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The clinical effectiveness and cost-effectiveness of exercise referral schemes: a systematic review and economic evaluation

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Abstract

The clinical effectiveness and cost-effectiveness of exercise referral schemes: a systematic review and economic evaluation

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Background: Exercise referral schemes (ERS) aim to identify inactive adults in the primary-care setting. The GP or health-care professional then refers the patient to a third-party service, with this service taking responsibility for prescribing and monitoring an exercise programme tailored to the needs of the individual.

Objective: To assess the clinical effectiveness and cost-effectiveness of ERS for people with a diagnosed medical condition known to benefit from physical activity (PA). The scope of this report was broadened to consider individuals without a diagnosed condition who are sedentary.

Data sources: MEDLINE; EMBASE; PsycINFO; The Cochrane Library, ISI Web of Science; SPORTDiscus and ongoing trial registries were searched (from 1990 to October 2009) and included study references were checked.

Methods: Systematic reviews: the effectiveness of ERS, predictors of ERS uptake and adherence, and the cost-effectiveness of ERS; and the development of a decision-analytic economic model to assess cost-effectiveness of ERS.

Results: Seven randomised controlled trials (UK, $n = 5$; non-UK, $n = 2$) met the effectiveness inclusion criteria, five comparing ERS with usual care, two compared ERS with an alternative PA intervention, and one to an ERS plus a self-determination theory (SDT) intervention. In intention-to-treat analysis, compared with usual care, there was weak evidence of an increase in the number of ERS participants who achieved a self-reported 90–150 minutes of at least moderate-intensity PA per week at 6–12 months' follow-up [pooled relative risk (RR) 1.11, 95% confidence interval 0.99 to 1.25]. There was no consistent evidence of a difference between ERS and usual care in the duration of moderate/vigorous intensity and total PA or other outcomes, for example physical fitness, serum lipids, health-related quality of life (HRQoL). There was no between-group difference

in outcomes between ERS and alternative PA interventions or ERS plus a SDT intervention. None of the included trials separately reported outcomes in individuals with medical diagnoses. Fourteen observational studies and five randomised controlled trials provided a numerical assessment of ERS uptake and adherence (UK, $n = 16$; non-UK, $n = 3$). Women and older people were more likely to take up ERS but women, when compared with men, were less likely to adhere. The four previous economic evaluations identified suggest ERS to be a cost-effective intervention. Indicative incremental cost per quality-adjusted life-year (QALY) estimates for ERS for various scenarios were based on a de novo model-based economic evaluation. Compared with usual care, the mean incremental cost for ERS was £169 and the mean incremental QALY was 0.008, with the base-case incremental cost-effectiveness ratio at £20,876 per QALY in sedentary people without a medical condition and a cost per QALY of £14,618 in sedentary obese individuals, £12,834 in sedentary hypertensive patients, and £8414 for sedentary individuals with depression. Estimates of cost-effectiveness were highly sensitive to plausible variations in the RR for change in PA and cost of ERS.

Limitations: We found very limited evidence of the effectiveness of ERS. The estimates of the cost-effectiveness of ERS are based on a simple analytical framework. The economic evaluation reports small differences in costs and effects, and findings highlight the wide range of uncertainty associated with the estimates of effectiveness and the impact of effectiveness on HRQoL. No data were identified as part of the effectiveness review to allow for adjustment of the effect of ERS in different populations.

Conclusions: There remains considerable uncertainty as to the effectiveness of ERS for increasing activity, fitness or health indicators or whether they are an efficient use of resources in sedentary people without a medical diagnosis. We failed to identify any trial-based evidence of the effectiveness of ERS in those with a medical diagnosis.

Future work should include randomised controlled trials assessing the cinical effectiveness and cost-effectivenesss of ERS in disease groups that may benefit from PA.

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Contents

List of abbreviations

AIC	Akaike information criterion
BHFNC	British Heart Foundation National Centre
BIC	Bayesian information criterion
BMI	body mass index
CENTRAL	Cochrane Central Register of Controlled Trials
CHD	coronary heart disease
CI	confidence interval
CMO	Chief Medical Officer
COPD	chronic obstructive pulmonary disease
CRD	Centre for Reviews and Dissemination
CVD	cardiovascular disease
DARE	Database of Abstracts of Reviews of Effects
EoP	exercise on prescription
EQ-5D	European Quality of Life-5 Dimensions
ERS	exercise referral scheme
FVC	forced vital capacity
GP	general practitioner
GPPAQ	General Practitioner Activity Questionnaire
HADS	Hospital Anxiety Depression Scale
HbA_{1c}	glycosylated haemoglobin
HRQoL	health-related quality of life
HSE	*Health Survey for England*
HTA	Health Technology Assessment
ICER	incremental cost-effectiveness ratio
ITT	intention to treat
MI	myocardial infarction
NHS EED	NHS Economic Evaluation Database
NICE	National Institute for Health and Clinical Excellence
NQAF	National Quality Assurance Framework
OQAQ	Overview Quality Assessment Questionnaire
ONS	Office for National Statistics
OR	odds ratio
PA	physical activity
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PSA	probabilistic sensitivity analysis
PSW	physical self-worth
QALY	quality-adjusted life-year
QoL	quality of life
RCT	randomised controlled trial
RR	relative risk
SBP	systolic blood pressure
SD	standard deviation
SDT	self-determination theory
SE	standard error
SF-12	Short Form questionnaire-12 items
SF-36	Short Form questionnaire-36 items
SMD	standardised mean difference
VIF	variable inflated factor

VO_{2max}	maximal oxygen uptake
WMD	weighted mean difference

All abbreviations that have been used in this report are listed here unless the abbreviation is well known (e.g. NHS), or it has been used only once, or it is a non-standard abbreviation used only in figures/tables/appendices, in which case the abbreviation is defined in the figure legend or in the notes at the end of the table.

Executive summary

Background

Physical activity (PA) contributes to the prevention and management of many medical conditions and diseases including coronary heart disease, type 2 diabetes mellitus, osteoporosis, cancers and mental illness, such as depression. The *Health Survey for England* in 2008 estimated that 39% of men and 29% of women met the 5 × 30 minutes per week public health target for PA, leaving the majority of the population unable to gain the known health benefits from activity. Primary care has been recognised as a potentially important setting for the promotion of PA, with over 85% of the population in the UK visiting their general practitioner (GP) at least once a year. Exercise referral schemes (ERS) aim to identify inactive adults in the primary-care setting. The GP or health-care professional refers the patient to a third-party service, with this service taking responsibility for prescribing and monitoring an exercise programme that is tailored to the individual needs of the patient. Guidance in 2006 from the National Institute for Health and Clinical Excellence (NICE) concluded that there was insufficient evidence to currently recommend the routine use of ERS to promote PA and called for further research to be undertaken.

Objectives

In people with a diagnosed medical condition known to benefit from PA:

- to assess the clinical effectiveness of ERS
- to assess the cost-effectiveness of ERS
- to identify predictors of uptake and adherence to ERS
- to explore the factors that might influence the clinical effectiveness and cost-effectiveness of ERS.

Given the extremely limited evidence base for ERS in people with a diagnosed medical condition known to benefit from PA, we extended the scope of this report to include consideration of those without a diagnosed condition, but who were sedentary.

Methods

Three systematic reviews were undertaken: (1) assessment clinical effectiveness of ERS; (2) assessment of the cost-effectiveness of ERS; and (3) identification of predictors of ERS uptake and adherence. Several electronic bibliographies (MEDLINE, EMBASE, PsycINFO, The Cochrane Library, ISI Web of Science, and SPORTDiscus) and ongoing research registers were searched from 1990 to October 2009. We also searched the references of included studies. Studies published only in languages other than English were excluded. Outcomes sought were specific to each of the three systematic reviews: clinical effectiveness – PA, physical fitness, health outcomes [e.g. blood lipids, health-related quality of life (HRQoL), and adverse events]; cost-effectiveness – costs and cost-effectiveness; predictors of uptake and adherence – quantitative reports of the level of uptake and adherence, statistical measures of the association/relationship between participant and programme factors versus uptake or adherence; and qualitative reports of factors influencing uptake and adherence.

An economic model was developed to examine the cost-effectiveness of ERS in comparison with usual care. Using a decision-analytic model, the costs of ERS and the quality-adjusted life-years (QALYs) gained were modelled over the patient lifetime. Estimates for the effectiveness of ERS were drawn from the systematic review undertaken as part of the current research. Sensitivity analyses investigated the impacts of varying ERS cost and effectiveness assumptions.

Results

Summary of exercise referral scheme effectiveness

Seven randomised controlled trials (RCTs; UK, $n = 5$; non-UK, $n = 2$) met the inclusion criteria, recruiting a total of 3030 participants (1391 randomised to ERS). Five studies compared ERS with usual care, two studies compared ERS with an alternative PA intervention (walking or motivational counselling programme) and one study compared ERS with ERS plus a self-determination theory (SDT) intervention. Studies were judged to have a moderate-to-low risk of bias. The most consistently reported outcome was self-reported PA. In an intention-to-treat analysis, compared with usual care, there was weak evidence of an increase in the number of ERS participants who achieved 90–150 minutes of at least moderate-intensity PA per week at 6–12 months' follow-up [pooled relative risk (RR) 1.11, 95% confidence interval 0.99 to 1.25]. There was no consistent evidence to support a difference between ERS and usual care in the duration of moderate/vigorous-intensity and total PA, physical fitness, blood pressure, serum lipids, glycaemic control, obesity indices (body weight, body mass index and per cent fat), respiratory function, psychological well-being (perception of self-worth, symptoms of depression or anxiety) or HRQoL. There were no differences in PA or other outcomes in ERS versus alternative PA interventions or versus ERS plus a self-determination intervention. None of the included trials separately reported outcomes in individuals with medical diagnoses.

Summary of predictors of exercise referral scheme uptake and adherence

Fourteen observational studies and five RCTs provided a numerical assessment of ERS uptake and adherence (UK, $n = 16$; non-UK, $n = 3$). There was considerable evidence of variation in levels of both ERS uptake (35–100% of people attending the first ERS induction visit) and adherence to ERS (12–82% of people taking up ERS completing the programme). ERS uptake levels were generally higher in RCTs (79%) than in observational studies (62%), with no clear difference in adherence between different study designs (37% vs 48%). Women and older people appeared to be more likely to take up ERS. Furthermore, while older people were also more likely to adhere, women were less likely to adhere than men. There was little evidence to be able to judge the influence of participant psychosocial or programme-level factors on ERS uptake or adherence. The majority of the 10 included qualitative studies highlighted participants' perception of a range of short-term physical and psychosocial benefits associated with ERS.

Summary of exercise referral scheme cost-effectiveness

Four previous economic evaluations (UK, $n = 3$; non-UK, $n = 1$) assessing the cost-effectiveness of ERS were identified – three trial-based economic evaluations and one model-based analysis. Broadly, the evidence base suggested that ERS was a cost-effective intervention in sedentary populations without a medical diagnosis.

Indicative incremental cost per QALY estimates for ERS for various scenarios were based on de novo model-based economic evaluation. Compared with usual care, the mean incremental cost for ERS was £169 and the mean incremental QALY was 0.008, with the base-case incremental cost-effectiveness ratio (ICER) for ERS at £20,876 per QALY in sedentary individuals without a diagnosed medical condition and £14,618 per QALY in sedentary obese individuals, £12,834

per QALY in sedentary hypertensive patients, and £8414 per QALY for sedentary individuals with depression; however, findings report small incremental costs and QALYs, and ICERs were therefore highly sensitive to plausible variations in the RR for change in PA and cost of ERS.

Discussion

Strengths, limitations, uncertainties of the analysis

Our electronic database searches were restricted to controlled trials, to examine the highest level of evidence for effectiveness, with ERS studies carefully selected on the basis that there was clear evidence of referral by a primary-care health professional to a third-party exercise provider. We extended the scope of this report to undertake a review of quantitative and qualitative literature so as to better understand the potential predictors of ERS uptake and adherence. However, we did not incorporate formal methods of qualitative synthesis such as meta-ethnography. A particular strength of our cost-effectiveness analysis was the further development of the economic model originally used in the NICE evaluation of primary care-based exercise interventions. These further developments included the incorporation of epidemiological data linking PA and the future risk of clinical outcomes in specific diagnoses groups (i.e. obesity, hypertension and depression). For the purposes of generating a cost per QALY for people with a specific medical diagnosis, we assumed that the same benefit in terms of PA gains in those populations as sedentary 'at-risk' individuals.

Because of limitations and gaps in the evidence base there remain several key uncertainties regarding the effectiveness of ERS. These include (1) the certainty in the improvement in short-term PA seen in sedentary individuals without a medical diagnosis; (2) the impact of ERS in people with a medical diagnoses; (3) whether or not ERS consistently affect clinical outcomes such as blood pressure and serum lipids; and (4) whether or not the potential small gains in short-term self-reported PA with ERS are maintained over the longer term. The cost-effectiveness for ERS is uncertain because of the limitations and gaps in the clinical effectiveness evidence base. Sensitivity analyses show that the cost per QALY associated with ERS can change markedly, with plausible changes in model effectiveness and cost inputs, which means that robust evidence on whether or not ERS are likely to be cost-effective cannot currently be provided.

Conclusions

Implications for service provision

In 2006, NICE commented that there was insufficient evidence for ERS and recommended that the NHS should only make ERS available as part of a controlled trial. Although we have identified four additional trials since the NICE review, there remains very limited support for the potential role of ERS for impacting on PA and, consequently, public health. Arguably, such an uncertain impact provides a case for the disinvestment in ERS. However, little evidence was found of how the ERS intervention sought to develop a sustainable active lifestyle in participants, as recommended in the NHS National Quality Assurance Framework. Although ERS programmes in our review aimed to increase medium- to long-term PA, they were typically based on only a 10- to 12-week leisure centre-based period intervention. With the exception of one trial (Jolly K, Duda JL, Daley A, Ntoumanis N, Eves F, Rouse P, *et al. An evaluation of the Birmingham exercise on prescription service: standard provision and a self-determination focused arm*. Final Report; 2009), there was minimal reference to health behaviour change techniques and theories that typically underpin interventions to promote an increase in daily PA.

Research priorities

- Randomised controlled trials assessing the clinical effectiveness and cost-effectiveness of ERS in disease groups that might benefit from PA. In addition, RCTs should seek to incorporate hard to reach populations (e.g. ethnic minorities) that are traditionally not represented in trials.
- Such RCTs should be better reported, include long-term data on the clinical effectiveness of ERS and the sustainability of PA change, incorporate objective measures of PA (e.g. accelerometers) and health outcomes (e.g. blood pressure, serum lipids) and incorporate parallel-process evaluations to better understand the mediators and barriers to behaviour change.
- Exercise referral scheme programmes vary in their procedures and this may impact on uptake and adherence. Future trials should, therefore, be designed to better understand the contribution of different programme components (e.g. level of staff training) to the clinical effectiveness and cost-effectiveness of ERS.
- Head-to-head RCTs comparing the clinical effectiveness and cost-effectiveness of different models of primary-care interventions aimed at promoting PA.
- Further quantitative and qualitative studies are needed to determine the moderators of uptake and adherence to ERS.
- Theory-driven interventions should be developed to complement ERS to foster long-term change in PA, and evaluated to enhance our understanding of mediators and processes of behaviour change (e.g. SDT, motivational interviewing).
- The development of improved approaches to modelling the cost-effectiveness of ERS, capturing the potential impact on a wide range of health outcomes.

Funding

Funding for this study was provided by the Health Technology Assessment programme of the National Institute for Health Research.

Chapter 1

Background

Physical activity and health

Physical activity (PA) contributes to the prevention and management of over 20 medical conditions and diseases, including coronary heart disease (CHD), stroke, type 2 diabetes mellitus, chronic back pain, osteoporosis, cancers, falls in the elderly, chronic obstructive pulmonary disease (COPD), decline in physical and cognitive function, depression and dementia, as summarised in the Chief Medical Officer's (CMO) report *At Least Five a Week: Evidence on the Impact of Physical Activity and its Relationship to Health*[1] and, more recently, the US guidelines for physical activity.[2] *Table 1* lists some of the key conditions in which exercise has been shown to be beneficial. The CMO report estimated the total cost of physical inactivity in England to be £8.2B per year.

Current recommendations are for adults to aim to be active daily. Over a week, activity should add up to at least 150 minutes (2.5 hours) of moderate-intensity activity in bouts of 10 minutes or more – one way to approach this is to do 30 minutes on at least 5 days a week. Emerging evidence on the effects of time spent in sedentary activities (e.g. television viewing) on obesity, metabolic processes and type 2 diabetes, independent of PA, suggests that reducing time spent in sedentary activities may be an additional useful indicator of the effectiveness of interventions. Worldwide, over 20% of CHD[4] has been attributed to physical inactivity, and the most active are at 30% lower risk for developing CHD than the least active,[5] with a stepped reduction in risk. The dose for reducing risk in respect of other diseases and for promoting positive well-being is less clear, but the minimum target has been widely recommended as being reasonable for general health benefit at population level.[3]

The *Health Survey for England* (HSE) provides national data on PA prevalence in England. The 2008 HSE report estimated that 39% of men and 29% of women meet the public health target of 5×30 minutes per week, with evident variations across age, sex, class and ethnicity.[6] The proportion achieving the targets for PA appears to have increased from 32% in 1997 to 39% in 2008 for men and from 21% to 29% for women. Nevertheless, there is a clear need to promote PA, particularly among the least active, who may have most to gain in terms of health. For adults, efforts in promoting PA have focused on changes in the environment (e.g. walking and cycle paths),[7] mass media campaigns, web- and information technology-based communications at population and individual level,[8] corporate and workplace initiatives,[9] community programmes,[10] and provision of individualised professional support[11] and new health-care structures.[12]

Reviews have also focused on the effectiveness of different PA interventions among specific groups in the population, such as the elderly[13] and workers.[14] Systematic reviews suggest that no single approach can be wholly effective[8] in helping sedentary people to maintain a physically active lifestyle, and that a wide variety of approaches can each facilitate small increments in behaviour change. The Foresight report on obesity[15] reflected determinants of PA with regard to its influence on energy balance, and this is reflected in the cross-governmental policies in transport, health, schools and the built environment to tackle it.

TABLE 1 Summary of conditions with evidence that exercise is beneficial for prevention or treatment

Mental health
Anxiety[a]
Depression[b]
Dementia[b]
Cancer
Breast[a]
Lung[a]
Prostate[a]
Colon[c]
Cardiovascular
MI[a]
Chronic heart failure[a]
Stroke[c]
Peripheral vascular disease[b]
Hypertension[a]
Metabolic
Hyperlipidaemia[a]
Type 1 diabetes[a]
Type 2 diabetes[b]
Musculoskeletal
Low back pain[a]
Osteoarthritis[a]
Rheumatoid arthritis[a]
Osteoporosis[b]
Other
Chronic kidney disease[a]
Chronic obstructive lung disease[a]
Chronic fatigue syndrome[a]
Falls prevention[a]
Fertility[a]
Obesity[a]
Parkinson's disease[a]
Asthma[c]
Human immunodeficiency virus[c]
Immunodeficiency syndrome (AIDS)[c]

AIDS, acquired immunodeficiency syndrome; MI, myocardial infarction; NICE, National Institute for Health and Clinical Excellence; RCT, randomised controlled trial.

a Conditions for which there is a NICE clinical guideline in which exercise was given a either as a class A (evidence for >1 RCT) or B (>1 non-RCT) recommendation or their mention of level 1a evidence (meta-analysis of RCTs).

b Conditions that were not suggested in the NICE clinical guideline (as outlined in 1). However, they are conditions where exercise has been recommended in the US Surgeon General's Report on Physical Activity[2] and/or UK CMO's report *At Least Five a Week: Evidence on the Impact of Physical Activity and its Relationship to Health*[1] and for which we have been able to locate a published meta-analysis(es) (of RCTs or non-randomised controlled studies) of benefits of exercise in the condition (based on a MEDLINE search).

c No NICE guideline currently available. However, there are conditions where exercise has been recommended in the US Surgeon General's Report on Physical Activity[2] and/or UK CMO's report *At Least Five a Week: Evidence on the Impact of Physical Activity and its Relationship to Health*[1] and for which we have located a published meta-analysis(es) (of RCTs or non-randomised controlled studies) of benefits of exercise in the condition (based on a MEDLINE search).

