

REVIEW

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Get the message? A scoping review of physical activity messaging



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Abstract

Background: Understanding how to create and deliver effective physical activity (PA) messages for and to various population subgroups may play a role in increasing population PA levels. This scoping review aimed to provide an overview of what is known about PA messaging and highlight key research gaps.

Methods: We followed a 5-stage protocol proposed by Arksey & O'Malley and the Preferred Reporting Items For Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping reviews checklist. *Stage 1:* research questions were identified. *Stage 2:* we identified relevant studies by searching electronic databases, contacting existing networks and hand searching reference lists. *Stage 3:* studies were screened in Covidence™ software. *Stage 4:* study data were extracted and charted. *Stage 5:* findings from included studies were collated, summarised and reported in two ways: (1) a descriptive numerical analysis providing insight into extent, nature and distribution of the included studies, and (2) a narrative summary summarizing the evidence reviewed organised by messaging concepts and by population subgroup.

Results: A total of 9525 references were imported into Covidence™ for screening. Of these, 123 studies were included in final analysis. We found that PA messaging evidence is complex and multidimensional in nature, with numerous concepts to consider when creating or evaluating messages. The extent to which these different PA messaging concepts have been researched is variable. Where research has accumulated and evidence is consistent, it supports the following: (1) PA messages should be framed positively and highlight short-term outcomes specifically relating to social and mental health, (2) message content should be tailored or targeted to intended recipient(s), and (3) when developing messages, formative research, psychological theory and/or social marketing principles should be used.

Conclusion: While it is unlikely to address global inactivity on its own, PA messaging may play a valuable role improving population PA levels. However, it is a complex and multidimensional concept and greater understanding is still needed. We present a synthesis of the existing evidence, highlighting key areas where evidence has accumulated and where gaps lie, as well as recommendations for PA messaging to different population subgroups.

Keywords: Exercise, Public health, Guidelines, Communication, Dissemination

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Introduction

Physical inactivity is a major contributor to the growing global burden of non-communicable diseases including cancer, cardiovascular disease, depression and diabetes [1]. Recent research shows that overall, global trends are worsening with physical inactivity levels rising in many high-income Western countries and with the steady prevalence of inactivity in low income countries making a substantial contribution to the burden of disease [2]. It has been suggested that a systems approach may play an important role in responding to complex public health challenges, such as efforts to increase PA at population level [3–7]. A systems approach acknowledges that alongside efforts to modify policy and the physical environment to promote PA [8] there is an important role for interventions which aim to address individual factors. One such approach is PA messaging.

Interventions utilising a PA messaging approach tend to feature the delivery of information to members of a target group within the public with the aim of either directly or indirectly improving PA levels. Understanding how to utilise PA messaging effectively is important for three reasons. Firstly, messaging is a scalable approach that can be used to reach large numbers of people at relatively low cost [9]. Secondly, effective messaging can augment the dissemination of PA guidelines and related information such as benefits of PA to various population subgroups, as this information is generally not created to be public facing or to motivate people to become or remain physically active [10]. Indeed, evidence suggests that the general public have limited knowledge of the current PA recommendations for health [11]. Thirdly, existing evidence shows PA messaging interventions to date have had limited effects on PA behaviour itself and mixed findings on outcomes such as awareness and motivation [9, 10, 12–18]. Further research to understand how to effectively develop and deliver PA messages for and to different population subgroups is therefore warranted.

In terms of previous research into PA messaging, a number of reviews exist. While these reviews have focused on specific aspects of messaging such as guideline dissemination [16, 17], solely on message content [10], specifically on mass media campaigns [9, 12, 13, 19], or only included research from the USA [18], no review that provides a broad overview of the evidence on PA message content and delivery from multiple countries across the globe has been conducted. A summary paper which maps and synthesises what is currently known across the various PA messaging concepts may be an important step in understanding how to optimally create and deliver effective PA messages for various population subgroups. Therefore, the aim of this study was to provide the first such broad scoping of the evidence on PA messaging. Specifically, we sought to answer the following research questions:

- (1) What is known about (a) PA message content and (b) PA message delivery?
- (2) What is known about PA message content and delivery for specific population groups?
- (3) What are the research gaps?

Methods

Study design and protocol

Based on the study aim, a scoping review was determined to be the most appropriate method. The aim was too broad to address via a traditional systematic review (and meta-analysis), and could be more appropriately answered through examining the extent, range and nature of research in this area, summarising and disseminating research findings to date, and identifying research gaps in this area; all of which are common scoping review purposes [20]. The process of conducting a scoping review is often iterative, allowing for changes to inclusion and exclusion criteria, research questions and analytical approaches as more is learned about the evidence base. Furthermore, a scoping review allows for inclusion of a broad range of study designs, providing a more comprehensive picture of the research area. To ensure robustness, this study adopted an established five-stage scoping review protocol proposed by Arksey & O'Malley [20] and built upon by Levac, Colquhoun & O'Brien [21], and followed the Preferred Reporting Items For Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping reviews checklist (Additional File 1) [22].

