, children/adolescents and those that did not report evaluation data were excluded.

Selection of articles

Article titles and abstracts were examined for appropriateness for full text review. The reference lists of the selected articles were examined for additional eligible articles. Review articles were not included, but the reference lists of relevant articles were checked for additional papers. One author was contacted by email and an article ‘In press’ was included; an updated results paper for one campaign was also included. No unpublished studies have

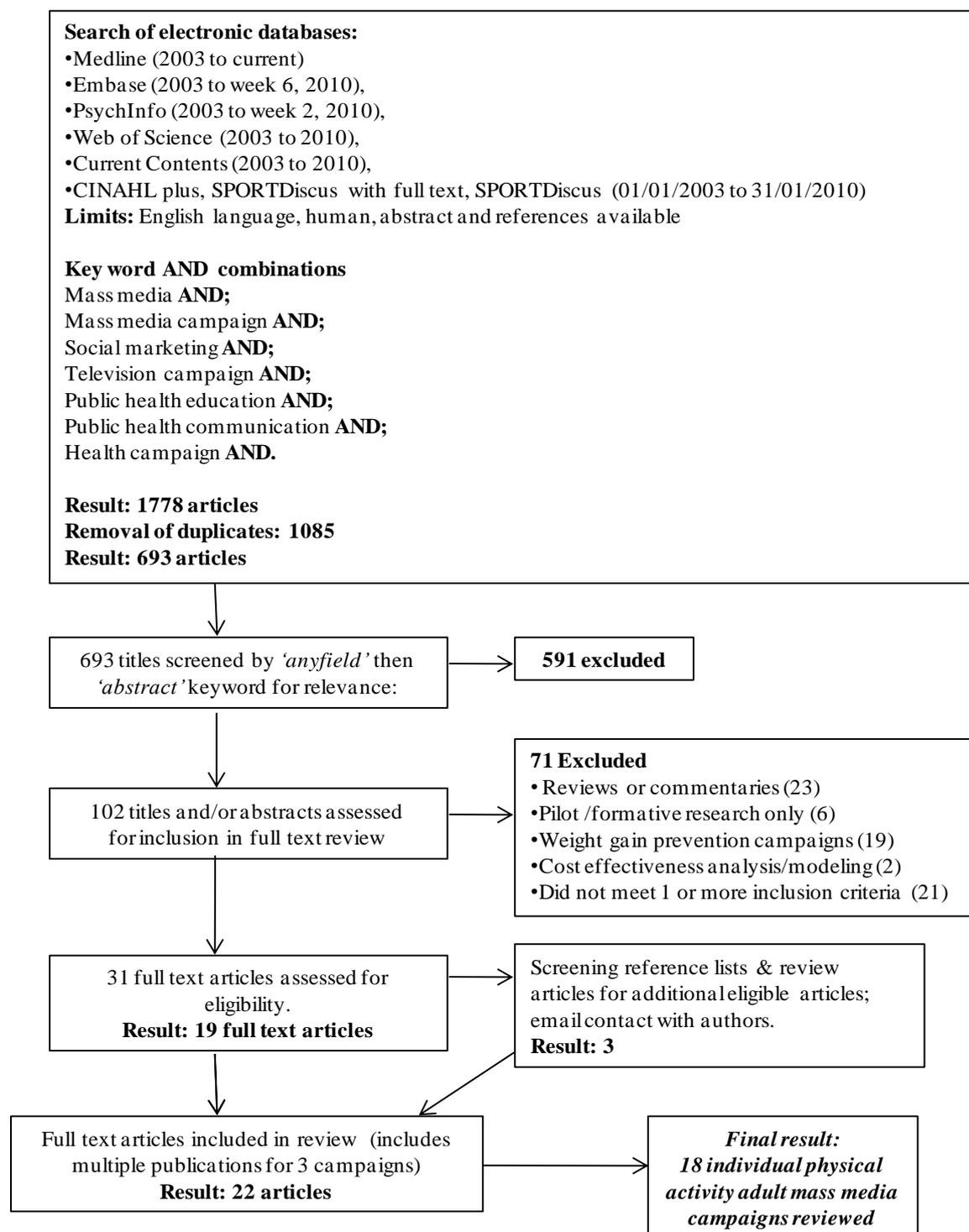
been included. Twenty-two articles met the inclusion criteria, they were confirmed by all investigators and resulted in 18 individual adult-focussed mass media campaigns (Figure 1).

Data analysis

A data extraction table, adapted from the Cavill and Bauman [5] and NICE [18], was constructed with several additional components: country of origin; theoretical framework; process evaluation; campaign cost and environmental support. The following outcomes were sought across the 18 mass media campaigns: ‘dose’; exposure; awareness; physical activity related knowledge; attitudes; beliefs; intention, physical activity behaviour and campaign costs.

To allow comparison of campaign awareness across studies, we defined awareness as the combination of ‘unprompted recall’ (respondents are asked if they have heard of any campaign promoting physical activity, open ended) and/or ‘prompted recall/recognition’ (respondents are told or shown the name of the campaign materials and asked if they recall/recognise them) [19].

Campaign impact was classified as: ‘proximal’ (exposure/awareness); intermediate (knowledge, attitudes, beliefs, saliency and intention or ‘initial trial’ behaviours); and ‘distal’ (physical activity behaviour). This typology aligns with the Hierarchy of Effects (HOE) framework [5, 20].

Figure 1: Search strategy schematic

Results

Characteristics of studies

The majority of the 18 campaigns assessed in this review were conducted in high income countries, the USA (n=8), Australia (n=3), Canada (n=3), Belgium (n=1) and New Zealand (n=1). Two were conducted in middle income countries in South America (Columbia and Brazil). This set of campaigns used a diverse range of media channels including: television commercials (TVCs) (network and/or cable); public service announcements (PSAs); radio commercials; paid and unpaid print media inserts; bus backs and wraps; billboards; print media; website traffic; public health activities, policy and environmental change. Campaign duration ranged from: as short as 8-13 weeks (n=6); around 6 months (n=3); 12 months (n=2); several phases over 12-24 months (n=2) and; greater than 2 years (n=5). More details on other characteristics of the 18 studies are summarised in Tables 1 and 2.

Evaluation design and sampling

The evaluation designs used for the 18 campaigns included: quasi experimental (n=5); non-experimental (n=12); and a mixed methods design (n=1).

Three of the five quasi-experimental design studies collected baseline and follow-up measures from a cohort using telephone surveys in the intervention and a comparison community selected to have similar demographic profile but separated geographically and with distinct media markets [21-23]. *Wheeling Walks* (USA) also used a quasi-experimental, cohort design but had multiple collection points at baseline and three, six and twelve month follow-up [24]. *10 000 Steps Rockhampton* used a quasi-experimental design, collecting baseline and follow-up using a cross sectional sample of populations from the intervention and comparison communities [25]. The fifth study *Walk to Work Day* (Australia), was a national campaign, and it was not feasible to find an uncontaminated comparison community [26].