Theories of behaviour change also support the need for multiple-level (e.g. targeting attitudes of both recipients and providers of health promotion messages) and multicomponent approaches (e.g. targeting different belief and attitudinal dimensions, such as the importance or salience of new behaviours, confidence to change, expectancy of benefits and beliefs of others).[16] The past 15 years have seen a growth in the understanding of physically active behaviour and in how to promote it with strategies matched to individual needs.[17] Achieving and maintaining a physically active lifestyle may require numerous and diverse changes in how individuals interact with the environment and with others, as well approaches such as self-monitoring of PA.[18] In evaluating the effectiveness of interventions, it is important to understand precisely what the intervention was and whether this was achieved, and also what process or mediating variables were implicated in changes in primary outcomes (i.e. behavioural and health outcomes). Many reviews and individual studies report the behavioural outcomes or biomedical markers yet very few describe the processes involved in behaviour change.[19]

Physical activity promotion in primary care

Primary care has been recognised as a potentially important setting for the promotion of PA.[20] Over 85% of the population in the UK visit their general practitioner (GP) at least once a year, and almost 95% do so over a 3-year period,[21] suggesting an opportunity to promote PA. Taylor[22] identified, in a review of literature, several barriers that GPs perceived in promoting PA: (1) lack of time in the course of normal clinical interactions in primary care; (2) a lack of desire to pressure patients; (3) a belief that it may not be as beneficial as other therapies or other behavioural targets (e.g. smoking); (4) that patients would not follow advice; and (5) that PA promotion often seemed irrelevant for the needs of patients at the time of consultation.[22]

Within the primary-care setting, there are broadly two models of PA promotion – exercise recommendation and EFSs. Although often referred to interchangeably, there are important differences between the two models:

1. *Exercise recommendation* Within the exercise recommendation framework, primary-care practitioners identify inactive adults and directly offer the advice or counselling regarding exercise, and/or a written prescription of exercise. In its guidance on PA promotion,[23] the National Institute for Health and Clinical Excellence (NICE) recommended that a validated tool, such as the Department of Health GP Activity Questionnaire (GPPAQ[24]), be used to identify inactive adults. *Boxes 1* and *2* summarise the intervention description from two randomised controlled trials (RCTs) that illustrate the model of exercise recommendation.
2. *Exercise referral schemes* As in the exercise prescription approach, inactive adults are identified in the primary-care setting. In this case, instead of direct PA advice, the GP or health-care professional refers the patient to a third-party service, with this service taking responsibility for prescribing and monitoring an exercise programme tailored to the individual needs of the patient. NICE defines an exercise referral scheme (ERS) as a process whereby a health professional 'directs someone to a service offering an assessment of need, development of a tailored PA programme, monitoring of progress and a follow-up. They involve participation by a number of professionals and may require the individual to go to an exercise facility such as a leisure centre'.

Within this intervention model, the third-party service may often involve a referral to a local sport or leisure centre. However, the model can also include referral to a practice-based exercise specialist or physiotherapist. The interventions of two recent RCTs evaluating ERS are detailed in *Boxes 3* and *4*.

BOX 1 Example of an exercise recommendation intervention I

Little *et al*.[25]

'In a balanced 2x2x2 factorial design, the three factors were: booklet or no booklet; a counseling session given by a nurse based on attitudes, perceived control of behaviour and techniques for implementing behaviour, or no counseling session; an exercise prescription by the GP or no exercise prescription.'

Exercise prescription

'GPs briefly discussed the benefits of exercise, targets, how to start, and anticipating relapse, and wrote a prescription for 30 minutes, 5 times a week, of brisk walking (or equivalent).'

BOX 2 Example of an exercise recommendation intervention II

Marshall *et al*.[26]

'The intervention strategy was similar across the two intervention groups; the only difference was in the focus of the advice given. Patients recruited to the HP (health promotion) intervention group received materials and advice that encouraged them to be more active in order to protect or promote their general health. Patients recruited to the RF (risk factor) intervention group received materials and "medicalised" advice which focused on encouraging them to be more active as an adjunct to managing their hypertension. Physicians were encouraged to discuss the benefits of physical activity, to identify the patient's preferred types of activity, and to negotiate a program of activity which was then recorded on an "Active Prescription". The advice and prescription were then supplemented with one of two self-help booklets. The two control groups, HP control and RF control received only usual medical care from their physician. The "Active Prescription" was the same as that used by Smith *et al*. With the appearance of a clinical prescription; it included a precise prescription of the type, duration and frequency of activity suggested, plus additional space for other comments, a recommended review date and the physician's signature. Carbon copy duplicates could be kept in the patient's clinical notes to prompt review during subsequent consultations.'

Some trials have been conducted that have evaluated a primary care-based PA promotion including elements of both exercise prescription and ERS. One particular example is The New Zealand 'green prescription' (*Box 5*). In this model, the GP prescribes for the patient an exercise programme, and advises the patient that telephone support is available from the local sports foundation, if required. The failure to differentiate between different models has led to ambiguity within the literature, with different interpretations of these models, particularly in systematic reviews (see *Chapter 3*, *Quality of previous systematic reviews*, *Scope of previous systematic reviews*, and *Findings of previous systematic reviews*, for further discussion).

Development of exercise referral schemes in the UK

Formal links between health care and promoting healthy living through opportunities to exercise are not new. For example, the Peckham Health Centre, in south London, was a bold departure in the medical field in the 1930s, concentrating on a preventative rather than a curative approach to health. To facilitate their grand project, two doctors housed in this purpose-built building engaged with over 900 families as part of 'the Peckham Experiment'. For one shilling (£0.05 in today's currency) a week, they relaxed in a club-like atmosphere: physical exercise, games, workshops or even simple relaxation were all encouraged.

The first contemporary ERS was set up around 1990, and over the past two decades there has been a significant and sustained growth in the number with possibly over 600 ERS operating

BOX 3 Example of ERS intervention I

Taylor *et al.*[27]

'Patients were given a signed prescription card, with a reason for referral, resting heart rate and blood pressure, intensity of recommended exercise (three levels), and prohibited activity. They were instructed to take it to Hailsham Lagoon Leisure Centre, East Sussex, and arrange an appointment for an introductory session to start a 10 week programme with up to 20 sessions at £1.30 each (that is, half the normal admission price). The introductory session entailed a simple lifestyle assessment, a brief discussion about exercise perceptions and goals, an assessment of blood pressure, weight and height, and advice on use of the cycle ergometers, rowing machines, treadmills, stair climbing machines, and patient record cards. Patients were encouraged to progressively increase the duration and intensity of exercise during the referral period. Supervision was available when requested but patients attended informally between 9 AM and 5 PM on weekdays, usually for up to an hour. A mid and end of programme individual assessments were the only formal sessions, though attendance was recorded by leisure centre staff.'

BOX 4 Example of ERS intervention II

Harrison *et al.*[28]

'After receiving a referral form, the exercise officers telephoned clients to arrange a one-hour consultation at one of three leisure centres. During the consultation, the exercise officer gave person-specific advice and information with the aim of increasing the amount of physical activity clients carried out each week. This included tailored information to meet the needs o each client, taking account of their preferences and abilities, for different types of activity. All clients were offered a subsidized 12 week leisure pass, providing reduced entrance fees to any of the council-run physical activity facilities across the Borough, and were encouraged to attend at least two centre-based sessions a week. Participants were also given information about non-leisure-centre-based activities available across the Borough. At the end of 12 weeks, participants attending the first consultation were invited for an exit interview. This provided an opportunity to review their progress and to identify opportunities to maintain/increase physical activity through the longer term.'

BOX 5 Example of a combined exercise prescription and ERS intervention

Elley *et al.*[29]

The 'green prescription' intervention

- Primary-care clinicians are offered 4 hours of training in how to use motivational interviewing techniques to give advice on PA and the green prescription.
- Patients who have been identified as 'less active' through screening at the reception desk and who agree to participate receive a prompt card, stating their stage of change, from the researcher, to give to the GP during consultation.
- In the consultation, the primary care professional discusses increasing PA and decides on appropriate goals with the patient. These goals, usually home-based PA or walking, are written on standard green prescription and given to the patient.
- A copy of the green prescription is faxed to the local sports foundation with the patient's consent. Relevant details such as age, weight and particular health conditions are often included.
- Exercise specialists from the sports foundation make at least three telephone calls (lasting 10–20 minutes) to the patients over the next 3 months to encourage and support them. Motivational interviewing techniques are used. Specific advice about exercise or community groups is provided if appropriate.
- Quarterly newsletters from the sports foundations about PA initiatives in the community and motivational material are sent to participants. Other mailed materials, such as specific exercise programmes, are sent to interested participants.
- The staff of the general practice is encouraged to provide feedback to the participant on subsequent visits to the practice.

across the UK. This rapid growth in the number of ERS has occurred, in part, in response to new legislation (e.g. compulsory competitive tendering and private management[30]) of such facilities. Leisure centres with swimming pools and other exercise facilities provide the opportunity to offer diverse options, as well as providing social facilities and became more business orientated, and broadening their clientele base and selling more direct debit-type memberships instead of 'pay as you go'. The first evaluation of schemes was commissioned by the Health Education Authority in 1994.[31]

In the 1990s, several limitations in ERS were indentified:[32,33] (1) there were few of them, so they had little potential to impact on public health; (2) staff lacked the training to adapt exercise programmes to the specific health needs of patients; (3) there was little interest in the broader promotion of a more physically active lifestyle, but more interest in building leisure centre membership numbers; (4) GPs were reluctant to refer patients to exercise professionals who had unknown expertise and credentials; (5) there was only limited reference in key NHS policy documents to the promotion of PA; and (6) schemes were inadequately resourced for long-term evaluation.[34] As a result, and after broad consultation with health and exercise professionals, leisure industry operators and exercise scientists, a National Quality Assurance Framework (NQAF) was launched in the UK in 2001 to guide best practice and best value from ERS.[12] The document was aligned with the emerging range of NHS National Service Frameworks (e.g. for CHD, older people) that prioritise PA promotion.

The NQAF[12] recommended a service-level agreement to drive the operational links between the primary-care referrer and the exercise or leisure provider, with exercise professionals on the Register for Exercise Professionals (www.exerciseregister.org/) at least at a level compatible with the needs of their clients (level 3: Instructing Physical Activity and Exercise). National Occupational Standards for level 4 (Specialist Exercise Instructor) in Health and Physical Activity were developed in 2007, with core units for CHD, mental health, obesity/diabetes, frailer older adults/falls prevention, after-stroke care and back pain. Despite the publication of the NQAF, capacity and resource constraints have largely dictated the extent to which schemes are meeting these standards. Furthermore, researchers have argued that the NQAF has failed to achieve consistency and comparability of standards, audit and evaluation mechanisms across the country.[33]

The most recent survey of ERS programmes was undertaken by the British Heart Foundation National Centre for Physical Activity and Health (BHFNC[34]), from September 2006 to February 2008. In total, 158 schemes from England and Scotland provided information for the survey. Among these schemes, reported referral rates ranged from 20 to 6500 patients per year. Reported uptake rates (patients attending the initial consultation) ranged from 30% to 98%, with 82.5% of schemes having follow-up system for patients not attending initial consultations (telephone calls, letter/postcard). Scheme completion rates ranged between 20% and 90% depending on the 'completion' measure used. Although 95% of schemes reported collecting routine adherence data, adherence levels were not reported as part of the survey.

Fifty per cent of schemes had PA-based inclusion criteria, varying from less than 30 minutes' activity per week or $< 5 \times 30$ minutes of activity per week, with others using PA questionnaires (e.g. GPPAQ) to determine activity levels. Most schemes received patients with a range of medical conditions, including hypertension, weight problems, diabetes, arthritis, osteoporosis, anxiety and depression (see *Appendix 1*, *Figure 21*).

The survey reported further information regarding ERS in the UK that included how long schemes have been running; the aims of the scheme; the scheme characteristics (facilities and activities); the length of referral period (in 47% of schemes this was a 12-week period); and

the extent to which the NQAF was used to inform the scheme. However, it was acknowledged that this information provided only a snapshot of operating EFSs, as an estimated 64% provided information.

Current guidance on exercise referral schemes in the UK

In 2006, the NICE Public Health Intervention programme undertook a review of the effectiveness of brief primary care-based intervention for PA promotion that included ERS.[35] NICE determined that there was insufficient evidence to recommend the use of ERS as an intervention to promote PA, other than as part of research studies where their effectiveness could be evaluated. NICE guidance[35] recommended that:

> Practitioners, policy makers and commissioners should only endorse exercise referral schemes to promote PA that are part of a properly designed and controlled research study to determine effectiveness. Measures should include intermediate outcomes, such as knowledge, attitudes and skills, as well as a measure of PA levels. Individuals should only be referred to schemes that are part of such a study.

Following NICE guidance, and in consultation with exercise referral professionals, commissioners and referring practitioners, the BHFNC published *A Toolkit for the Design, Implementation & Evaluation of Exercise Referral Schemes*.[34] As noted by its authors, this toolkit is not meant as a replacement for NICE or NQAF guidance, but aims to provide a set of guidance on the implementation and evaluation of ERS for referring health-care professionals, exercise referral professionals and ERS commissioners.

Summary

- Physical activity contributes to the prevention and management of a number of medical conditions and diseases.
- Currently, only 25–40% of adults in UK meet the CMO's target for PA.
- Primary care is a potentially important setting for the promotion of PA, resulting in the ERS model being developed.
- Although variations in the model of delivery in ERS across the UK exist, common features include (1) identification of sedentary individuals at risk of lifestyle diseases by a health-care professional operating within a primary health-care setting; (2) referral to an exercise professional who seeks to develop a programme of exercise tailored to the needs of that individual patient; (3) monitoring of progress throughout the programme with appropriate feedback to the referring health-care professional; and (4) auditing to ensure adherence to quality assurance processes (e.g. appropriate staffing, health and safety procedures, ethical and data protection consideration).
- Despite a NQAF for ERS, capacity and resource constraints have largely dictated the extent to which the majority of schemes are meeting these standards.
- The NICE guidance in 2006 concluded that there was insufficient evidence to recommend the routine use of ERS to promote PA and called for further clinical effectiveness research.

Chapter 2

Definition of the decision problem

Decision problem

- *Interventions* For the purposes of this report, an ERS was defined as comprising the following three core components:
  - referral by a primary-care health-care professional to a service designed to increase PA or exercise
  - PA/exercise programme tailored to individual needs
  - initial assessment and monitoring throughout the programme.
- *Population including subgroups* The population for this study was defined as people with a diagnosed condition known to benefit from PA. [Although the commissioned scope of this report was to focus on those with a diagnosed condition (known to benefit from PA), given the lack of evidence in this population, we broadened the scope of this report to include individuals without a medical diagnosis.] Subgroups of interest will be identified by diagnosed condition.
- *Relevant comparators* All relevant comparators were considered including usual care (e.g. PA advice or leaflets), an alternative form of PA intervention or different forms of ERS.
- *Outcomes* All relevant outcomes were sought. Given the nature of the intervention, we were particularly interested in changes in PA. PA can be assessed in number of ways [e.g. self-report or objective measures of PA, proportion of people meeting guideline recommendations, minutes per week of PA (total or moderate intensity), energy expenditure] and we considered all of these approaches. Other outcomes sought were uptake and adherence to ERS, physical fitness, clinical outcomes (e.g. blood pressure, serum lipids), psychological well-being, health-related quality of life (HRQoL), patient satisfaction, and potential adverse events of ERS (e.g. musculoskeletal injuries).

Overall aims and objectives of assessment

The overall aim of this review was to assess the clinical effectiveness and cost-effectiveness of ERS in people with a diagnosed condition known to benefit from PA. [Although the commissioned scope of this report was to focus on those with a diagnosed condition (known to benefit from PA), given the lack of evidence in this population, we broadened the scope of this report to include individuals without medical diagnosis.]

This aim is addressed through undertaking:

- a systematic review of the clinical effectiveness of ERS
- a systematic review of published economic evaluations of ERS
- a systematic review to identify predictors of ERS uptake and adherence
- the development of a decision-analytic model to extend published results and to generate expected values for the health and cost gains/losses associated with ERS.

The specific objectives of the review are to:

- assess the clinical effectiveness of ERS (see *Chapter 3*: includes individuals without a medical diagnosis – see note in parentheses above)
- assess the cost-effectiveness of ERS (see *Chapters 4* and *6*: includes individuals without a medical diagnosis – see note in parentheses above)[2]
- identify predictors of uptake and adherence to ERS (see *Chapter 5*)
- explore the factors that might influence the clinical effectiveness and cost-effectiveness of ERS (see *Chapters 3* and 6: includes individuals without a medical diagnosis – see note in parentheses above)
- identify priorities for future research in this area (see *Chapters 7* and *8*).

Chapter 3

Systematic review of the clinical effectiveness of exercise referral schemes

Methods

This clinical effectiveness review was conducted and reported in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement.[36]

Search strategy

An experienced information scientist (TM) conducted an extensive scoping search that resulted in the utilisation of a two-part search strategy. Part 1 searched for 'exercise referral' and related synonyms within the title and abstract of articles. Part 2 expanded the terminology for 'exercise referral' within the title and abstract, and combined with 'primary care' search terms and a controlled trial filter. Limitations were also applied for English language and year of publication where possible (see *Appendix 2* for full search strategies).

Both stages of the searches were run in the following databases:

- Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid
- MEDLINE(R) 1950 to October 2009
- Ovid EMBASE 1980 to 2009 week 39
- Ovid PsycINFO 1967 to September week 4 2009
- Cochrane Central Register of Controlled Trials (CENTRAL) and Cochrane Database of Systematic Reviews (CDSR), NHS Health Technology Assessment (HTA), NHS Economic Evaluation Database (NHS EED), Database of Abstracts of Reviews of Effects (DARE) via The Cochrane Library version 2009 v3
- SPORTDiscus via Ebsco 1990 to October 2009
- ISI Web of Knowledge 1900 to October 2009
- Science Citation Index Expanded (SCIE)—1900 to October 2009
- Social Sciences Citation Index (SSCI) – 1898 to October 2009.

Records identified from the part 1 and part 2 searches were combined. The reference lists of included studies were then checked for any additional studies. Given the inception of contemporary ERS in the 1990s, any studies before 1990 were excluded from the search results.

Inclusion criteria

Studies were considered eligible for inclusion if they met the following criteria.

Study design

Systematic reviews, meta-analyses, RCTs (cluster or individual) and non-randomised controlled studies. We excluded studies not published in a peer-reviewed journal (e.g. annual reports of UK ERS programmes), non-systematic reviews, editorials, opinions and reports published as meeting abstracts only (where insufficient methodological details are reported to allow critical appraisal of study quality).

Population
Any individual with or without a medical diagnosis and deemed appropriate for ERS.

