

## **Physical activity interventions for the management of chronic disease in low-income populations: A systematic review**

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### **Abstract**

The objectives of the study were to conduct a systematic literature review examining the specific intervention techniques in an updated taxonomy of behaviour change techniques that were included in successful interventions to change physical activity behaviour in low-income individuals, to assess the relevant behaviour change theories that underpinned the interventions, and to examine the relationship between behaviour change theory and intervention content. The study was a systematic literature review by narrative synthesis examining studies from 1980 to 2014. Data sources for the review included the following electronic databases: Medline, PubMed and Google Scholar. The eligibility criteria for the selected studies included in the review were only randomised controlled trials aimed at increasing physical activity among low-income adults. The outcome measure for the study was physical activity. Eleven studies met the inclusion criteria. 'Provide feedback on performance', 'goal setting (behaviour)', and 'plan social support/social change' were the most frequently used behavioural change techniques. Among the existing theories, the Transtheoretical model of behaviour change and the Social Cognitive theory were the common theoretical frameworks to form the basis of most study interventions. Interventions to increase physical activity in low-income persons had positive effects on changing physical activity behaviour. Policy makers and physical activity practitioners should engage effective and context-sensitive behavioural change techniques and advocate for theoretically grounded interventions in order to increase physical activity behaviour in low-income populations.

### **Introduction**

Chronic diseases of lifestyle are typified by a lengthy incubation period, an extended period of illness, an intricate and poorly understood etiology, and a resilient resistance to remedy (Powell, Carspen, Koplan & Ford, 1989). Low-income populations are at an increased risk of chronic disease (U.S. Department of Health and Human Services, 1996; Centers for Disease Control and Prevention, 2002) and all-cause mortality (Lantz, House, Lepkowski, Williams, Mero & Chen, 1998). This is more likely so, because this population has been reported to be more likely to smoke (Scottish Government, 2008), lead a sedentary lifestyle (Stamatakis, 2006), and consume a poor diet (Drewnowski & Spector, 2004) compared to populations of higher socioeconomic status.

The health benefits of regular physical activity (PA) are well documented in the literature (Lee & Paffenbarger, 2000; Kokkinos & Myers, 2010; Jones, Hawkins, Mullin, Nepusz, Naughton, Sheraan et al., 2012). Habitual PA reduces the risk of chronic disease, and has been closely linked with a reduced risk of cardiovascular disease (United States Department of Health Services, 2008), decreased coronary events (Manson et al., 1999), disease control in persons with type 2- diabetes mellitus and insulin insensitivity (Wareham, Wong & Day, 2000; Mayer-Davis et al., 1998), mental, physical health benefits (United States Department of Health and Human Services, 1996), an enhanced quality of life (Pate, Pratt, Blair, Haskell, Macera, Bouchard et al., 1995) and an extended lifespan (Lissner et al., 1996; Lee & Paffenbarger, 2000). Given the foregoing, it is crucial that effective techniques and a sound theoretical base be identified for PA interventions. This is particularly so for low-income populations, because it has been reported that the lower one is on the income spectrum, the higher the likelihood of disease and early death (National Center for Health Statistics, 2012).

People from low-income communities are burdened by unhealthy behaviours that are detrimental to their health (Pampel, Krueger & Denney, 2010). Low-income neighbourhoods have fewer PA resources i.e., fewer parks, green spaces, bike paths and recreational facilities, making it difficult for the inhabitants to lead physically active lifestyles (Estabrooks, Wallin & Milner, 2003). Understandably, limited access to such resources will result in less PA and consequently, lead to such communities suffering from poorer health outcomes, such as obesity and heart disease (Gordon-Larsen, Nelson, Page & Popkin, 2006; Pampel et al., 2010).

Research that analyses the effectiveness of behaviour change interventions across different societal settings and populations is scarce (Michie, Jochelson, Markham & Bridle, 2009). Specifically, a paucity of data has been reported on the effectiveness of health promotion interventions in low-income and socially excluded persons (Michie et al., 2009). Albarracin, Gillette, Earl, Glasman, Durantini and Ho (2005) further note that the effects of health behaviour change interventions are dependent on gender, age, ethnicity and other population-specific factors. The implications are that standard interventions cannot be applied across populations with the assurance that they will be effective implicitly.