Table 1: Update of design, reach and evaluation of adult physical activity mass media campaigns 2003-2010

Author/year	Country	Campaign name/logo	Target population	Campaign delivery	Combined media	Models and frameworks	Overall Evaluation design	Sampling strategy	Sample size (response rate=RR)
[33]	Delaware, USA	<i>Get up and do something</i>	18-30 year olds	13 weeks Sept-Dec 2001	<ul style="list-style-type: none"> • 30 second TVCs limited to cable networks and Comedy Channel • 2 x bus wraps • 14 x billboards 	TPB & RA	Post campaign cross sectional	Convenience sample.	n=363
[24]	Wheeling, West Virginia, USA (comparison community Parkersburg, WV)	<i>Wheeling Walks (WW)</i>	Sedentary /irregularly active 50-65 year olds	1 year Phase 1 - mid April-mid June 2001. Phase 2 - Mar 2002	<ul style="list-style-type: none"> • 30 second TVCs on network TV • 60 second radio ads • 1/8 page ads • Website 	TPB & RA, SoC, Social ecological framework	Quasi experimental Serial evaluation baseline, 3, 6, 12 months. Cohort design	Random digit dialing CATI.	Wheeling n= 750 baseline n= 519 3/12 n= 425 6/12 n= 373 12/12. Parkersburg n= 750 baseline n= 572 3/12 n= 442 6/12 n= 357 12/12.
[22]	West Virginia, USA (North central) (comparison community Cabell, WV)	<i>WV walks</i>	40-65 year olds	8 weeks Mar 2005	<ul style="list-style-type: none"> • 30 second TVCs on 2 network stations • 60 sec radio ads on 3 stations • 1/8 page ads • Website 	Not reported	Quasi experimental, pre and post campaign survey. Cohort design	Random digit dialing.	West Virginia (Nth central) n=1223 (57%) baseline n=887 (73%) follow-up Cabell n=611 (46%) baseline n=426 (70%) follow-up
[23]	Broome County, New York USA (comparison	<i>BC Walks</i>	Insufficiently active 40-65 year olds	8 weeks May -June 2003	<ul style="list-style-type: none"> • 30 second TVCs on network TV. • 60 sec radio ads • 1/8 page ads • 1 additional print ad for 	Not reported	Quasi experimental, pre- post campaign survey. Cohort design.	Random digit dialing. CATI.	Broome County BC n=575 baseline n= 393 (68%) follow-up

	community Chautauqua County, NY)				African Americans • Media relations • Website		Intervention - Broome County with comparison community		Chautauqua n= 374 baseline n=207 (55%) follow-up
[34]	St. Joseph Missouri, USA	<i>Walk Missouri</i>	Adult residents	5 months Summer 2003	• Radio ads • Billboards • Newspaper advertisements • Posters	HBM informed formative research	Post campaign cross sectional design	Random digit dialing, adults 18 years and older	n=297 (RR=17%)
[28]	New Orleans, USA	<i>Steps</i> “Treat you Right”	African American women 18-49 year olds.	6 months Feb - August 2005	• 2 TVCs • 4 radio ads • 26 tail light bus signs • 2 large side panel street car signs.	Not reported	Pre and post campaign cross sectional design	Random digit dialing, adults 18 years and older	n = 3137 baseline (RR=26.6%). n = 1500 follow-up (RR=20.4%) Baseline April 21 - Nov 24, 2004 Follow-up Feb –July, 2005
[32]	Omaha, Nebraska, USA	<i>Activate Omaha</i>	Adults	2 years Phase 1 - 2005 - 8 weeks Phase 2 – 12 weeks Phase 3 – 2007	• Billboards • Newspaper ads • PSAs • e-newsletter • Wellness site • Social marketing tool kit • Photography series • www.activateomaha.org	Social marketing framework	Post campaign cross sectional design	Random digit calling. adults, 25-54 years, head of household.	n=250
[42], [35, 40]	Hawaii, USA	<i>Healthy Hawaii Initiative (HHI)</i> ‘Start Living Healthy’ ‘Step it up, Hawaii!’	Hawaiian adults 35-55 year old	PA Phase- 10 weeks April-June 2007	• 6 x30 second TVC • 4 x radio ads • Mall ads and posters • Movie theatre ads • Website • Supermarket partnership • Special events	Social ecological framework; TPB Informed strategy design.	Post campaign cross sectional design	Annual ongoing surveillance survey. Stratified random digit dialing to reach residents aged 18 years and	n= 3600

								older	
[25]	Rockhampton, Australia	<i>10 000 Steps Rockhampton</i>	Adults	2 years 2001-2003	<ul style="list-style-type: none"> • TVCs • Radio ads • Print • (paid & non paid marketing) • Newsletters • Email 	Social ecological and social marketing framework	Quasi experimental pre and post campaign survey. Cross sectional.	Random samples from regularly updated electronic databases. CATI.	Rockhampton n=1280 baseline n=1242 follow-up Mackay n=1059 baseline n=1236 follow-up. RR 46.4%, 2001 47.3%, 2003. Baseline Aug-Sep 2001 and follow-up Aug-Sep 2003
	(comparison community Mackay)						Intervention - Rockhampton with comparison community		
[26]	Australia	<i>Walk to Work: "Walk to work: make time, Walk Every Day"</i>	Urban dwelling, 18-65year old adults	Sept. 2003 - Oct 2003.	<ul style="list-style-type: none"> • Newspaper ads • PSAs on 3 national FTA TV channels and radio nationally. • Annual short term media and PR campaign • Govt. intranet networks 	Not reported	Pre and post campaign survey. Cohort.	Random selected households electronic white pages from major Australian metro areas. Screened for age and English language	n=1100 55% RR
[36]	NSW Australia	<i>Stay Active Stay Independent (SASI)</i>	Older adults 60-75 years of age	Phase 1 July-Aug 04 Phase 2 Sep-Oct 04 Phase 3 – Oct 04 - Dec 05	<ul style="list-style-type: none"> • TVCs • Newspaper ads • Bus backs • Free call no. • Website 	Social marketing framework, SoC, HOE	Post campaign. Cross sectional intercept	Face to face interviews. Conducted during Sept-Oct, 2004	n= 693
[29],	Canada	<i>Canada on the</i>	Canadian	Phase 1 -	<ul style="list-style-type: none"> • Mass media 	Not reported	Pre and post	Monthly	1 yr follow-up