Intervention
An ERS (as defined in the decision problem of this report: see *Chapter 2*).

The ERS exercise/PA programme was required to be more intensive than simple advice and needed to include one or a combination of counselling (face to face or via telephone); written materials; supervised exercise training. Programmes or systems of exercise referral initiated in secondary or tertiary care, such as conventional comprehensive cardiac or pulmonary rehabilitation programmes, were excluded. We excluded trials of exercise programmes for which individuals were recruited from primary care, but there was no clear statement of referral by a member of the primary care team.

Comparator
Any control, for example usual ('brief') PA advice, no intervention, attention control or alternative forms of ERS.

Outcomes
Physical activity (self-report or objectively monitored), physical fitness [e.g. maximal oxygen uptake (VO_{2max})], health outcomes (e.g. blood lipids), adverse events (e.g. musculoskeletal injury) and uptake and adherence to ERS. As we were also interested in patient (e.g. diagnosis, age) and programme factors (e.g. length of and intensity of the exercise programme) that might influence the outcome of ERS, we also extracted these factors from included studies.

Study selection process
Titles and abstracts were screened in a three-stage process. In stage 1, a single reviewer (TP) initially ruled out clearly irrelevant titles and abstracts. At stage 2, two reviewers (TP and RT or KF or MH or AT) then independently screened the remaining titles and abstracts. In stage 3, full papers of abstracts categorised as potentially eligible for inclusion were then screened by a consensus meeting of least two reviewers (TP and RT or KF or MH or AT) and disagreements were resolved in real time by consensus.

Data extraction
Data were extracted by one reviewer (TP) using a standardised data extraction form (see *Appendix 3*) and checked by another (RT). Discrepancies were resolved by discussion, with involvement of a third reviewer when necessary. Extraction included data on patient characteristics (e.g. age, disease diagnosis), intervention (e.g. duration, location, intensity and mode of the exercise intervention delivered), comparator, study quality, and reported outcomes pertinent to the review. All included study authors were contacted to seek information that was not available in the publication(s).

Risk of bias assessment
Risk of bias criteria were derived from previous quality/risk of bias assessment instruments using published criteria relevant to controlled studies [Centre for Reviews and Dissemination (CRD) report 4[37] and *Cochrane Handbook for Systematic Reviews of Interventions*[38]].

Data analysis and synthesis
Given the heterogeneous nature of outcomes and variable quality of outcome reporting, the primary focus of our data synthesis was descriptive, and detailed tabular summaries are presented. For a small number of outcomes it was possible to consistently extract data across studies to allow quantitative summary using meta-analysis. Dichotomous outcomes were

expressed as relative risks (RRs) and 95% confidence intervals (CIs) calculated for each study. For continuous variables net changes were compared (that is exercise group minus control group to give differences) and a weighted mean difference (WMD) or standardised mean difference (SMD) and 95% CI was calculated for each study. Heterogeneity was explored through consideration of the study populations, methods and interventions, by visualisation of results and, in statistical terms, by the chi-squared test for homogeneity and the I^2-statistic. A fixed-effect model meta-analysis was used except where statistical heterogeneity was identified (χ^2 p-value ≤ 0.05 or $I^2 \geq 50\%$), in which case a random-effects model was used. Given the small number of studies consistently reporting outcomes in a format to allow meta-analysis, we were not able to undertake a funnel plot and publication-bias analysis. Analyses were conducted using RevMan version 5.0 (Cochrane IMS, London, UK).

Results

Identification and selection of studies

Our bibliographic search yielded 21,563 titles, of which seven primary studies and five systematic reviews were judged to meet the inclusion criteria. *Figure 1* summarises the selection and exclusion process.

Previous systematic reviews of exercise referral scheme effectiveness

A review of previous systematic reviews of the effectiveness of ERS was undertaken to gain an understanding of the evidence for the effectiveness of ERS and information scope and methods of the present systematic review.

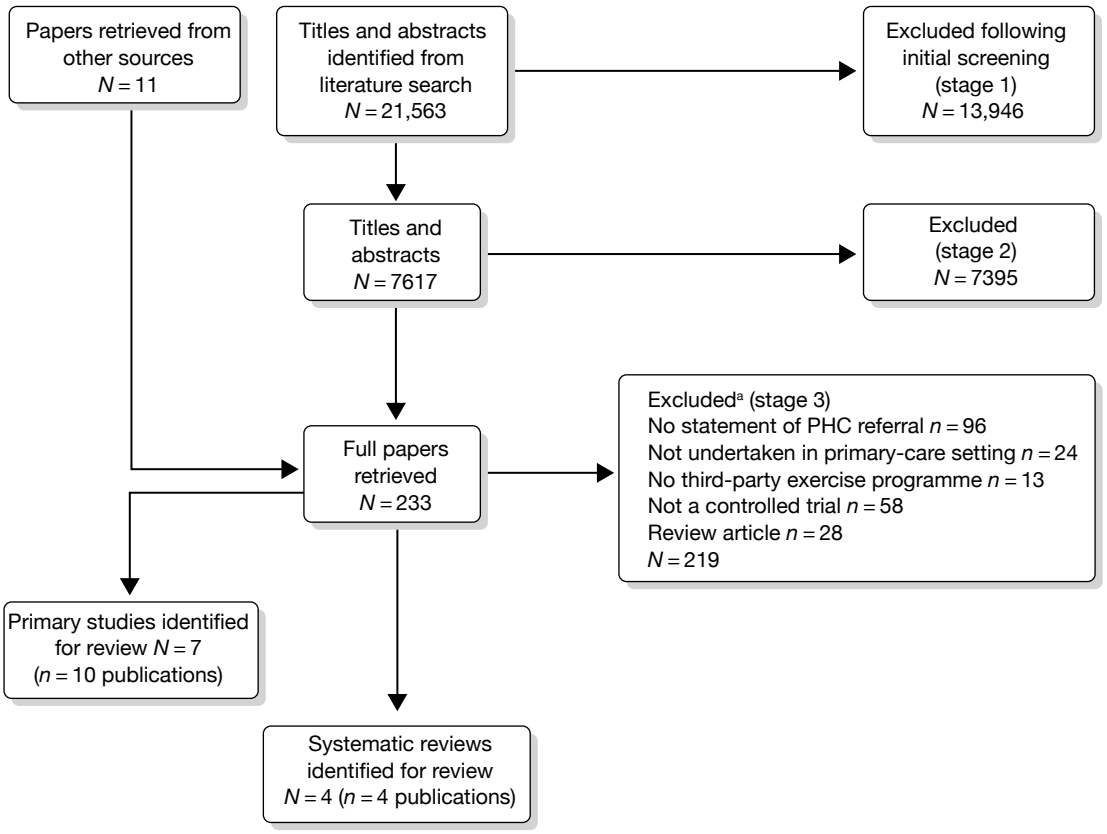

FIGURE 1 Study inclusion process for ERS effectiveness systematic review. a, Primary exclusion criteria identified. PHC, primary health care.

Description of included reviews

Four previous systematic reviews of the effectiveness of ERS were identified.[35,39–41] Details of these systematic reviews are summarised in *Tables 2–4*.[35,39–41] There was considerable variation in the ERS definition applied by these reviews and the type of study design that they included (see *Table 2*). The systematic reviews by Morgan,[39] Sorensen *et al.*[40] and NICE[35] focused on the effectiveness of ERS and included only RCTs. In contrast, Williams *et al.*[41] included RCTs, non-RCTs, and observational and qualitative studies.

Quality of previous systematic reviews

A modified version of the Oxman and Guyatt[42] Overview Quality Assessment Questionnaire (OQAQ) assessment tool and scale was used to assess the quality of reviews (see *Table 5*), with total scores for the reviews ranging from 10 to 18 points. All of the reviews provided a comprehensive search strategy, inclusion/exclusion criteria and risk of bias measure for the included primary studies, with conclusions supporting the data reported in the overview. Three of the reviews[35,39,40] were lacking in the application of the quality criteria to inform the review analysis, and the reporting and subsequent application of methods used to combine the findings of included studies. Only the review by Williams *et al.*[41] fulfilled all of the criteria.

Scope of previous systematic reviews

Table 3 highlights the lack of consistency in the studies included by these four previous systematic reviews of ERS. Although some of this variation reflects the inclusion of non-randomised studies, the principal reason for this difference is in the scope of inclusion criteria for the interventions.

TABLE 2 Summary of objectives and methods of previous ERS systematic reviews

Authors	Objectives of review (stated by authors)	Databases/end date of searches	ERS definition	Inclusion criteria
Morgan (2005)[39]	Review current evidence of the effectiveness for ERS	MEDLINE; EMBASE; CINAHL 2002	Interventions providing access to exercise activities or facilities and studies based in a primary-care setting	Experimental or quasi-experimental studies, with control groups. Studies including an exercise component with measures of PA or adherence
Sorensen *et al.* (2006)[40]	1. Does EoP increase PA level or physical fitness and is more intensive EoP more effective than less intensive? 2. Is EoP acceptable and feasible in general practice, and for sedentary patients and is EoP cost-effective?	MEDLINE; WinSPIRS; NLM Gateway 2005	Exercise prescribed by GP or other primary-care staff where EoP included more than just simple advice	Sedentary adults with signs of lifestyle disease Peer-reviewed studies Reported PA or maximal oxygen uptake Follow-up ≥ 6 months
NICE (2006)[35]	Examine the evidence for the effectiveness of ERS in increasing PA levels in adults	MEDLINE; PubMed; EMBASE; CINAHL; PsycINFO; SPORTDiscus 2005	Referral by appropriate professional to a service with formalised process of assessment; development of tailored PA programme; monitoring of progress	Controlled study design Measurement of PA outcomes or physical fitness at baseline and at least 6 weeks post intervention
Williams *et al.* (2007)[41]	Assess whether ERS are effective in improving exercise participation in sedentary adults	MEDLINE; AMED; EMBASE; CINAHL; PsycINFO; SPORTDiscus; The Cochrane Library; SIGLE 2007	Referred adults from primary care to intervention where encouraged to increase PA; initial assessment; tailored programme; monitoring	RCT; non-RCT; observational; process evaluation; qualitative Any outcome

AMED, Allied and Complementary Medicine Database; CINAHL, Cumulative Index to Nursing and Allied Health Literature; EoP, exercise on prescription; NLM Gateway, National Library of Medicine Gateway; SIGLE, System for Information on Grey Literature In Europe; WinSPIRS, Windows software for SilverPlatter CD-ROMs.

The systematic review by Sorensen *et al.*[40] assessed what the researchers called 'exercise on prescription' (EoP) and included studies that involved physician-delivered PA advice (i.e. exercise recommendation). As discussed in the *Background* section of this report, such interventions do not meet the standard definition of ERS in the UK.

A number of studies included in these previous systematic reviews did not appear to formally involve a referral from a primary-care health-care practitioner to a third party. For example, the study by Harland *et al.*[43] took place in primary care and involved an exercise intervention delivered by a third party/service. The methods section of the study publication states:

> the researcher (JH) approached all patients aged 40–64 attending routine surgeries. Patients completed a recruitment card, signed by their general practitioner, which they returned to the researcher before leaving
>
> (Harland *et al.*,[43] p. 828)

Thus, no referral from the GP was made; the researcher recruited subjects opportunistically from the waiting room. Indeed, in response to correspondence following publication of this trial, the authors confirmed that 'our scheme was not an exercise prescription scheme' (p. 1470).[44]

TABLE 3 Summary of controlled trials included in previous ERS systematic reviews

Studies	Morgan (2005)[39]	Sorensen *et al.* (2006)[40]	NICE (2006)[35]	Williams *et al.* (2007)[41]
RCTs				
King *et al.* (1991)[45]	✓			
Marcus and Stanton (1993)[46]	✓			
McAuley *et al.* (1994)[47]	✓			
Munro *et al.* (1997)[48]				✓
Bull and Jamrozik (1998)[49]		✓		
Taylor *et al.* (1998)[27]	✓		✓	✓
Stevens and Hillsdon (1998)[50]	✓			✓
Dunn *et al.* (1998, 1999)[51,52]	✓			
Goldstein *et al.* (1999)[53]		✓		
Harland *et al.* (1999)[43]	✓			
Naylor *et al.* (1999)[54]		✓		
Halbert *et al.* (2000)[55]		✓	✓	
Writing Group for the Activity Counselling Trial (2001)[56]		✓		
Dubbert *et al.* (2002)[57]		✓		
Lamb *et al.* (2002)[58]	✓		✓	✓
Petrella *et al.* (2003)[59]		✓		
Elley *et al.* (2003)[29]		✓		
Harrison *et al.* (2005)[28]		✓	✓	✓
Marshall *et al.* (2005)[26]		✓		
Jimmy and Martin (2005)[60]		✓		
Isaacs *et al.* (2007)[61]				✓
Non-randomised trials				
Robertson *et al.* (2001)[62,63]				
Fritz *et al.* (2006)[64]				✓

The study of Lamb *et al.*[58] has been included in three previous systematic reviews,[35,39,41] including the review by NICE.[35] In this study, the participant recruitment process involved several stages: the practice manager initially identified a random sample from computerised records; individuals in this sample were sent a questionnaire and covering letter from GPs to assess inclusion criteria and willingness to participate in a PA promotion trial; eligible patients who returned the questionnaires were sent a second letter explaining the trial in more detail; positive responses were followed up with a telephone call to gain consent and registration. However, there is no actual referral from the GPs, with the researchers using the primary-care setting as a gateway to recruit patients for their PA promotion trial. Finally, Elley[29] (included in one of the previous reviews) is an example of an alternative model of PA intervention, i.e. the 'green prescription' PA model. In this model, the GP prescribes the patient's exercise programme and advises the patient that telephone support is available from the local sports foundation, if required, but third-party service provision is not an essential component.

Findings of previous systematic reviews

These previous systematic reviews[35,39–41] appear to conclude that ERS have a small effect in increasing PA in the short term, with little or no evidence of long-term sustainability (i.e. 12 months or longer) (*Tables 4* and *5*). The one review that undertook a meta-analysis (of five UK-based RCTs) reported that participants in the ERS were 20% more likely to be moderately physically active at the threshold of 90–150 minutes/week) than those not participating in ERS [odds ratio (OR) 1.20, 95% CI 1.06 to 1.35].[41] These reviews provide limited consideration of either the impact of ERS on disease-specific groups or outcomes other than PA.

Primary exercise referral scheme studies

As shown in *Figure 1*, the most frequent reason for exclusion from the present review was that studies used primary care as means of recruiting individuals into exercise programmes, but there was no clear statement of a referral by a member of the primary-care team to a third-party exercise provider. Examples of three such studies are presented in *Boxes 6–8*. A full list of excluded papers is provided in *Appendix 3*.

Characteristics of included primary studies

The characteristics of the seven included ERS studies are summarised in *Table 6*.[26,27,49,60,67–69] These studies included a total of 3030 participants. All studies were RCTs: five undertaken in the UK,[27,28,50,61,68] one in Denmark[69] and one in Spain.[70] The studies of Jolly *et al.*[68] and Gusi *et al.*[70]

TABLE 4 Summary of previous ERS systematic review findings

Authors	No. of included studies	Method of data synthesis	Key findings (as reported by author)
Morgan (2005)[39]	UK ($n=4$) Non-UK ($n=5$)	Narrative	1. ERS appears to increase PA levels, particularly for those already partially active, older adults and those overweight (not obese) 2. Increases may not be sustained 3. Need strategies to increase long-term adherence
Sorensen *et al.* (2006)[40]	Effectiveness ($n=12$) Total ($n=22$)	Narrative, included assessment of quality	4. Most studies reported moderate improvements in PA or physical fitness for 6–12 months 5. EoP patients displayed 10% improvement in PA compared with control
NICE (2006)[35]	($n=4$)	Narrative, included, quality appraisal; study type; applicability	6. Insufficient evidence to make conclusions/recommendations about ERS 7. More research required (e.g. long-term effects)
Williams *et al.* (2007)[41]	Meta-analysis ($n=5$) Total ($n=18$)	Narrative and meta-analysis (heterogeneity, quality)	8. Significant increase in participants doing moderate exercise (number needed to treat: 17 sedentary adults would need referring for one to become moderately active) 9. Poor uptake and adherence to ERS

TABLE 5 Quality assessment of previous ERS systematic reviews

Quality assessment items	Morgan (2005)[39]	NICE (2006)[35]	Sorensen *et al.* (2006)[40]	Williams *et al.* (2007)[41]
1. Were the search methods used to find evidence on the primary question(s) stated?	Yes: 2 points	Yes: 2 points	Yes: 2 points	Yes: 2 points
2. Was the search for evidence reasonably comprehensive?	Yes: 2 points	Yes: 2 points	Yes: 2 points	Yes: 2 points
3. Were the criteria used for deciding which studies to include in the review reported?	Yes: 2 points	Yes: 2 points	Yes: 2 points	Yes: 2 points
4. Was bias in the selection of articles avoided?	No: 0 points	Yes: 2 points	Can't tell: 1 point	Yes: 2 points
5. Were the criteria used for assessing the validity for the studies (i.e. meeting inclusion criteria) reviewed reported?	Yes: 2 points	Yes: 2 points	Yes: 2 points	Yes: 2 points
6. Were study quality assessment criteria used to inform the review analysis?	No: 0 points	Yes: 2 points	Partially: 1 point	Yes: 2 points
7. Were the methods used to combine the findings of the relevant studies (to reach a conclusion) reported?	No: 0 points	No: 0 points	No: 0 points	Yes: 2 points
8. Were findings of the relevant studies combined appropriately relative to the primary question of the overview?	No: 0 points	No: 0 points	No: 0 points	Yes: 2 points
9. Were the conclusions made by the author(s) supported by the data and/or analysis reported in the overview?	Yes: 2 points	Yes: 2 points	Yes: 2 points	Yes: 2 points
Total	*10/18 points*	*14/18 points*	*12/18 points*	*18/18 points*

BOX 6 Example I of recruitment from primary care

Hardcastle *et al.*[65]

'Participants were drawn from a patient electronic database at a local health centre.'

'A total of 1439 patients were contacted by mail with an invitation letter and information sheet telling them about the study. Three hundred and fifty-eight (28%) accepted the invitation to enter the study by completing a form and returning it in a stamped addressed envelope.'

BOX 7 Example II of recruitment from primary care

Lawton *et al.*[66]

'General practitioners at participating practices were asked to identify women in the age group from their practice register, excluding patients deemed inappropriate for participation in a physical activity trial. The general practitioners sent letters to those identified as suitable, inviting them to participate in a lifestyle study. The invitation letter requested that women contact the research team if they were interested in learning more about the study using the reply slip and prepaid envelope supplied.'

BOX 8 Example III of recruitment from primary care

Kolt *et al.*[67]

'Two research assistants recruited patients through three primary care practices from different socioeconomic regions of Auckland, New Zealand, from June 2003 to March 2004. The primary care physicians identified and screened all those aged 65 and older on the practice databases (from their files). Those for whom physical activity was not contraindicated and were contactable at the address and telephone number on the practice database ($N = 831$) were invited to participate in the study via a letter from their primary care physician and follow-up telephone call from the practice where necessary.'

