A scoping review of behaviour change theories in adults without dementia to adapt and develop the '*PHYT in dementia'*, a model promoting physical activity in people with dementia

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Abstract

Introduction. Research has established that exercise and physical activity can improve executive functioning, independence and quality of life in people with dementia. A dedicated theory explaining behaviour change in physical activity in people with dementia does not exist. We aimed to develop a theoretical model, which can be used to inform effective interventions to promote physical activity in people with dementia.

Methods. There were five phases: 1. A search of the literature to identify theories which have been used to explain behaviour change in physical activity in adult populations without a diagnosis of dementia; 2. Description of the theories (and sub-theories) and their main constructs; 3. Synthesis of the constructs; 4. Adaptation of the constructs to dementia; 5. Development and explanation of a model for physical activity in people with dementia (the *'PHYT in dementia'*).

Results. We identified nine theories used to explain behaviour change in physical activity in adult populations without a diagnosis of dementia. Through our synthesis, we identified nine umbrella constructs. We integrated three more dementia-relevant constructs and developed the *'PHYT in dementia'*. The model was explained by providing a practical example of its application.

Discussion. Based on a scoping review of behaviour change theories in adults without dementia and following adaptation of the constructs from these theories to dementia, we derived a new theoretical model, the *'PHYT in dementia',* which includes both individual and environment-levels constructs. The model needs to be tested empirically, which our research team will do in the process evaluation of the Promoting Activity, Independence and Stability in Early Dementia and Mild Cognitive Impairment (PrAISED 2) study. Results from field-testing will inform refinement of the model.

Keywords: Physical activity; exercise; behaviour change; dementia; theory; scoping review

1. Introduction

Dementia is a neurodegenerative condition, which presents with a cluster of symptoms, including deteriorating cognition and progressive loss of executive function. As the condition advances, because of gait alterations, memory loss, poor insight, behavioural symptoms, use of medications and reduced visual acuity, people with dementia lose physical abilities and experience a high risk of falls (1,2). The consequences of falls may include fractures and hospitalisation (3,4), so people with dementia and their carer(s) may be encouraged by health care professionals and / or on their own initiative to engage in risk-averse behaviours and practices. While reducing the incidence of falls, such behaviours may also reduce the person's mobility and independence, adversely affecting their quality of life.

People with dementia wish to continue with purposeful and meaningful activities of daily living (5), as these promote the preservation of skills (6,7), improve functional ability (8) and cognitive function (9), reduce carer burden (10,11) and contribute to their overall wellbeing (12). There is, therefore, a need for complex intervention programmes including progressive balance-challenging exercise and physical activity, to promote the maintenance of independence and physical ability in people with dementia. Although the National Institute for Health and Care Excellence (13) has produced guidance on assessment and prevention, specific guidelines or programmes designed for people with dementia do not exist at present.

The uniqueness of the experience of living with dementia (e.g. loss of memory, motivation and confidence) requires the development of dedicated programmes aimed at behaviour change, which determine the factors impinging on the ability of the person with dementia to fully engage in an intervention and maintain the behaviour over time (14,15). Theories of behaviour change can aid intervention developers by identifying the psychological factors associated with physical activity and how these mediate adherence and intervention outcomes (16,17). The UK Medical Research Council advocates the use of theory in developing and evaluating complex interventions (18).

A recent systematic review identified behaviour change techniques applicable to older community dwellers (19). The authors concluded that the most commonly used techniques may not work for an older population. This highlights a need to undertake behaviour change theory development to identify those aspects that really affect physical activity levels among older people, including those affected by dementia.

A *behaviour change theory* is a conceptual framework based on generalised statements, which attempts to explain why behaviours change (20). A *theoretical model* derived from theory allows, through (visual) structures or schemes, composed of practical statements and concepts, an understanding of specific phenomena (21). However, many have wrongly used the two terms interchangeably (22).

Different theories have been used to explain physical activity behaviour change. However, existing studies have tended to adopt a single theory (23), which may be unable to capture the full range of constructs influencing behaviour change. Intervention effectiveness can be boosted by incorporating theories identifying both individual-level (i.e. locating the cause of behaviour within single individuals) factors such as personal goals, and system-level (i.e. explaining behaviour as caused by the interaction of different systems relating with each

other) factors, such as pressure from society, which affect behaviour (22). At the same time, theories are flexible enough to accommodate new predictors of behaviour (24). In a recent scoping review identifying theories of behaviour and behaviour change, Davis et al. (22) have advocated for work of synthesis to ensure building of cumulative understanding and refinement of existing theories. In the words of Hagger (23): *'Through the elimination of redundancy, integrated theories are invaluable as they highlight the essential psychological variables and processes that do most of the 'work' when it comes to predicting and explaining behaviour'.*

These elements provide a rationale for the development of integrated theories, which synthesise constructs from existing models to derive more effective systems explaining behaviour change (23; 25). In light of the absence of behaviour change theories applicable to physical activity in people with dementia, the aim of this study was to develop a theoretical model, which can be used to inform effective interventions to promote physical activity in people with dementia.

The study comprised the following elements: 1. A scoping search of the literature to identify theories which have been used to explain behaviour change in physical activity in adult populations without a diagnosis of dementia; 2. A description of the theories (and sub-theories) and of their main constructs; 3. A synthesis of the constructs; 4. A cross-checking of the relevance of the constructs in dementia through analysis of data from the feasibility study of an intervention to promote activity and independence in people with dementia (PrAISED); 5. The development and explanation of the model for physical activity in people with dementia (the *'PHYT in dementia'*).

2. Methods

In line with similar work by Davis et al. (22), a scoping review was deemed the most suitable method, given that this is a complex subject area which has not been reviewed comprehensively. Our review complied with the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist (26). Appendix 1 shows where in the paper each of the items in the checklist were addressed.

2.1. Search of the literature

We identified theories used to explain behaviour change in physical activity in adults without dementia through a search of the literature. Searches were run in October 2018 on four databases covering relevant discipline areas: Psychology (PsycINFO), Medicine (Medline and Embase), and the Social Sciences (International Bibliography of Social Sciences – IBSS). We also searched the Cochrane Database for relevant trials. Finally, in order not to miss any relevant unpublished documents, we ran a Google search and inspected the first 100 results. The reference lists of the papers retrieved were screened for further relevant literature.