Given that most low-income populations are sedentary (Shelton, McNeill, Puleo, Wolin, Emmons & Bennet, 2011), and that among other health related behaviours, PA behaviour has been recommended as a mediator of the link between social position and health outcomes (Whitley, Batty, Hunt, Popham & Benzeval, 2014), PA interventions for low-income populations can be a major means of reducing health disparities. Therefore, this review analyses the intervention techniques and the theoretical basis of the interventions that are aimed at increasing PA participation amongst low-income populations.

Specifically, the review aims to assess:

- (a) the specific intervention techniques in an updated taxonomy of behavior change techniques (Michie, Ashford, Sniehotta, Dombrowski, Bishop & French, 2011) that were found to be successful in changing PA behaviour.
- (b) the relevant behaviour change theories used to develop the intervention content.

## **Methodology**

Electronic databases (Medline, PubMed and Google Scholar) were searched for publications from January 1980 to April 2014. Searches were conducted in 2014 and the eligibility of each study was determined by the authors. The databases were searched using the following search terms: chronic conditions, chronic diseases, low socioeconomic status, resource-poor, low-income, PA, PA interventions, exercise and training. Abstracts were double-checked against the inclusion criteria and, where necessary, the full text was retrieved. Three experts in the field of PA and health were also e-mailed for possible studies to include in the review. Manual searches were conducted on bibliographies of published systematic reviews obtained from the search strategy. Where the individual authors were unsure about the suitability of certain studies, the final decision regarding inclusion or exclusion of the study was resolved by joint discussion and consensus among the authors collectively. The PEDro scale was used by the reviewers to assess the methodological quality of the included studies. The scale is based on the Delphi consensus list: a criteria list for quality assessment of randomized controlled studies (RCTs) for conducting systematic reviews developed by the Delphi consensus (Verhagen, de Vet, de Bie, Kessels, Boers, Bouter et al., 1998). The scale has been found reliable to serve this purpose (Maher, Sherrington, Herbert, Moseley & Elkins, 2003). Studies that did not reach a cut-off of five points were excluded from subsequent analysis. Table 1 shows the results of the included studies after being critically appraised using the PEDro scale.

**Table 1:** Results of the PEDro rating after critical appraisal.

Study	1	2	3	4	5	6	7	8	9	10	11	Total
Lowther et al. (2002)		✓		✓			✓	✓	✓	✓	✓	7
Albright et al. (2005)	✓	✓		✓				✓	✓	✓	✓	6
Emmons et al. (2005)	✓	✓		✓				✓	✓	✓	✓	6
Webel et al. (2013)	✓	✓		✓				✓	✓	✓	✓	6
Hovell et al. (2008)	✓	✓	✓	✓			✓	✓	✓	✓	✓	8
Whitehead et al. (2007)		✓		✓				✓	✓	✓	✓	6
Pekmezi et al. (2009a)	✓	✓	✓	✓			✓	✓	✓	✓	✓	8
Pekmezi et al. (2009b)	✓	✓		✓				✓	✓	✓	✓	6
Marcus et al. (2013)	✓	✓		✓			✓	✓	✓	✓	✓	7
Dutton et al. (2007)	✓	✓		✓				✓	✓	✓	✓	6
Keyserling et al. (2008)	✓	✓	✓	✓		✓		✓	✓	✓	✓	8

The inclusion criteria for this study were:

1. Population: adults (18+ years), males and females, clinical and non-clinical, from a low-income community.
2. Interventions: any interventions promoting PA or adherence for the management of chronic disease.
3. Outcome: increased PA or adherence for the management of chronic diseases.
4. Language: English only.
5. Methodological criteria: Only RCTs and cluster RCTs.
6. Studies with a rating of 5 points or more on the PEDro scale. Studies with a rating of 5 points or more on the PEDro scale.

### ***Exclusion criteria:***

1. Reviews were excluded.
2. Interventions that did not explicitly state that the intervention purpose was to initiate, increase, or maintain PA adherence for the management of chronic conditions.
3. Interventions not focusing on low-income/ low socioeconomic populations.