TABLE 6 Summary of characteristics of included ERS trials

Study	No. of GP practices	Date study conducted	RCT design	Overall *n*	Randomised (*n*) (ERS/ control)	Comparator group description	Follow-up periods
[a]Taylor *et al.*[27] UK	3	January to December 1994	Individual	142	97/45	Initial screen No exercise programme	8, 16, 26 and 37 weeks
Stevens *et al.*[50] UK	1	Not stated		714	363/351	No exercise programme; sent exercise promotion materials	8 months
Harrison *et al.*[28] UK	46	March 2000 to December 2001		545	275/270	No exercise programme; sent a written information pack	6, 9 and 12 months
Isaacs *et al.*[61] UK	88	October 1998 to April 2002		943	317/315/311	Initial assessment No exercise programme, advice only *or* 10-week walking scheme, 2 × 45 minutes/week, 60–80% of heart rate max., group setting	10 weeks, 6 and 12 months
[a]Sorensen *et al.*[69] Denmark	14	2005–6	Individual	52	28/24	Initial health profile and motivational counselling (45–60 min/session) No exercise programme	4 and 10 months
Gusi *et al.*[70] Spain	Four	Not stated	Cluster	287	127/160	Best care in general practice, which consisted of routine care and a recommendation of PA	6 months
Jolly *et al.*[68] UK	Not reported (13 leisure centre sites)	November 2007 to July 2008		347	184/163	ERS plus SDT programme	3 and 6 months

max., maximum; ref., reference; SDT, self-determination theory.

a Taylor *et al.* provided three publications[27,71,72] from which data were extracted; for ease of reading, ref. 25 shall be used, with ref. 69 used for the *Psychological well-being* section. Sorensen *et al.* provided two publications[69,73] from which data were extracted; for ease of reading, ref. 67 shall be used.

used cluster allocation (i.e. allocating participants to ERS and control at the ERS provider and general practice level, respectively). The other included studies undertook participant level randomisation. Studies had a median sample size of 347 (range 54–943) and follow-up duration ranged from 2 to 12 months. The GP was the main referrer, usually using a bespoke referral form to a fitness or exercise instructor/officer.

Inclusion and exclusion criteria

Most studies determined their inclusion and exclusion of participants based on criteria of the ERS they were evaluating (*Table 7*). Four studies[27,50,68,70] excluded patients with any form of heart condition. Gusi *et al.*[70] excluded patients with severe obesity or major depression and Taylor *et al.*[27] excluded patients with diabetes. All excluded individuals were considered to be at especially high risk [e.g. systolic blood pressure (SBP) of > 200 mmHg, insulin-dependent diabetes].

Trial participants

Studies mainly recruited sedentary, middle-aged white adults who had no medical diagnosis and evidence of at least one lifestyle risk factor, i.e. high blood pressure, raised serum cholesterol, smoking or being overweight (*Tables 7* and *8*). Studies also included a number of individuals with

TABLE 7 Summary of inclusion and exclusion criteria for included ERS trials

Study	Age range of patients (years)	Inclusion criteria	Exclusion criteria	Inclusion/ exclusion criteria determined/ evaluated by	No. of participants excluded
Taylor *et al.*[27] UK	40–70	Smokers, hypertension (140/90 mmHg), overweight (BMI > 25)	SBP > 200 mmHg, history of MI or angina pectoris, diabetes mellitus, musculoskeletal condition preventing PA, previous ERS referral	Research team and GP determined and evaluated	44
Stevens *et al.*[50] UK	18+	Sedentary–less than 20 × 30 minutes of moderate-intensity PA or less than 12 × 20 vigorous-intensity PA in the last 4 weeks	Medical reasons for exclusion, e.g. registered disabled, diagnosis of heart disease	Research team determined and evaluated	113
Harrison *et al.*[28] UK	18+	Sedentary, participating in < 90 minutes of moderate/vigorous PA a week, additional CHD risk factors; obesity, previous MI, on practice CHD risk management register, diabetes	GP identified contradiction to PA, SBP > 200 mmHg, not sedentary, only one family member (to avoid contamination–research team criterion)	GP evaluation using the trial's ERS-determined criteria	285
Isaacs *et al.*[61] UK	40–74	Not active (no definition reported), raised cholesterol, controlled mild/moderate hypertension, obesity, smoking, diabetes, family history of MI at early age	Pre-existing overt CVD, uncontrolled hypertension, uncontrolled insulin-dependent diabetes, psychiatric or physical conditions preventing PA, conditions requiring specialist programme	GP evaluation using criteria determined by an existing ERS	Not reported
Sorensen *et al.*[69] Denmark	18+	Patients must meet all criteria: (1) having medically controlled lifestyle diseases or at risk of developing lifestyle diseases; (2) motivated to change lifestyle; (3) believed by the GP to be able to improve health from an increased PA level; and (4) willing to pay 750 Danish krone (€100) for the intervention	Not meeting the inclusion criteria	GP evaluation using the trial's ERS-determined criteria	Not reported
Gusi *et al.*[70] Spain	60+	Moderately depressed (6–9 points on the Geriatric Depression Scale), overweight (BMI 25–39.9), capable of walking for more than 25 minutes	Severe obesity, major depression, debilitating medical condition, known unstable cardiac condition, attention or comprehension problems	Research team determined, GP evaluation	32

continued

a medical diagnosis that included diabetes, hypertension, depression, CHD and obesity. However, all included studies reported outcomes aggregated across all participants (see *Findings*, below). Only Gusi *et al.*[70] reported a rural population with 66% of participants living in a rural area.

Exercise referral scheme intervention

The ERS intervention of all studies, except that of Gusi *et al.*,[70] undertook an initial consultation by the third-party provider, such as an exercise professional (*Table 9*). The consultations varied in content, but all contained information and advice about being physically active. Other components of the screen (dependent on study outcomes) included lifestyle and health questionnaires and physical fitness measures. Scheme length was typically 10–12 weeks, and

TABLE 7 Summary of inclusion and exclusion criteria for included ERS trials *(continued)*

Study	Age range of patients (years)	Inclusion criteria	Exclusion criteria	Inclusion/ exclusion criteria determined/ evaluated by	No. of participants excluded
Jolly *et al.*[68] UK	18+	People with two or more major risk factors of coronary heart disease: ■ family history of CHD, smoking, raised cholesterol ■ obese (BMI > 30 or BMI > 25 plus one other risk factor) People suffering from well-controlled chronic medical conditions: ■ mild or controlled asthma, chronic bronchitis, controlled diabetes mellitus, mild-to-moderate depression and/or anxiety, people for whom the onset of osteoporosis may be delayed through regular exercise: i.e. post-menopausal women, borderline hypertensive patients with a blood pressure no higher than 160/102 mmHg prior to medication, people exhibiting motivation to change	Angina pectoris, moderate-to-high (or unstable) hypertension ≥ 160/102 mmHg Poorly controlled insulin-dependent diabetes, history of MI within the last 6 months – unless the patient has completed stage III cardiac rehabilitation, established cerebrovascular disease, severe chronic obstructive airways disease, uncontrolled asthma	GP evaluation using the trial's ERS-determined criteria	Not reported

BMI, body mass index; MI, myocardial infarction.

TABLE 8 Summary of participant characteristics of included ERS trials

	Age (mean, years)		Gender (% male)		Ethnicity (%)		Reported diagnosed conditions or risk factors (%)	
Study	Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Comparator
Taylor *et al.*[27] UK	54.1	54.4	37	38	Not reported	Not reported	Smokers: 43% Overweight: 77% Hypertensive: 46%	Smokers: 40% Overweight: 71% Hypertensive: 58%
Stevens *et al.*[50] UK	59.1	59.2	40	44	White: 87 Black: 5 Asian: 4 Other: 4	White: 83 Black: 4 Asian: 6 Other: 5	BMI > 25: 46 Smoker: 18	BMI > 25: 42 Smoker: 17
Harrison *et al.*[28] UK	18–44 = 111 45–59 = 101 > 60 = 63	18–44 = 107 45–59 = 98 > 60 = 65	33	34	White: 71.9	White: 74.1	Smoker: 24.4 At least one CHD risk factor: 75.3	Smoker: 20.7 At least one CHD risk factor: 75.2

took place in a leisure centre,[27,28,50,61,68] a clinic, public parks or forest tracks (*Table 10*). Exercise sessions were usually twice per week, lasted between 30 and 60 minutes per session, and were conducted at either a moderate or individually tailored intensity. Two studies[69,70] provided group-based exercise sessions, and four[27,28,61,68] provided a combination of group and individual exercise sessions. Only three studies[28,50,68] reported an assessment at the end of the ERS programme.

TABLE 8 Summary of participant characteristics of included ERS trials *(continued)*

	Age (mean, years)		Gender (% male)		Ethnicity (%)		Reported diagnosed conditions or risk factors (%)	
Study	**Intervention**	**Control**	**Intervention**	**Control**	**Intervention**	**Control**	**Intervention**	**Comparator**
Isaacs *et al.*[61] UK	57.1	Usual care: 57 Walk: 56.9	ERS: 35	32 Walk: 31	White: 75.7 Asian:16.7	(Control/walking) White: 76.5/75.9 Asian: 14/12.2	(Exercise/walking) Raised cholesterol: 24.0 Hypertension: 44.5 Obesity: 65.9 Smoking: 10.4 Type 2 diabetes: 12.3/11.3 Family history of MI: 13.9	(Control/walking) Raised cholesterol: 17.1/21.5 Hypertension: 43.5/46.3 Obesity: 63.5/58.5 Smoking: 8.3/12.2 Diabetes: 15.6/11.3 Family history of MI: 16.2/12.9
Sorensen *et al.*[69] Denmark	53.9	52.9	43	37	Not reported	Not reported	Metabolic syndrome: 36 Type 2 diabetes: 18 CVD: 32 Other diseases: 14	Metabolic syndrome: 25 Diabetes: 21 Heart disease: 42 Other diseases: 13
Gusi *et al.*[70] Spain	71	74	0	0	Not reported	Not reported	Overweight (BMI>25): 80 Type 2 diabetes: 39 Moderate depression: 34	Overweight: 86 Type 2 diabetes: 37 Moderate depression: 38
Jolly *et al.*[68] UK	<30: 19 30–49: 76 50–64: 64 65+: 25	<30: 11 30–49: 77 50–64: 50 65+: 25	24	30	White: 74.9 Black: 10.6 Asian: 9.5 Other: 5	White: 67.5 Black: 14.9 Asian: 14.9 Other: 2.6	Smoker: 22.1 Hypertension: 38 Overweight (BMI >25): 25.3 Obese (BMI >30): 52.3 Morbidly obese (BMI>40): 12.1 Probable anxiety: 34.2 Probable depression: 21.9	Smoker: 23.1 Hypertensive: 37.5 Overweight: 26.3 Obese: 51.9 Morbidly obese: 13.5 Probable anxiety: 31.9 Probable depression: 15.3

BMI, body mass index; MI, mycardial infarction.

Control/comparator group

Five studies[27,28,50,61,70] compared ERS with a 'usual care' control group, which consisted of no exercise intervention or simple advice on PA (see *Table 6*). Sorensen *et al.*[69] compared ERS with motivational counselling aimed at increasing daily PA. In addition to a no-exercise group, the Isaacs *et al.* study[61] also included an instructor-led walking programme. The Jolly *et al.* study[68]

TABLE 9 Summary of referral characteristics of included ERS trials

Study	Referrer	Format of referral	Referred to where	*Participant cost*	Referred to who
Taylor *et al.*[27] UK	GP	Signed prescription card	Leisure centre	*Half-price admission*	Fitness instructor
Stevens *et al.*[50] UK	GP	Letter	Leisure centre	*Not reported*	Exercise development officer
Harrison *et al.*[28] UK	GP	Faxed referral form	Leisure centre	'*Subsidised*'	Exercise officer
Isaacs *et al.*[61] UK	GP or practice nurse	Specially prepared 'prescription pad' – referral form	Leisure centre	*Free*	Fitness instructor
Sorensen *et al.*[69] Denmark	GP	Not reported	Clinic	*Pay €100*	Physiotherapist
Gusi *et al.*[70] Spain	GP	Not reported	Supervised walks in a public park or forest tracks	*Not reported*	Qualified exercise leaders
Jolly *et al.*[68] UK	Member of the primary-care team	Not reported	Leisure centre	*Not reported*	Health and fitness adviser

TABLE 10 Summary of ERS intervention characteristics of included ERS trials

			Exercise programme				
Study	Initial screen/ assessment	Scheme duration	Provider	Exercise sessions per week	Exercise session intensity	Group or individual	Exit assessment
Taylor *et al.*[27] UK	Yes	10 weeks	Leisure centre	2 × 30–40 minutes	Moderate intensity	Group and/or individual	Not reported
Stevens *et al.*[50] UK	Yes	10 weeks	Leisure centre	Not reported	Not reported	Not reported	Yes
Harrison *et al.*[28] UK	Yes	12 weeks	Leisure centre	2 × 1 hour	Individually based	Group and/or individual	Yes
Isaacs *et al.*[61] UK	Yes	10 weeks	Leisure centre	2 × 45 minutes	Not reported	Group and/or Individual	
Sorensen *et al.*[69] Denmark	Yes (and motivational counselling)	4 months	Clinic	First 2 months 2 sessions × 1 hour Second 2 months 1 session × 1 hour	More than 50% of heart rate reserve for a minimum of 20 minutes	Group	
Gusi *et al.*[70] Spain	Not reported	6 months	Walking scheme	3 × 50 minutes	Not reported	Group	
Jolly *et al.*[68] UK	Yes	12 weeks	Leisure centre	Individually based	Individually based	Group and/or Individual	

compared two forms of ERS, i.e. standard ERS versus a combined ERS plus self-determination theory (SDT)-based intervention.

Risk of bias

Table 11 summarises the risk of bias for each of the included studies. Most included a power calculation and allocated participants using an appropriately generated random number sequence. However, the reporting of concealment of trial group allocation was poor, although

TABLE 11 Summary of risk of bias assessment

Risk of bias criterion	Taylor *et al.*[27] UK	Stevens *et al.*[50] UK	Harrison *et al.*[28] UK	Isaacs *et al.*[61] UK	Sorensen *et al.*[69] Denmark	Gusi *et al.*[70] Spain	Jolly *et al.*[68] UK
Power calculation reported?	Yes	Unclear	Yes	Yes	Yes	Yes	Yes
Method of random sequence generation described?	Yes	Yes	Yes	Yes	Yes	Yes	Yes+
Method of allocation concealment described?	Yes+	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Method of outcome (assessment) blinding described?	Unclear	Unclear	Unclear	No	Unclear	Unclear	Yes
Were groups similar at baseline?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was ITT analysis used?	No	Yes	Yes	Yes	Yes	Yes	Yes
Was there any statistical handling of missing data?	Unclear	Yes	Unclear	Yes	Yes	Yes	Yes
Were missing data (dropout and loss to follow-up) reported?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

+, Correspondence with author.

there was good evidence of participant characteristics of intervention and control groups at baseline. Although blinding of participants and intervention providers in these studies was not feasible, blinding of outcome assessment was possible. Outcome blinding is particularly important in preventing assessment bias in the case of outcomes that require observer judgement or involvement (e.g. blood pressure measurement or exercise testing). However, only the study of Jolly *et al.*[68] reported outcome blinding, i.e. self-reported PA using the 7-Day Physical Activity Recall Questionnaire was assessed via telephone to maintain blinding. The reporting and handling of missing data was detailed for most studies, and all studies, except one,[27] reported the use of intention-to-treat (ITT) analysis. The level of missing data at follow-up ranged across studies from 16.5% to 50%. Most studies used imputation methods (last observation carried forward or complete case average values) to replace missing data values at follow-up. Overall, three studies were judged to be at moderate overall risk of bias[27,28,50] and four to be at low overall risk of bias.[61,68–70]

Exercise referral scheme eligibility, uptake and adherence

There was a considerable range in the proportion of individuals randomised compared with those deemed eligible (*Table 12*). In both the Sorensen *et al.*[69] and Jolly *et al.*[68] studies, of those deemed eligible for ERS, a substantial number refused participation in the trial. For Sorensen *et al.*[69] this low number maybe reflective of the €100 payment by patients as part of a standard Danish EoP.

Uptake was defined as the proportion of those individuals offered entry to ERS who attended an initial consultation with an 'exercise professional' or attended a first exercise session. Although Taylor *et al.*,[27] Issacs *et al.*[61] and Sorensen *et al.*[69] reported uptake rates in excess of 85%, in the Stevens *et al.*[50] study only 126 (35%) of the 233 randomised to ERS attended the first consultation. Stevens *et al.*[50] discussed how the low uptake they experienced may have been reflective of the nature of the invitation letter sent to participants and the point of randomisation (pre-invitation letter). Furthermore, they hypothesise that a change in the format of the letter (e.g. including a specific appointment date for the first ERS appointment) would have improved participation. Uptake was not reported by Jolly *et al.*[68] or Gusi *et al.*[70]

Harrison *et al.*[28] and Jolly *et al.*[68] failed to provide information on participants' adherence to the ERS intervention. Stevens *et al.*[50] and Gusi *et al.*[70] reported ERS programme completion rates of

TABLE 12 Summary of eligibility and uptake figures for included studies

Study	No. deemed eligible (*n*)	Total *n* randomised	ERS (*n*)	Control (*n*)	ERS uptake
Taylor *et al.*[27] UK	345	142 (41%)+	97	45	85 (88%)
Stevens *et al.*[50] UK	827	714 (86%)+	363	351	126 (35%)
Harrison *et al.*[28] UK	830	545 (66%)+	275	270	232 (84%)
Isaacs *et al.*[61] UK	1305	949 (73%)+	317	315 + 311	293 (92%)
Sorensen *et al.*[69] Denmark	327	52 (16%)+	28	24	28 (100%)
Gusi *et al.*[70] Spain	160	127 (79%)+	64	63	Not reported
Jolly *et al.*[68] UK	1683	347 (21%)+	184	163	Not reported

+, Percentage of individuals deemed eligible who were randomised.

25% and 86%, respectively. However, these rates do not reflect the number of sessions attended, only those who attended a second consultation[50] or follow-up assessment.[70]

Sorensen *et al.*[69] reported that an average 18 of a total of 24 ERS exercise sessions were attended and 68% and 75% of participants attended the counselling sessions at 4 and 10 months, respectively. Both Taylor *et al.*[27] and Isaacs *et al.*[61] provide a detailed description of ERS programme adherence. Taylor[27] reported 13% attending no exercise sessions and 28% attending 75–100% of exercise sessions, with an average of 9.1 out of 20 prescribed exercise sessions attended. Isaacs *et al.*[61] reported 7.6% attending no exercise sessions and 42% attending 75–100% of exercise sessions in the leisure centre group. In the walking group, 23.5% attended no exercise sessions, with 21.5% attending 75–100% of exercise sessions. As shown in *Table 13*, there was no consistent difference in attendance rates between those in at-risk groups and the overall study population in the studies of Taylor *et al.*[27] and Isaacs *et al.*[61] In the Isaacs *et al.*[61] study, the 60- to 69-year age group had the highest adherence in both the ERS (53.3%) and the walking (24.2%) groups. There were no significant differences in attendance rate with employment status, educational level, socioeconomic status, ethnicity or relationship status. Adherence was lower for those without access to private transport in both the ERS and walking groups.

Findings

Only Isaacs *et al.*[61] reported all outcome domains applicable to this systematic review (*Table 14*). Outcome results are reported according to the three categories of comparator, i.e. ERS versus usual care; ERS versus alternative exercise intervention and ERS versus alternative form of ERS.

Physical activity

All studies, with the exception of Gusi *et al.*,[70] provided a measure of self-reported PA. Self-reported measures included the validated 7-Day Physical Activity Recall Questionnaire,[27,28,50,68] a modified version of the validated Minnesota Leisure Time Activity Questionnaire[61] and an invalidated questionnaire designed by the research team.[63] No studies reported assessed PA using objective methods. A summary of the main PA outcomes at follow-up is provided in *Table 15*.