The search strategy (Appendix 2) was informed by the PICO (Population, Intervention, Comparison, Outcomes) approach. Although an effort was made to keep the search strategy

consistent across databases, minor modifications were required to suit the individual characteristics of databases.
Inclusion criteria:

- Both qualitative or quantitative peer-reviewed papers, including editorials, original research, discussion papers and literature reviews, as long as the primary aim was discussion, development, synthesis, testing or refinement of theory (as per our definition in the introduction) used to explain behaviour change in physical activity.
- On behaviour change in adults.
- Any language and year.

Exclusion criteria:

- Papers on behaviour change techniques (e.g. providing rewards contingent on effort or progress) or therapies (e.g. Cognitive Behavioural therapy) aimed at changing behaviour. Only papers on theoretical frameworks, which have higher level of abstraction (making them suitable for synthesis), are considered.
- Empirical studies grounded in theoretical models, but whose primary outcome was not discussing theory.
- Empirical studies which did not explicitly refer to a theory, but used empirical methods to determine factors impacting on physical activity.
- Papers around physical health (e.g. obesity), as opposed to physical activity.
- Papers around behaviour change in physical activity with children.
- Paper synthesising existing theories, unless they had not been included in the review.

Title and abstract screening of all records was carried out by one author (CDL), who excluded the sources that were clearly ineligible. The full texts of the remaining records were independently screened by two independent reviewers within the research team (CDL and VVDW) against the inclusion / exclusion criteria. Any disagreement was discussed between the two reviewers and in case it was not immediately resolved, a final decision was made with a third author from the research team. The references of the sources retrieved were screened for further relevant literature.

We did not carry out a formal quality appraisal of the sources for the following reasons:

1. The different nature of the sources (e.g. literature reviews, empirical studies, discussion papers) would require the use of more appraisal tools, making ranking based on different scoring systems meaningless;
2. We were not concerned with the quality of the sources, because the purpose of the review was to merely identify the theoretical models mentioned / described in the literature, as opposed to using data from the sources, which would require greater attention to methodological quality;
3. We had a large representation of theory development papers and to the best of our knowledge, there is currently no quality appraisal tool for theory development papers.

2.2. Description of theories, sub-theories and their main constructs

For each of the theories identified, one author (CDL) extracted a brief description of the theory (and any sub-theories) and of its main constructs. The extraction process was checked for accuracy by all the other co-authors.

2.3. Synthesis of constructs and development of operational definitions

We synthesised the theories' and sub-theories' constructs, by aggregating similar constructs across different theories into umbrella constructs (or themes). This work is possible because many theories have overlapping constructs, despite they use different terminologies (27).

One author (CDL) extracted the constructs from each theory and generated tentative umbrella themes as they emerged from the data (deductive approach). For example, for the *Theory of Planned Behaviour*, the following main constructs were extrapolated: attitude towards behaviour, subjective norms and perceived behavioural control. These were coded respectively into the umbrella themes expectations, personal beliefs and self-efficacy. When coding constructs from another theory, if these fit into one of the existing themes, they were coded accordingly. Otherwise, new umbrella constructs were created.

Once all the theories' constructs had been coded, each one of the research team members individually examined the umbrella constructs and provided ideas / comments on potential improvements. The umbrella constructs were iteratively edited through creating, eliminating, merging and separating, until the research team reached consensus on a final list.

We then developed operational definitions for the final umbrella constructs and provided practical examples on how they would apply in the context of an intervention promoting independence and physical activity in people with dementia. We used a randomised controlled trial we are currently undertaking (the Promoting Activity, Independence and Stability in Early Dementia and Mild Cognitive Impairment – PrAISED 2)[1] as an example to illustrate the relevance of the identified constructs in the context of behaviour change in physical activity in people with dementia.

[1] The Promoting Activity, Independence and Stability in Early Dementia and Mild Cognitive Impairment (PrAISED 2) is a multi-centre, pragmatic, parallel-group, randomised controlled trial, to test the clinical and cost-effectiveness of a therapy intervention designed to promote activity and independence amongst people with early dementia or mild cognitive impairment. For details about the study, see Harwood et al., 2018 (55).

2.4. Adapting the constructs to dementia

To ensure that the synthesised constructs had validity and relevance in a population with dementia, we utilised data from our feasibility study of the PrAISED 2 (28). Twenty participants with dementia and their carers who had taken part in the PrAISED feasibility study were qualitatively interviewed, to investigate which aspects had promoted or hindered engagement in the intervention.

The transcripts of the interviews were extracted onto NVIVO (29) and analysed through thematic analysis (30) by one author (CDL). The main constructs synthesised in the synthesis (section 2.3) were used as initial themes to code the transcripts (deductive approach). However, if data emerged from the participants' interviews, which did not fit into the initial themes, a new theme was created and an operational definition developed. If no data from the feasibility interviews fit into one of the initial themes, we would dismiss it on the ground that it was not relevant for people with dementia. The tentative list of themes obtained after coding represented the code book.

Through use of the code book, a second independent rater (VVDW) coded 10% of the interviews (i.e. two transcripts). The research team resolved any discrepancies emerging between the two raters and reached consensus on a final list of themes. These represented the constructed used to develop our model (section 2.5).

2.5. Diagrammatical illustration and explanation of the model

Based on the final list of constructs, we developed the '*PHYT in dementia'* (Physical Activity Behaviour change Theoretical model in dementia). A diagram of the new theoretical model illustrates how the constructs mediate behaviour change (and in turn, intervention outcomes). In order to explain how the model applies to practical scenarios, we related it to the PrAISED 2 study.

3. Results

3.1. Search of the literature

The initial search identified 1,623 sources. Their title and abstract were inspected for relevance and 1,135 records were excluded. After removing duplicates (n=401), the remaining records (n=87) were assessed against the inclusion criteria. Of these, we excluded 65 records (reasons for exclusion in Figure 1). Of the remaining 21 sources, we were not able to retrieve the full-text of five (through the author or library services), obtaining a final number of 16 articles for review. Full details of the selection process are reported in Figure 1 through a PRISMA flow diagram (31).