### ***Data extraction***

The first author (SZM) coded the intervention content using a taxonomy of behaviour change techniques that was found reliable for coding behaviour change techniques in intervention trials (Michie et al., 2011). After the initial coding, the second author (LLL) then looked for any discrepancies and checked for accuracy. When interventions targeted any other behaviour other than physical activity, only the techniques and results for the PA intervention were recorded.

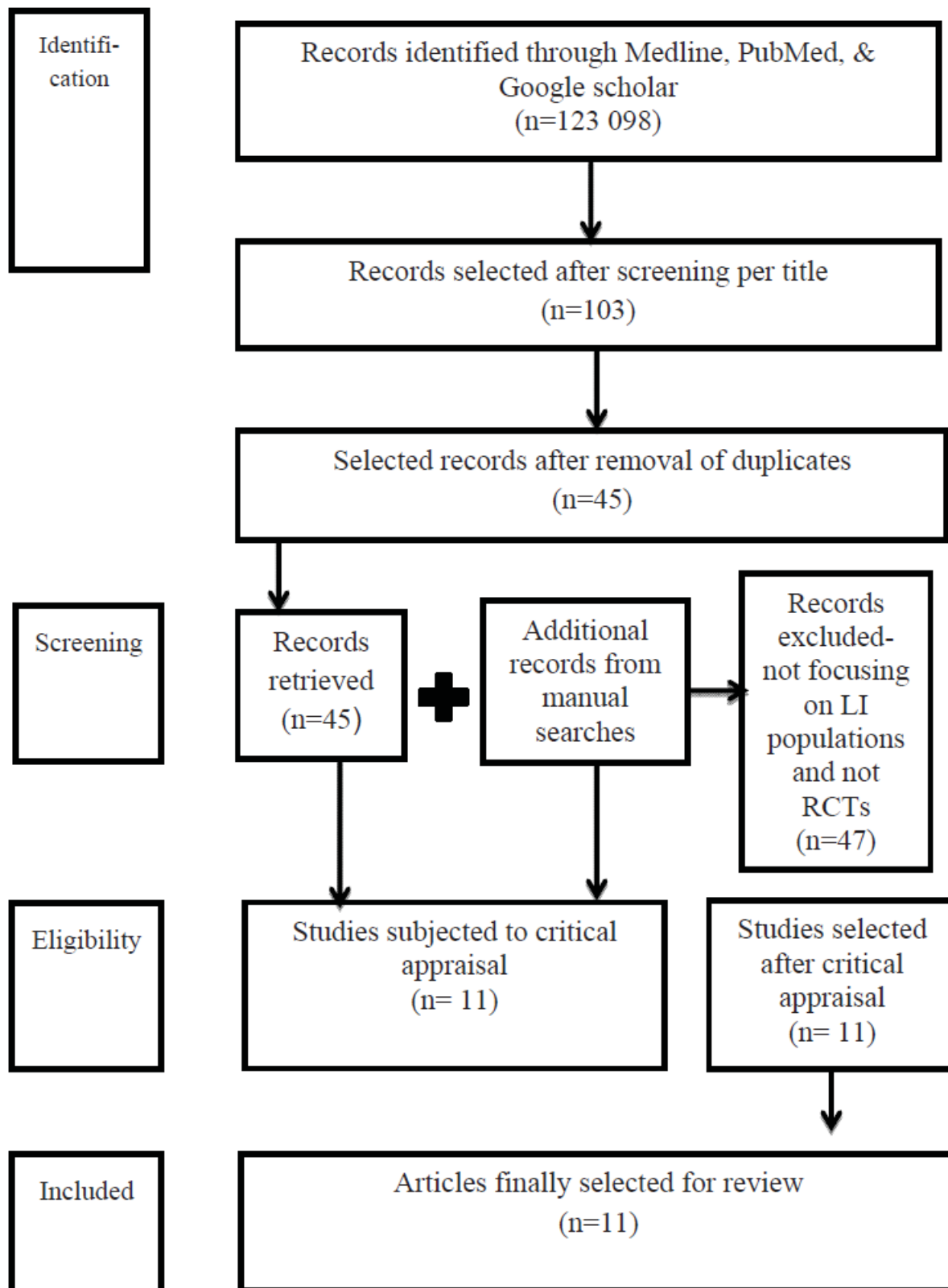
### ***Data analysis***

This systematic review employed a narrative synthesis in analysing the selected studies. The studies were described according to the country in which they were conducted, the behavioural change techniques employed in the interventions, the behaviour change theories underpinning the study, intervention content, sample size of the study, low-income descriptor, delivery mode, study context, follow-up, outcome of the intervention, mode of PA assessment and the general effect of the intervention. Behavioural change theories were identified if the study explicitly stated the theory underpinning the study. The results were described to reveal the behavioural change techniques employed in the studies and the frequency of their use.

### **Results**

Figure 1, shows the flowchart of studies included in the review. Nine of the eleven studies had strong fundamental theories that underpinned the substance of the interventions. The theoretical framing of the interventions by Keyserling et al. (2008) and Lowther et al. (2002) was not clear. In terms of examining the association between theory and intervention content, a strong connection between theory and intervention content was evident, especially in studies that employed the Transtheoretical model of change (TTM) and the Social Cognitive theory (SCT).

Table 2 shows the underpinning theoretical framework and the corresponding study. A variety of techniques were employed as interventions in each of the studies. The number of techniques employed across the studies ranged from 5 to 12. Table 3 shows the frequency of use of each technique in the 11 studies.



**Figure 1:** Flowchart of studies included in the review (LI= low-income)

## Discussion

The present review aimed to assess the specific intervention techniques included in carefully selected studies that strived to change PA behaviour in low-income populations. In addition, the review also sought to assess the theories used to develop the interventions and examine the association between theory and intervention content. The review identified 11 studies mainly containing PA interventions, with only two studies (Emmons et al., 2005; Keyserling et al., 2008) focusing on both PA and dietary interventions. Studies employed a variety of methods to recruit and engage low-income participants. As in the Bull et al. (2014) review, most studies were conducted in the USA.