[30]		<i>Move</i> (COTM) “Keep it simple” “Add 2000 steps” “Donate your steps to health research”	adults aged 18 and over	Dec 2003 Phase 2 - June 2004 Phase 3 - 2004	<ul style="list-style-type: none"> • Concomitant mass distribution of pedometers via cereal boxes • Concomitant messages on cereal boxes • Website for logging step 		campaign cross sectional design.	rolling sample selected CFLRI PAM. 18 years and over, random digit dialing. CATI.	n=7217 (50% RR) 2 yr follow-up n=9935
[37]	Alberta, Canada	<i>Healthy U</i>	Adults 55-70 years of age, Alberta province, Canada	8 weeks, 2007	<ul style="list-style-type: none"> • TVCs x 2 (1 x F&V; 1 x PA) • Website and URL 	HOE (informed evaluation design)	Post campaign cross sectional design. (telephone survey & focus groups)	Random digit dialing	n=1600 45.1% over 55yo (n=721) (46.3% RR)
[31]	Canada	<i>ParticipACTION</i>	Parents of 7-12 years of age and parents in general.	6 months Oct 15, 2007– Mar 31, 2008	<ul style="list-style-type: none"> • 7 messages: • 4 in English • 2 in French • TV spots 	HOE (informed campaign design)	Post campaign on line design.	Convenience sampling from online panel, 18 years and over stratified by region, age, gender to reflect demographics.	n= 1500
[27, 41]	São Paulo, Brazil	<i>Agita São Paulo</i>	Students, workers, elderly	Dec 1996 ongoing	<ul style="list-style-type: none"> • Extensive free media coverage. • Posters, flyers and brochures 	SoC	Serial cross sectional design.	Cities randomly selected within regions, random census tracts used to systematically select households. 1 resident sampled.	n~2474, 2002 n~2490, 2003 n~2133, 2006 n~2155, 2008
[38]	Bogota, Columbia	<i>Muévete Bogotá</i>	Bogota adults aged 18 and over	Nov 1998 ongoing	Mass media with programs targeted to change PA behaviour in a variety of settings.	Not reported	Cross sectional annual evaluation.	Not reported	Not reported
[2]	New Zealand	<i>Push Play</i>	NZ adults, middle aged, male 30-54 years	Phase 1 Mar-Apr 1999 Phase 2	<ul style="list-style-type: none"> • 2 x 15 sec TVCs • 1 x 30 sec TVCs • Billboards, radio, magazine promotions 	Social marketing framework	Serial cross sectional design.	Serial cross sectional population based surveys.	n=665, 1999 n=506, 2000 n=504, 2001 n=507, 2002

				2000 Phase 3 2001 Phase 4 2004	<ul style="list-style-type: none"> National Push Play Day November 2001, 2002. 			Population sampling techniques covering 26 main urban areas, 55 random set start points a pre-set cluster of 9-10 interviews. Adult 18 years and over.	(RR ranged 64-70%).
[21]	Ghent, Belgium (comparison community Aalst)	<i>10 00 steps Ghent</i> “Every step counts”	Adults	1 year 2005-2006	<ul style="list-style-type: none"> Local media project included: press conferences, a full page advertisement in town magazine delivered to every household Website 6 x press conferences subsequent publicity in the town magazine 20 billboards 	Social ecological framework	Quasi experimental, pre- post campaign survey. Cohort design.	Random selection from population registers	Ghent n=872 baseline n=660 follow-up (42% RR) Aalst n=810 baseline n=634 follow-up. (41% RR)

Abbreviations: TVCs – television commercials; FTA – free to air; TA – Target Audience; PSA – Public Service Announcements; PA – Physical Activity; PR – Public Relations F & V – Fruit & vegetable; SoC - Stages of Change ; TRA&PB - Theory of Reasoned Action and Planned Belief; HBM – Health Belief Model; TPB – Theory of Planned Behaviour; HOE - McGuire’s hierarchy of effects; AC- active commuting; CFLRI PAM – Canadian Fitness and Lifestyle Research Institute Physical Activity Monitor; HP- health professionals; PATF- Physical Activity Task Force; Env- environmental; Suff PA – sufficient physical activity; ass’d - associated; vig PA – vigorous physical activity; GPs – General Practitioners; RR – response rate; mins – minutes.

Table 2: Update of adult physical activity mass media campaigns since 2003: formative, process and impact evaluation.

Author/year	Campaign name	Evaluation outcome measure used	Formative evaluation	Process evaluation	Impact Evaluation			Cost
					Awareness	Knowledge, attitudes, beliefs & intention	Physical activity behaviour	
[33]	<i>Get up and do something</i> , USA	<ul style="list-style-type: none"> Advertisement recall Intention to be active 	Extensive formative work Message pre-tested with 3 focus groups	Average 10.4 ads to target household over 13 weeks	<p>Prompted recognition 62.5% 39.1% saw TVC in past month 24.9% saw billboard/bus back</p>	<p>70.1% correct message interpretation.</p> <p>Of 39.1% who saw TVC 25.5% talked to someone; 31.2% indicated intention to be active.</p> <p>Of 62.5% who saw either TV/ billboard/bus ad 22.9% talked to someone; 27.7% intended to be more active.</p>	Not reported	Not reported
[24]	<i>Wheeling Walks</i> , USA	<ul style="list-style-type: none"> Media exposure Self-reported walking 	Participatory planning process, formative research, message development (12 weeks)	<p>Phase 1 GRPs: TVC 5104; radio 3450. 14 x ¼ page ads. 170 news stories.</p> <p>Phase 2 GRPs: TVC 521; radio 371. 2 x ¼ page ads, 4 PR events, 1 x16 week walking clinic. Weekly column</p>	<p>Awareness Phase 2- 81% Phase 3- 83%</p> <p>Exposure: TVC Phase 2 -77% Phase 3- 93% Heard radio: Phase 2 -34% Phase 3- 36%</p> <p>92, 85, 89% Wheeling knew about WW campaign at phases 2,3,4.</p>	Not reported	<p>Increase among the least active sustained after 12 months. Net increase 14%.</p> <p>Least active intervention subjects almost twice as likely to have ↑ their daily walk at phase 2 (OR 1.93 CI: 1.21-3.08); phase 4 (OR 1.72 CI: 1.01-2.95) & significantly more likely to achieve ‘suff active walking’ phase 2 (OR 2.13, CI 1.25-3.62); phase 4 (OR 1.94 CI 1.06-3.55).</p>	<p>Total (without evaluation) \$150 000 USD over 12 months.</p> <p>Cost calculated at \$4.10pp/per month.</p> <p>The cost pp who changed from sedentary to regular walker \$26.32 pp/per month.</p>