Key definitions and position of messaging

Health communication encompasses the study and use of communication strategies to inform, influence and motivate individual, institutional and public audiences about important health issues [23]. At the outset of this review, we sought to define and position PA messaging within the wider context of health communication to inform searches and inclusion criteria. We present PA messaging as a subtype of health communication and as an overall concept that encompasses both content and delivery aspects of a PA message. As no universally used definition of PA messaging exists, working definitions were developed by the study authors for the purpose of this study (Table 1).

Initial literature searching to establish an understanding of key PA message and messaging terms revealed multiple sub-concepts and inconsistencies in the use of terminologies surrounding these. Indeed, these inconsistencies and the need to take caution when comparing studies have been previously noted [25]. One example of this are the terms *tailoring* and *targeting*. Although some authors clearly distinguish between tailoring as an exclusively individual level approach and targeting as an exclusively group level approach [16], the term tailoring

Table 1 Working definitions for the purpose of this research

Term	Working definition
Physical activity messaging	The overall process of designing, creating and delivering physical activity messages
Physical activity message	Educational or persuasive material to be relayed to a specific individual or group within the public with the aim of ultimately increasing physical activity levels
Physical activity message content	The specific aspects which comprise a PA message, such as the type, amount and presentation of information
Physical activity message delivery	The process by which a physical activity message is delivered to the target individual or group of the public

Definitions adapted from Latimer et al. [10] and drawing on Michie et al., intervention functions [24]

has also been used to describe customisation of message content at an individual level [26], and at a group level [27]. Similarly, the term targeting has been used to describe a group-level approach [28] as well as to describe individually-customised messages [29]. Thus, a glossary of PA messaging sub-concepts and their working definitions for the purpose of this scoping review was created and is presented in Table 2. Establishing these working definitions was a fundamental step as it allowed us to standardise information from various studies despite inconsistencies in terminologies used and thus reliably extract data in Stage 4.

Stage 1: identifying the research question

Our research aim was to provide a broad overview of what is known about PA messaging. To address this aim, three specific research questions were identified.

- (1) What is known about (a) PA message content and (b) PA message delivery?
- (2) What is known about PA message content and delivery for specific population groups?
- (3) What are the research gaps?

Stage 2: identifying relevant studies

We identified relevant studies by:

1. Searching the following electronic databases: Ovid (MEDLINE), ProQuest, SPORTDiscus (Ebscohost), and Web of Science
2. Contacting existing academic, policy and practice networks requesting relevant studies
3. Hand searching reference lists of key studies and checking recent publications by key authors

The database search strategy was designed to be as comprehensive as possible with the available resources. Databases were searched for titles that contained at least one “PA” term as well as at least one “messaging” term (full list of search terms can be found in Supplementary Table 1, Additional File 2). Appropriate truncation symbols and wild cards were used to account for search term variations and maximise searches. No limits on journals searched were used. As an example, the full electronic search strategy for MEDLINE can be found in Supplementary Table 2, Additional File 2. Searches were conducted up to August 30th, 2019. Inclusion and exclusion criteria (see Table 3) were designed to be highly inclusive.

Stage 3: study selection

All identified studies were uploaded to Covidence™ software where duplicates were automatically removed at

Table 2 Working definitions of key physical activity message content and delivery concepts

	Working definition
Message Content	
<i>Type of information</i>	The nature or purpose of information included in the message. Messages identified in the literature can generally be grouped into three broad categories: ‘how much and what type’ information (such as physical activity guidelines), ‘why’ information (such as benefits of physical activity), and ‘how to’ information (practical and supportive information).
<i>Use of gain- or loss-framing [10]</i>	The use of framing a message to highlight either the benefits of taking part in physical activity or the consequences of not taking part.
<i>Tailoring [30]</i>	Information based on individual user data (e.g. specific feedback on pre-established goals such as step counts)
<i>Targeting [30]</i>	Information designed to be relevant to a specific group (e.g. inactive individuals or diabetics)
<i>Personalisation [30]</i>	The use of static, user-specific information in a message (e.g. name or home address).
Message Delivery	
<i>Media or mode of delivery</i>	The type of media through which the message is being relayed, for example, emails, posters or radio adverts.
<i>Provider or source</i>	The provider or source of the message, for example, GP, the media, or friends and family.
<i>Frequency and dose</i>	How often the message is delivered and for how long, for example, emails sent 3 times a week for 4 weeks.

Table 3 Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> • Research articles or reports in any geographical location or setting • Research conducted in healthy or clinical populations • Articles published in peer-reviewed journals and grey literature • Articles reporting on development of or effects of PA messages • Articles published in English • Research designs including: empirical research studies (qualitative, cross-sectional or longitudinal designs, interventions or natural experiments with pre-post measures or comparison) and non-empirical research (systematic and non-systematic reviews, and methods or theory papers) 	<ul style="list-style-type: none"> • Articles focusing on wider PA communication not within the scope of this review, for example messages not directed to public or studies using other communication techniques such as one-to-one counselling • Abstracts without full text

time of upload. Titles and abstracts were screened by CW with 15% double screened by either GB or PK. Full text level reviewing was carried out by two independent researchers (CW, PK, GB or AN) with conflicts resolved by a third researcher.