‘Providing feedback on performance’, ‘Goal setting’ (behaviour), and ‘Plan social support/social change’ were the most frequent techniques that were employed in the interventions. In their behaviour change taxonomy, Michie et al. (2011) describe ‘providing feedback on performance’ as a technique that involves providing the participant with information regarding their own recorded behaviour or commenting on a participant’s behavioural performance and a set goal, or a discrepancy between one’s own performance in relation to others’. For example, Dutton et al. (2007) used this technique when they reviewed the current PA habits of each participant based on their last visit. The results of the review were used to guide the participant’s future progress and to set individualised goals. Giving feedback on performance gives the participant a platform to reflect on, that will ultimately determine the future direction of their actions pertaining to the behaviour in question (Bandura, 1971). As such, this technique reinforces targeted behaviour (e.g., increasing PA or adhering to PA) and in line with Bandura’s Social Learning theory, causes participants to develop thoughts or hypotheses about the types of behaviours most likely to succeed. Consequently, when participants are given feedback about their performance, it serves as an unarticulated way of informing them about what they must do, so that they gain beneficial outcomes from indulging in the behaviour in question (Bandura, 1971).

Michie et al. (2011) have described ‘Goal setting’ (behaviour) as a technique in which the participant is encouraged to make a behavioural resolution (e.g., to exercise more in the following week). An example is the strategy employed by Keyserling et al. (2008). The authors stated that, during the first counselling session, the counsellor and the participant developed an action plan and, then, they negotiated two to three specific PA goals. A goal is “what an individual is trying to accomplish; it is the object or aim of an action” (Locke, Shaw, Saari & Latham, 1981: 126). Collaborative goal-setting for behaviour change has been viewed as a process by which the caregiver and patient agree on a health-related goal (Bodenheimer & Handley, 2009). This particular behavioural change technique affects the participant’s performance by directing a participant’s attention towards goal-relevant activities, energising participants to perform better and with greater

persistence leading to the building of skills on how to achieve the goals (Locke & Latham, 2002).