				in Sunday paper over 12 months				
[22]	<i>WV walks, USA</i>	<ul style="list-style-type: none"> Awareness Walking behaviour Mod & vigorous PA 	Participatory planning process, formative research, message development (12 weeks)	GRPs: TV 2316; radio 1876. 1143 TV, 167 radio, & 104 print media reports. 17 newspaper photos. Website: 5400 enrolled, logged 6862771 walk mins.	Awareness 87% of <i>WV walks</i> intervention vs 52% in the comparison community Exposure: 65% <i>WV walks</i> TVC	Not reported	Intervention subjects 'insuff active' at baseline 82% more likely to become active walkers (Adj OR=1.82, CI 1.05-3.17) 12% ↑ in sufficiently active by walking in intervention community.	Not reported
[23]	<i>BC Walks, USA</i>	<ul style="list-style-type: none"> Campaign exposure & Knowledge Source of media Walking behaviour Mod and vigorous PA 	Not reported	GRPs: TV 4835; radio 3245, 30 sec ads cable TV 1314. 10 x ¼ page ads in local paper; 28 news, 5 radio, 10 newspaper stories. 125 news promotions. 11360 hits, 961 logged mins. 42 Speaker's Bureau. 30 worksite & 5 school walking programs. 250 prescription pads distributed	Awareness 36% at baseline and 78% at follow up. Exposure: TVC 62%; radio 28%; newspaper 36%; TVC, radio or newspaper 43%; worksite programs 5%; speaker's bureau 4% Any non specific media messages about being active ↑ 61% at baseline to 81% at follow up compared with 62% to 56% in comparison community (p<001)	Not reported	47% of intervention subjects 'any gain' walking time compared to 36% in comparison community (Adj OR 1.66, CI 1.14-2.44). 41% of intervention subjects gained at least 30 mins walking time compared to 31% in comparison community (Adj OR 1.56, CI 1.07-2.28). 16% intervention participants changed from non active to active vs 11% in comparison (Adj OR=1.71, CI 0.99-2.95).	\$155 656 (without evaluation) \$431 pp spent
[34]	<i>Walk Missouri, USA</i>	<ul style="list-style-type: none"> Pro walking beliefs and behaviours 	2 phase: formative research and message development	1296 radio ads 8 billboards 16 newspaper adverts 200 posters	Exposure: Media 32% Radio ads 8% Billboards 13% Newspaper ads 7%	Exposure to campaign was significantly ass'd with 2 pro-walking beliefs and	Exposure to campaign was significantly ass'd with number of days walking when adjusted for age and health.	\$19 298 USD

			and pre-test		Newspaper articles 13%	community sponsored events.		
					32% reported seeing or hearing campaign on one or more types of media.			
[28]	<i>Steps</i> “Treat you Right”, USA	<ul style="list-style-type: none"> • Campaign recall • Attitudinal measures to walking • Leisure walking • Utilitarian walking 	Qualitative focus group research with African American (AA) women (50% who were overweight)	GRPs: TV 293-588 (mean 366.8); radio 0-171 (mean 70.2)	<p>Brand recall increased.</p> <p>Significant increases in walking message ($\beta=0.05$, $p<0.001$) & recall of ‘Steps’ ↑ from 21% in 2004 to 23.2% in 2005.</p> <p>Recall of trademark phase ↑ 22% 2004 to 25.3% 2005.</p> <p>In 2005 28.7% of AA recalled ‘Steps’ vs 15.5% Others. In 2005 33.8% of AA recalled “Treat you Right” vs 13.2% Others</p>	<p>Respondents considered walking to be ‘very imp’ ↑ 2004-05 for ‘all’ subjects (73% to 76%); ↑ AA women aged 18-49 (75% to 78%).</p> <p>AA more positive attitudes to walking ($\beta=0.06$, $p<0.001$) but less positive attitudes to leisure walking ($\beta=-0.04$, $p<0.05$)</p> <p>Walking message recall ($\beta=0.13$, $p<0.001$) and brand recall ($\beta=-0.07$, $p<0.05$) both predicated attitudes towards walking.</p>	Non significant behaviour change.	Not reported
[32]	<i>Activate Omaha</i> , USA	<ul style="list-style-type: none"> • Perception of the importance of an active lifestyle • Behaviour change as a result of this perception shift • Physical 	Formative qualitative focus group research with local exercise physiologists, and HP experts	200% ↑ in participation 2008 Bicycle commuter challenge. 76% ↑ in miles cycled.	Not reported	78% -2008 vs 63% -2005 reported Omaha as a community in which to be active and of leading an active lifestyle as ‘good’ or ‘very good’.	2005 - 68% explored Omaha on foot ↑ 79% in 2008	An additional \$1 475 000 USD was leveraged to fund media campaigns and sustainable programming

			change to the Omaha environment						
			<ul style="list-style-type: none"> • Increase in social capital • Additional funding 						
[42], [40],[35]	Healthy Hawaii Initiative (HHI) 'Start Living Healthy' 'Step it up, Hawaii!', USA	<ul style="list-style-type: none"> • Campaign awareness • Campaign perception • Stage of change • Self report PA 	Extensive formative research: pre-production research, production testing, focus groups and quantitative survey	GRPs: TV 2205; radio 3443.	<p>Awareness 'Start Living Healthy' 54%.</p> <ul style="list-style-type: none"> • Prompted recall of 3 different walking messages 60.4%; 52.7% & 49.0%. • 51.7% recall seeing ads on TV • 20.0% recalled radio ads • 28.3% recall seeing campaign materials while grocery shopping. <p>Men significantly less likely (p>0.05) than women to recall any campaign message.</p>	Not reported	Not reported	\$150 000 USD on TV and radio advertising. \$51 000 USD earned media value	
[25]	10 000 Steps Rockhampton, Australia	<ul style="list-style-type: none"> • Project awareness • Self report PA levels 	Community consultation and PATF collaboration	Not reported	<p>Awareness 95% in intervention community.</p> <ul style="list-style-type: none"> • Unprompted 69% Rockhampton vs 56% of comparison community had seen or heard any message about PA in the past month. • Prompted 95% of Rockhampton vs 34% in comparison community. 	Not reported	Change in PA over the 2 yr period was different for men and women. 5% increase in women in intervention categorized as 'active' (35.8% to 40.8%) vs 4.1% decrease in control women (47.1% to 43.1%) Control men a significant decrease of 8.9% in being 'active' (49.6% to 40.7%) compared with Intervention decrease 4.2 (from 49.0% to 44.8%) Not significant results.	\$800 000 AUD Direct intervention cost calculated to be AUD \$14 pp	

					¼ of respondents reported they had received advice about PA from a HP.			
[26]	<i>Walk to Work</i> Themes: “Walk to work: make time, Walk Every Day”, Australia	<ul style="list-style-type: none"> • Awareness • AC behaviour 	Not reported	Not reported	Prompted recognition 50.1% of employed participants were aware of ‘Walk to Work’ vs 40% who were not employed.	Not reported	<p>Among non-active commuters a sig ↓ in ‘car only’ use and ↑ in walking combined with PT.</p> <p>Among employed a sig ↑ in total time walking (p<0.5) ;other mod int PA (p<0.05), resulting in a sig ↓ in the proportion who were inactive</p> <p>In NSW ↓ in ‘car only’ and ‘public transport’ only were accompanied by a significant increase in trips that combined walking & public transport to work (p<0.05)</p> <p>Other metro areas sig ↑ in walking/cycling only offset by a sig ↓ in proportion combining walking and public transport.</p> <p>Mean minutes spent walking increased among employed by 16 min/wk (p<0.05) and passive commuters (p<0.5).</p> <p>Mean total mins in mod intensity activity ↑ for both employed and unemployed groups.</p>	Total \$350 000 USD \$178 356 USD spent on TV and radio
[36]	To Be Young at Heart – <i>Stay Active</i>	<ul style="list-style-type: none"> • Campaign awareness 	Formative qualitative	Phase 1: 131 TV spots, ½ full	Prompted recognition 36% recognised the	11.6% intend to become more	7.7% have become more active.	\$191 000 AUD (Includes in

