



## Review Article

# Self-directed exercise programmes in sedentary middle-aged individuals in good overall health; a systematic review



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## ABSTRACT

Many chronic diseases and illnesses are caused by the lifestyle, including the physical activity habits, of an individual. As such, consistent high levels of exercise should be encouraged across the lifespan, to limit the risk of developing one of these conditions and allowing for healthy aging to occur. Exercise prescriptions that encourage high completion and adherence rates in an independent manner and improve health related outcomes should be provided to individuals. To date, no review has identified optimal prescriptions of exercise to achieve this in sedentary middle-aged adults and this is important, given the higher risk of developing illnesses in this population as they age. This review examines the effects prescriptions of self-directed (SD) exercise has on adherence and health related outcomes in sedentary middle-aged individuals in good general health currently and aims to identify the most suitable forms of planned SD exercise that can be carried out independently. A systematic search of the electronic database PubMed was conducted. Randomised controlled trials published in English between February 2007 and February 2017 examining healthy, sedentary middle-aged participants only were included. Studies were critically appraised using the PEDro scale and data were presented on standardised tables. Twenty-one articles examining different aerobic activities, combined training and non-traditional exercise prescriptions were included. This review summarised in detail the effects SD exercise interventions had on sedentary middle-aged individuals alongside the adherence to the prescriptions. SD exercise was seen to be beneficial for improving metabolic outcomes physical characteristics, cardiorespiratory fitness and functional measures.

## 1. Introduction

Exercise is vital for treating and preventing chronic illnesses (Pedersen and Saltin, 2015; Zanuso et al., 2017; Helmrich et al., 1991; Booth et al., 2000; Garber et al., 2011; O'Neill and O'Driscoll, 2015). However, poor adherence away from the environments where exercise is supervised such as research or healthcare settings is expected to contribute to rates of chronic conditions soaring over coming decades (Wild et al., 2004). Increasing adherence to exercise programmes in sedentary middle-aged individuals in good health in more natural day to day environments may limit the future prevalence and impact of chronic diseases. Lifestyle changes in this population may lead to large long-term benefits for the individuals alongside healthcare systems by reducing the need to provide supervision to the individuals to encourage adherence.

Although reviews have examined the effects of exercise in middle-

aged populations, none have identified which planned self-directed (SD) exercise prescriptions can yield a high adherence and improve health related outcomes in the population thoroughly to date (Cavill et al., 2012; Yang et al., 2012; Bolam et al., 2013; Swift et al., 2014). Reviewing supervised exercise programmes provides an insight into the cellular effects of specific programmes but it is not known if these programmes are transferable away from supervised environments. Providing supervision for all individuals is not sustainable or reflective of what occurs in a real-life setting, where individuals usually exercise and it may alter adherence rates and outcomes. In SD programmes, individuals carry out exercise independently with minimal or no contact with practitioners or study staff. The practitioner provides a programme to the patient but it is the patient's responsibility to complete the exercise as prescribed with little or no supervision and/or instruction from healthcare personnel which minimises the burden on healthcare systems. A recent review has identified that these forms of

*Abbreviations:* SD, self-directed; NTE, non-traditional exercise; LB, longer bouts; SB, shorter bouts

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exercise are beneficial in type 2 diabetic individuals and so evidence is required to assess which prescriptions may encourage motivation and adherence most effectively and how best they can be used as a preventative tool for chronic diseases in at risk groups such as sedentary middle-aged individuals (Byrne et al., 2017).

This review examines the effects of planned and SD exercise on adherence, metabolic, functional and anthropometric outcomes and cardiorespiratory fitness in sedentary but healthy middle-aged individuals. It aims to identify effective forms of SD exercise in this population in improving health related outcomes to minimise the risks of illness with aging.

## 2. Methods

### 2.1. Study design

This review which has not been registered was guided by the PRISMA guidelines (Moher et al., 2009). A systematic search of PubMed was conducted to identify literature published between February 2007 and February 2017. Search terms were split into categories using the population, intervention and possible outcomes of the intervention headings of the PICOT (Population, Intervention, Comparison, Outcome, Time) method. Correct truncation and Medical Subject Headings (MeSH) terms were used. A “not” category was added to the search to ensure only papers relating to exercise interventions for healthy sedentary adults were retrieved. Two authors independently assessed eligibility and agreement was reached for each article. Reference lists of papers identified in the search process were also searched. The search terms and inclusion/exclusion criteria are presented in Supplementary Material. A list of definitions is presented in Table 1.