Study characteristics are reported in Table 1. In brief, five papers aimed to develop new theory (32-35), six studies empirically validated existing theories (36-41), three studies discussed existing theory (42-44), and two studies were literature reviews around theories which have been used to explain behaviour change in physical activity (45; 46).

The studies identified nine theoretical models. The number of nominations for each theory was as follows:

- Stages of Change Model (47) (n = 6)
- Self-Determination Theory (48) (n = 4)
- Theory of planned behaviour (24) (n = 3)
- Social Cognitive Theory (49) (n = 3)
- Sport Commitment Model (36) (n = 2)
- Health Belief Model (50) (n = 1)
- Schema Theory (51) (n = 1)
- Psychological Continuum Model (52,53) (n = 1)
- COM-B (Capability, Opportunity, Motivation, behaviour) system (32) (n = 1)

In addition, two studies (34;54) identified several theories from disciplines not directly related to health, but which can still be relevant for behaviour change in physical activity. These were grouped into the umbrella category *"social-ecologic perspectives"*.

3.2. Description of theories, sub-theories and their main constructs

A brief overview of each theory (and of its respective sub-theories, when applicable) is provided, as well as an explanation of the main constructs making up the theory.

3.2.1. The Stages of Change Model

The Stages of Change Model or Transtheoretical Model (47) is a stage-based model which postulates that behaviour change occurs through a number of chronological stages: *Pre-contemplation*, when individuals do not intend to change their behaviour, as they often do not feel there is a need; *Contemplation*, when individuals intend to change the behaviour, as they realise that there might be a need; *Determination*, when individuals fully commit to changing

and prepare for the behaviour change; *Action*, when behaviour change occurs; and *Maintenance*, when individuals sustain their behaviour change for a period of time.

The process of change is driven by ten cognitive, affective and evaluative processes:

- *Consciousness raising* (awareness about the behaviour);
- *Dramatic Relief* (positive or negative emotional arousal about the behaviour);
- *Self-Re-evaluation* (integrating the health behaviour into one's identity);
- *Environmental Re-evaluation* (considering the consequences of the behaviour on others);
- *Social Liberation* (opportunities in place to promote the behaviour);
- *Self-Liberation* (commitment to change behaviour);
- *Helping Relationships* (support in place to promote the behaviour);
- *Counter-Conditioning* (replacing the old behaviour with the new behaviour);
- *Reinforcement Management* (promoting the new behaviour through rewards);
- *Stimulus Control* (create strategies that support the new behaviour).

3.2.2. The Self-determination Theory

Self-Determination Theory (SDT) (48) contends that behaviour change is driven by motivation, which can be of different degrees lying on a continuum:

- *Amotivation* (The absence of motivation, resulting in no behaviour change);
- *Extrinsic motivation* (Behaviour change is only maintained in the short-term, as it is driven by expected outcomes and not based on the inherent pleasure derived from doing the activity);
- *Intrinsic motivation* (Behaviour change is maintained long-term, as it is driven by inherent pleasure, satisfaction and accomplishment).

SDT is composed of several sub-theories. Cognitive Evaluation Theory and Goal Contents Theory are concerned with the promotion of intrinsic, as opposed to extrinsic goals, to promote long-lasting behaviour change. Causality Orientation Theory emphasises the importance of internal locus of control as a facilitator to extrinsic motivation.

Basic Psychological Needs Theory, posits that motivation to engage in behaviour change is also sustained by fulfilling three main psychological needs:

- *Autonomy* (desire to be causal agents of one's own life)
- *Competence* (experience mastery)
- *Relatedness* (will to interact, be connected to, and experience caring for others). The idea of the relevance of supportive relationships to motivate change is further supported by the Relationship Motivation Theory.

3.2.3. The Theory of Planned Behaviour

According to the Theory of Planned Behaviour (24), behaviour change depends on the (actual) ability and intention (i.e. motivation) of the person to perform the behaviour. Intention is influenced by three constructs, which are interlinked with each other:

1. *Attitude toward the behaviour* (How favourably or not the person views the behaviour of interest. For example, anticipated positive or negative outcomes affect the intention of the individual to perform the behaviour);
2. *Subjective norms* (Individual views on the behaviour, influenced by the cultural milieu of the person (e.g. parents, spouse, friends. For example, carers views on risk associated with physical activity may influence the view of the person with dementia of the behaviour);
3. *Perceived behavioural control* (Perceived or actual ability to perform the behaviour).

3.2.4. The Social Cognitive Theory

The Social Cognitive Theory (49) posits that behavioural change is caused by three factors affecting each other reciprocally (Reciprocal Determinism):

- *Cognitive processes*, also knowns as *"personal factors"*, which pertain to the level of self-efficacy (i.e. belief in one's ability to carry out the behaviour). This is influenced by aspects such as past experiences which shape expectations, modelling (i.e. watching similar individuals, successfully completing the behaviour), social input and knowledge and skills;
- *Environmental factors*, which pertain to the characteristics of the setting, which influence the person's ability to carry out the behaviour. These include, for example, social norms, impediments and facilitators;
- *Behavioural factors*, which pertain to the response following the behaviour. These include, for example, internal or external reinforcements which affect the likelihood of continuing the behaviour.

3.2.5. The Sport Commitment Model

The Sport Commitment Model (35) theorises that engagement in physical activity is influenced by:

- *Enjoyment* (a positive affective response to the activity including pleasure and fun);
- *Involvement alternatives* (the degree to which the person is also involved in other physical activities, which would decrease commitment to the primary activity);
- *Personal investments* (e.g. time, money, emotions). The more the personal investment, the more the commitment to the activity;
- *Social constraint* (social pressure to remain in the activity). The more the external pressure, the higher the likelihood to continue with the activity;
- *Involvement opportunities* (opportunities that arise from continuing involvement in the activity).