TABLE 13 Proportion of individuals by risk group with 75–100% ERS attendance rates

Study	Smoking (%)	Obesity (%)	Hypertension (%)	Overall (%)
Taylor *et al.*[27] UK	12	28	23	28
Isaacs *et al.* ERS group[61] UK	45.5	38.8	46.1	42
Isaacs *et al.* control walking group[61] UK	26.3	18.7	22.9	21.5

TABLE 14 Summary of outcome domains assessed

Study	PA	PA measure	Physical fitness	Clinical outcomes	Psychological well-being	HRQoL	Patient satisfaction	Adverse events
Taylor *et al.*[27] UK	Yes	Self-report 7-day PAR	Yes Sub-max HR	Yes BP, BMI, BF%, waist to hip	Yes PSW	No	No	No
Stevens *et al.*[50] UK	Yes	Self-report 7-day PAR	No	No	No	No	No	No
Harrison *et al.*[28] UK	Yes	Self-report 7-day PAR	No	No	No	No	Yes	No
Isaacs *et al.*[61] UK	Yes	Self-report Minnesota LTPAQ	Yes Sub-max bike test Sub-max walking test	Yes BP, cholesterol, lipoproteins, triglycerides, weight, BMI, BF%, waist-to-hip ratio, FEV, PEF	Yes Anxiety, depression	Yes SF-36 mental	Yes	Yes GP records
Sorensen *et al.*[69] Denmark	Yes	Self-report Unspecified	Yes Sub-max bike test	Yes Weight, BMI	No	Yes SF-12 mental, physical	No	No
Gusi *et al.*[70] Spain	Not reported	N/A	No	Yes BMI	Yes Anxiety, depression	Yes EQ-5D	No	No
Jolly *et al.*[68] UK	Yes	Self-report 7-day PAR	No	Yes BMI	Yes Anxiety, depression	Yes Dartmouth QoL	No	No

BF%, body fat %; BMI, body mass index; BP, blood pressure; EQ-5D, European Quality of Life-5 Dimensions; FEV, forced expiratory volume; HR, heart rate; LTPAQ, Leisure Time Physical Activity Questionnaire; N/A, not applicable; PAR, Physical Activity Recall; PEF, peak expiratory flow; PSW, physical self-worth; QoL, quality of life; SF-12, Short Form questionnaire-12 items; sub-max, sub-maximal.

Exercise referral scheme versus usual care The most consistently reported PA outcome across studies was the proportion of individuals achieving 90–150 minutes of at least moderate-intensity activity per week. (The use of 90–150 minutes of at least moderate-intensity PA/week is pragmatic

TABLE 15 Summary of PA data at follow-up

Study and time of follow-up	Patients achieving PA guidance (90–150 minutes/at least moderate-intensity per week)		Minutes per week at least moderate intensity				Total PA (minutes per week)		Energy expenditure (kcal/kg/day)[a]	
	ERS, *n/N*	Usual care, *n/N*	ERS, mean (SD)		Usual care, mean (SD)		ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)
ERS vs usual care										
Taylor et al.[27]										
			(Moderate)	(Vigorous)	(Moderate)	(Vigorous)				
8 weeks[b]	51/63	20/31[c,d]	247 (174)	49 (60)	145 (178)[e]	21 (61)[e]	Not reported	Not reported	34.6 (1.2)	33.7 (1.7)[e]
16 weeks[b]	51/57	18/31[d,e]	226 (252)	59 (72)	160 (262)[c]	21 (72)[e]	Not reported	Not reported	34.6 (1.2)	33.9 (1.7)[e]
26 weeks[b]	39/47	18/31[d,e]	183 (234)	56 (108)	206 (251)[c]	34 (111)[c]	Not reported	Not reported	34.4 (1.8)	34.3 (1.2)[c]
37 weeks[b]	39/57	19/[c,d]	158 (228)	42 (96)	162 (245)[c]	23 (106)[c]	Not reported	Not reported	34.1 (2.4)	33.9 (2.2)[c]
Stevens et al.[50]										
8 months[f]	204/363	174/351[c,d]	Not reported		Not reported		Not reported	Not reported	Not reported	Not reported
Harrison et al.[28]										
6 months[b]	38/168	22/162[d,e]	Not reported		Not reported		Not reported	Not reported	Not reported	Not reported
9 months[b]	36/149	31/140[c]	Not reported		Not reported		Not reported	Not reported	Not reported	Not reported
12 months[b]	40/155	32/157[c]	Not reported		Not reported		Not reported	Not reported	Not reported	Not reported
Isaacs et al.[61]										
10 weeks[g]	48/164	29/157[d,e]	93 (115)		79 (114)[c]		584 (479)	668 (555)[c]	34 (26)	36 (32)[c]
6 months[g]	70/179	66/200[c,d]	65 (106)		58 (98)[c]		692 (496)	647 (463)[c]	38 (27)	35 (27)[c]
Gusi et al.[70]										
	Not reported	Not reported	Not reported		Not reported		Not reported	Not reported	Not reported	Not reported

Study and time of follow-up	Patients achieving PA guidance (90–150 minutes/at least moderate-intensity per week)		Minutes per week at least moderate intensity		Total PA (minutes per week)		Energy expenditure (kcal/kg/day)[a]	
	ERS, *n/N*	Alternative PA, *n/N*	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)
ERS vs alternative PA intervention								
[h]*Sorensen* et al.[69]								
4 months[b]	Not reported	Not reported	Not reported	Not reported	63 (114)	23 (107)[c]	43 (2.4)	41 (4.8)
10 months[b]	Not reported	Not reported	Not reported	Not reported	20 (124)	20 (152)[c]	41 (2.1)	40 (5)
Isaacs et al.[61]								
10 weeks[g]	48/164	53/92[d,e]	93 (115)	113 (291)[c]	584 (479)	863 (1026)[e]	34 (26)	43 (38)[e]
6 months[g]	70/179	62//141[c,d]	65 (106)	89 (150)[e]	692 (496)	759 (539)[c]	38 (27)	42 (27)[c]
	ERS, *n/N*	ERS plus SDT, *n/N*	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)
ERS vs ERS plus SDT								
Jolly et al.[68]								
3 months[g]	Not reported	Not reported	319 (338)[c]	331 (336)[c]	Not reported	Not reported	Not reported	Not reported
6 months[g]	66/156	83/169[c,d]	249 (356)[c]	246 (343)[c]	Not reported	Not reported	Not reported	Not reported

SD, standard deviation.
a Sorensen *et al.*[69] metabolic equivalent (METS)/hour/day.
b Numbers of individuals with complete data/questionnaires.
c Between-group difference not statistically significant at $p \leq 0.05$.
d The *p*-value calculated by authors of the present report.
e Between-group difference statistically significant at $p \leq 0.05$.
f All randomised participants.
g Provides b (patients achieving PA guidance) and f (all other PA measures).
h Mean change score.

with the included studies.) When pooled across studies there was a 16% (95% CI 3% to 30%) increase in the RR of achieving this outcome with ERS compared with usual care at 6–12 months' follow-up (*Figure 2*).

The studies of Taylor *et al.*[27] and Harrison *et al.*[28] reported this outcome based on the number of individuals who were available at follow-up. In order to assess the potential (attrition) bias in using completers, we adjusted the denominators of these two studies to all individuals randomised – an ITT analysis (*Figure 3*). We assumed that all missing cases did not meet the PA threshold. In the pooled ITT analysis, the proportion achieving the PA threshold with ERS than usual care (11%, 95% CI –1% to 45%) this effect was no longer statistically significant.

There was no difference between ERS and usual care in either the minutes spent in at least moderate-intensity PA/week or estimated PA-induced energy expenditure (*Figures 4* and *5*).

Exercise referral scheme versus alternative physical activity intervention Sorensen *et al.*[69] reported a higher level of energy expenditure with ERS than with PA counselling. In contrast, the study by Isaacs *et al.*[61] observed a higher level of PA (minutes of total and moderate-intensity activity, and energy expenditure) in those in the walking programme than in the ERS group. When pooled across studies, there was no significant difference in the total amount of physical or energy expenditure between ERS and alternative PA interventions (*Figures 6* and *7*).

Exercise referral scheme versus exercise referral scheme plus self-determination theory In the Jolly *et al.* study,[68] the proportion of patients achieving at least 150 minutes of moderate PA per week increased in the standard ERS group from 27% at baseline to 63% at 3 months and 46% at 6 months. There were no significant differences in these proportions between the standard ERS and ERS-plus-SDT groups (*Table 15*).

Subgroup analysis Harrison *et al.*[28] reported no statistically significant interaction effects between the ERS effect and pre-specified baseline variables (i.e. CHD risk factors, sex and age). Comparing high adherers (≥ 75% attendance at ERS) with low adherers (< 75% attendance at ERS) in the Isaacs *et al.* study,[61] 32 high adherers and 16 low adherers were achieving ≥ 150 minutes of moderate PA per week at 10 weeks. At 6 months, 41 high adherers and 29 low adherers were achieving ≥ 150 minutes of moderate PA per week. However, these proportions were not significantly different. In the Jolly *et al.* study,[68] age, gender, deprivation (Index of Multiple Deprivation score), ethnicity, depression at baseline and level of PA at baseline were assessed by regression methods as predictors of PA at 6 months. Only PA at baseline was associated with PA at the 6-month follow-up ($p < 0.001$).

Physical fitness

The studies by Taylor *et al.*,[27] Isaacs *et al.*[61] and Sorensen *et al.*[69] reported physical fitness outcomes (*Table 16*).

Exercise referral scheme versus usual care Taylor *et al.*[27] reported a lower (more favourable) submaximal heart rate (at 150 W) for ERS compared with usual care. Isaacs *et al.*[61] reported no significant differences in any of the physical fitness measures (submaximal bike and shuttle walk, isometric knee strength, leg extension power) between the ERS and usual care groups at follow-up except at 10 weeks for the submaximal bike ergometer test. Pooling of the cardiorespiratory measures (mode: cycle ergometer or cycle/walking) showed no difference between ERS and usual care (*Figure 8*). There was considerable evidence of statistical heterogeneity.

Study or subgroup	ERS Events	ERS Total	Comparator Events	Comparator Total	Weight	Risk ratio M–H, Fixed, 95% CI	Year
ERS vs usual care							
Stevens *et al.*[50]	204	363	174	351	59.8%	1.13 (0.99 to 1.30)	1998
Taylor *et al.*[27]	39	57	19	31	8.3%	1.12 (0.80 to 1.55)	1998
Harrison *et al.*[28]	40	155	32	157	10.8%	1.27 (0.84 to 1.90)	2005
Isaacs *et al.*[61]	70	179	66	200	21.1%	1.19 (0.91 to 1.55)	2007
Subtotal (95% CI)		**754**		**739**	**100%**	**1.16 (1.03 to 1.30)**	
Total events	353		291				
Heterogeneity: $\chi^2 = 0.35$, df = 3 ($p = 0.95$); $I^2 = 0\%$							
Test for overall effect: $z = 2.52$ ($p = 0.01$)							
ERS vs alternative PA intervention							
Isaacs *et al.*[61]	70	179	62	141	100%	0.89 (0.69 to 1.15)	2007
Subtotal (95% CI)		**179**		**141**	**100%**	**0.89 (0.69 to 1.15)**	
Total events	70		62				
Heterogeneity: not applicable							
Test for overall effect: $z = 0.88$ ($p = 0.38$)							
ERS vs alternative ERS							
Jolly *et al.*[68]	66	156	83	169	100%	0.86 (0.68 to 1.09)	2010
Subtotal (95% CI)		**156**		**169**	**100%**	**0.86 (0.68 to 1.09)**	
Total events	66		83				
Heterogeneity: not applicable							
Test for overall effect: $z = 1.22$ ($p = 0.22$)							

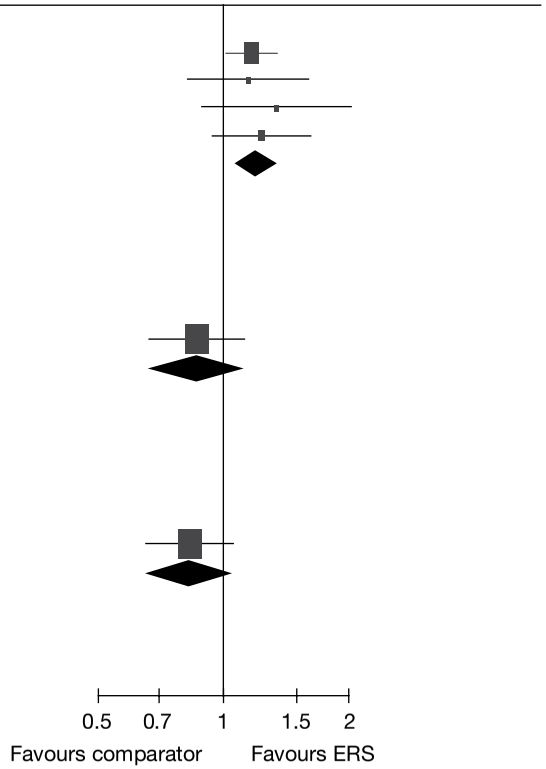

FIGURE 2 Meta-analysis of the number of patients achieving 90–150 minutes of at least moderate-intensity PA per week at 6–12 months' follow-up (denominators as reported by authors).

Study or subgroup	ERS Events	ERS Total	Comparator Events	Comparator Total	Weight	Risk ratio M–H, Fixed, 95% CI	Year
ERS vs usual care							
Stevens *et al*.[50]	204	363	174	351	58.7%	1.13 (0.99 to 1.30)	1998
Taylor *et al*.[27]	39	97	19	45	8.6%	0.95 (0.63 to 1.45)	1998
Harrison *et al*.[28]	40	275	32	270	10.7%	1.23 (0.80 to 1.89)	2005
Isaacs *et al*.[61]	70	317	66	315	22.0%	1.05 (0.78 to 1.42)	2007
Subtotal (95% CI)		**1052**		**981**	**100%**	**1.11 (0.99 to 1.25)**	
Total events	353		291				
Heterogeneity: $\chi^2 = 0.92$, df = 3 ($p = 0.82$); $I^2 = 0\%$							
Test for overall effect: $z = 1.71$ ($p = 0.09$)							
ERS vs alternative PA intervention							
Isaacs *et al*.[61]	70	317	62	311	100%	1.11 (0.82 to 1.50)	2007
Subtotal (95% CI)		**317**		**311**	**100%**	**1.11 (0.82 to 1.50)**	
Total events	70		62				
Heterogeneity: not applicable							
Test for overall effect: $z = 0.66$ ($p = 0.51$)							
ERS vs alternative ERS							
Jolly *et al*.[68]	66	163	83	184	100%	0.90 (0.70 to 1.15)	2010
Subtotal (95% CI)		**163**		**184**	**100%**	**0.90 (0.70 to 1.15)**	
Total events	66		83				
Heterogeneity: not applicable							
Test for overall effect: $z = 0.86$ ($p = 0.39$)							

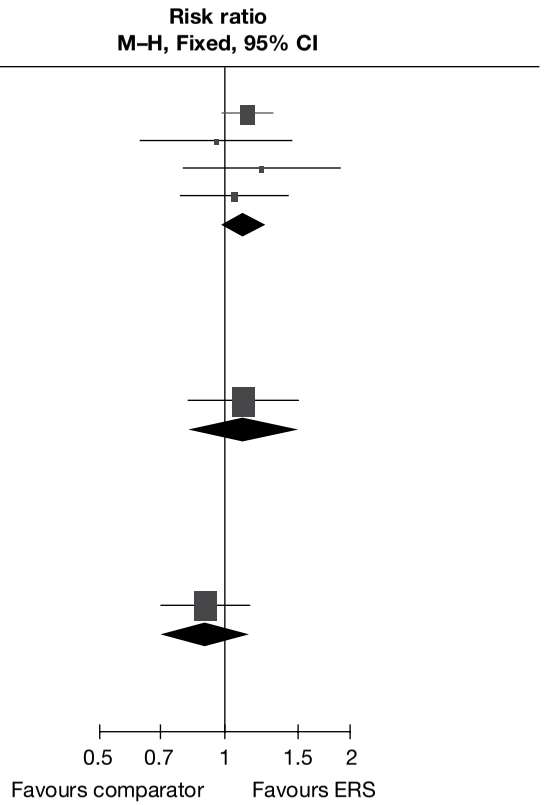

FIGURE 3 Meta-analysis of the number of patients achieving 90–150 minutes of at least moderate-intensity PA per week at 6–12 months' follow-up (denominators adjusted to all randomised – ITT analysis).

Study or subgroup	ERS Mean	ERS SD	ERS Total	Comparator Mean	Comparator SD	Comparator Total	Weight	Mean difference IV, Fixed, 95% CI	Year
ERS vs usual care									
Taylor *et al.*[27]	158	228	36	162	244.9	31	2.0%	–4.00 (–117.93 to 109.93)	1998
Isaacs *et al.*[61]	65	106	301	58	98	305	98.0%	7.00 (–9.26 to 23.26)	2007
Subtotal (95% CI)			**337**			**336**	**100%**	**6.78 (–9.32 to 22.88)**	
Heterogeneity: $\chi^2 = 0.04$, df = 1 ($p = 0.85$); $I^2 = 0\%$									
Test for overall effect: $z = 0.83$ ($p = 0.41$)									
ERS vs alternative PA intervention									
Isaacs *et al.*[61]	65	106	301	89	150	300	100%	–24.00 (–44.77 to –3.23)	2007
Subtotal (95% CI)			**301**			**300**	**100%**	**–24.00 (–44.77 to –3.23)**	
Heterogeneity: not applicable									
Test for overall effect: $z = 2.26$ ($p = 0.02$)									
ERS vs alternative ERS									
Jolly *et al.*[68]	249	356	163	246	343	184	100%	3.00 (–70.78 to 76.78)	2010
Subtotal (95% CI)			**163**			**184**	**100%**	**3.00 (–70.78 to 76.78)**	
Heterogeneity: not applicable									
Test for overall effect: $z = 0.08$ ($p = 0.94$)									

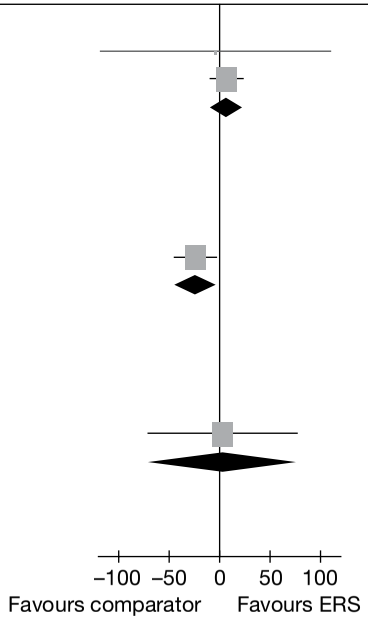

FIGURE 4 Meta-analysis of patient's minutes spent in at least moderate-intensity PA per week at 6–12 months' follow-up. SD, standard deviation.

Study or subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean difference IV, Fixed, 95% CI	Year
ERS vs usual care									
Taylor *et al.*[27]	34.1	2.4	36	33.9	2.2	31	93.7%	0.20 (–0.90 to 1.30)	1998
Isaacs *et al.*[61]	38.0	26.5	301	38.0	26.7	305	6.3%	0.00 (–4.24 to 4.24)	2007
Subtotal (95% CI)			**337**			**336**	**100%**	**0.19 (–0.88 to 1.25)**	
Heterogeneity: $\chi^2 = 0.01$, df = 1 ($p = 0.93$); $I^2 = 0\%$									
Test for overall effect: $z = 0.34$ ($p = 0.73$)									

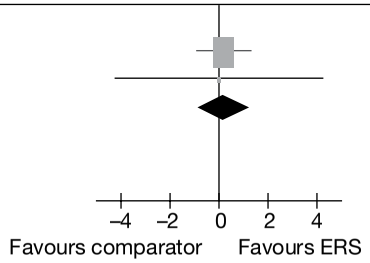

FIGURE 5 Meta-analysis of energy expenditure (kcal/kg/day) ERS vs usual care at 6–12 months' follow-up. SD, standard deviation.