Stage 4: charting the data

Data were extracted and entered into a data charting form using Excel. Where available, the data charted included all of the following:

- General study information including author, title, study location, study design and participant information
- Description of study and message used
- Primary focus of study (message content, delivery or both)
- The use or absence of psychological theory
- The use or absence of social marketing principles

Key findings

- Implications

Stage 5: collating, summarising and reporting

In a scoping review, there are numerous ways in which data from identified studies can be organised, synthesised and reported. Findings of this scoping review were reported in two ways: (1) through a descriptive numerical analysis providing insight into extent, nature and distribution of the included studies, and (2) through a narrative summary of the evidence base. To address our research questions and maximise relevance for researchers, policymakers, practitioners and other relevant stakeholders, we made the decision to organise the narrative summary by the pre-identified messaging constructs of content and delivery (see Table 2) as well as by UK Chief Medical Officer's guideline groups (Children and Young People, Adults, Older Adults, Pregnant Women and Disabled People) [31]. Finally, a matrix displaying where consistent research had accumulated and where gaps lay, organised by messaging concept and population group was created. This matrix displays

research areas across 5 levels of evidence from strong (e.g. systematic review level evidence) to non-existent (i.e. no research identified in this review) based on the number, type and agreement of findings across studies relating to each research area.

Results

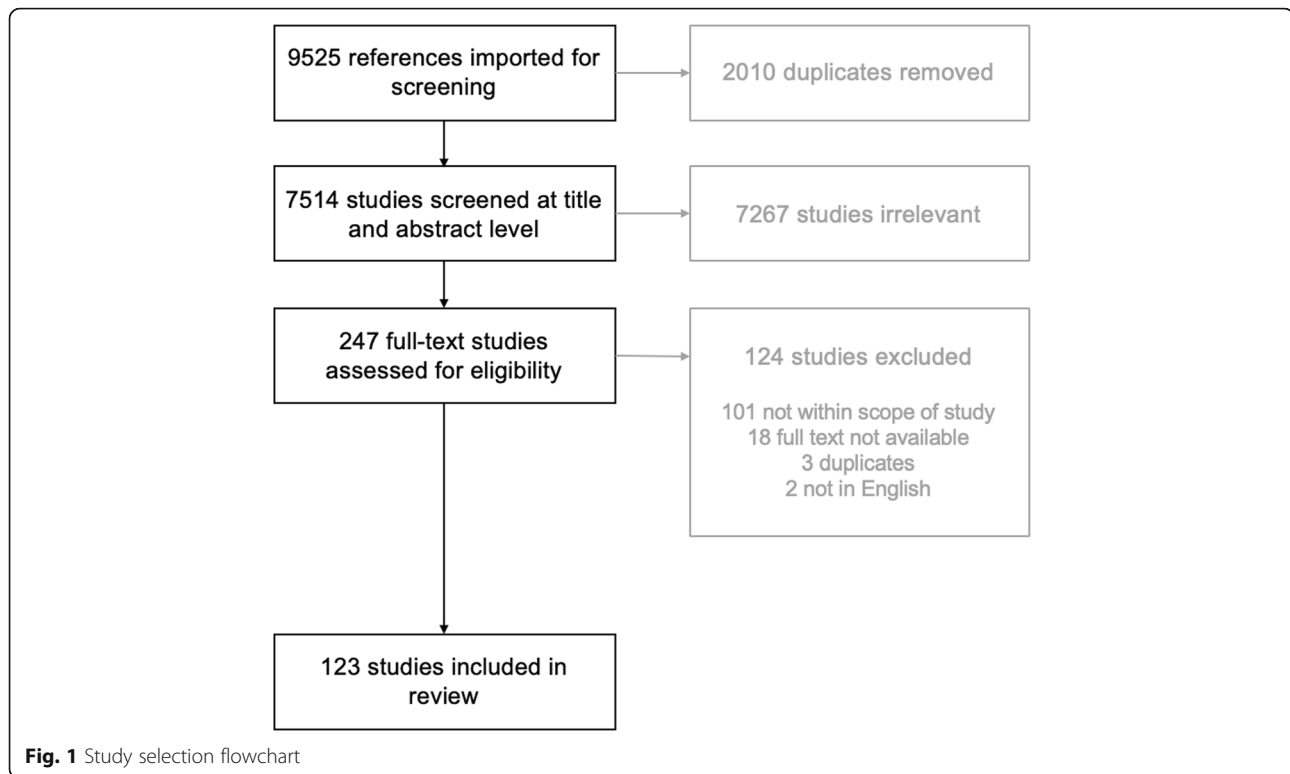
Descriptive numerical analysis

A total of 9525 references were identified for screening ($n = 9514$ from database searches, $n = 6$ from existing networks, and $n = 5$ from hand searching). Following removal of duplicates and screening, 123 studies were included in final analysis. A study selection flowchart is presented in Fig. 1.