3.2.6. The Health Belief Model

The Health Belief Model (50) posits that a person's likelihood to take action is influenced by:

- *Sociodemographic factors*, such as gender, age, education, ethnicity;
- *Individual perceptions*, which is the sum of perceived susceptibility (how much at risk the person feels by not doing the behaviour) and severity (how severe the consequences of not changing behaviour would be);
- *Individual expectations*, the sum of perceived benefits and barriers of the behaviour and self-efficacy (ability to perform the behaviour);
- *Cue to action*, which is the presence of triggers (reminders) necessary to initiate behaviour.

3.2.7. The Schema Theory

Schema Theory (51) stresses the cruciality of past experiences as predictors of future behaviour. It suggests that change is facilitated when the person has shaped (over time) ideas around the self and the behaviour which promote adherence to that behaviour.

These cognitive processes are the central construct of the theory. They are defined Self-schemata when they relate to oneself (e.g. "I see myself as a physically active individual") and Schemata when they refer to the behaviour in question (e.g. "Physical exercise is good for your health").

3.2.8. The Psychological Continuum Model

The Psychological Continuum Model (PCM) (52,53) posits that behaviour change occurs through four stages:

- *Awareness*, occurring when the individual develops knowledge around a behaviour, usually through socialisation. Becoming aware about a certain behaviour may serve as input for attraction;
- *Attraction*, occurring when the individual forms positive affects around the behaviour;
- *Attachment*, occurring when positive affects around the behaviour become contingent on personal, as opposed to social, processes. In this phase, individuals integrated the behaviour within their own identity / core values;
- *Allegiance*, occurring when the psychological connection to the behaviour becomes persistent over time.

3.2.9. The COM-B system

The COM-B system (32) theorises that behaviour change is facilitated by an interacting system, made up of:

- *Capability* (physical and psychological abilities necessary for behaviour change);

- *Opportunity* (socio-cultural and physical infrastructure enabling the occurrence behaviour change);
- *Motivation* (automatic and conscious processes driving behaviour change).

The COM-B has been operationalised into the Behaviour Change Wheel (32), presenting nine intervention functions, which may help optimise Capability-Opportunity-Motivation configurations and maximise behaviour change: Education (increasing knowledge), persuasion (proposing arguments to promote behaviour change), incentivisation (giving reinforcements), coercion (i.e. giving punishment), training (i.e. providing skills), enablement (i.e. increasing capability), modelling (i.e. offering examples to imitate), environmental restructuring (changing environment physically), and restriction (i.e. setting rules).

3.2.10. Social-ecologic models

Social-ecologic theories (34), such as theories of environment stress (55-58), theories of neighbourhood disorder (59-62), restorative environments theory (63), ecologic psychology and the theory of behaviour settings (64-66), the theory of urban imageability (67), and environmental psychology of the internet (68,69), share the following principles:

- Intrapersonal, interpersonal, physical, environmental, and sociocultural factors interacting with each other impinge on behaviour;
- Environment and behaviour (i.e. people) influence each other, as opposed to the idea of a linear relationship whereby the former only influences the latter;
- Different levels of the environment, ranging from the micro (e.g. home) to the macro (e.g. urban planning, architecture of community spaces) impinge on behaviour change and any intervention promoting physical activity should consider all these aspects.

3.3. Synthesis of constructs and development of operational definitions

Through our synthesis, we derived a final number of nine umbrella constructs: autonomy / control, motivation, self-efficacy, capability, expectations, support, personal beliefs, personal characteristics and characteristics of intervention. Table 2 displays the theories and sub-theories, the constructs extrapolated from them, and the umbrella constructs under which each construct was assigned.

Operational definitions of the nine constructs and how they affect behaviour change in people with dementia taking part in an intervention to promote physical activity (PrAISED 2) are displayed in Table 3.

3.4. Adapting the constructs to people with dementia

All of the constructs identified through the synthesis were found to be relevant to the sample of participants with dementia involved in the PrAISED feasibility trial interviews. However, we expanded the operational definitions of some constructs (Table 3) to include elements which were reported as being crucial to promote behaviour change in dementia.

Data from the PrAISED feasibility study evidenced that because of their deteriorating physical health and declining cognition, individuals with dementia may need intensive support to initiate and maintain behaviour change. In some instances, the reliance on others was such that it led to an imbalance in decisional power, whereby the decision on whether to engage and continue physical activity was made on behalf of and in the interest of the person with dementia by others (carers or clinicians), based on their views around risks and benefits. This often led to the person with dementia being restricted from certain activities. We therefore added the concept of *'gatekeeping'* in the operational definition of *'support'*. In the construct *'support'*, we also included the concept of *'good communication'*, as this was found to be an essential skill for anyone supporting the person with dementia.

In relation to *'self-efficacy',* we integrated the operational definition with the concept of *'embarrassment'*, which was felt by the participants in the PrAISED feasibility study when others monitored / supervised them during the activity. Many reported that this had a negative impact on their willingness to engage in the intervention. In the operational definition of *'personal beliefs'*, we added the concept of *'concerns'*, as several participants with dementia in the PrAISED feasibility study reported that anxieties related to the condition (e.g. risk of falls, declining health) discouraged them from doing physical activity.

The construct *'characteristics of the intervention'* was expanded to accommodate the idea of *'routine'*, the need for physical activities to be well integrated in the daily engagements of the person with dementia. This often requires a degree of flexibility in the activity regime (e.g. the routine can be performed at home and at different times during the day). We also added the concept of *'challenge'* in the *'characteristics of the intervention'*, as many of the participants contended that if the intervention had this quality, it further promoted behaviour change.

We included in the operational definition of *'personal characteristics'* the concept of *'identity'*, to emphasise how behaviour change in physical activity is further promoted when the person with dementia self-identifies as being a physically active person (i.e. "a sports person"). In this case, engaging in physical activity is valued as a means to maintaining a sense of identity. The *'motivation'* construct was expanded to accommodate some factors that are unique to the experience of dementia and which were found to hinder the person's motivation to engage in behaviour change, thus often requiring a boost from external sources (e.g. carer or clinicians). These factors include loss of confidence, apathy, fatigue, physical and cognitive deterioration.

In addition to expanding the operational definitions of the nine initial constructs, three further constructs were developed: social opportunity, progress, and physical infrastructure. These have been added with their respective operational definitions and how they are relevant in a programme promoting physical activity in people with dementia in Table 3.