Michie et al. (2011) have described 'Plan social support/change' as a technique that involves prompting the participant to plan how to elicit social support from other people to help him/her achieve their target behaviour or outcome. In their intervention group, Marcus, Dunsinger, Pekmezi, Larsen, Bock, Gans et al. (2013) emphasised the use of social support as a strategy for increasing PA. The role of social support has been found to be positively related to the level of PA participation (Sharma, Sargent & Stacey, 2005; Asare & Sharma, 2010). For example, Sharma et al. (2005) reported that social support from friends was a significant predictor for PA among African American women. Social support in community settings is an example of a behavioural change technique that exploits social networks to reinforce PA behaviour (Heath, Parra, Sarmiento, Andersen, Owen, Goenka et al., 2012). Strategies for utilising this technique include the creation of buddy systems, behavioural contracts between the participant and programme leaders, and the formation of walking or other PA support groups (Lin, O'Connor, Whitlock & Beil, 2010).

There has been growing awareness of the need for theory-driven research in the process of health behaviour change (Sparling, Owen, Lambert & Haskell, 2000). Consequently, a number of articles have focused on the need to use theory to inform behaviour change programmes (Glanz & Bishop, 2010; Painter, Borba, Hynes, Mays & Glanz, 2008). Glanz, Burke and Rimer (2011) have further stated that health behaviour theories offer a number of benefits which can be viewed as: tools for moving beyond intuition to designing and evaluating health interventions that are founded on an understanding of why people engage in certain health behaviour; a basis for programme planning and development that is consistent with the current emphasis on using evidence-based interventions; a road map for studying problems, developing appropriate interventions, identifying indicators and evaluating impacts; a guide to help explain the processes for changing health behaviour and the influences of the many forces that affect it; and a compass to assist planners identify the most suitable target audiences, methods for fostering change and outcomes for evaluation.

The findings of the present review revealed that the SCT and the TTM were the most commonly employed theoretical foundations to inform interventions. The SCT is one of the most extensively applied theories to health promotion (Sparling et al. 2000). It is based on the principle of reciprocal determinism which refers to the way behaviour and the environment continuously interact and influence each other. The theory holds that two basic cognitions are vital for the prediction of a behaviour change. Outcome expectancy, the first cognition, is defined as a person's assumption that a given behaviour will lead to certain outcomes (e.g., 'if I exercise, I will lose weight'). Self-efficacy, the second



cognition, is a conviction that one can successfully execute the required behaviour to produce a desired outcome (e.g., 'I 'am capable of exercising to the extent that I will lose weight').

The TTM, on the other hand, describes five different stages of motivational readiness which appear to be common to most behaviour change processes (i.e., precontemplation, contemplation, preparation, action and maintenance) (Sparling et al., 2000). A major contribution of this model is that people in different stages are shown to use different processes to move to the next stage (Sparling et al., 2000). In line with the principles of the TTM, Albright et al. (2005) made use of interactive teaching techniques and behavioural principles to teach participants how to become more active by moving them from the contemplation stage to preparation into the action stage of motivational readiness. The researchers also employed brief structured counselling conducted via telephone and mail, and used theoretically grounded counselling strategies to match the participant's current stage of change.

In terms of the association between theory and intervention content, a clear link was evident in most studies. Whitehead et al. (2007) used the TTM and made use of stage-targeted, exercise promotion material specific to precontemplation, contemplation, preparation and action/maintenance. In Albright et al's. (2005) study, where the TTM was also employed, the use of behavioural skill-building classes was meant for informing and motivating participants to be physically active. Use of the SCT was also evident in the study by Emmons et al. (2005). The intervention employed a socio-contextual approach that targeted multiple levels of influence on behaviours, with special emphasis to low literacy skills. The researchers used intervention materials that included strategies, images, messages and vocabulary that were inclusive and non-stereotyping for the participants, as well as specific tactics to reach participants with limited literary skills (e.g., plain language, simple graphics, and stories). The researchers also provided participants with a tailored prescription for the recommended health behaviour changes. Project messages also explicitly acknowledged that health behaviour is influenced by context. Their intervention also encouraged the establishment of social support networks. All of these strategies are linked to the SCT.