Of these 123 studies, 99 were empirical (original research) and 24 were non-empirical (reviews, commentary, methods, etc). Of the 99 empirical studies, there were 78 experimental studies (34 between-groups studies, 16 pre-post, 13 randomised controlled trials, 6 cross-sectional, 4 within-subjects, 3 quasi-experimental, 1 longitudinal, 1 post-test only, 1 single-group experiment, and 1 uncontrolled trial) and 21 non-experimental (18 qualitative and 3 cross-sectional) studies. Of the non-empirical studies, there were 13 non-systematic reviews, 6 systematic reviews, 3 commentaries, 1 conference foreword, and 1 methods paper.

The 99 empirical studies took place in the following locations: Canada ($n = 34$), USA ($n = 32$), Australia ($n = 12$), UK ($n = 8$), China ($n = 2$), France ($n = 2$), Germany ($n = 2$), Japan ($n = 2$), Belgium ($n = 1$), Brazil ($n = 1$), Ireland ($n = 1$), Netherlands ($n = 1$) and 1 took place in multiple countries (Bulgaria, Croatia and Romania). Almost half of the included studies ($n = 58$, 47.2%) were published in the past 5 years (2014–2019). The relevant guideline groups of the 123 studies were as follows: Adults ($n = 61$), Adults and Older Adults ($n = 17$), Children and Young People ($n = 16$), Children and Young People & Adults ($n = 9$), Pregnant Women ($n = 4$), Older Adults ($n = 3$), Disabled People ($n = 3$), and All ($n = 10$).

Of the 99 empirical studies, 62 (62.6%) stated use of psychological theory. The most commonly identified psychological theories were Theory of Planned Behaviour ($n = 11$), Social Cognitive Theory ($n = 9$), Self-



Determination Theory ($n = 5$) and Elaboration Likelihood Model ($n = 4$). Authors in 8 of the 99 empirical studies (18.2%) reported use of social marketing principles, although no universally referred to set of principles was apparent. Study descriptions, participant information, key findings and implications of these 123 studies are presented in a Additional File 3. Of the 123 studies, 60 primarily focused on message content, 6 primarily focused on delivery, and 57 focused on both.

Narrative summary of findings

The main findings around concepts relating to message content (type of information, use of framing and use of tailoring or targeting), and message delivery (media or mode, provider/source and frequency & dose) (see Table 2 for definitions) are summarised below. This scoping review identified studies reporting on the following 11 outcomes: message recall, messages awareness, message appeal, message preference, affect, beliefs about PA, attitudes towards PA, PA intentions, self-efficacy, motivation, and PA behaviour. These outcomes can be

broadly classified as proximal, intermediate or distal (see Table 4).

Children and young people

Message content

Evidence from qualitative research [33, 34], existing reviews [17, 35] and experimental research [36] supports the use of messages targeting affective outcomes and highlighting the social and mental health benefits of being physically active (e.g. PA is fun and cool) in this population. Although one experimental study found no advantage for gain-framed messages over loss-framed in encouraging parent's support for child PA [37], evidence from existing reviews and qualitative research generally supports the use of gain-framed messages when focusing on children or their parents [17, 33, 38]. Messages targeting cognitive antecedents of PA specified by Theory of Planned Behaviour (e.g. attitude) also had positive effects on intentions to exercise [39].

Mass media campaigns targeting children and young people (namely the VERB [40] and WIXX [41]

Table 4 Working definitions of relevant outcomes

Outcomes	The effects/impacts of the message
Proximal [32]	Immediate impacts e.g. awareness and recall of the message.
Intermediate [32]	Short term impacts e.g. intent, motivation, self-efficacy and knowledge.
Distal [32]	Medium- and long-term impacts/outcomes e.g. physical activity behaviour(s).

campaigns) have had promising effects on PA [42] and on campaign recall and awareness [41, 43, 44]. Following the success of the social marketing-based VERB campaign, a 10-year review was published on how the campaign had informed other campaigns [45]. They found evidence of numerous program planners having aspired to follow the VERB approach, but few had taken advantage of the full capabilities of social marketing principles to bring about changes in PA behaviour.

Message delivery

Qualitative research suggests young people would prefer to hear messages from adults other than general practitioners (GPs) or teachers whom they felt “lectured” by [33]. Rather, formative evidence supports delivering PA messages to young people through mass media, websites and smartphone apps [17]. Experimental and survey evidence also exists to support the use of video messages over static images when targeting motivation and message recall [46, 47].

Adults

Message content

Experimental evidence focusing on “how much” information (e.g. 150 min each week, 30 min × 5 days a week, or 10,000 steps each day) does not clearly support one ‘amount’ or dose as the most effective message [48, 49]. However, evidence does exist to suggest presenting 150 min each week as a minimum threshold may be damaging to perceived benefits of shorter bouts of PA [50], and that adult populations (in a national survey) show high willingness to increase PA by short bouts (i.e. 10 min per day) [51].

Overall, existing evidence from formative research and existing reviews supports the use of gain-framed messages when targeting various outcomes for adults [10, 17, 52–54]. Some experimental evidence from studies comparing gain- and loss- framed message content in trial designs have found no significant difference in effectiveness on proximal or distal outcomes in young adults [55–58], adults over 55 years [56], inactive colorectal cancer survivors [59], or in community dwelling individuals with multiple sclerosis [60]. However, an advantage for gain-framed messages over loss-framed messages has been found in general adult populations [10, 61, 62], university students [63], overweight females [64], sedentary adults [65], and cardiac rehabilitation patients [66] on outcomes including attitude, exercise intentions and PA behaviour. It also appears the effect of framing may depend on the type of outcome emphasised and on the individual’s need for cognition (i.e. an individual’s tendency to enjoy activities that require thinking) [67], or on an individual’s emotional risk perception [68]. Messages involving threat-based information or forceful

language appear to be ineffective or may even have detrimental effects on PA and PA-related outcomes such as intentions, motivation and affect [69–72].