3.5. Diagrammatical illustration and explanation of the model

The constructs identified in sections 3.3 and 3.4 are mapped out in Figure 2, which illustrates our new model, the '*PHYT in dementia'* (Physical Activity Behaviour change Theoretical model in dementia). The model shows that behaviour change (or any intervention aimed at behaviour change), occurs within ecological systems. Ecological systems, as theorised by the Ecological Systems Theory (70), span from the macro-system (e.g. the culture the person

lives), to the micro-system (e.g. the immediate context such as the home). These different systems interact with the person, thus having an impact on behaviour change. At the outer layer of the ecological system, there is the chrono-system (i.e. the dimension of time), which renders the behaviour (or the behaviour change intervention) highly time-bound.

Within the micro-environment, behaviour change is in turn dependent on the interaction of the agents involved in the person's life, or in the case of an intervention to promote physical activity in people with dementia, on the interaction of the agents involved in the delivery of the intervention [i.e. the person with dementia, the person's carer(s) and the therapist(s)]. Each of these agents, while interacting and mutually influencing each other, bring their own personal constructs (e.g. motivation, self-efficacy, expectations, support, autonomy, capability, personal characteristics and personal beliefs) into the micro-context. Behaviour change (or intervention outcomes) is the result of all these interacting forces.

4. Discussion

The present work aimed to review theories which have been used to explain behaviour change in physical activity in adults without a diagnosis of dementia, to synthesise their constructs, adapt them to dementia and derive a theoretical model which could be further tested for applicability in a sample of people with dementia.

The timeliness of our work stems from the overreliance, reported in the MRC guidance on Process Evaluation (71), on individual-level theorising, with a neglect of holistic perspectives, also weighing in the effects of the context (environment) (within which an intervention operates) on behaviour change (22). In line with this argument, we propose a theoretical model which echoes realist approaches, emphasising that behaviour change is a highly individual response affected by people's subjective views, attitudes, values, beliefs and states, operating within complex and time-bound environmental systems (72). We argue that only by appreciating the dynamic interaction between intrapersonal, interpersonal and environmental forces (operating within a specific moment in time), can behaviour change be achieved.

We also engaged in an effort to synthesise theory because at present, there are no theories (and models) that have been designed to be applicable to people with dementia, targeting behaviour change for physical activity. It follows that thus far, programmes and interventions targeting this population have largely utilised theoretical approaches which have not been validated in the specific context of dementia. In addition, developers of programmes usually select one specific behaviour change model among the many available, which may fail to take into consideration some crucial aspects impinging on behaviour change. For example, the Self Determination Theory does not include the concept of "Intervention / programme characteristics" (e.g. enjoyable) as a relevant factor affecting behaviour, a factor which, instead, is central to the Sports Commitment Model. Similarly, the Sports Commitment Model seems to overlook how different types of motivations (intrinsic vs extrinsic) have different impact on long-term behaviour change, a concept which is central to Self-Determination Theory. We felt there was a need to undertake theory synthesis which would strive for conceptual density across the whole spectrum of existing behaviour change models.

Our work was characterised by some limitations. In our scoping review of the literature, we were not able to retrieve the full-text of five studies. However, through accessing their abstract, we were able to ascertain that they reported on theories which we had already included in the review. We are confident, therefore, that no theoretical model was missed. We did not conduct a formal quality assessment of the sources, potentially leading us to include sources with lower quality standards. However, the aim of the review was merely to derive a list of theoretical models discussed in the literature and not to actively use data form the studies. We believe that this rendered methodological quality less crucial than otherwise. Also, the diversity of our sources made comparisons based on different appraisal tools unreliable.

This study was also characterised by several strengths. The literature review was based on standard reporting systems (e.g. PRISMA), ensuring transparent reporting of findings. Our sources were screened by two independent raters, minimising single researcher bias. The development of the theoretical model was based on the synergetic work of a team made up of academics and professionals from a diverse range of relevant disciplines, including psychiatry, applied psychology, health psychology, geriatrics, sport, physiotherapy, occupational therapy and the social sciences, each contributing their own expertise.

We do not claim that we have derived a model which fully reflects behaviour change in dementia. People with dementia present with unique behaviour, cognition and physical health compared to people without the condition (from which this model was derived), which may result in different mechanisms having an impact on behaviour change or on certain mechanisms having more or less relevance that in a population without dementia. For example, extrinsic motivation (e.g. being encouraged by the carer to do physical activities) may play a more central role in behaviour change in people with dementia compared to adults without the condition, given the increased reliance / dependence on significant others (73).

However, our model was adapted to people with dementia through use of raw empirical data, which ensures a preliminary validation of our constructs. Aware that the PHYT-in-dementia model at this stage may fail to fully capture the mechanisms affecting behaviour change in interventions aimed at promoting physical activity in people with dementia, we acknowledge that it is crucial to empirically test the applicability of our model with a population of people with dementia and refine it based on the results of the testing, if necessary.

We aim to test the congruence of the model within the context of the PrAISED 2 process evaluation[1] (74) in two ways:

[1] The PrAISED 2 process evaluation investigates the individual and environment mechanisms that produced certain outcomes during the main trial. For example, if one participants successfully obtains reduced disability in Activities of Daily Living, the process evaluation may find that at the individual level, the participant was highly motivated and that at the environmental level, there was good access in the community for people with dementia to do physical activity.

1. We will present the model to members of the Patient and Public Involvement (PPI) team of PrAISED 2. This will represent a first opportunity to investigate the relevance and face-validity of the model, by gathering feedback from people who have a lived experience of dementia (either as people with the condition or their carers). Should any additional constructs be identified at this stage, we will integrate them within our existing framework.
2. We will conduct qualitative interview as part of the process evaluation at two points in time during the PrAISED 2 process evaluation. The topic guide for the qualitative interviews will be based on the constructs synthesised through this work. The responses from the participants during the first sets of interviews will determine the accuracy and comprehensiveness of our constructs. If, during the first sets of interviews, any further constructs are identified, we will integrate them within our existing framework, and test the revised model during the second set of interviews.

