Social Science & Medicine 192 (2017) 125–133

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Review article

Effectiveness of physical activity interventions in achieving behaviour change maintenance in young and middle aged adults: A systematic review and meta-analysis☆

Jennifer M. Murray [a, *], Sarah F. Brennan [a], David P. French [b], Christopher C. Patterson [a], Frank Kee [a], Ruth F. Hunter [a, **]

[a] UKCRC Centre of Excellence for Public Health/Centre for Public Health Queen's University Belfast, School of Medicine, Dentistry and Biomedical Sciences, Institute of Clinical Science B, Royal Victoria Hospital, Grosvenor Road, Belfast, BT 12 6BJ, UK
[b] Manchester Centre of Health Psychology, School of Health Sciences, University of Manchester, UK

ARTICLE INFO

Article history:
Received 25 October 2016
Received in revised form
31 August 2017
Accepted 14 September 2017
Available online 19 September 2017

Keywords:
Physical activity
Maintenance
Systematic review
Meta-analysis
Behaviour change
Public health

ABSTRACT

Background: Physical activity (PA) interventions are generally effective in supporting short-term behaviour change, but increases are not always maintained. This review examined the effectiveness of PA interventions for behaviour change maintenance in young and middle–aged adults, and investigated which Behaviour Change Techniques (BCTs) and other intervention features were associated with maintenance.

Methods: Six databases (Medline, EMBASE, PsycINFO, Cochrane Database of Systematic Reviews, CINAHL, Web of Science) were systematically searched. Eligibility criteria were controlled trials investigating the effectiveness of PA interventions with adult (mean age 18–64 years) non-clinical populations using validated measures of PA behaviour at baseline and ≥six months' post-baseline. Results were pooled in meta-analyses using standardised mean differences (SMD) at five time intervals (6–9, 9–15, 15–21, 21–24, >24 months). Moderator analyses investigated the influence of sample and intervention characteristics on PA maintenance at 6–9 months.

Results: Sixty-two studies were included. PA interventions had a significant effect on behaviour maintenance 6–15 months post-baseline relative to controls. Interventions had a larger effect on maintenance at 6–9 months (SMD = 0.28; 95% *CI*: 0.20, 0.35; I^2 = 73%) compared to 9–15 months (SMD = 0.20; 95% *CI*: 0.13, 0.26; I^2 = 70%). Beyond 15 months, PA measurements were infrequent with little evidence supporting maintenance. Moderator analyses showed some BCTs and intervention settings moderated PA outcomes at 6–9 months. A multivariable meta-regression model showed interventions using the BCTs 'Prompt self-monitoring of behavioural outcome' (b = 1.46, p < 0.01) and 'Use of follow-up prompts' (b = 0.38, p < 0.01) demonstrated greater effectiveness at promoting PA maintenance at 6–9 months. Interventions implemented in primary care (versus community or workplace/university) settings (b = −0.13, p = 0.10) tended to demonstrate less effectiveness.

Conclusions: This review provides evidence of some effective BCTs for maintaining behaviour to 15 months. Greater consideration must be given to how future interventions encourage and measure maintenance of changes, and investigate broader psychological, social and environmental influences of PA behaviour.

PROSPERO registration: PROSPERO 2015:CRD42015025462.

☆ JM is supported by a PhD studentship funded by the Department for the Economy (DfE). RH is supported by a Career Development Fellowship from the National Institute of Health Research (NIHR) and acknowledges funding support from the HSC Research and Development Division.

* Corresponding author.
** Corresponding author.
E-mail addresses: jmurray39@qub.ac.uk (J.M. Murray), sbrennan19@qub.ac.uk (S.F. Brennan), david.french@manchester.ac.uk (D.P. French), c.patterson@qub.ac.uk (C.C. Patterson), f.kee@qub.ac.uk (F. Kee), ruth.hunter@qub.ac.uk (R.F. Hunter).

https://doi.org/10.1016/j.socscimed.2017.09.021
0277-9536/

1. Introduction

Current World Health Organization (WHO) guidelines recommend that adults aged 18–64 years should perform at least 150 minutes of moderate-intensity aerobic physical activity (PA), at least 75 min of vigorous-intensity aerobic PA, or an equivalent combination of moderate-vigorous intensity physical activity (MVPA) weekly for maintained health (World Health Organization, 2010). Approximately 6–10% of global mortality associated with non-communicable diseases (NCDs) is due to physical inactivity (Lee et al., 2012), making it the fourth principal risk factor for death (Kohl et al., 2012). However, encouraging regular PA initiation (i.e. taking up regular PA within six months) and maintenance (i.e. continuing to undertake regular PA longer than six months) is a challenge.

Previous PA interventions have shown modest effects on initiation of PA (Conn et al., 2011; Foster et al., 2005), and reviews have highlighted a lack of reporting of maintenance outcomes (Foster et al., 2013, 2005). A Cochrane review investigating the effectiveness of interventions for promoting PA in adults aged ≥16 years found that only six out of 19 included studies reported PA outcomes after six months, none of which found improvement in PA for intervention groups relative to controls (Foster et al., 2005). A more recent review examining the effectiveness of web-based PA interventions on long-term PA behaviour among adults reported a small effect at 12 months (9 studies; standardised mean difference (SMD) = 0.20, 95% *CI*: 0.11, 0.28) and 24 months (1 study; SMD = 0.19, 95% *CI*: 0.08, 0.32) compared to controls (Foster et al., 2013). Another review of PA interventions delivered face-to-face showed similar effectiveness on PA behaviours at 12 months (8 studies; SMD = 0.19, 95% *CI*: 0.06, 0.31) compared to controls, which was not maintained at 24 months (Richards et al., 2013). Unfortunately, most studies included in this last review failed to measure the long-term (i.e. >12 months) effects on PA (only 3 studies reported PA outcomes >12 months).