Evidence from an existing scoping review suggests mental health benefits are less frequently focused on than physical health benefits in PA messages [18]. Despite a lack of focus, evidence from existing reviews, qualitative research and experimental research supports the use of messages highlighting short-term social (e.g. PA an opportunity to connect with others) and mental (e.g. improved mood and energy levels) health benefits in university students [73], adults [74–77] and specifically in active adults [78] when targeting various outcomes including motivation and self-efficacy. Experimental evidence identified does not support the use of appearance-based messages to improve PA intentions or attitudes in young adults [79, 80].

This scoping review identified more evidence from experimental studies demonstrating a benefit of messaging tailoring (see Table 2) in improving PA behaviour, self-efficacy and feelings towards PA [10, 81–83] than no benefit [26]. Experimental evidence also supports the use of tailoring over simple personalisation of a generic message when targeting PA behaviour [81], and no evidence was found to support the use of non-tailored messages over tailored messages. Qualitative research and existing reviews support the use of psychological theory to help identify behavioural determinants that messages can be tailored to [10, 15]. This scoping review identified a number of determinants by which messages could be tailored to, namely: Stage of Change (as described in Transtheoretical Model) [10, 84], social support needs [84–86] and self-efficacy [10, 28]. The increasing potential for intervention designers to create individually tailored messages due to advancements in technology is also apparent in the evidence base [30, 87].

The evidence supports the use of messages targeted to specific demographics, such as women [88, 89] or young healthy adults [56] to improve outcomes such as attitudes and intentions. Further, the importance of identifying and targeting to more specific population subgroups (such as education level, physical activity level, intention to be active, attitudes towards PA and perceived benefits of PA) beyond traditional demographics (such as age and gender) was evident across multiple studies and study types identified in this scoping review [25, 29, 53, 80, 82, 90–92].

Previous reviews support the use of practical advice and “how to” information in PA messages [10, 16, 74]. Existing evidence also highlights the importance of including information that is relevant to the target audience and using formative research to highlight what the specific focus of messages should be. For example, qualitative research suggests messages for women may

address identified barriers to women such as poor body image [73, 93]. Mixed findings were found on the use of descriptive norm information (e.g. information about prevalence of PA amongst peers) on intentions and PA behaviour in adults [94–97].

One study found the use of spouse's health risk information to be promising in promoting PA in middle-aged adults [98], and another found active women had higher confidence in response to reading information that PA was preventive of heart disease compared to breast cancer [99]. Potentially adverse effects of PA messages were identified in only one study, where recipients who viewed exercise-related messages consumed more calories post-message than those in control group [100].

Numerous existing reviews focusing on mass media campaigns targeting mixed adult populations were found in this scoping review [9, 12, 13, 19, 32, 101–103] as well as numerous evaluations of single mass media campaigns [47, 104–107]. Mixed findings were found for effects of campaigns on proximal outcomes (e.g. awareness and campaign recall) and intermediate outcomes (e.g. intention to be active), but generally campaigns had less of an effect on intermediate outcomes than on proximal. Campaign effects on distal outcomes such as PA behaviour itself were modest and inconsistent, with few campaigns reporting increases. However, mass media campaigns specifically targeting walking have had positive effects on awareness [108–112], attitudes [111, 113, 114] and levels of walking [108–111].

The evidence supports the use of social marketing principles (e.g. branding and promotional strategies) in the development of mass media campaigns [40, 45, 115], and suggests that interventions which use campaign building principles or social marketing benchmarks (e.g. formative research, audience segmentation and channel placement) are more successful in bringing about behaviour change than those which do not use these principles [116, 117].

Message delivery

The internet was found to be a common source of PA information in a general adult population [118], and interventions using the internet as a method of message delivery (e.g. email) have had promising results [119]. In terms of provider or messenger, the evidence from formative research supports the delivery of PA messages through peers [28, 53, 74] in a general adult population. In terms of media or mode of message (see Table 2), the general public find guideline documents unappealing [120], and the evidence from existing reviews and qualitative research supports the use of commercial style messages [77, 120]. Mobile phone text messages have also been successfully used in PA messaging interventions identified in this review [85, 121].

In terms of frequency and dose, when staff and students in UK universities received text messages on top of regular PA promotion emails, PA levels decreased significantly more than in the group that received emails only [122]. In young adults, evidence supports sending short messages [73] at times where there is opportunity to act on them (e.g. near morning or afternoon work break) [123], and a maximum of 2 messages per day [84]. Lastly, relating to media or mode of delivery, some experimental evidence exists to support the use of images in social media posts promoting PA [124].