	<i>Stay Independent</i> (SASI), Australia	<ul style="list-style-type: none"> • Increased interest • Intention to participate • Actual PA 	focus group research	<p>colour weekly ads in 5 regional newspapers. 3000 posters distributed. 4 full bus backs.</p> <p>Phase 2: 203 TV spots, weekly ads 5 regional newspapers 3000 posters. SASI website & Free call launched.</p> <p>Phase 3: 131 TVC spots, 9 TV news items. 11 human interest stories.</p> <p>10 000 directories distributed</p>	campaign	active.		kind, sponsorship and direct costs).
[29], Craig, Tudor-Locke et al. 2007)	<i>Canada on the Move</i> (COTM) 'Keep it simple' 'Add 2000 steps' 'Donate your steps to health research', Canada	<ul style="list-style-type: none"> • Campaign & pedometer awareness • Pedometer ownership 	Not reported	Register & monitor step count	<p>Awareness 29.3% Recall of specific messages higher Sept 2004 than baseline Nov 2003. 'add 2000 steps' ↑ 3.8% to 11.9% ; 'donate your steps to health research' ↑ 4.5% to 14.5%</p> <p>Women 37% more likely to report hearing about COTM.</p> <p>Adults who recall</p>	Not reported	<p>A year after launch awareness of COTM ass'd 13% higher odds of suff walking (Adj for demographics).</p> <p>32.4% of those aware of COTM & 32.8% of those aware of 'add 2000 steps' were 'suff walkers' compared to not aware.</p> <p>Prevalence of sufficient walking was higher amongst tagline 'donate your steps to health</p>	Not reported

					specific COTM message were 16 to 22 times more likely to own a pedometer than those unaware of COTM.		research' than among those aware of COTM and 'add 2000 steps'.	
					Those aware of specific messages of COTM were 4 times more likely to have worn a pedometer in the last week.		Pedometer owners 14% more likely to engage in sufficient walking than those not owning one.	
[37]	<i>Healthy U, Canada</i>	<ul style="list-style-type: none"> • Campaign awareness • Positive & negative aspects of advertisements 	Not reported	Average wkly GRPs 110.	<p>Awareness 17.4 % recalled PA advertisement.</p> <ul style="list-style-type: none"> • Prompted participants over 55 years 1.46 times (p=0.04) more likely to recall <i>Healthy U</i> PA TVC. 	Not reported	Not reported	Not reported
[31]	<i>ParticipACTION, Canada</i>	<ul style="list-style-type: none"> • Campaign awareness • Saliency • Physical activity - related trial behaviours 	Not reported	8390 English TV spots 573 French TV spots Total TV spots estimated at 140 million for an average of 5.4 exposures among Canadians older than 15 years.	<p>Awareness 57%.</p> <ul style="list-style-type: none"> • Unprompted 22.3% described a message specific to <i>ParticipACTION</i>. • Prompted 25.2% (95% CI 23.1, 27.4) had seen one message, 20.5% (95% CI; 18.5, 22.5) recalled seeing two, and 11.1% seeing three or more 	Overall, 58.8% (95% CI: 56.3, 61.2) strongly agreed that PA is ass'd with higher risk of chronic health problems.	26.5% reported started/doing more PA on own or with family.	Not reported
[27, 41]	<i>Agita São Paulo, South America</i>	<ul style="list-style-type: none"> • Recall of program name 		Annual PA Day mega event.	Awareness 60% (2008 up from 37% in 2002)	Not reported	Inactive subjects ↓ 9.6% to 2.7%, 2002-08.	\$152 000 US per year

		and message		2002 – 88 events 2008-2030 events.	in the state of São Paulo)		Very active subjects ↑ 7.0% to 15.7%, 2002-2008.	
		• Physical activity behaviour		2002 - 80 newspaper stories, 54 radio shows on 12 different stations, 22 TV segments. Discovery channel 17 sec TVC shown 6 times over 7 days.	<ul style="list-style-type: none"> • Prompted recall ↑ 9.5% (1999) to 31.3% (2002) in metro area. • Prompted recall ↑ 9.5% to 24.0% in the state of São Paulo. • 2008 - 49% aware of main message. 		Significant decreases in proportion of individuals achieving <150 mins/wk threshold 43.7% in 2002 to 11.6% in 2008 (p<0.001).	Significant decreases in proportion of individuals failing to reach 60 min/wk vig intensity PA. 77.9% in 2002 to 62.1% in 2008 (p=0.001)
[38]	<i>Muévete Bogotá, South America</i>	<ul style="list-style-type: none"> • Physical activity level • Building program awareness • Education & training of program implementers • Delivering interventions 	Not reported	12136 promoters of PA 31.3% from business sector. 9 capacity building workshops in 5 years. 27% of companies created own logo & PA message. 59.2% partner companies participated community-wide activities.	Not reported	Not reported	1999 - 84% of adults were 'insufficiently active'. 2003 'some improvement' no data stated.	Not reported
				15 'Healthy & Active' stations, 2800 people participated fitness testing, 650 people				