Study or subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean difference IV, Fixed, 95% CI	Year
ERS vs usual care									
Isaacs *et al.*[61]	692	496	301	647	463	305	100%	45.00 (–31.42 to 121.42)	2007
Subtotal (95% CI)			**301**			**305**	**100%**	**45.00 (–31.42 to 121.42)**	
Heterogeneity: not applicable									
Test for overall effect: $z = 1.15$ ($p = 0.25$)									
ERS vs alternative PA intervention									
Isaacs *et al.*[61]	692	496	301	759	539	300	50.6%	–67.00 (–149.82 to 15.82)	2007
Sorensen *et al.*[69]	20	124	21	20	152	21	49.4%	0.00 (–83.90 to 83.90)	2008
Subtotal (95% CI)			**322**			**321**	**100%**	**–33.93 (–92.87 to 25.01)**	
Heterogeneity: $\chi^2 = 1.24$, df = 1 ($p = 0.27$); $I^2 = 19\%$									
Test for overall effect: $z = 1.13$ ($p = 0.26$)									
ERS vs alternative ERS									
Subtotal (95% CI)			0			0		Not estimable	
Heterogeneity: not applicable									
Test for overall effect: not applicable									

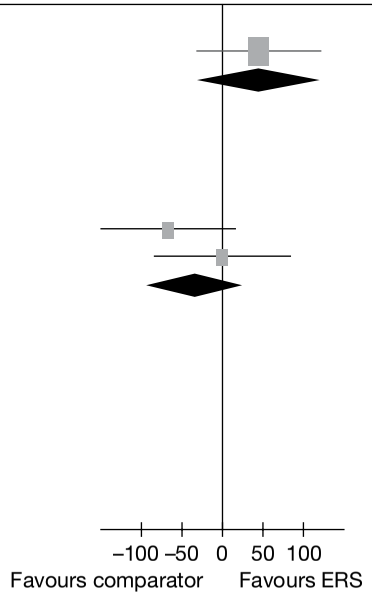

FIGURE 6 Meta-analysis of patient's minutes of total PA/week at 6–12 months' follow-up. SD, standard deviation.

Study or subgroup	ERS Mean	SD	Total	Comparator Mean	SD	Total	Weight	Std mean difference IV, Fixed, 95% CI	Year
ERS vs alternative PA intervention									
Isaacs *et al.*[61]	38	26.5	301	42	26.5	300	93.7%	–0.15 (–0.31 to 0.01)	2007
Sorensen *et al.*[69]	41	2.1	21	40	5.0	20	6.3%	0.26 (–0.36 to 0.87)	2008
Subtotal (95% CI)			**322**			**320**	**100%**	**–0.12 (–0.28 to 0.03)**	
Heterogeneity: $\chi^2 = 1.59$, df = 1 ($p = 0.21$); $I^2 = 37\%$									
Test for overall effect: $z = 1.58$ ($p = 0.11$)									

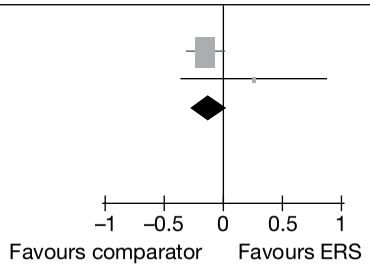

FIGURE 7 Meta-analysis of energy expenditure ERS vs alternative PA intervention at 6–12 months' follow-up. SD, standard deviation.

TABLE 16 Summary of physical fitness data at follow-up in included ERS trials

Study and time of follow-up	Mean predicted heart rate at a workload of 150 W		VO_{2max} (ml/kg/minute)		Submaximal bike ergometer (minutes)		Submaximal shuttle walk (m)		Isometric knee strength (N)		Leg extension power (W)	
	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)
ERS vs usual care												
Taylor et al.[27]												
16 weeks[a]	138.6 (23.0)	147.2 (29.7)[b]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
26 weeks[a]	136.3 (22.6)	142.3 (28.5)[b]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
37 weeks[a]	134.2 (19.0)	146.0 (24.2)[c]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
Isaacs et al.[61]												
10 weeks[a]	Not reported	Not reported	Not reported	Not reported	9.65 (1.5)	8.87 (1.5)[c]	456 (102)	434 (104)[b]	277 (54)	265 (56)[b]	174 (31)	165 (31)[b]
6 months[a]	Not reported	Not reported	Not reported	Not reported	8.86 (1.7)	9.08 (1.7)[b]	445 (96)	434 (97)[b]	265 (58)	267 (66)[b]	173 (66)	167 (68)[b]
	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)
ERS vs alternative: PA intervention												
Sorensen et al.[69]												
4 months[a]	Not reported	Not reported	23.8 (7.1)	21.7 (11.0)[b]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
10 months[a]	Not reported	Not reported	23.0 (8.2)	22.4 (12.7)[b]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
Isaacs et al.[61]												
10 weeks[a]	Not reported	Not reported	Not reported	Not reported	9.65 (1.5)	8.92 (1.7)[b]	456 (102)	437 (100)[b]	277 (54)	275 (58)[b]	174 (31)	166 (32)[b]
6 months[a]	Not reported	Not reported	Not reported	Not reported	8.86 (1.7)	8.92 (1.8)[b]	445 (96)	448 (95)[b]	265 (58)	264 (66)[b]	173 (66)	164 (68)[b]

N, newton; N/A: not applicable; SD, standard deviation; VO_{2max}, maximal oxygen uptake; W, watt.

a Numbers of individuals with complete data/questionnaires.

b Between-group difference not statistically significant at $p \leq 0.05$.

c Between-group differences statistically significant at $p \leq 0.05$.

Study or subgroup	ERS Mean	ERS SD	ERS Total	Comparator Mean	Comparator SD	Comparator Total	Weight	Std mean difference IV, Random, 95% CI	Year
ERS vs usual care (cycle ergometer)									
Taylor *et al.*[27]	146.20	24.2	25	134.20	19.0	32	43.6%	0.55 (0.02 to 1.09)	1998
Isaacs *et al.*[61]	8.86	1.7	142	9.08	1.7	130	56.4%	–0.13 (–0.37 to 0.11)	2007
Subtotal (95% CI)			**167**			**162**	**100%**	**0.17 (–0.49 to 0.83)**	
Heterogeneity: $\tau^2 = 0.19$; $\chi^2 = 5.22$, df = 1 ($p = 0.02$); $I^2 = 81\%$									
Test for overall effect: $z = 0.50$ ($p = 0.62$)									
ERS vs usual care (cycle/walking)									
Taylor *et al.*[27]	146.2	24.2	25	134.2	19	32	34.0%	0.55 (0.02 to 1.09)	1998
Isaacs *et al.*[61]	446.0	96.0	124	434.0	97	138	66.0%	0.12 (–0.12 to 0.37)	2007
Subtotal (95% CI)			**149**			**170**	**100%**	**0.27 (–0.13 to 0.67)**	
Heterogeneity: $\tau^2 = 0.05$; $\chi^2 = 2.05$, df = 1 ($p = 0.15$); $I^2 = 51\%$									
Test for overall effect: $z = 1.33$ ($p = 0.18$)									
ERS vs alternative PA intervention (cycle ergometer)									
Isaacs *et al.*[61]	8.86	1.7	142	8.97	1.8	125	87.2%	–0.06 (–0.30 to 0.18)	2007
Sorensen *et al.*[69]	23.00	8.2	19	22.40	12.7	20	12.8%	0.05 (–0.57 to 0.68)	2008
Subtotal (95% CI)			**161**			**145**	**100%**	**–0.05 (–0.27 to 0.18)**	
Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 0.12$, df = 1 ($p = 0.73$); $I^2 = 0\%$									
Test for overall effect: $z = 0.42$ ($p = 0.68$)									
ERS vs alternative PA intervention (cycle/walking)									
Isaacs *et al.*[61]	446	96.0	124	448.0	95.0	141	87.1%	–0.02 (–0.26 to 0.22)	2007
Sorensen *et al.*[69]	23	8.2	19	22.4	12.7	20	12.9%	0.05 (–0.57 to 0.68)	2008
Subtotal (95% CI)			**143**			**161**	**100%**	**–0.01 (–0.24 to 0.21)**	
Heterogeneity: $\tau^2 = 0.00$; $\chi^2 = 0.05$, df = 1 ($p = 0.83$); $I^2 = 0\%$									
Test for overall effect: $z = 0.10$ ($p = 0.92$)									

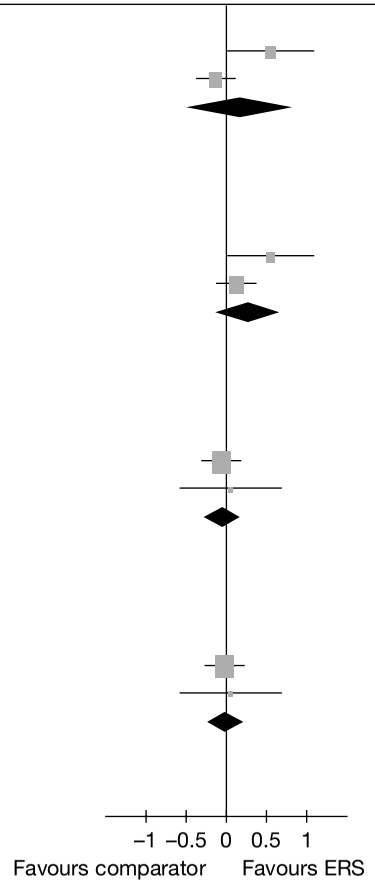

FIGURE 8 Meta-analysis of patient's physical fitness, at 6–12 months' follow-up. SD, standard deviation.

Exercise referral scheme versus alternative physical activity intervention Isaacs *et al.*[61] and Sorensen *et al.*[69] reported no significant differences in any of the physical fitness measures between the ERS and the alternative PA intervention groups at follow-up (see *Figure 8*).

Exercise referral scheme versus exercise referral scheme plus self-determination theory The study of Jolly *et al.*[68] did not assess physical fitness.

Clinical factors

Five studies[27,61,68–70] provided information on clinical outcomes, i.e. CHD risk factors (*Table 17*), weight and obesity measures (*Table 18*) and respiratory function (*Table 19*).

Exercise referral scheme versus usual care Taylor *et al.*[27] reported percentage of body fat in ERS participants compared with usual care at follow-up. Gusi *et al.*[70] reported a lower BMI, with no other between-group differences in weight and body fat outcomes for the other measured clinical factors (*Figures 9* and *10*). There was no significant difference in resting blood pressure, serum lipids or respiratory function between ERS and usual care at follow-up (*Figures 11* and *12*).

Exercise referral scheme versus alternative physical activity intervention In both the studies by Isaacs *et al.*[61] and Sorensen *et al.*[69] there were no significant between-group differences at follow-up in resting blood pressure (*Figures 9* and *10*), BMI (*Figure 9*), body fat outcomes, serum lipids and respiratory function. The Sorensen *et al.*[69] trial reported reduced levels of glycosylated haemoglobin (HbA_{1c}) in both the ERS group (mean –0.26%, 95% CI –0.79% to 0.27%) and the PA counselling group (mean –0.23, 95% CI –0.47 to 0.02) at 4-month follow-up, although there was no difference between groups.

Exercise referral scheme versus exercise referral scheme plus self-determination theory Jolly *et al.*[68] reported no significant difference between standard ERS and ERS plus SDT in body mass index (BMI) or resting blood pressure.

Psychological well-being

Four studies[61,68,70,71] reported psychological well-being outcomes and are summarised in *Table 20*.

Exercise referral scheme versus usual care Taylor and Fox[71] reported physical self-perceptions measures, with improvements shown in physical self-worth (PSW), and perceptions of physical condition and physical health collected physical self-perceptions data, and reported significant in the ERS group compared with usual-care group at 16 and 37 weeks. Isaacs *et al.*[61] reported no differences between the ERS and usual-care groups in the anxiety and depression scores using the Hospital Anxiety Depression Scale (HADS) at 6 months. In the Gusi *et al.*[70] study, all measures [Geriatric Depression Scale, State Trait Anxiety Inventory and the anxiety/depression subscale of the European Quality of Life-5 Dimensions (EQ-5D)] at 6 months were found to favour ERS participants compared with those receiving the usual care.

Exercise referral scheme versus alternative physical activity intervention Isaacs *et al.*[61] reported no differences between the ERS and walking programme in anxiety or depression outcomes at 6 months' follow-up.

Exercise referral scheme versus exercise referral scheme plus self-determination theory Jolly *et al.*[68] reported no difference between groups in anxiety or depression outcomes at either 3 or 6 months' follow-up.

Health-related quality of life

Four studies[61,68–70] reported HRQoL, as summarised in *Table 21*.

TABLE 17 Summary of CHD risk factors in included ERS trials

Study and time of follow-up	SBP (mmHg)		DBP (mmHg)		Cholesterol (mmol/l)		High-density lipoproteins (mmol/l)		Low-density lipoproteins (mmol/l)		Triglycerides (mmol/l)	
	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)
ERS vs usual care												
Taylor et al.[27]												
16 weeks[a]	130 (14.5)	130 (14)[b]	84 (8)	84 (8)[b]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
26 weeks[a]	130 (14)	131 (14)[b]	84 (8)	84 (8)[b]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
37 weeks[a]	130 (17)	131 (18)[b]	85 (9)	83 (9)[b]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
Isaacs et al.[61]												
10 weeks	133 (10)	132 (10)[b]	82 (6)	83 (6)[b]	5.68 (0.53)	5.71 (0.42)[b]	1.35 (0.18)	1.35 (0.18)[b]	3.41 (0.46)	3.44 (0.47)[b]	2.12 (0.71)	2.14 (0.71)[b]
6 months	133 (12)	133 (12)[b]	82 (6)	82 (7)[b]	5.65 (0.50)	5.60 (0.50)[b]	1.37 (0.25)	1.38 (0.17)[b]	3.40 (0.48)	3.37 (0.50)[b]	2.04 (0.74)	2.00 (0.84)[b]
	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)
ERS vs alternative PA intervention												
Isaacs et al.[61]												
10 weeks	133 (10)	134 (10)[b]	82 (6)	84 (6)[b]	5.68 (0.53)	5.69 (0.53)[b]	1.35 (0.18)	1.33 (0.17)[b]	3.41 (0.46)	3.45 (0.46)[b]	2.12 (0.71)	2.05 (0.76)[b]
6 months	133 (12)	134 (12)[b]	82 (6)	83 (6)[b]	5.65 (0.50)	5.56 (0.57)[b]	1.37 (0.25)	1.37 (0.16)[b]	3.40 (0.48)	3.36 (0.48)[b]	2.04 (0.74)	1.95 (0.74)[b]
	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)
ERS vs ERS plus SDT												
Jolly et al.[68]												
6 months[a]	130 (17)	127 (16)[b]	82 (11)	79 (11)[b]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported

DBP, diastolic blood pressure; N/A, not applicable; SD, standard deviation.

a Numbers of individuals with complete data.

b Between-group difference not statistically significant at $p \leq 0.05$.

TABLE 18 Summary of weight and measures of obesity outcomes in included ERS trials

Study and time of follow-up	Weight (kg)		BMI (kg/m^2)		Body fat (%)[a]		Waist–hip ratio (cm)	
	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)
ERS vs usual care								
Taylor et al.[27]								
16 weeks[b]	Not reported	Not reported	27.5 (0.6)	27.6 (0.6)[c]	70 (8)	76 (8)[d]	0.87 (0.08)	0.83 (0.09)[c]
26 weeks[b]	Not reported	Not reported	27.3 (1.3)	27.5 (1.1)[c]	70 (11)	75 (11)[d]	0.87 (0.08)	0.83 (0.09)[c]
37 weeks[b]	Not reported	Not reported	27.5 (1.3)	27.6 (1.1)[c]	71 (13)	76 (13)[d]	0.87 (0.08)	0.84 (0.09)[c]
Isaacs et al.[61]								
10 weeks[e]	81 (3)	81 (3)[c]	30.2 (0.8)	30.1 (1.5)[c]	37.4 (1.9)	37.5 (1.9)[c]	0.88 (0.06)	0.89 (0)[c]
6 months[e]	82 (3)	82 (3)[c]	30.5 (1.1)	30.4 (1.1)[c]	37.8 (2.4)	37.8 (2.4)[c]	0.88 (0)	0.88 (0)[c]
Gusi et al.[70]								
6 months[b]	Not reported	Not reported	29.7 (4.2)	30.6 (4.3)[d]	Not reported	Not reported	Not reported	Not reported

continued

TABLE 18 Summary of weight and measures of obesity outcomes in included ERS trials *(continued)*

Study and time of follow-up	Weight (kg)		BMI (kg/m^2)		Body fat (%)[a]		Waist–hip ratio (cm)	
	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)	ERS, mean (SD)	Alternative PA, mean (SD)
ERS vs alternative PA intervention								
[f]*Sorensen* et al.[69]								
4 months[b]	–1.1 (4)	–1.1 (4)[c]	–0.3 (1.3)	–0.04 (1.6)[c]	Not reported	Not reported	Not reported	Not reported
10 months[b]	–0.3 (4.4)	–0.3 (4.4)[c]	–0.1 (1.9)	–0.6 (2.8)[c]	Not reported	Not reported	Not reported	Not reported
Isaacs et al.[61]								
10 weeks[e]	81 (3)	81 (3)[c]	30.2 (0.8)	30.2 (1.6)[c]	37.4 (1.9)	37.1 (1.9)[c]	0.88 (0.06)	0.88 (0.06)[c]
6 months[e]	82 (3)	82 (3)[c]	30.5 (1.1)	30.5 (1.1)[c]	37.8 (2.4)	37.8 (1.1)[c]	0.88 (0)	0.88 (0)[c]
	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)	ERS, mean (SD)	ERS plus SDT, mean (SD)
ERS vs ERS plus SDT								
Jolly et al.[68]								
6 months[e]	Not reported	Not reported	32.8 (6.9)	32.8 (6.4)[c]	Not reported	Not reported	Not reported	Not reported

N/A, not applicable; SD, standard deviation.
a Taylor *et al.*,[27] sum of four skinfolds (mm).
b Numbers of individuals with complete data.
c Between-group difference not statistically significant at $p \leq 0.05$.
d Between-group differences statistically significant at $p \leq 0.05$.
e All randomised participants.
f Mean change score.

TABLE 19 Summary of respiratory function outcomes in included ERS trials

	FEV/FVC ratio		PEF	
Study and time of follow-up	**ERS, mean (SD)**	**Usual care, mean (SD)**	**ERS, mean (SD)**	**Usual care, mean (SD)**
ERS vs usual care				
Isaacs et al.[61]				
10 weeks[a]	0.86 (0.0)	0.86 (0.06)[b]	417 (58)	409 (58)[b]
6 months[a]	0.86 (0.09)	0.86 (0.09)[b]	407 (115)	411 (117)[b]
	ERS, mean (SD)	**Alternative PA, mean (SD)**	**ERS, mean (SD)**	**Alternative PA, mean (SD)**
ERS vs alternative PA intervention				
Isaacs et al.[61]				
10 weeks[a]	0.86 (0.0)	0.85 (0.06)[b]	417 (58)	407 (61)[b]
6 months[a]	0.86 (0.09)	0.85 (0.09)[b]	407 (115)	416 (117)[b]

FEV, forced expiratory volume; FVC, forced vital capacity; PEF, peak expiratory flow; SD, standard deviation.
a All randomised participants.
b Between-group difference not statistically significant at $p \leq 0.05$.