In terms of mass media campaigns, qualitative research, experimental research and existing reviews identified in this scoping review support the use of multiple modalities (e.g. TV and billboard) of message delivery [47], the use of messages focusing on mental and social health benefits [125], and working with local partnerships to provide opportunities for the behaviours promoted in the campaign [126]. Longitudinal evidence following campaign effects has shown disparities between high and low socio-economic status and between majority and minority ethnic groups, highlighting the importance of considering social inequalities when designing, implementing and evaluating mass media campaigns [127].

Older adults

Message content

Experimental research in older adults supports the use of gain-framed messages over loss-framed messages in bringing about improvements in motivation and PA levels [55, 128, 129]. Qualitative evidence exists to suggest messages to older adults should highlight the short term social and mental health benefits of PA (e.g. feeling relaxed and connecting with others) [74, 130]. Messages promoting mental imagery (e.g. encouraging older adults to imagine themselves walking) may also be a promising approach to improve PA behaviour [131].

Message delivery

Qualitative research in older adults has found that this population have difficulty digesting technical language (e.g. 'cardiovascular' rather than 'heart') [74], and dislike the format of existing PA guideline documents [130]. Qualitative evidence also suggests older adults value messages from health care professionals (HCPs) and peers [74, 132].

Pregnant women

Message content

Qualitative research found that pregnant women with Gestational Diabetes want to feel confident about

being physically active during pregnancy, and that they would like practical information on safe physical activities they can take part in [133]. Empirical research suggests that appearance and health based messages were equally ineffective at improving intentions to exercise post-partum [134], but that persuasive messages grounded in Theory of Planned Behaviour resulted in significantly greater improvements in PA related outcomes than control [135].

Message delivery

Qualitative research supports message delivery through credible sources such as HCPs in pregnant women [133]. A randomised controlled trial found that pregnant women who received 6 PA messages/week had greater decreases in PA and increases in sedentary time than those who received fewer messages [136].

Disabled people

Message content

A commentary on research conducted in disabled people supports messages promoting short term affective outcomes of PA (e.g. PA makes you feel good, do what you enjoy) [137]. Qualitative research with disabled people and their carers has highlighted the importance of acknowledging the heterogeneity of disabilities and conducting formative research to determine appropriate message content and delivery methods [138]. Qualitative research with parents of disabled children supports the use of messages including targeted information, inclusive images that promote belongingness, and messages providing self-regulatory tools [139]. One study conducted with community dwelling men and women with spinal cord injury found greater effects on proximal and intermediate outcomes following loss-framed messages targeting psychological health than gain-framed messages [140].

Message delivery

In parents of disabled children, qualitative research has revealed that preferred PA message providers are reliable and credible organisations, other parents [37], and the school [138]. Role models (e.g. coaches or mentors), doctors, psychologists, physiotherapists, social workers and peers have also been highlighted as important messengers for disabled people [137, 138]. Community dwelling people with spinal cord injury stated preference messages delivered via the internet and via HCPs [132].

Gaps in the literature

With the findings from studies summarised above, it is also helpful to consider an overview of where evidence has and has not accumulated on the topic of PA messaging. Overall, studies more frequently focused on aspects

of message content than on aspects of message delivery, and on adults more than other populations. A matrix displaying where evidence has accumulated and where evidence is lacking (based on the studies reviewed) is displayed in Fig. 2.

Discussion

Summary of principal findings

This scoping review aimed to map the literature on PA messaging and identify key research gaps. We found that PA messaging is complex and multidimensional in nature, with numerous concepts to consider when creating or evaluating messages. The extent to which each individual concept has been researched across different populations is variable and for many concepts there is no clear consensus on how to optimally design or deliver PA messages. However, the review has successfully mapped where evidence has accumulated and where clear gaps exist. Where consistent evidence does exist, it suggests that PA messages should be gain-framed, should highlight short-term outcomes (specifically relating to social and mental health), message content should be tailored or targeted, and formative research, psychological theory and/or social marketing principles should be used in message development.

Comparison with literature and plausible explanations for findings

Our principal findings agree with those from another recent scoping review [18] that reviewed PA communication efforts solely in the USA from 1995 to 2015. The authors of that review found that 68% of messages were grounded in theory with the majority of communication research being conducted in adult populations [18]. They also recommended that PA campaigns should use visual content such as videos, content targeted to specific populations, and multiple modalities to deliver messages [18]. Our scoping review builds on these findings by providing an up to date overview of PA messaging research evidence from multiple countries across the globe and making recommendations for population groups aligning with PA for health guidelines (see Table 5 below). Our review also supports findings from a systematic review of different approaches to PA message construction [10]. In line with our findings, Latimer et al., found a benefit for gain-framed messages over loss-framed messages, found that message tailoring is important for success, and found messages targeting the psychological determinant of self-efficacy to be beneficial but concluded that overall understanding of PA messaging was lacking [10].