				participated in 'Health & Active' meetings.				
[2]	<i>Push Play</i> , New Zealand	<ul style="list-style-type: none"> • Campaign recognition, understanding & attitudes • Contemplating & trialing PA 	Focus testing with numerous population groups	Target audience reached once: Phase 1a - 87% Phase 1b - 78% Phase 2 - 88% Phase 3 - 61% Phase 4 - 84%	<p>Awareness of Push Play (PP) message 30% in 1999 to 57% in 2002 (prompted)</p> <p>Seen any advertisement ↑ 1.5- 2 fold since 1999 Peak 2001 with 3-4 times more likely to recognise PP.</p> <p>Logo recognition ↑ 13.5% to 52% in 2002</p>	<p>Intention to be active across all 4 surveys: thought about = 4%; 12% talked about it; 2% started.</p> <p>Proportion who thought about it ↑ significantly; as did those who started.</p> <p>No significant increase in those who talked about it.</p> <p>Significant increase in any intention to be more active 18% to 90%.</p>	<p>No sustained increase in PA levels 1999-2002</p> <p>Those who had seen message (Adj OR 4.27 95% CI 2.59-7.02) & recognised PP logo 3 times as likely (Adj OR 2.71 95% CI 1.89-3.86) to think/intend/start to be more active.</p>	\$3 million over 4 years
[21]	<i>10 000 steps Ghent</i> , "Every step counts" Europe	<ul style="list-style-type: none"> • Pedometer assessment • Self-reported physical activity level 	Not reported	6 local newscasts. 20 billboards. 23 workplace kits. 30 loan pedometers. Posters/ information about pedometers sent to schools (169); GPs (592) dieticians (26); physical therapists (308).	<p>Awareness 54% intervention Ghent vs 41% comparison Aalst</p> <ul style="list-style-type: none"> • Unprompted 12% in Ghent recalled source of information • Prompted 63% in Ghent respondents had heard of the project vs 10% in comparison respondents. <p>Most commonly cited sources of information were print media, local TV and street signs. 32% of intervention</p>	Not reported	<p>After 1 year 8% ↑ in reaching 10 000 steps in intervention Ghent (42% to 50%). Corresponding proportions in comparison Aalst (41% to 40%).</p> <p>Significant effect mean steps/day. Average ↑ 896 steps/day compared with no increase in comparison community. Significant increase in steps in men (p=0.001), women p<0.001), young (p=0.029), middle aged (p=0.009) and older (p=0.002).</p>	Not reported

respondents were aware of sale of pedometers; 12% aware of loan system; 7% aware of walking circuits.

Significant intervention effects for time spent walking; mod, work-related & leisure time PA.

Abbreviations: TVCs – television commercials; FTA – free to air; TA – Target Audience; PSA – Public Service Announcements; PA – Physical Activity; PR – Public Relations F & V – Fruit & vegetable; SoC - Stages of Change ; TRA&PB - Theory of Reasoned Action and Planned Belief; HBM – Health Belief Model; TPB – Theory of Planned Behaviour; HOE - McGuire’s hierarchy of effects; AC- active commuting; CFLRI PAM – Canadian Fitness and Lifestyle Research Institute Physical Activity Monitor; HP- health professionals; PATF- Physical Activity Task Force; Env- environmental; Suff PA – sufficient physical activity; ass’d - associated; vig PA – vigorous physical activity; GPs – General Practitioners; RR – response rate; mins – minutes.

Push Play (New Zealand) and *Agita São Paulo* (Brazil) were evaluated using independent cross sectional population-based surveys at annual or biennial intervals [2, 27]. Two other campaigns were evaluated using an intervention group only, pre- post campaign cross sectional design [28-30]. Notably both had large sample sizes. Six campaigns used ‘post only’ cross sectional designs [31-36]. *Healthy U* (Canada) used a ‘mixed methods’ combining quantitative telephone surveys and qualitative focus groups to gain insights into campaign effects [37]. *Muévete Bogota* (Columbia) did not detail their overall evaluation design [38], and only stated that they used extensive formal and informal evaluation of the settings-based strategies including: participation rates at community-wide events; number of capacity building workshops delivered; and the percentage of companies who created their own physical activity message/logo [38].

Across the 18 campaigns, 14 used random (representative) population samples [2, 21-28, 30, 32, 34, 35, 37]; one used convenience sampling [31]; a combined cluster and convenience sampling [33]; an intercept technique [36]. One study did not state their sampling strategy [38]. Sample sizes ranged from 250 [32] to 3600 [35] and response rates varied from 17% [34] to 70% [2].

Twelve studies used a telephone administered survey instrument [21-26, 28-30, 32, 34, 39]. Of interest, *ParticiPACTION* (Canada) used an existing online forum and offered a \$3 incentive [31] and *Stay Active Stay Independent* (Australia) used face-to-face intercept surveys [36]. Overall, the survey instruments were established and reliable self-report

measures of physical activity and often the measures were consistent with the countries national physical activity surveillance measures.

Conceptual theory/framework and formative research

A consideration in the development of mass media campaigns is whether a conceptual theory or framework underpinned message development. Across these 18 campaigns, the theories and frameworks reported included: theory of reasoned action and planned belief [33]; theory of planned behaviour [40]; McGuire's hierarchy of effects (HOE) [31, 36, 37]; stages of change [27, 36, 41, 42]; health belief model [34]; social ecological model [21, 24, 25, 27, 42]; and a social marketing framework [25, 32, 33, 36]. Some campaigns reported a combination of both theory and a framework [22, 25, 27, 33, 36, 40, 42] but only half of the 18 campaigns reported formative research [2, 22-25, 28, 32, 34-36, 40]. In these studies both qualitative and quantitative processes were reported and included: 12 week participatory planning processes; extensive message testing with multiple focus groups; and pre- and post production ad-testing (see Table 1).

Campaign Effects

Fifteen campaigns reported a quantified measure of the 'dose' of media exposure in the campaign [2, 21-24, 28, 29, 31-34, 36-38, 41]. Three did not report or the information was unclear [25, 26, 42]. In addition, the measurement of dose varied and included: gross rating points (GRPs or TARPs); TV 'spots'; or approximate media estimates [2]. Six campaigns described GRPs [22-24, 28, 35, 37] and two campaigns reported TV 'spots' [31, 36]. Dose was difficult to ascertain in dual message campaigns that promoted healthy nutrition and physical activity [37, 42]. Very few reported data on billboard exposure beyond estimates of traffic volume estimates, which are not considered reliable [33].

Fifteen of the 18 campaigns reported some measure of recall. Four campaigns mentioned using both unprompted and prompted recall measures [2, 21, 31, 37], two were unclear [36, 41], and the remainder used a combination of prompted recall and/or recognition to determine campaign awareness. Campaign awareness levels, ranged from 95% prompted recall of *10 000 Steps Rockhampton* (Australia) [25] to 17.4% prompted post campaign recall for the physical activity component of the *Healthy U* (Canada) campaign [37]. A number of campaigns reported higher awareness among women, [21, 25, 29-31, 35] among those with a tertiary level of education, [31] and among women who tended to be physically active, [28] or had children who were active [31]. Two reported recall of messages either not related to the current campaign or related to other physical activity messages. These ‘spurious responses’ were either a fabricated campaign name [23] or unrelated campaign tag lines [29] used as part of their evaluation. Two campaigns evaluated campaign awareness by assessing specific brand, trademark or campaign logo recognition and showed an increase in recognition of between 13.5% and 52% from baseline [2].

Only seven of the 18 campaigns measured any changes in intermediate campaign effects related to physical activity [2, 28, 31-34, 36]. Only one campaign found a significant increase in any intention to be more active [2], while the others reported smaller non-significant changes in intention to be more active [33, 36].