Investigation of PA maintenance is hindered by several unresolved conceptual issues. One of the most problematic is that researchers use different definitions of maintenance. Some define it in terms of a timeframe over which the new behaviour is carried out, typically 3–6 months after intervention completion (Fjeldsoe et al., 2011; Prochaska and DiClemente, 1982), while others conceptualise it in terms of achieving behavioural automaticity (i.e. when it is efficiently and effortlessly carried out) (Rothman, 2000). Kwasnicka et al. (2016) suggest maintenance is achieved when the new behaviour becomes the 'dominant response' (i.e. has the highest probability of being enacted across times and contexts). In terms of behaviour change theories, the Transtheoretical Model (TTM) defines the individual as being in the maintenance stage after being sufficiently active for six months (Prochaska and DiClemente, 1982).

To address these issues, Fjeldsoe et al. (2011) adopted a two-fold definition of maintenance in their review of the effectiveness of PA and dietary interventions for behaviour change maintenance among adults. With this definition, behaviour change maintenance was achieved when a significant intervention effect was reported (i.e. any increase in PA for the intervention compared to control group) at end of-intervention *as well as* at follow-up (i.e. three months post-intervention). However, the authors noted that this may have been restrictive with respect to longer-term community-based interventions with ongoing contact. This definition also restricts inclusion of studies with no defined end period, (e.g., altering the built environment). Furthermore, applying a threshold-based maintenance criterion is complicated by heterogeneity of outcomes and measurement tools across studies, and infrequent reporting of the magnitude of behaviour change between post-intervention and follow-up (Fjeldsoe et al., 2011). Evidently, there are many complexities inherent in conceptualising behaviour change maintenance and researchers have diverse opinions as to how it should be defined.

This lack of consensus has impeded our understanding of what interventions are most effective for behaviour change maintenance (Ory et al., 2010). The present review adopts the operational definition of maintenance as any positive and significant intervention effect at least six months post-baseline (with no restriction on intervention duration) in line with the TTM. This is also consistent with the argument that individuals who maintain an increase in PA for six months are usually viewed as successful maintainers (Marcus et al., 2000). Further, research shows that the highest likelihood for relapse occurs within six months of starting an exercise program (Dishman, 1994). Physical activity interventions involving inactive participants usually aim to achieve any increase in PA rather than solely focusing on increasing PA to a target level (Conn et al., 2011). Indeed, current PA guidelines acknowledge that getting some PA is better than none (Office of Disease Prevention and Health Promotion, 2017). Given the lack of consensus in defining PA maintenance, we also examined an alternative definition (i.e., requiring a significant post-intervention effect on PA behaviour with PA outcomes measured again at least six months after the intervention-end), which is consistent with how intervention studies typically operationalise maintenance (Marcus et al., 2000).

There are also weaknesses in the theoretical developments in understanding maintenance. In particular, there is limited evidence regarding which theories best support behaviour change maintenance and whether they differ from those supporting PA initiation (Kwasnicka et al., 2016; Nigg et al., 2008; Rothman, 2000). A comprehensive review of 83 behaviour change theories reported that the most popular theories (e.g., TTM, Social Cognitive Theory (SCT)) rely on a static structure, rarely accounting for behavioural changes over time (Michie et al., 2014). More recent studies have compared theoretically-derived predictors of maintenance (Kassavou et al., 2014) and there is increasing evidence to support Rothman's hypothesis that the determinants of initiation and maintenance differ for a range of health behaviours, including PA (McAuley and Blissmer, 2000; Rothman, 2000). For example, Nigg et al. (2008) highlight that the correlates of PA initiation versus maintenance differ in terms of the focus of fundamental psychological variables (and temporal associations), and the inclusion of factors that impede PA. The Health Action Process Approach defines a phase-specific model of causality, separating the concept of self-efficacy according to the individual's phase (i.e., motivation or action) of behaviour (Schwarzer, 1992). Physical Activity Maintenance Theory considers the impact of life stress in terms of re-directing personal resources away from focusing on PA, and increasing negative affect (Nigg et al., 2008).

One way to understand differences in the effectiveness of PA interventions for initiation and maintenance of behaviour is to examine the Behaviour Change Techniques (BCTs) employed. BCTs have been defined as the irreducible components or 'active ingredients' of interventions, designed to redirect the process of behaviour (Michie et al., 2013). Recent reviews examining whether BCTs, and other intervention features, are associated with increased effectiveness (i.e., greater improvements in behavioural changes) have mainly focused on initiation of behaviour change. These reviews suggest that self-regulation techniques such as goal setting, self-monitoring, action planning, and prompts are associated with more effective interventions in terms of initiation of PA (Dombrowski et al., 2012; Michie et al., 2009; Williams and French, 2011). In comparison, Fjeldsoe et al. (2011) specifically examined effectiveness of interventions for behaviour change maintenance