Evidence from this scoping review supports the use of gain-framed messages. Message framing originates from Prospect Theory, which suggests individuals will respond

	Children and young people	Adults	Older adults	Pregnant women	Disabled people
Message content					
Type of information	Consistent evidence from formative primary research and non-systematic reviews. Little evidence from experimental research.	Consistent evidence from formative primary research, non-systematic reviews and experimental research.	Some evidence from formative primary research and non-systematic reviews. No evidence from experimental research identified in this review.	Little evidence from formative and experimental research.	Some evidence from non-systematic reviews and formative research.
Use of framing	Some evidence from formative primary research and non-systematic reviews. Little evidence from experimental research.	Systematic review level evidence.	Little evidence from formative research and non-systematic reviews. Consistent evidence from experimental studies.	No evidence identified in this review.	No evidence identified in this review.
Use of tailoring and targeting	Little evidence from formative research and non-systematic reviews. No evidence from experimental research identified in this review.	Systematic review level evidence.	Little evidence from formative research and non-systematic reviews. No evidence from experimental research identified in this review.	No evidence identified in this review.	Little evidence from formative research. No evidence from experimental research identified in this review.
Message delivery					
Media or mode of delivery	Some evidence from formative primary research and non-systematic reviews. Little evidence from experimental studies.	Some evidence from formative primary research and non-systematic reviews. Little evidence from experimental studies.	Some evidence from formative primary research and non-systematic reviews. No evidence from experimental research identified in this review.	No evidence identified in this review.	No evidence identified in this review.
Provider or source	Some evidence from formative primary research and non-systematic reviews. No evidence from experimental research identified in this review.	Some evidence from formative primary research and non-systematic reviews. No evidence from experimental research identified in this review.	Some evidence from formative primary research and non-systematic reviews. No evidence from experimental research identified in this review.	Little evidence from formative research. No evidence from experimental research identified in this review.	Some evidence from formative research and non-systematic reviews. No evidence from experimental research identified in this review.
Frequency and dose	No evidence identified in this review.	Some evidence from experimental research.	No evidence identified in this review.	Little evidence from experimental research.	No evidence identified in this review.

Colour coded based on level of existing evidence in each population from **strong** (dark green) to **non-existent** (orange).

Fig. 2 Matrix displaying where research evidence relating to physical activity messaging has accumulated and where gaps lie

differently to factually equivalent messages depending on whether they are worded to highlight benefits or consequences [141]. The benefit of gain-framing over loss-framing in promoting PA may be partially due to the greater ability or likelihood of a gain-framed messages to include information targeting psychological determinants of PA. For example, it would be difficult to construct a loss-framed message that aimed to improve an individual’s self-efficacy. This links with the finding that messages are more promising when grounded in psychological theory. This is not surprising, as the importance of using theory in the development of public health interventions is widely recognised [142] although we acknowledge this is a currently debated topic in the literature [143]. The evidence supporting the use of

tailoring or targeting in PA messaging is also intuitive. It is believed that customising a message increases message salience [144], which leads to greater information processing and behaviour change [145, 146].

In a field where the physical long-term health benefits of taking part in PA are often at the forefront of epidemiology and subsequent communications, an important finding of this scoping review is that evidence supports the use of messages highlighting short-term outcomes, particularly those relating to mental and social health. This finding may relate to social marketing, which involves applying marketing techniques to influence human behaviour for social good and to improve health outcomes [147]. Social marketing involves presenting a product (in this case PA) in exchange for a

Table 5 Physical activity message recommendations based on summary of findings

Guideline group	Physical activity message recommendations
Children and young people	<ul style="list-style-type: none">• Messages to this population should be framed positively, highlighting the benefits of physical activity. Specifically, messages should highlight the social and acute affective benefits of physical activity, for example, "physical activity is fun".• Messages to this population should be delivered via engaging modes such as videos and should be delivered through informal sources such as smartphone apps or the media.
Adults	<ul style="list-style-type: none">• Messages to this population should be framed positively, with specific focus on social and mental health benefits of physical activity, for example, "physical activity makes you feel good".• Messages should be brief and should avoid threat-based language. To the general adult population, informal modes of delivery are encouraged such as through the media.• In clinical populations, messages should be delivered through health care professionals.
Older adults	<ul style="list-style-type: none">• Messages to this population should be framed positively, with specific focus on social and mental health benefits of physical activity, for example, "physical activity is an opportunity to connect with others".• Messages delivered through health care professionals are likely to be well-received
Pregnant women	<ul style="list-style-type: none">• Messages to this population should include clear and practical information on physical activity during pregnancy, for example, messages could include examples of safe exercises.• Messages should be delivered through credible sources such as health care professionals.
Disabled people	<ul style="list-style-type: none">• Messages to this population should highlight short-term affective benefits of physical activity and should use inclusive images.• Messages should be delivered through credible organisations, health care professionals and social workers.

cost (in this case somebody's time, energy, or other potential resources). To market such a product effectively to an individual, it is important we make it as appealing as possible. It seems logical then that an individual may respond better to what they can get out of 'buying into' this product immediately (e.g. feel good, have more energy, spend time with others) than what they may get out of it later (e.g. reduced risk of cardiovascular disease later in life). An individual may know that eating cake regularly could increase their risk of weight gain and negatively affect their health, but they may continue to do so for the immediate enjoyment of eating cake. Social marketing therefore highlights the importance of utilising affective and emotional responses to make a 'product' more appealing [147], and this aligns with creating messages that depict PA as, for example, fun, enjoyable, or an opportunity to spend time with loved ones.