Once it has been ascertained that the model can accurately explain behaviour change in people with dementia, this work will have implications in clinical practice, constituting a robust theoretical base upon which to tailor programmes / interventions for people with dementia.

Declarations of interest: none

Ethics

The PrAISED 2 trial has received ethical approval number 18/YH/0059. The ISRCTN Registration Number for PrAISED 2 is 15320670.

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All the co-authors have equally contributed to the development of the protocol of this process evaluation and have seen and approved the final version.

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Figure 1. Selection of papers

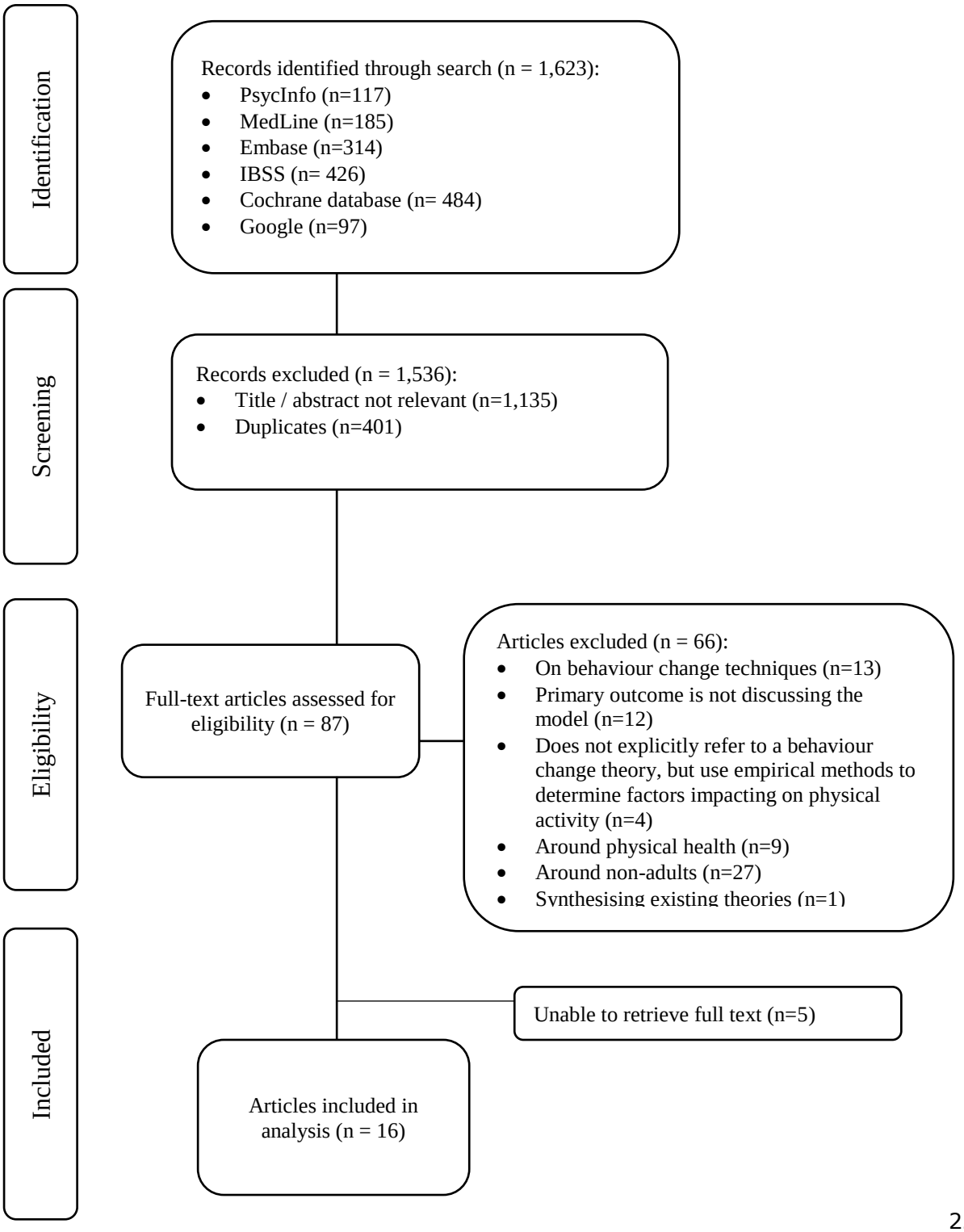


Table 1. Study characteristics

Author(s)	*Year*	*Type of article*	*Theoretical model identified*
Beaton et al.	2008	Literature review	Theory of Planned Behaviour, Health Belief Model, Sport Commitment Model, Stages of change, Schema theory, Psychological Continuum Model
Buchan et al.	2012	Literature review	Stages of change, Self Determination Theory, Social Cognitive Theory, Theory of Planned Behaviour, |Ecological model
Buxton et al.	1996	Empirically validating existing theory	Stages of change
Chatzisarantis et al.	2007	Empirically validating existing theory	Theory of Planned Behaviour
Chatzisarantis et al.	2002	Empirically validating existing theory	Self Determination Theory
Duncan et al.	1995	Theory synthesis and development	Social Cognitive Theory
Dzewaltowski	1994	Discussion of existing theory	Social Cognitive Theory
Edmunds et al.	2008	Empirically validating existing theory	Self Determination Theory
King et al.	2002	Theory synthesis and development	Social-ecologic models
Marcus et al.	1993	Empirically validating existing theory	Stages of change
Marcus et al.	1994	Discussion of existing theory	Stages of change
Marshall et al.	2001	Empirically validating existing theory	Stages of change
Michie et al.	2011	Theory synthesis and development	COM-B system
Scanlan et al.	1993	Theory synthesis and development	Sport commitment model
Spence et al.	2003	Theory synthesis and development	Social-ecologic model
Vallerand et al.	1999	Discussion of existing theory	Self Determination Theory