Change in physical activity behaviour was measured in 15 of the 18 campaigns and seven studies reported a statistically significant increase in physical activity levels [21-24, 26, 27, 34]. *10 000 Steps Ghent* (Belgium) found significant increases in mean steps/day in the intervention community compared with the control [21]. In contrast, the *10 000 steps Rockhampton* (Australia) campaign reported no overall effect on physical activity levels

between intervention and comparison communities over the two year period [25]. *Wheeling Walks* (USA) reported a significant increase in the likelihood of being ‘sufficiently active through walking’ three months after the initial campaign, with similar effects noted in the *WV Walks* (USA) replication campaign [22, 24]. There was also a significant increase in weekly walking time between the intervention and the comparison community in *BC Walks* (USA) [23].

The Australian ‘*Walk to Work Day*’ campaign reported a significant increase in total walking and other moderate intensity physical activities amongst “employed” compared with “not employed” respondents, resulting in a significant decrease in those categorized as “inactive” [26]. *Agita São Paulo* (Brazil) found significant increases in individuals reporting more than 150 minutes/week of walking or moderate intensity physical activity, and significant increases in those reaching 60 minutes/week of vigorous intensity physical activity increased through cross sectional surveys undertaken between 2002-2008 [27]. *Walk Missouri* (USA) found a small statistically significant increase in walking behaviour [34]. Interestingly, *Walk Missouri* (USA) was a ‘post only’, cross sectional design with a small sample size and used no television advertisements whilst the other two campaigns used substantial free and paid media and were either pre- post cohort [26] or serial cross sectional population based survey [27].

Craig et al. [30] reported a 13% higher odds of sufficient walking among those aware of the *Canada on the Move* (COTM) campaign message. Also, pedometer ownership increased the likelihood of sufficient walking by 14% and those who were aware of the COTM message and owned a pedometer were 52% more likely to report sufficient walking [30]. One study *Steps* (USA) reported small but not significant changes in leisure time and utilitarian walking

participation among African-American women over a one year period [28]. Similarly, *Stay Active Stay Independent* (Australia) also reported a small behavioural change (7%) in their respondents [36]. *Activate Omaha* (USA) reported an 11 percentage point increase in a weak measures of physical activity (“exploring Omaha on foot”) [32]. *ParticipACTION* (Canada) reported an increase in respondents reporting “*Being physically active on their own or with their family*” (26.5%) and in “*Parents enrolling their children in sport*” (12.2%) [31].

Push Play (New Zealand) reported no sustained changes in physical activity levels between 1999-2002 [2] and *Muévete Bogota* (Bogata) described finding improvements in physical activity levels they did not report any actual data [38]. Similarly, *Healthy Hawaii Initiative* (USA) reported it measured physical activity behaviour but *Step it up, Hawaii!* did not present any data on behaviour change as part of the evaluation [35].

Finally, *Healthy U* (Canada) and *Get Up and Do Something* (USA) did not report behaviour change measures. *10 000 Steps Ghent* (Belgium) was the only campaign that used a combination of self-report and an objective measure (pedometer) to determine physical activity levels [21]. Campaigns measuring active commuting outcomes [26] and pedometer ownership [29, 30] were atypical in this review.

Discussion

Mass media continues to be used widely to promote public health messages, raise awareness and influence physical activity behavior. This review of eighteen mass media campaign aimed at physical activity and delivered between 2003 and 2010 found mixed findings on their overall effectiveness. Our review found some progress in the more frequent use of conceptual theory/framework and formative evaluation as part of campaign development.

However, our findings on the modest campaign duration and diversity of evaluation measures are consistent with earlier reviews [5, 11]. Campaign duration varied from just several weeks to around 12 months and this restricts any opportunity to measure sustained behaviour change. Furthermore, campaign evaluation tended to focus on proximal impacts such as campaign exposure and awareness, yet there was limited consistency in how these were measured and reported. Intermediate campaign effects were reported less frequently and in varying ways, and although change in physical activity was assessed in most studies the measurement varied and data were not available for all studies.

This review found that beyond awareness raising, changes in other outcomes were measured and assessed, but in varying ways. It may be that awareness and understanding of a particular message is seen as the primary goal of mass media campaigns [43] and the generally high population reach is encouraging. Of interest, gender differences were found with higher awareness reported in women than in men in 30% of the campaigns [21, 25, 29-31, 35]. This raises the question of whether there is selective exposure [28], positing that individuals are most likely to remember campaign information promoting physical activity if it confirms their previously held attitudes and beliefs towards being active. However, exposure to messages may be reflective of the market segmentation inherent in selecting media to place advertisements.

Physical activity was reported in 15 campaigns however, only seven of the campaigns produced significant improvements in physical activity. [21-24, 26, 27, 34] Of interest, four of these seven campaigns were quasi experimental design and used a cohort sample [21-24] which adds strength in detecting campaign effects [25]. Four of the campaigns were five months or longer in duration [21, 24, 27, 34]. In contrast, *Walk Missouri*, a non-experimental

post only study design and with a small sample size, asked only three items to determine physical activity behaviour. Their results may reflect the less than optimal evaluation design [34]. Eleven of non-experimental studies used cross sectional surveys to assess campaign effects. We suggest that cross sectional surveys have a role to play in evaluating mass media campaigns however, better designs might include; serial cross sectional surveys and/or the use of comparison communities.

The Agita São Paulo campaign was delivered in a low and middle income country (LMIC). This campaign was undertaken as part of a comprehensive whole-of-community approach and provides some of the first robust evidence for other LMIC to use this approach to promote physical activity [44]. Accordingly, we call for the need for more and ongoing campaign evaluation research to be undertaken in LMICs as a priority.

Non-significant findings on physical activity were found in eight campaigns; two studies were around six months in duration [28, 31], three studies comprised multiple short-term phases delivered over a 12-18 month period [30, 32, 36]. *Muévete Bogota* (Bogata), *Push Play* (New Zealand) and *10 000 Steps Rockhampton* (Australia) were longer campaigns over several years and yet reported no overall effect on physical activity behaviour. These findings are consistent with a recent review of mass media campaigns across multiple health behaviours (including physical activity) which concluded there was little evidence of sustained campaign effects over time and non-comparable measures were used [17]. We also found the consistency and strength of the results on physical activity varied within studies and across the set of 18 campaigns as a whole. For example, within some studies positive findings are found on some outcomes and not others, this diminishes overall confidence in interpreting overall campaign effectiveness. It also highlights the importance of selecting

appropriate outcome measures. This highlights the importance of assessing all aspects of the study - evaluation design, sample size, duration and dose of the campaign and the measures of physical activity - when interpreting the physical activity findings.

Of the 14 campaigns, 11 used items from either the IPAQ [21] or a shortened version [27] or standard self-report items from national surveillance systems [22-24, 26, 30, 31, 34]. Two studies used other standardised items asking respondents to self-report the number of days that they were physically active in the past week [2, 25]. Whilst this may provide consistency, the data may not be sensitive enough to detect changes specific to campaign objectives. Of interest, *Wheeling Walks* (USA) included specific evaluation questions on walking that linked with the campaign's objective, furthermore *Steps* (USA) added specific questions that linked to intended effects in a national surveillance survey [24, 28]. We recommend that physical activity items explicitly linked with the campaign objectives or endpoints are more suitable than generic measures of physical activity and more likely to detect change resulting from campaigns than measures used for overall population physical activity surveillance.