The study by Webel et al. (2013), the only study that targeted participants with HIV/AIDS, also clearly showed a link between intervention content and theoretical framework. The study employed the Socioecological Model to develop the intervention. The Socioecological Model is grounded on findings that a single cause for health behaviours is unlikely. Instead, processes that lead to these behaviours include combinations of factors at numerous environmental levels (Webel et al., 2013). As such, socioecological factors at the individual, interpersonal and environmental levels of one's ecosystem are of significance

when attempting to change self-management behaviours (Webel et al., 2013). Thus, the intervention designed by Webel et al. (2013) used structured sessions to make small changes at the individual, interpersonal and environmental levels which could be self-monitored and incorporated into the daily routines of the participant. Table 2 shows examples of how intervention content was matched to the theoretical framework of some of the studies.

**Table 2:** Studies with underpinning theoretical framework and associated strategy

Study	Underpinning Theoretical Framework	Example of strategy employed
Whitehead et al. (2007)	TTM	Use of stage-targeted, exercise promotion material specific to precontemplation, contemplation, preparation and action/maintenance.
Albright et al. (2005)	TTM	Use of interactive teaching and behavioural principles to educate the participants on how to become active by moving them from the contemplation stage to preparation into action.
Emmons et al. (2005)	SCT	Use of project messages that emphasised that health behaviour is influenced by context.
Webel et al. (2013)	Socioecological Model	Used structured sessions to make small changes at the individual, interpersonal and environmental levels.
Hovell et al. (2008)	Operant Learning Theory	Use of aerobic exercises amounting to 390-minute sessions/week for 6 months coupled with individualised feedback and “hands-on” exercise education.
Marcus et al. (2013)	TTM and SCT	Use of behavioural strategies for increasing PA e.g., social support.
Dutton et al. (2007)	TTM and SCT	Use of components from SCT and TTM including self-efficacy, motivational readiness, decisional balance and social support.
Pekmezi et al. (2009b)	TTM and SCT	Emphasis on behavioural strategies for increasing PA and social support and use of PA manuals matched to the participant’s current level of motivational readiness.

### ***Key contributions of the study***

The review has identified successful behavioural change techniques that can be implemented to promote PA in low-income populations. The review also managed to affirm the theoretical foundations that underpin the behavioural intervention techniques

for the promotion of PA in low-income communities. It also revealed that there is a scarcity of RCT studies that aim to promote PA among low-income persons. Most importantly, the review showed that there was no RCT study set in the African continent that was aimed at increasing PA for the management of chronic conditions in low-income communities.

### ***Recommendations for future Research***

More research focusing on the promotion of PA among low-income persons must be conducted, especially in an African setting. Studies must also start focusing on the employment of PA to manage various chronic conditions, such as diabetes, obesity, heart disease, etc., but especially debilitating conditions, such as HIV/AIDS, that appear to be endemic to low-income communities.

PA presents a cheap, non-pharmacological approach to the treatment and management of chronic conditions that might lessen the financial burden common to health systems in low-income communities. RCTs meant to promote PA participation in low-income communities must also be specific in terms of the underpinning theoretical framework and how it is used to inform the intervention and impact the different outcome variables. Studies conducted within the African setting should make use of both the SCT and the TTM as their reference frameworks. Of particular importance is the identification of context-sensitive behavioural change techniques that are applicable in economically deprived communities. South African researchers in particular, should aim at using the SCT and the TTM, together with the associated behavioural change techniques, to develop context-sensitive PA interventions to manage HIV/AIDS, a pandemic which is very prevalent in the country. Researchers are also encouraged to specify the stage at which specific intervention techniques are used when implementing a PA intervention.

### **Conclusion**

Providing feedback on performance, goal setting (behaviour) and planning social support/social change are the most frequently used behaviour change techniques to increase PA amongst individuals of low-income socioeconomic status. Other behavioural techniques that were identified as successful interventions were prompting self-monitoring of behavioural outcomes, providing information about where and when to perform the behaviour, using follow-up prompts, barrier identification/problem solving, prompt review of behavioural goals, prompt self-monitoring of behaviour, action planning, providing rewards contingent on successful behaviour, providing instruction on how to perform the behaviour, relapse prevention/coping planning, motivational interviewing, prompt reviewing of outcome goals, providing information on the consequences of behaviour to the individual, setting graded tasks, environmental structuring, model/demonstrate behaviour, providing information on the consequences of behaviour

in general, facilitating social comparison, teaching use of prompts/cues and time management. The SCT and the TTM are effective and the most frequently employed theoretical frameworks for informing PA interventions in low-income communities. A clear link between theoretical framework and intervention content is evident in most PA interventions for low-income persons. Therefore, there is a potential for researchers to employ these techniques and theories to inform interventions that aim to promote PA for the management of chronic conditions. This is especially so for chronic illnesses, such as HIV/AIDS, that is already an economic burden to African health systems. Policy makers and PA practitioners should advocate for theoretically grounded interventions with effective techniques to increase PA behaviour in low-income populations.