Table 2. Meta-synthesis of constructs from theories of behaviour change

Main theory	**Sub-theory**	**Main construct of the theory**	**Umbrella construct under which the main construct was categorised**
Stages of Change Model		Consciousness Raising	Personal beliefs
		Dramatic Relief	
		Self-Re-evaluation	
		Environmental Re-evaluation	
		Social Liberation	Support
		Self-Liberation	Personal beliefs
		Helping Relationships	Support
		Counter-Conditioning	Personal beliefs
		Reinforcement Management	Support
		Stimulus Control	
		Decisional balance	Personal beliefs
		Self-efficacy	Self-efficacy
		Temptation	Support
Self-Determination Theory	Organismic Integration Theory	Type of extrinsic motivation	Motivation
	Cognitive Evaluation Theory	Promotion of intrinsic vs. extrinsic motivation/goals	
	Causality Orientation Theory	Locus of control	Autonomy
	Goal Contents Theory	Intrinsic goals	Motivation
		Extrinsic goals	
	Basic Psychological Needs Theory	Autonomy	Autonomy
		Competence	Capability
		Relatedness	Support

Theory of Planned Behaviour		Attitude towards behaviour	Expectations
		Subjective norms	Personal beliefs
		Perceived behavioural control	Self-efficacy
Social Cognitive Theory		Observational learning	Support
		Behavioural Capability	Capability
		Reinforcements	Support
		Self-regulation	Personal input
		Outcome / expectations	Expectations
		Self-efficacy	Self-efficacy
Sport Commitment Model		Enjoyment	Characteristics of the intervention
		Involvement opportunities	Expectations
		Social constraints	Motivation
		Personal investment	Personal beliefs
		Involvement alternatives	Motivation
Health Belief Model		Sociodemographics	Personal characteristics
		Perceived consequences not doing the behaviour	Expectations
		Perceived benefits	Support
		Perceived barriers	Personal beliefs
		Self-efficacy	Self-efficacy
		Reminders / prompts to take actions	Support
Schema Theory		Self-schemata	Self-efficacy
		Schemata	Personal beliefs
Psychological Continuum Theory		Awareness	Motivation
		Attraction	
		Attachment	
		Allegiance	
COM-B system		Capability	Capability
		Motivation	Motivation
		Physical opportunity	Capability

		Social opportunity	Support
		Education	
		Restrictions	
		Persuasion	
		Incentivisation	
		Coercion	
		Training	
		Enablement	
		Modelling	
		Environmental restructuring	
		Restrictions	
Social-ecologic Models		Environmental factors	Support
		Intrapersonal factors	Personal beliefs
		Interpersonal factors	Support
		Physical factors	
		Socio-cultural factors	
		Micro, meso, exo, macro-systems	

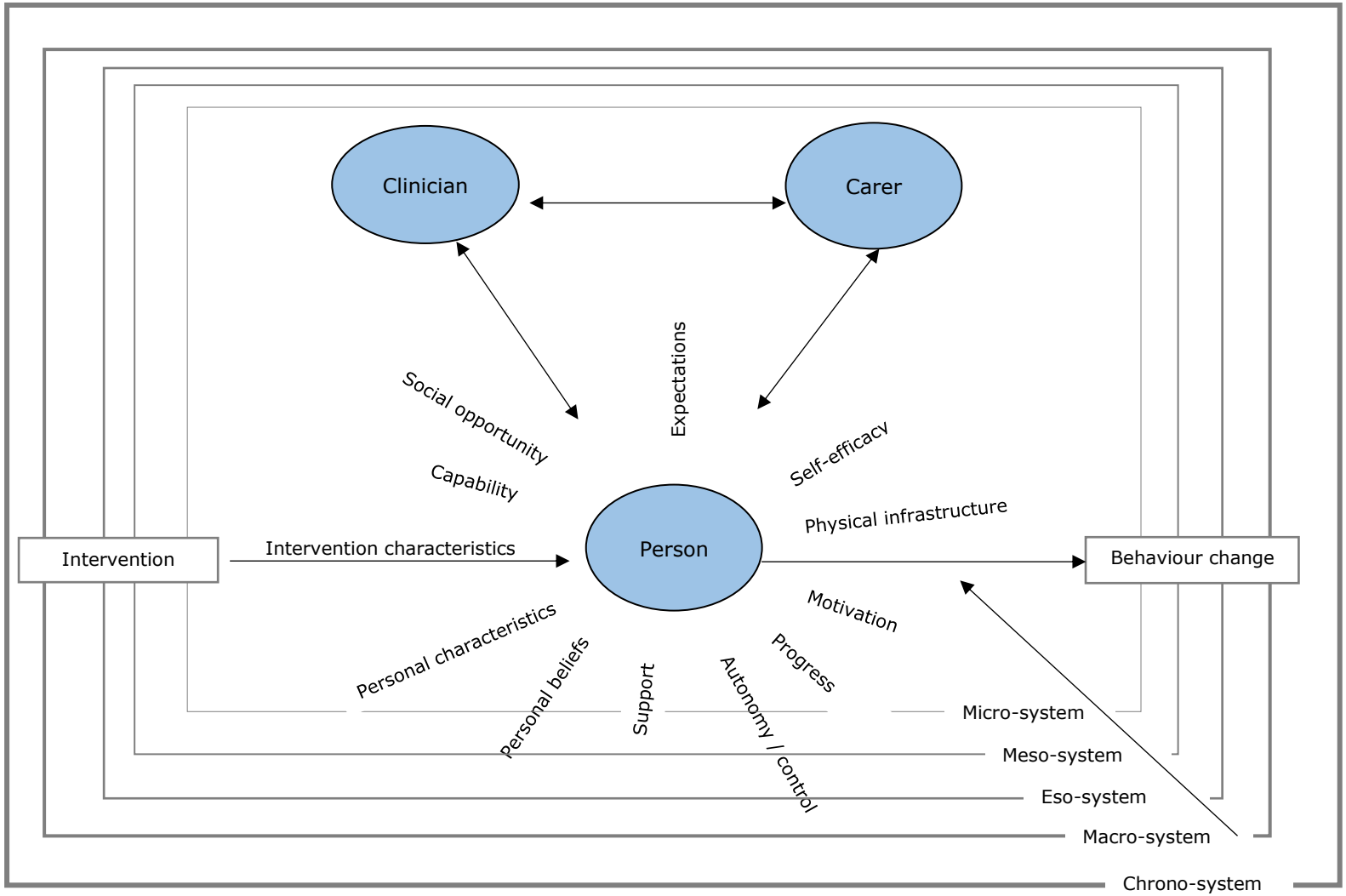
Table 3. Constructs having an impact on behaviour change in physical activity in people with dementia