Exercise referral scheme versus usual care Isaacs *et al.*[61] reported no differences between the ERS and usual-care groups at follow-up on the Short Form questionnaire-36 items (SF-36) mental health scale. Gusi *et al.*[70] observed higher EQ-5D scores in the ERS group than in the usual care group at 6 months.

Exercise referral scheme versus alternative physical activity intervention Isaacs[61] reported no differences between the ERS and walking groups at follow-up on the SF-36 mental health scale score. Similarly, Sorensen[69] found no differences between the groups at follow-up on the Short Form questionnaire-12 items (SF-12) mental and physical scales.

Exercise referral scheme vs exercise referral scheme plus self-determination theory Jolly *et al.*[68] reported no difference between groups in overall Dartmouth CO-OP chart score although there was a difference for the feelings subscale at 6 months in favour of the alternative ERS group (not tabularised).

Patient satisfaction

Three studies[27,28,61] reported patient satisfaction and results are summarised in *Table 22*.

Exercise referral scheme versus usual care The Harrison *et al.* study[28] reported that the ERS group were significantly more satisfied with the information they received and felt they needed less information about PA, compared with usual care group. In the Taylor *et al.*[27] study, comments about the concept of ERS (measured at 8 weeks) identified that 50% of patients were positive, 35% had mixed feelings and 15% had only negative comments. Negative comments included a long waiting time before introductory session, lack of staff support, crowded facilities and inconvenient facility times.

Exercise referral scheme versus alternative physical activity intervention In the Isaacs *et al.*[61] study there was no between-group difference in participant satisfaction with received information or the need for additional information. In the ERS group, 97.8% felt better for taking part and enjoyed the programme compared with 93.8% feeling better for taking part and 95.2% enjoying the programme for the walking group.

Study or subgroup	ERS Mean	ERS SD	ERS Total	Comparator Mean	Comparator SD	Comparator Total	Weight	Mean difference IV, Fixed, 95% CI	Year
ERS vs usual care									
Taylor *et al.*[27]	130	17	40	131	17.8	31	4.8%	–1.00 (–9.19 to 7.19)	1998
Isaacs *et al.*[61]	133	11.8	317	133	11.7	314	95.2%	0.00 (–1.83 to 1.83)	2007
Subtotal (95% CI)			**357**			**345**	**100%**	**–0.05 (–1.84 to 1.74)**	
Heterogeneity: $\chi^2 = 0.05$, df = 1 ($p = 0.82$); $I^2 = 0\%$									
Test for overall effect: $z = 0.05$ ($p = 0.96$)									
ERS vs alternative PA intervention									
Isaacs *et al.*[61]	133	11.8	317	134	11.7	311	100%	–1.00 (–2.84 to 0.84)	2007
Subtotal (95% CI)			**317**			**311**	**100%**	**–1.00 (–2.84 to 0.84)**	
Heterogeneity: not applicable									
Test for overall effect: $z = 1.07$ ($p = 0.29$)									
ERS vs alternative ERS									
Jolly *et al.*[68]	130	17	77	127	16	73	100%	3.00 (–2.28 to 8.28)	2010
Subtotal (95% CI)			**77**			**73**	**100%**	**3.00 (–2.28 to 8.28)**	
Heterogeneity: not applicable									
Test for overall effect: $z = 1.11$ ($p = 0.27$)									

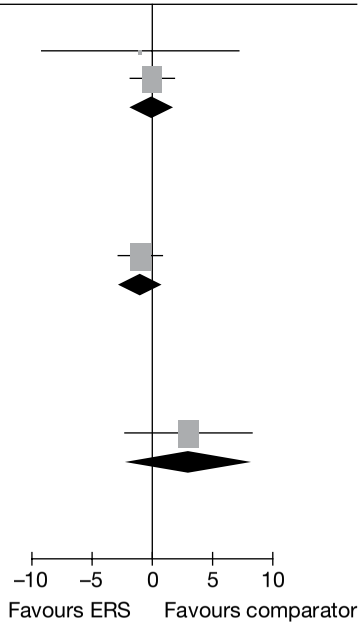

FIGURE 9 Meta-analysis of SBP at 6–12 months' follow-up. SD, standard deviation.

Study or subgroup	ERS Mean	ERS SD	ERS Total	Comparator Mean	Comparator SD	Comparator Total	Weight	Mean difference IV, Fixed, 95% CI	Year
ERS vs usual care									
Taylor *et al.*[27]	85	9.4	40	83	9.5	31	5.4%	2.00 (–2.44 to 6.44)	1998
Isaacs *et al.*[61]	82	6.3	317	82	7.2	315	94.6%	0.00 (–1.06 to 1.06)	2007
Subtotal (95% CI)			**357**			**346**	**100%**	**0.11 (–0.92 to 1.13)**	
Heterogeneity: $\chi^2 = 0.74$, df = 1 ($p = 0.39$); $I^2 = 0\%$									
Test for overall effect: $z = 0.20$ ($p = 0.84$)									
ERS vs alternative PA intervention									
Isaacs *et al.*[61]	82	6.3	317	83	6.3	311	100%	–1.00 (–1.99 to –0.01)	2007
Subtotal (95% CI)			**317**			**311**	**100%**	**–1.00 (–1.99 to –0.01)**	
Heterogeneity: not applicable									
Test for overall effect: $z = 1.99$ ($p = 0.05$)									
ERS vs alternative ERS									
Jolly *et al.*[68]	82	11	76	79	11	73	100%	3.00 (–0.53 to 6.53)	2010
Subtotal (95% CI)			**76**			**73**	**100%**	**3.00 (–0.53 to 6.53)**	
Heterogeneity: not applicable									
Test for overall effect: $z = 1.66$ ($p = 0.10$)									

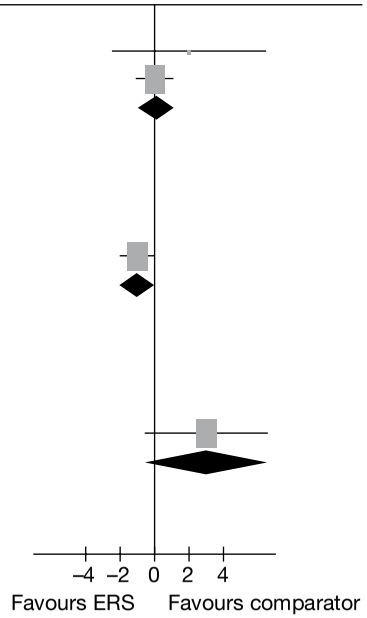

FIGURE 10 Meta-analysis of diastolic blood pressure at 6–12 months' follow-up. SD, standard deviation.

Study or subgroup	ERS Mean	ERS SD	ERS Total	Comparator Mean	Comparator SD	Comparator Total	Weight	Mean difference IV, Fixed, 95% CI	Year
ERS vs usual care									
Taylor *et al.*[27]	27.50	1.2	40	27.60	1.1	31	7.7%	–0.10 (–0.64 to 0.44)	1998
Isaacs *et al.*[61]	30.47	1.0	317	30.44	1.0	315	91.4%	0.03 (–0.13 to 0.19)	2007
Gusi *et al.*[60]	29.40	4.2	55	30.60	4.3	51	0.8%	–1.20 (–2.82 to 0.42)	2008
Subtotal (95% CI)			**412**			**397**	**100%**	**0.01 (–0.14 to 0.16)**	
Heterogeneity: $\chi^2 = 2.37$, df = 2 ($p = 0.31$); $I^2 = 16\%$									
Test for overall effect: $z = 0.13$ ($p = 0.90$)									
ERS vs alternative PA intervention									
Isaacs *et al.*[61]	30.47	1.0	317	30.48	1.0	311	98.8%	–0.01 (–0.17 to 0.15)	2007
Sorensen *et al.*[69]	–0.10	1.8	21	–0.60	2.8	21	1.2%	0.50 (–0.92 to 1.92)	2008
Subtotal (95% CI)			**338**			**332**	**100%**	**–0.00 (–0.16 to 0.15)**	
Heterogeneity: $\chi^2 = 0.49$, df = 1 ($p = 0.49$); $I^2 = 0\%$									
Test for overall effect: $z = 0.05$ ($p = 0.96$)									
ERS vs alternative ERS									
Jolly *et al.*[68]	32.8	6.9	160	32.8	6.4	173	100%	0.00 (–1.43 to 1.43)	2010
Subtotal (95% CI)			**160**			**173**	**100%**	**0.00 (–1.43 to 1.43)**	
Heterogeneity: not applicable									
Test for overall effect: $z = 0.00$ ($p = 1.00$)									

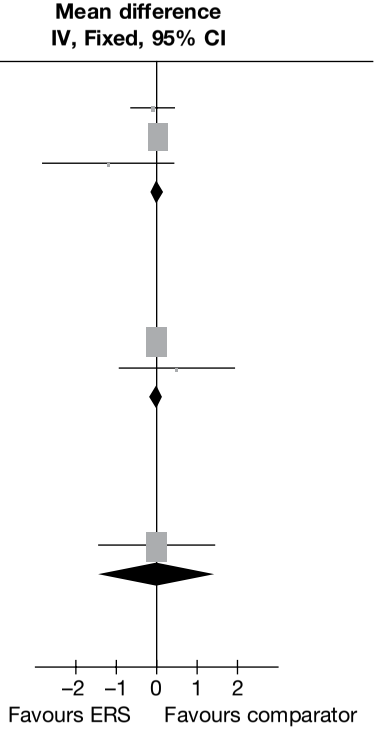

FIGURE 11 Meta-analysis of BMI at 6–12 months' follow-up. SD, standard deviation.

Study or subgroup	ERS Mean	ERS SD	ERS Total	Comparator Mean	Comparator SD	Comparator Total	Weight	Std mean difference IV, Fixed, 95% CI	Year
ERS vs usual care									
Taylor *et al.*[27]	37.7	2.3	317	37.8	2.3	315	90.2%	–0.04 (–0.20 to 0.11)	1998
Isaacs *et al.*[61]	71.0	13.2	40	76.3	12.8	31	9.8%	–0.40 (–0.88 to 0.07)	2007
Subtotal (95% CI)			**357**			**346**	**100%**	**–0.08 (–0.23 to 0.07)**	
Heterogeneity: $\chi^2 = 1.99$, df = 1 ($p = 0.16$); $I^2 = 50\%$									
Test for overall effect: $z = 1.04$ ($p = 0.30$)									
ERS vs alternative PA intervention									
Isaacs *et al.*[61]	37.7	2.3	317	37.8	2.3	311	100%	–0.04 (–0.20 to 0.11)	2007
Subtotal (95% CI)			**317**			**311**	**100%**	**–0.04 (–0.20 to 0.11)**	
Heterogeneity: not applicable									
Test for overall effect: $z = 0.54$ ($p = 0.59$)									

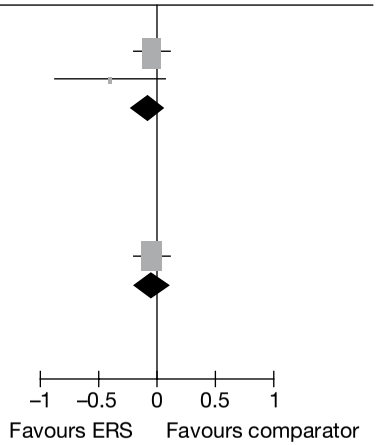

FIGURE 12 Meta-analysis of body fat at 6–12 months' follow-up. SD, standard deviation.

TABLE 20 Summary of psychological well-being data at follow-up in included ERS trials

Study	PSW		Anxiety		Depression		Anxiety/depression	
	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)
ERS vs usual care								
[a] *Taylor and Fox*[71]								
16 weeks[b]	2.31 (0.79)	2.31 (0.67)[c]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
37 weeks[b]	2.41 (0.79)	2.42 (0.54)[c]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
[d] *Isaacs* et al.[61]								
6 months[e]	Not reported	Not reported	6.9	7.1[f]	4.8	4.9[f]	Not reported	Not reported
Gusi et al.[70]								
6 months[e]	Not reported	Not reported	14.1 (9)	22.2 (9.8)[c]	1.8 (2.3)	2.9 (2.5)[c]	1.2 (0.4)	1.5 (0.7)[c]
	ERS, mean (SD)	**Alternative PA, mean (SD)**	**ERS, mean (SD)**	**Alternative PA, mean (SD)**	**ERS, mean (SD)**	**Alternative PA, mean (SD)**	**ERS, mean (SD)**	**Alternative PA, mean (SD)**
ERS vs alternative PA intervention								
[d] *Isaacs* et al.[61]								
6 months[e]	Not reported	Not reported	6.9	7.5[f]	4.8	5.1[f]	Not reported	Not reported
	ERS, mean (SD)	**ERS plus SDT, mean (SD)**	**ERS, mean (SD)**	**ERS plus SDT, mean (SD)**	**ERS, mean (SD)**	**ERS plus SDT, mean (SD)**	**ERS, mean (SD)**	**ERS plus SDT, mean (SD)**
ERS vs ERS plus SDT								
Jolly et al.[68]								
3 months[b]	Not reported	Not reported	7.7 (4.4)[f]	8.89 (4.3)	5.9 (4.2)[f]	6.68 (4.1)	Not reported	Not reported
6 months[b]	Not reported	Not reported	7.9 (4.8)[f]	8.86 (4.7)	6.1 (4.4)[f]	6.65 (4.3)	Not reported	Not reported

SD, standard deviation.

a Significant difference in change from baseline between groups.

b All randomised participants.

c Between-group differences statistically significant at $p \leq 0.05$.

d Only mean values available.

e Numbers of individuals with complete data/questionnaires.

f Between-group difference not statistically significant at $p \leq 0.05$.

TABLE 21 Summary of HRQoL data at follow-up in included ERS trials

Study and time of follow-up	SF-36 mental		SF-12 mental		SF-12 physical		EQ-5D		Dartmouth QoL (overall QoL scale)	
	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)	ERS, mean (SD)	Usual care, mean (SD)
ERS vs usual care										
[a]*Isaacs* et al.[61]										
6 months[b]	54.2	54.3[c]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
Gusi et al.[70]										
6 months[d]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	0.89 (0.18)	0.51 (0.2)[e]	Not reported	Not reported
	ERS, mean (SD)	**Alternative PA, mean (SD)**	**ERS, mean (SD)**	**Alternative PA, mean (SD)**	**ERS, mean (SD)**	**Alternative PA, mean (SD)**	**ERS, mean (SD)**	**Alternative PA, mean (SD)**	**ERS, mean (SD)**	**Alternative PA, mean (SD)**
ERS vs alternative PA intervention										
Sorensen et al.[69]										
4 months[b]	Not reported	Not reported	40 (10.7)	37 (11.9)[c]	49 (1017.6)	46 (13.1)[c]	Not reported	Not reported	Not reported	Not reported
10 months[b]	Not reported	Not reported	41 (10.8)	39 (10.9)[c]	51 (11.6)	45 (15.4)[c]	Not reported	Not reported	Not reported	Not reported
[a]*Isaacs* et al.[61]										
6 months[b]	54.3	53[c]	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
	ERS, mean (SD)	**ERS plus SDT, mean (SD)**	**ERS, mean (SD)**	**ERS plus SDT, mean (SD)**	**ERS, mean (SD)**	**ERS plus SDT, mean (SD)**	**ERS, mean (SD)**	**ERS plus SDT, mean (SD)**	**ERS, mean (SD)**	**ERS plus SDT, mean (SD)**
ERS vs ERS plus SDT										
Jolly et al.[68]										
3 months	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	3.16 (0.8)[c]	3.25 (0.7)[c]
6 months	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	3.15 (0.8)[c]	3.24 (0.8)[c]

QoL, quality of life; SD, standard deviation.
a Only mean values available.
b All randomised participants.
c Between-group difference not statistically significant at $p \leq 0.05$.
d Numbers of individuals with complete data/questionnaires.
e Between-group differences statistically significant at $p \leq 0.05$ (p-value calculated by authors of the present report).

TABLE 22 Summary of participant satisfaction in included ERS trials

	Satisfied with received information (%)		Needed further information (%)	
Study	**ERS**	**Usual care**	**ERS**	**Usual care**
ERS vs usual care				
Harrison et al.[28]				
3 months	92	69[a]	43	54[a]
	ERS	**Alternative PA**	**ERS**	**Alternative PA**
ERS vs alternative PA intervention				
Isaacs et al.[61]				
10 weeks	97	96[b]	15	17[b]

a Statistically significant at $p \leq 0.05$ (p-value calculated by authors of the present report).
b Difference not statistically significant at $p \leq 0.05$.

Exercise referral scheme versus exercise referral scheme plus self-determination theory Jolly *et al.*[68] did not assess participant satisfaction.

Adverse events

Although participation in ERS has the potential to lead to negative events (e.g. an increase in exercise-related musculoskeletal injuries or exercise-related cardiac complications), only the Isaacs *et al.*[61] study assessed such events. Using GP records, the authors assessed the change in consultations before and after ERS. There was evidence of a small increase in GP visits for falls and fractures in the ERS and walking groups compared with usual care control after the start of the study (*Table 23*).

Health-care utilisation

No studies reported hospitalisations, primary care visits or use of medication.

Summary

- Given the lack of standardisation of the ERS definition used by previous systematic reviews and the publication of further recent evidence, we undertook a de novo systematic review of the effectiveness of ERS.
- We undertook a search of electronic databases – MEDLINE (Ovid) 1990 to October 2009; EMBASE (Ovid) 1990 to October 2009; PsycINFO; The Cochrane Library (Wiley) 2009 v3 (CENTRAL, DARE, NHS HTA, NHS EED, HTA database), ISI Web of Knowledge (WOK); and SPORTDiscus; ongoing trials registry – and contacted experts in the field to identify unpublished studies. We limited our inclusion criteria to controlled studies (randomised or non-randomised) that met our ERS definition, i.e. (1) referral by a primary-care health-care professional to a third party, (2) that provided a PA programme tailored to individual needs and (3) an initial assessment and monitoring throughout the programme.
- Our systematic review identified seven RCTs (3030 participants: UK, $n = 5$; non-UK, $n = 2$). These studies and were heterogeneous in their population, interventions and comparators. Five studies compared ERS to usual care (e.g. PA advice), two compared ERS with an alternative PA-promoting strategy (i.e. walking programme or PA counselling) and one study compared traditional ERS with combined ERS plus SDT intervention. Although all studies recruited predominantly sedentary middle-aged adults who had at least one lifestyle

TABLE 23 Adverse events reported by the Isaacs *et al.*[61] UK study (GP visits)

Adverse events	Leisure centre	Walking control	Advice-only control
Visits for chest pain			
12–6 months before start of study	1 (%)	3	7
6 months before start of study	3 (%)	4	7
Start of study to 6 months	2 (%)	9	7
6–12 months after start of study	10 (%)	4	–
Visits for aches/pains			
12–6 months before start of study	54	48	56
6 months before start of study	62	53	55
Start of study to 6 months	52	42	44
6–12 months after start of study	63	44	–
Visits for sprains			
12–6 months before start of study	2	2	7
6 months before start of study	3	6	2
Start of study to 6 months	1	4	6
6–12 months after start of study	2	0	–
Visits for falls			
12–6 months before start of study	1	1	0
6 months before start of study	1	1	2
Start of study to 6 months	9	2	0
6–12 months after start of study	3	6	–
Visits for fractures			
12–6 months before start of study	0	1	1
6 months before start of study	0	0	0
Start of study to 6 months	1	0	0
6–12 months after start of study	0	4	–

risk factor (i.e. hypertension, raised serum cholesterol, smoking or being overweight), a number of the studies also included a proportion of specific medical diagnoses [i.e. myocardial infarction (MI), type 2 diabetes, obesity (BMI > 35 kg/m^2), hypertension and depression]. ERS mainly took place at a leisure centre and typically involved 10–12 weeks of exercise intervention, with the longest study reporting outcomes up to 6–12 months post baseline measures. Uptake (proportion of individuals randomised to ERS who attended the first exercise session) varied widely across studies (35–85%), as did adherence to the ERS intervention (programme completion rates of 25–86%).