**Table 3:** Frequency of the use of behavioural change techniques in the 11 studies.

Technique	Frequency	Study
Provide feedback on performance	8	Keyserling et al. (2008); Albright et al. (2005); Webel et al. (2013); Hovell et al. (2008); Whitehead et al. (2007); Pekmezi et al. (2009b); Marcus et al. (2013); Dutton et al. (2007).
Goal setting (behaviour)	7	Keyserling et al. (2008); Albright et al. (2005); Webel et al. (2013); Whitehead et al. (2007); Pekmezi et al. (2009a); Pekmezi et al. (2009b); Marcus et al. (2013).
Plan social support/social change	7	Keyserling et al. (2008); Albright et al. (2005); Emmons et al. (2005); Pekmezi et al. (2009a); Pekmezi et al. (2009b); Marcus et al. (2013); Dutton et al. (2007).
Prompt self-monitoring of behavioural outcomes	6	Keyserling et al. (2008); Albright et al. (2005); Webel et al. (2013); Pekmezi et al. (2009a); Pekmezi et al. (2009b); Marcus et al. (2013).
Provide information on where and when to perform the behaviour.	5	Keyserling et al. (2008); Albright et al. (2005); Emmons et al. (2005); Pekmezi et al. (2009a); Dutton et al. (2007).
Use of follow-up prompts	5	Keyserling et al. 2008; Pekmezi et al. (2009a); Whitehead et al. (2007); Pekmezi et al. 2009(b); Marcus et al. (2013).
Barrier identification/Problem solving	4	Keyserling et al. (2008); Albright et al. (2005); Webel et al. (2013); Dutton et al. (2007).
Prompt review of behavioural goals.	4	Albright et al. (2005); Webel et al. 2013; Whitehead et al. (2007); Dutton et al. (2007).
Prompt self-monitoring of behaviour	4	Pekmezi et al. (2009a); Pekmezi et al. (2009b); Marcus et al. (2013); Dutton et al. (2007).
Action planning	4	Keyserling et al. (2008); Emmons et al. (2005); Webel et al. (2013); Dutton et al. (2007).
Provide rewards contingent on successful	4	Hovell et al. (2008); Pekmezi et al.

Technique	Frequency	Study
behaviour		(2009a); Pekmezi et al. (2009b); Marcus et al. (2013).
Provide instruction on how to perform the behaviour.	4	Keyserling et al. 2008; Pekmezi et al. (2009b); Hovell et al. (2008); Marcus et al. (2013).
Relapse prevention/coping planning.	3	Albright et al. 2005; Whitehead et al. (2007); Pekmezi et al. (2009a).
Motivational interviewing	3	Emmons et al. (2005); Pekmezi et al. 2009(a); Dutton et al. (2007).
Prompt review of outcome goals	3	Webel et al. (2013); Whitehead et al. (2007); Dutton et al. (2007).
Provide information on the consequences of behavior to the individual.	2	Albright et al. (2005); Emmons et al. (2005).
Set graded tasks	2	Keyserling et al. (2008); Albright et al. (2005).
Environmental structuring	2	Webel et al (2013); Dutton et al. (2007).
Model/Demonstrate behaviour	2	Keyserling et al. (2008); Hovell et al. (2008).
Provide normative information about others behaviour.	2	Pekmezi et al. (2009a); Marcus et al. (2013).
Provide information on the consequences of behaviour in general.	1	Albright et al. (2005).
Facilitate social comparison.	1	Albright et al. (2005).
Teach use of prompts/cues	1	Webel et al. (2013).
Time management	1	Hovell et al. (2008).

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