Construct	*Where it was identified in this study*	*General operational definition*	*How it applies in a programme promoting physical activity in dementia (PrAISED 2)*
Autonomy / control	Scoping review on behaviour change theories in adult populations without dementia	Being causal agents of one's behaviour	Degree of control and independence that participants feel they have over the intervention (development and implementation) and as a result of the intervention
Motivation	Scoping review on behaviour change theories in adult populations without dementia	Processes that energise and direct behaviour	Degree of motivation that participants have during involvement in the programme, what motivates them, and what has a positive/negative impact on their motivation. Dementia-specific factors which may affect motivation and require extra support include loss of confidence, apathy, fatigue, physical and cognitive dterioration
Self-efficacy	Scoping review on behaviour change theories in adult populations without dementia	Confidence in one's ability to execute a given behaviour	How confident the participants feel to carry out the activities of the programme, what makes them confident (or not) and what has an impact on their confidence level. Includes (perceived) physical, cognitive ability and competence, which in turn may cause embarrassment in performing the activity in front of others

Capability	Scoping review on behaviour change theories in adult populations without dementia	One's actual ability to perform a behaviour through essential knowledge and skills	Degree of (actual, as opposed to perceived) ability of participants to carry out the activities of the programme. Includes (actual) physical, cognitive ability and competence
Expectations	Scoping review on behaviour change theories in adult populations without dementia	Outcomes or expectations around the behaviour	Participants' expectations around the programme. Includes goals, benefits, barriers and facilitators
Support	Scoping review on behaviour change theories in adult populations without dementia	(Practical and emotional) support from others (e.g. carer, therapist, society) which affects behaviour	Support in place to help the participant take part in the programme. Includes practical support (e.g. instructions, information, reminders), emotional support (e.g. therapeutic alliance, relatedness, care). Possessing good communication skills is key for supporters. 'Gatekeeping' (i.e. restricting access to physical activity based on carers' or clinicians' views on risk / benefits) might occur with people with dementia
Personal beliefs	Scoping review on behaviour change theories in adult populations without dementia	Beliefs of the person which mediate behaviour	The self-regulated mechanisms that the participant uses in relation to initiation, adherence and withdrawal from the programme (e.g. personal views around dementia, risk and physical activity), and how they change as a result of involvement in the programme. Includes worries and anxieties that might reduce engagement in physical activity

Personal characteristics	Scoping review on behaviour change theories in adult populations without dementia	Personal characteristics which affect behaviour	Personal characteristics of the participant (e.g. personality, mental health, cognition, mobility, medications, identity)
Characteristics of intervention	Scoping review on behaviour change theories in adult populations without dementia	Characteristics of intervention which influence behaviour	Characteristics of intervention which influence participants' involvement in the programme. Includes how much the participant felt it is tailored to their needs, goal, preferences and aspirations, how helpful, enjoyable and challenging it is and how it fits into their routine.
Social opportunity	Thematic analysis of interviews from the feasibility study of PrAISED	Social contacts and networking opportunities (or lack thereof) granted through engaging in the behaviour	Physical activity can provide pleasure and enjoyment derived from a sense of community, relatedness and peer-support
Progress	Thematic analysis of interviews from the feasibility study of PrAISED	Perceived or actual improvement in the person's physical or mental health, following the behaviour	Progress sustains the person's motivation, confidence, sense of purpose and focus to keep active over time, especially when the active intervention is finished.
Physical infrastructure	Thematic analysis of interviews from the feasibility study of PrAISED	Systems in place needed to facilitate engagement in the behaviour	Includes both accessibility (in the home, in the community), practicalities (e.g. distance to venues) and specific tools / strategies that facilitate physical activity (e.g. prompts, reminders, equipment)

Figure 2. Conceptual diagram showing the meta-model



Appendix 1. PRISMA-ScR Checklist and where in the paper each item was addressed

Section		Item	Description	Where it was addressed
Title		1	Identify the report as a scoping review.	Title
Abstract	Structured summary	2	Provide a structured summary that includes (as applicable) background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Abstract
Introduction	Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Pages 3-4
	Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Page 4
Methods	Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	N/A
	Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Pages 4-5
	Information sources	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Page 4
	Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Appendix 1
	Selection of sources of evidence	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Page 5

	Data charting process	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Page 5
	Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Page 5
	Critical appraisal of individual sources of evidence	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	N/A
	Summary measures	13	Not applicable for scoping reviews	N/A
	Synthesis of results	14	Describe the methods of handling and summarizing the data that were charted.	Page 5
	Risk of bias across studies	15	Not applicable for scoping reviews.	N/A
	Additional analyses	16	Not applicable for scoping reviews	N/A
Results	Selection of sources of evidence	17	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Page 6 and Fig. 1
	Characteristics of sources of evidence	18	For each source of evidence, present characteristics for which data were charted and provide the citations.	Pages 6-7

	Critical appraisal within sources of evidence	19	If done, present data on critical appraisal of included sources of evidence (see item 12).	N/A
	Results of individual sources of evidence	20	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Pages 7-11
	Synthesis of results	21	Summarize and/or present the charting results as they relate to the review questions and objectives.	Page 11
	Risk of bias across studies	22	Not applicable for scoping reviews	N/A
	Additional analyses	23	Not applicable for scoping reviews	N/A
Discussion	Summary of evidence	24	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Page 12
	Limitations	25	Discuss the limitations of the scoping review process.	Page 12
	Conclusions	26	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Page 13
Funding		27	Describe sources of funding for the included sources of evidence, as well as sources of funding forthe scoping review. Describe the role of the funders of the scoping review.	Page 13

Appendix 2. Search strategy

1. “behaviour change".ti,ab.
2. "physical activity".ti,ab.
3. "physical exercise".ti,ab.
4. theory.ti,ab.
5. model.ti,ab.
6. "theoretical framework".ti,ab.
7. 2 OR 3
8. 4 OR 5 OR 6
9. 1 AND 7 AND 8