### 2.2. Critical appraisal of included studies

Two reviewers separately assessed the quality of studies using the PEDro scale (Maher et al., 2003; Bhogal et al., 2005; de Morton, 2009). Results were compared if a study was not already in the database and consensus was reached. The results of the critical appraisal scores are presented in Supplementary Material S1.

### 2.3. Data extraction

Data regarding adherence, metabolism, body composition, cardiorespiratory fitness and functional outcomes were analysed using the differences in means as the principal summary measures. Data from each exercise group were analysed and compared in subgroups, which were split according to the type of exercise conducted following the search. When necessary, the authors of papers were contacted to clarify information but no response was received from some.

## 3. Results

The search retrieved 51,855 papers. Nineteen of these remained following filtering, reading of abstracts and screening for eligibility

(Bailey and Brooke-Wavell, 2010; Kearney et al., 2014; Kanaya et al., 2014; Wu et al., 2011; Coghill and Cooper, 2008; Puglisi et al., 2008; Krause et al., 2014; Kukkonen-Harjula et al., 2007; Serwe et al., 2011; Williams et al., 2014; Khoo et al., 2015; Pressler et al., 2010; Masuo et al., 2012; Jung et al., 2015; Fritz et al., 2013; Fritz et al., 2011; Drexel et al., 2008; Turner et al., 2010; Arbour and Martin Ginis, 2008). Two papers were identified from reference lists and included (Thompson et al., 2009; Arbour and Martin Ginis, 2009). They present different data from 2 of studies identified and included from the search process. In total, 21 papers were included. Fig. 1 shows the study selection flow.

### 3.1. Methodological quality of included studies

The PEDro scale scores range from 4/10 to 8/10. The mean score was  $5.24 \pm 1.14$ . Full details of critical appraisal scores can be seen in Table S1.

### 3.2. Characteristics of included studies

Most papers used some form of walking as the intervention. Three of these studies used Nordic walking, a form of walking usually conducted using walking poles. One of these also included a standard walking intervention group. Fritz et al. reported on the effects of the intervention on 3 different overweight groups: individuals with T2DM, impaired or normal glucose tolerance (IGT or NGT). The group with T2DM was excluded (Kukkonen-Harjula et al., 2007; Fritz et al., 2013; Fritz et al., 2011; Drexel et al., 2008).

Other exercise modalities included are hopping, yoga, stretching, a home based aerobic video/stepping exercise, combination training, walking or swimming, or other forms of aerobic exercise including running, cross training, stationary cycling, elliptical machine and treadmill training. Intervention period lengths range from 6 weeks to 1 year. The 21 papers included present the findings of 19 studies. A paper which also presents the findings of 1 of these studies was excluded as it presented results that were not within the scope of the review (Coghill and Cooper, 2008). Thirteen studies made up of 16 papers include aerobic training groups. Two studies used a combination of aerobic and resistance training (Khoo et al., 2015; Pressler et al., 2010) and 4 included non-traditional exercise (NTE) modalities.

One study presented the results of a trial that assessed the effects of continuing 2 weeks of supervised high intensity interval training (HIIT) or moderate intensity continuous training (MICT) for a further 4 weeks in a SD environment (Jung et al., 2015). Data from the entire study were analysed in the review as the initial period quantified only a small portion of the intervention. A summary of the included studies and statistically significant effects of the interventions are presented in Tables S2–S6. The main findings of the review are summarised in Table 2.

**Table 1**  
Definitions.

Middle-aged	Participants of studies included were middle aged. This was a challenge to define given the wide variances in inclusion criteria of studies regarding age. Generally, intervention groups included in the review contained participants with a mean age of approx. 30–60 years. Ages of participants within included studies were predominantly within these ranges.
Nordic walking	A form of walking where the individual also actively uses walking poles.
Self-directed (SD) exercise	Individuals carry out the exercise independently away from a research or healthcare environment with minimal or no contact with practitioners or study staff. The practitioner or researcher may provide a prescription of exercise to the patient but it is the patient's responsibility to complete the exercise as prescribed with little or no supervision and/or instruction from healthcare personnel minimising the burden on healthcare systems.
NTE	Non-traditional exercise
HIIT	Physical exercise that is characterized by brief, intermittent bursts of vigorous activity, interspersed by periods of rest or low-intensity exercise (45).
MICT	Physical exercise that is conducted at a consistent moderate intensity pace by brief

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