10 000 Steps Rockhampton (Australia) and *10 000 Steps Ghent* (Belgium) were the only campaigns to report changes in behaviour by gender and other demographic sub groups. Accordingly, future campaigns should explore and present results for different sub populations as this would inform campaign design and development. Wakefield [17] noted that behaviour change from mass media campaigns is usually observed in highly motivated individuals and the challenge is to achieve sustained whole population level changes as well as in targeted segments of the community [17]. To date, the physical activity mass media literature has few examples of sustained behaviour change in adult populations. This may be due to under investment in campaign duration (dose), financial and/or other limitations

restricting data collection over longer periods. Evaluation designs with sufficient sample size to explore differential effects by gender and other characteristics should be undertaken in the future.

As a point of interest the ‘VERB™ – it’s what you do’ a tween physical activity campaign delivered in the US was found to have positively influenced children’s physical activity and these effects persisted as the children grew into adolescents [45, 46]. Whilst VERB™ does not have an adult focus, it did use evaluation as an integral part of the campaign design [45, 47]. Extensive formative, process and outcome evaluation was completed with a central component being the longitudinal cohort design, using multiple evaluation collection points conducted Spring 2002 through 2006 [47]. Despite some limitations and modest effects [45] the evaluation methodology of the VERB™ campaign systematically drew on theory and formative research, used a cohort design with multiple data collection points, was conducted over four years and had dedicated resources for evaluation. This aligns closely with our suggested optimal evaluation criteria. We suggest it is timely to also review the literature on physical activity mass media campaigns for children and adolescents to assess progress and quality.

In this review, we found the use of behavioural theory appeared to have increased and this is consistent with recommendations for successful mass media campaigns [36, 42]. One quarter of campaigns described a specific behavioural theory underpinning their formative research [24, 33, 34, 40] and almost half of the campaigns described dedicated formative research to develop and test their campaign messages. This contrasts with 30% in an earlier review conducted in 2004 [5]. This is a promising trend and further use of theoretical and conceptual frameworks, such as testing the hierarchy of effects (HOE) model, may help focus evaluation

on how campaigns work and what mediates campaign effects [48]. The HOE model outlines the assessment of short term impacts, intermediate impacts and endpoint changes in a stepwise cascade to allow assessment of campaign mechanisms as well as effectiveness [20, 49]. To date, this model has been rarely used by physical activity researchers to guide planning, evaluation and reporting of campaign effectiveness [31, 48]. Our recommendation is that researchers routinely use theory, formative research, theoretical and conceptual frameworks to add robustness to the evaluation design.

Compared to earlier reviews [5, 11], we found fewer studies using a quasi-experimental, cohort design, 22% compared to 33% in 2004 [5]. None of the studies we reviewed combined cohort and cross sectional survey elements compared with one quarter in 2004 [5]. In contrast, 50% of the non-experimental designs described post only cross sectional evaluation compared with none in the previous review [5]. Whilst both time and cost constraints may prohibit using a cohort and multiple data collection points, following individual people over a time is a more powerful design compared with cross sectional surveys to understand the determinants of behaviour change in a population. In this review, five of the seven campaigns with significant physical activity findings followed a cohort of individuals [21-24, 26] however, only one of these *Wheeling Walks* collected more than just baseline and one follow-up point. We recommend that the factors that influence researchers to choose one evaluation design over another be described to allow other researchers to gain an insight into the decision making process and assess the outcomes achieved.

Assessing and reporting process measures such as campaign ‘dose’ is an important element of evaluation because a strong link has been suggested between the amount of exposure to a campaign and the level of awareness achieved, that is, a dose-response effect exists [5, 7, 50].

This review found measures of media exposure or ‘dose’ were reported across 16 of the 18 campaigns, this contrasts with only 30% in the previous review [5]. However, the measures were reported inconsistently making it difficult to compare and contrast planned and achieved dose-related findings. Furthermore, the measures were not standardised and often relied on compiled data by commercial advertising companies. This observation is consistent with the previous review [5]. The future challenge is twofold: (1) to establish and use a standard unit of measurement, separate from those of commercial advertising companies, that would facilitate a greater translation of findings in relation to dose-response effects and allow greater comparison between campaigns; and (2) report both planned and achieved media exposure (dose).

Measures of campaign awareness varied in this review. Few studies reported the actual questions used to assess awareness whilst other studies used previously described awareness questions [2, 22-24, 33, 37]. There is still confusion around the definition of ‘unprompted recall’, ‘prompted recall’ and ‘prompted recognition’ exists and the methods for calculating overall awareness levels varies between researchers. Again, it would be timely for research collaboration to standardise a methodology for assessing awareness to allow more consistent reporting and stronger comparisons across campaigns nationally and globally.

Most campaigns used a self-reported measure to assess change in physical activity behaviour and these have well known inherent limitations [2, 21-28, 30-32, 34, 36]. Recently, researchers are using objective measures (such as pedometers and accelerometers) to quantify the amount and intensity of physical activity behaviour is increasing due to the affordability of the equipment [51]. Future studies aiming for optimal campaign evaluation should consider including both self-report and objective physical activity measures.

Methodological limitations

This review has a number of limitations. Although the search strategy included eight databases, studies were restricted to English language publications, an adult focus and time limits were imposed. Also, no grey (fugitive) literature was reviewed and we may have missed campaign evaluations reported outside of peer-reviewed journals. All but two of the campaigns were delivered in high income countries and many were from North America, which limits the generalisability of these findings on mass media campaigns to other countries or regions. Finally, we did not examine cost-effectiveness as the information available was limited or not reported.

Conclusion

This review has identified that the evaluation of mass media campaigns aimed at physical activity has improved since 2004 but some limitations still remain. There have been positive developments in the more frequent use of behavioural theory and formative evaluation as part of campaign development. This review found that beyond awareness raising, changes in other outcomes were measured, assessed and reported, but in varying ways. This review provides an update on the evaluation methodologies used in the adult literature, accordingly we suggest that it would be timely to update the physical activity mass media literature for children and adolescents. We recommend that optimal evaluation design should include: formative research to inform theory/conceptual frameworks, campaign content and evaluation design choice; use of a cohort study design with multiple collection points; sufficient campaign duration; use of valid measures; and sufficient and dedicated evaluation resources. Accordingly, this is likely to enhance the potential success of campaigns to increase awareness and sustained endpoint physical activity behaviour change. Future research might explore how we may routinely employ these criteria and provide more definitive evidence for

policymakers investing in mass media as part of a comprehensive strategy to increase and sustain regular physical activity.

Competing interests

All authors agree there are no conflicts of interest to declare.

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