Future research and implications

Our findings show an increasing interest in the area of PA messaging, with almost half of the studies identified published in the past 5 years. In terms of future research, there is a need for instructive studies with appropriate evaluative designs to systematically isolate and test individual components of message content and delivery for effectiveness, and thus develop our understanding of optimal PA content and delivery in different population subgroups. Such research efforts should prioritise PA the messaging concepts identified in this review as having little or no evidence focusing on them (e.g. message dose and frequency in all populations, see Table 5). In areas where evidence has accumulated but has not yet been synthesised (e.g. type of information in adults, see Table 5), systematic reviews with meta-analyses are also

warranted. Qualitative research and mediator analysis to help gain a greater understanding of the specific mechanisms by which existing PA messages work (i.e. which psychological determinants are affected by PA messages), or which outcomes future PA messages should target is also required to enhance our understanding of PA messaging. Also, although we attempted to identify commonly used theories from included studies, numerous potentially important theories were not discussed in this review (e.g. Knowledge Gap Hypothesis and Elaboration Likelihood Model). Therefore, to further enhance our understanding of PA messaging, a specific review of the role of theories and the extent to which they have been used in PA messaging using existing guidance [148] may also be warranted. Lastly, due to the complex and multidimensional nature of PA messaging highlighted in this review, there is a need to organise and conceptualise the area of PA messaging to encourage further understanding of, and application in, this area.

The findings of this research are timely as they could inform the dissemination of newly developed, or updated guidelines to various populations [31, 149–151]. At current, the World Health Organisation (WHO) are updating global PA guidelines, and these findings may aid their communication and dissemination plans. In the UK specifically, the Updated Chief Medical Officers' (CMO) guidelines (released on September 9th 2019) state that a Communications Working Group is being established to advise approaches to communicating PA recommendations and related messages to the wider public [31]. Based on key findings, recommendations which could be used by such working groups to aid development of PA messages to each guideline group are presented below (Table 5).

Strengths and limitations

This scoping review is the first to attempt to provide an overview of available evidence on PA messaging from across multiple countries. A key strength of this scoping review is its inclusivity of a range of study designs, allowing us to provide a more comprehensive overview of the evidence base. Further strengths of this scoping review include the use of established protocol [20–22], and presentation of findings by key concepts and population groups. This review has produced meaningful findings which may aid dissemination of PA guidelines (such as the under-development new WHO Global PA guidelines or the newly released UK PA guidelines for health [31]) and related information to various population subgroups.

Due to the nature of scoping reviews, we did not appraise the quality of evidence included. We are also unable to comment on the effectiveness of different messaging techniques as the heterogeneous nature of included studies do not allow for meta-analysis, and indeed that is not the aim of a scoping review [20]. Rather, we have presented a descriptive account of available research. Another limitation of this scoping review is that only titles were searched due to the time and resource constraints. This limitation means that some relevant studies were missed. For example, although our review identified the Canadian campaign ParticipACTION [46], not all publications on this campaign were identified due to the limitations of our search terms [152]. Indeed, given the nature of PA messaging, it could be argued that it is impossible for one review to completely capture all of the available evidence in this area. However, a substantial body of literature was generated (123 studies); almost double the number identified in a previous scoping review of PA communication in the USA alone [18]. We are confident we have included a range of studies that adequately provide an overview of the PA messaging evidence base, and which is sufficient in addressing our aims. Finally, there are likely lessons to be learned from other forms of PA communication (e.g. one-to-one counselling) however, these were deemed to be outside the scope of this study and therefore not included. Isolating PA messaging to the public from other forms of communication was necessary to focus our study and develop our understanding of PA messaging and its application in this area.

Conclusion

While it is unlikely to address global inactivity on its own, PA messaging may play a significant role in targeting individual factors in a systems approach to improve PA population levels, but is a complex and multidimensional concept. We present a synthesis of the PA messaging evidence from across the globe, highlighting key areas where evidence has accumulated and

where gaps exist. We provide recommendations for PA messaging to different population groups. Headline findings include support for the use of gain-framed messages highlight short-term mental and social health outcomes, tailored or targeted messages, and messages grounded in psychological theory or social marketing principles. Further instructive research is required to understand how to optimally message PA information to different populations.

Supplementary information

Supplementary information accompanies this paper at <https://doi.org/10.1186/s12966-020-00954-3>.

Additional file 1. PRISMA Scoping Review Checklist.

Additional file 2. Search terms and strategy.

Additional file 3. Supplementary datasheet of included studies.

Abbreviations

PA: physical activity; HCP: health care professional; GP: general practitioner; CMO: chief medical officers; UK: United Kingdom; USA: United States of America

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Authors' contributions

CW and PK conceived the study. CW, PK and GB designed the search strategy. CW conducted database searches. CW, PK, GB and AN screened records and extracted data. CW, PK, GB and NM led analysis of results. CW drafted the full manuscript, and all authors reviewed and approved for final submission.

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Availability of data and materials

Details of reviewed articles are available in Additional File 3.

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Competing interests

The authors declare that they have no competing interests.

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