- Studies were judged to have a low to moderate overall risk of bias. Outcome blinding for PA interventions of this nature is difficult to implement, with other quality issues generally poorly reported as opposed to not being implemented.
- The most consistently reported outcome was self-reported PA. Pooling across four studies, compared with usual care, 11% (95% CI –2% to 26%) more ERS participants achieved 90–150 minutes of at least moderate-intensity PA per week at 6–12 months' follow-up (ITT analysis). There was no significant difference in PA between ERS versus alternative PA promotion intervention or ERS versus ERS plus SDT at 6–12 months' follow-up. Other reported measures of PA (i.e. amount of total and moderate PA and energy expenditure) did not show a difference between ERS and usual care.

- No studies reported assessment of objective PA using, for example accelerometers. Validated self-report questionnaires were predominantly used.
- There was no consistent evidence of a difference at follow-up between ERS and comparator groups in respect of other outcomes, i.e. physical fitness, blood pressure, serum lipids, glycaemic control, obesity indices, respiratory function, psychological well-being and HRQoL. Only one study assessed adverse events, reporting a small increase in the rate of falls among those in both the ERS and walking programme compared with usual care.
- Although some studies reported within-group improvements (compared with baseline) in primary and secondary outcomes with ERS, these differences need to be interpreted with caution as they are subject to regression to the mean and/or a placebo/Hawthorne effect (therefore not tabularised/reported in *Results* section).
- None of the studies reported outcomes of ERS by disease-specific subpopulations.

Chapter 4

Systematic review of the cost-effectiveness of exercise referral schemes

Introduction

A systematic review of the literature was conducted to identify economic evidence on ERS as defined in the earlier stages of this report, i.e. schemes that involved referral from a primary health-care professional due to an underlying condition and access to a structured programme of exercise. Both economic evaluations and existing systematic reviews of economic evidence on exercise referral were considered for inclusion. By adhering to a relatively narrow definition of what constitutes ERS, a number of studies exploring the cost-effectiveness of PA were excluded on the basis that (1) they did not include a referral from a health-care professional; (2) they did not consider a population with an underlying health condition; or (3) they did not comprise a structured programme of exercise. In this respect, the findings of this economic review are intended to mirror those of the effectiveness review presented in *Chapter 3* of this report.

Methods

This review was conducted and reported in accordance with the PRISMA statement.[36]

Search strategy

Studies were identified using the methods described in *Chapter 3*. For inclusion in this economic systematic review, studies had to satisfy all the inclusion criteria outlined in *Chapter 3* and also include cost and/or cost-effectiveness data. Studies for possible inclusion were initially identified by reviewing titles.

Study selection

As described in *Chapter 3*.

Data extraction and critical appraisal methods

A data extraction framework was established to abstract information from economic evaluations identified for inclusion. For each study, data were extracted on the following: study objective, population characteristics, nature of the intervention and comparator, cost and cost-effectiveness findings and methodological strengths and weaknesses. Primary economic studies considered for review were formally appraised against recognised appraisal criteria for economic evaluations[74] and, where appropriate, decision-analytic models.[75] Data extraction was conducted independently by one reviewer (NA) and checked by a second (PT). Discrepancies were resolved by discussion within the research team. Systematic reviews identified as part of the literature search were also considered for inclusion.

Data synthesis

The findings of both the economic evaluations and systematic reviews identified are presented descriptively in the form of detailed tabular summaries. Given that only a small number of

primary studies were included in the review, a summary of each study, along with a commentary on the methods used, is provided below.

Results

Identification and selection of studies

The bibliographic searches identified three economic evaluations[50,61,70] of ERS that met our inclusion criteria (UK, $n = 2$; non-UK, $n = 1$). In addition, we included a model-based economic evaluation of brief interventions designed to promote PA developed to inform public health guidance issued by NICE.[76] This NICE evaluation considered ERS as one method of promoting PA in primary care. Although not published in a peer-reviewed journal, the full report of the study was available in the public domain (available at www.matrixknowledge.com/…/physical_activity_economic_modelling_report_april2006.pdf).

In addition to the primary economic evaluations, three systematic reviews of ERS were identified,[40,41,77] which included consideration of cost-effectiveness. Findings from the reviews and primary studies are reported separately below. See *Figure 13* for details.

Findings of previous systematic reviews

Two systematic reviews of the effectiveness of ERS included consideration of the cost-effectiveness evidence on ERS.[40,41] A quality appraisal of these systematic reviews is presented in *Chapter 3*. A third systematic review,[77] conducted to inform the development of NICE guidance, specifically considered evidence on the cost-effectiveness of ERS.

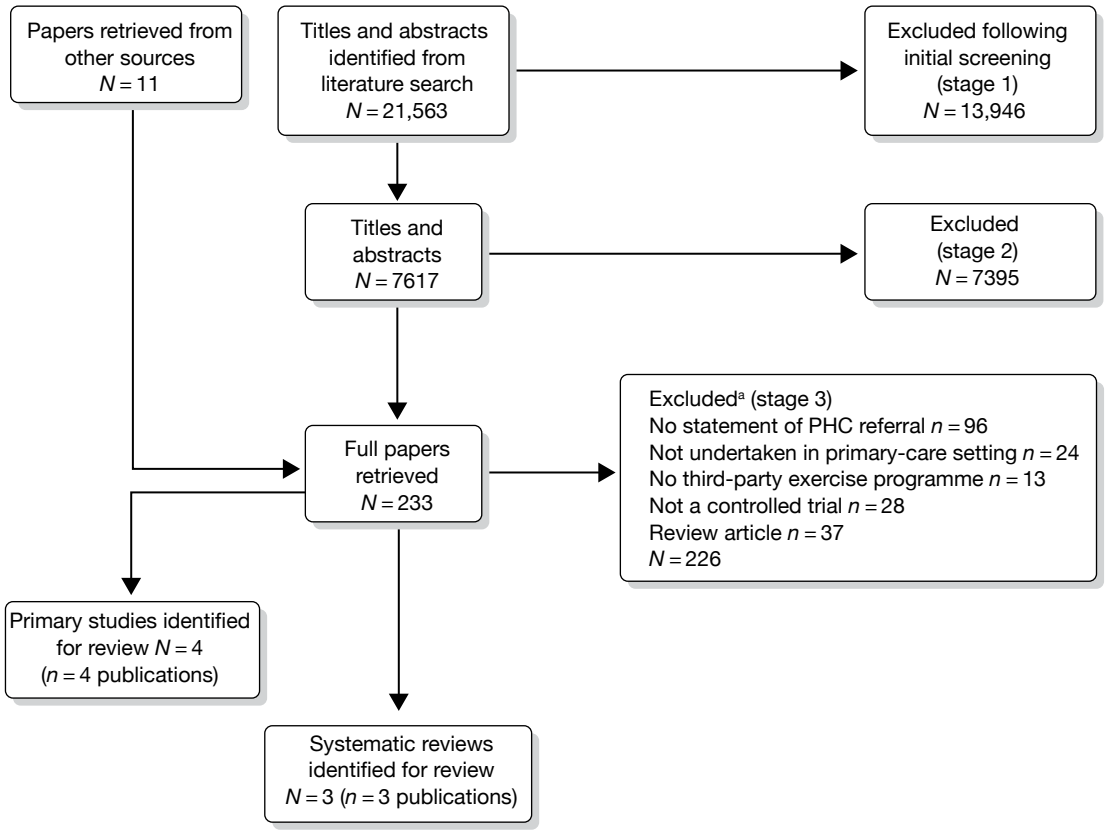

FIGURE 13 Study inclusion process for ERS cost-effectiveness systematic review. PHC, primary health care.

Table 24 summarises the objectives, methods and findings of the systematic reviews and highlights notable differences in the definition of ERS and the inclusion criteria applied. All three studies considered referral to exercise by a health-care professional in primary care. However, the review conducted to inform the development of NICE guidance adopted a broader definition of interventions, including the use of pedometers and community-based interventions as well as exercise referral. Although the NICE review focused specifically on economic evidence, the other reviews considered economic evidence alongside the evidence on clinical effectiveness, including uptake levels of PA and other effectiveness outcomes.

The findings of the three reviews differ somewhat. The review conducted for NICE[77] concluded that most brief interventions to promote PA are marginally more costly than a 'do-nothing' alternative, but generate improved long-term outcomes. The evidence relating to exercise referral was equivocal, with one study reporting that intervention was less costly and more effective (i.e. a dominant strategy) than the comparator, three studies reporting it to be more costly and more effective, and one study reporting it to be more costly and equally effective. On balance the authors indicate that the economic case for brief PA promotion interventions is largely

TABLE 24 Summary of systematic reviews of cost-effectiveness of ERS

Author	Objectives of review (stated by authors)	Databases/ dates covered by search	ERS definition	Inclusion criteria	Findings
NICE (2006)[77]	Identify economic studies of brief interventions in primary care aimed at improving PA: pedometers, exercise referral, and walking and cycling programmes in the community	NHS EED (1994 to August 2005); HEED (1958 to August 2008)	Referral by a member of the primary-care team to facilities such as leisure centres or gyms for supervised exercise programmes	Studies that assessed the cost-effectiveness of one of the four interventions to increase PA in the adult population	The evidence relating to exercise referral was equivocal with one study reporting that intervention was less costly and more effective (dominant strategy) than the comparator, three studies reporting it to be more costly and more effective, and one study reporting it to be more costly and equally effective
Sorensen *et al.* (2006)[40]	1. Does EoP increase PA level or physical fitness, and is more intensive exercise on referral more effective than less intensive? 2. Is EoP acceptable and feasible in general practice, and for sedentary patients? And is EoP cost-effective?	MEDLINE; WinSPIRS; NLM Gateway 2005	Exercise prescribed by GP or other primary-care staff where EoP included more than just simple advice	Sedentary adults with signs of lifestyle disease Peer-reviewed studies Reported PA or VO_{2max} Follow-up ≥6 months	ERS is a cost-effective intervention compared with usual care
Williams *et al.* (2007)[41]	Assess whether ERS is cost-effective in improving exercise participation in sedentary adults	MEDLINE; AMED; EMBASE; CINAHL; PsycINFO; SPORTDiscus; The Cochrane Library; SIGLE 2007	Referred adults from primary care to intervention where encouraged to increase PA; initial assessment; tailored programme; monitoring	RCT; non-RCT; observational; process evaluation; qualitative Any outcome	ERS is marginally more costly than a 'do-nothing' approach, but that inadequacies in the evidence of effectiveness mean that it is not possible to determine whether or not it is a cost-effective use of resources

AMED, Allied and Complementary Medicine Database; CINAHL, Cumulative Index to Nursing and Allied Health Literature; HEED, Health Economic Evaluations Database; NLM Gateway, National Library of Medicine Gateway; SIGLE, System for Information on Grey Literature In Europe; WinSPIRS, Windows Silver Platter Information Retrieval System.

positive, although the authors highlight concerns about the applicability of some of the evidence considered to the NHS.

The review by Sorensen *et al.*[40] indicated ERS to be a cost-effective intervention compared with usual care. This finding appears to be based on a single economic study.[78] Williams *et al.*[41] examined three UK-based studies and concluded that there is little evidence to suggest that ERS improves outcomes. On this basis, they conclude that an ERS is marginally more costly than usual care, but that inadequacies in the evidence of effectiveness mean that it is not possible to determine whether or not it is a cost-effective use of resources.

The degree to which the conclusions of the reviews differ is, at least in part, due to differences in the inclusion criteria adopted by the reviews. *Table 25* shows the lack of consistency in the studies included in the reviews.

Given the variation in the definition of ERS used, it is unsurprising that there were inconsistencies in the number of primary studies identified for inclusion in each of the reviews. This, together with the publication of recent trials of ERS, underscored the need for a de novo systematic review that used a standardised definition of ERS. The findings of this de novo review are presented in the following sections.

Findings of primary economic evaluations

Four economic evaluations were identified for inclusion in this systematic review. These comprised three trial-based economic evaluations of ERS[50,61,70] and one model-based evaluation[76] of the cost-effectiveness of brief interventions in primary care to promote PA, including ERS. Three of the studies were based on UK populations,[50,61,76] whereas one trial-based analysis was conducted in Spain.[70] Given the number of studies identified, a summary of each study is presented below along with a commentary on the quality of the study and the implications of the findings (detailed data extraction in *Appendix 5*).

Trial-based economic evaluations

Stevens *et al.*[50] assessed the cost-effectiveness of a primary care-based intervention aimed at increasing levels of PA in inactive people aged 45–74 years (further details of the study design, population and interventions are available in *Chapter 3*). The study comprised an economic evaluation conducted alongside an RCT. A within-trial analysis was undertaken and no attempt was made to extrapolate the findings beyond the duration of the study (8 months). Although not explicitly stated, the perspective of the analysis appears to be that of the health service. Costs were derived in a top-down manner, i.e. the total costs of administering the ERS scheme were divided by the number of participants to generate a mean cost per participant. Some adjustment

TABLE 25 Studies included in previous systematic reviews of cost-effectiveness of ERS

	Systematic reviews		
Primary studies	NICE (2006)[77]	Sorensen *et al.* (2006)[40]	Williams *et al.* (2007)[41]
Stevens *et al.* (1998)[50]	✓		✓
Lowensteyn *et al.* (2000)[79]	✓		
Sevick *et al.* (2000)[80]	✓		
Sevick *et al.* (2000)[81]	✓		
Elley *et al.* (2004)[78]	✓	✓	
Munro *et al.* (2004)[82]			✓
Isaacs *et al.* (2007)[61]			✓

was made to exclude costs associated with the research, as differentiated from administration of the intervention. As a result, it was not possible to report disaggregated estimates of resource use and costs.

Evidence on costs was synthesised with evidence on effectiveness to generate cost-effectiveness estimates. A number of outcomes were considered in this process. The primary outcome in the analysis was the cost of promoting one sedentary person to undertake more PA. The cost of doing so was £623. A second analysis considered the cost involved in moving a moderately active individual to the minimum recommended level of PA. This was achieved at a cost of £2498. Finally, the cost of moving an individual to the next level of PA (defined as sedentary, low intermediate, high intermediate and active) was reported as £327.

One-way sensitivity analyses were conducted to explore parameter uncertainty. The findings were found to be sensitive to changes in the response rate, leading the authors to conclude that particular attention should be paid to recruitment strategies in setting up ERS. Furthermore, given the top-down approach to costing, the cost of the intervention is dependent on the number of recipients, and the authors point out that the marginal cost of the intervention is expected to fall if the number of recipients can be increased.

Isaacs *et al.*[61] conducted an economic evaluation alongside the UK Exercise Evaluation Randomised Trial (EXERT), which compared the effectiveness of a leisure centre-based (ERS) programme, an instructor-led walking programme and advice only in patients referred for exercise by their GPs. (Further details of the trial design, study population and interventions can be found in the effectiveness review in *Chapter 3*.) A cost-effectiveness analysis was conducted alongside the trial. Outcomes were reported at 6 months and 12 months post intervention (determined by the trial duration) and a partial societal perspective to costing was adopted, capturing costs incurred by the NHS, local government and participants. Attempts were made to provide a detailed assessment of the costs involved in the provision of the interventions. Intervention costs included costs to the provider and the participant, as well as any equipment

Commentary on Stevens *et al.*[50]

The study was reported to be based on the largest RCT trial of PA promotion conducted in the UK and, as such, provides a valuable source of economic evidence on ERS. Methodologically, the study is a reasonable attempt to estimate the cost-effectiveness of an intervention alongside a trial (see *Table 28*). However, there are some methodological weaknesses, some of which are acknowledged by the authors. The use of a top-down costing methodology is a limitation and raised challenges for the authors in deriving an accurate estimate of the cost per participant. In particular, there are challenges about whether or not recruitment can be increased at a modest additional cost once the programme is up and running. If this were possible, then it would be possible to reduce the cost per participant significantly by increasing the number of participants. A further challenge relates to the outcome measures considered in the analysis. Although these are perfectly legitimate and translate into meaningful measures of effectiveness, it would have been desirable to present the findings in the form of a cost–utility analysis, reporting an incremental cost per quality-adjusted life-year (QALY) or similar outcome. Best practice recommendations for cost-effectiveness analysis developed by NICE in England and Wales identify the use of cost–utility analysis based on preference-based outcome measures as the preferred end point for economic evaluations, as they allow for comparison between different interventions and populations. The absence of this makes interpretation of the findings somewhat challenging for a health-care policy audience. Finally, the economic evaluation is essentially a within-trial analysis and, as such, adopts a relatively short time horizon. Previous research has indicated that the cost-effectiveness of public-health interventions is likely to be dependent not just on their short-term effect, but also on the degree to which any behaviour change is lasting. As such, an attempt to model the benefits over a longer time horizon may provide a richer source of information for health-care planners, acknowledging that this would introduce a greater degree of uncertainty.

costs that might be incurred. In addition to this, the study also captured information on GP and hospital consultations and pharmaceutical use prior to the intervention and over the course of the study through a case note review, to determine whether or not PA had any influence on general health-care resource consumption. Detailed costs for the control group and both intervention groups derived from the study are presented in *Table 26*.

TABLE 26 Description of cost of ERS (adapted from ref. 59)

Cost components	Observations	Mean (£)	SD (£)	Median (£)	Minimum (£)	Maximum (£)
Control group[a]						
GP costs 12 months pre-randomisation	123	118.86	77.68	109	0	411.00
GP costs 6 months post-randomisation	123	46.57	46.17	34.00	0	284.00
Pharmaceutical costs 12 months pre-randomisation	123	81.85	136.18	10.95	0	697.15
Pharmaceutical costs 6 months post-randomisation	123	53.76	89.80	12.98	0	541.07
Hospital costs 12 months pre-randomisation	310	119.13	479.95	0	0	4356.42
Hospital costs 6 months post-randomisation	310	46.58	206.98	0	0	1995.73
Cost of the intervention to the providers	316	0	0	0	0	0
Cost of the intervention to the participants[b]	316	0	0	0	0	0
Equipment costs (a component of participants costs)[b]	316	0	0	0	0	0
Leisure centre group						
GP costs pre-intervention	149	125.49	93.99	110.00	0	714.00
GP costs 6 months post-intervention	149	57.60	49.88	51.00	0	255.00
GP costs 12 months post-intervention	149	107.28	82.47	85.00	0	476.00
Pharmaceutical costs 12 months pre-intervention	149	109.08	293.01	16.7	0	2764.15
Pharmaceutical costs 6 months post-intervention	149	74.25	168.91	23.73	0	1585.92
Pharmaceutical costs 12 months post-intervention	149	136.82	329.55	47.45	0	3184.25
Hospital costs 12 months pre-intervention	312	134.32	662.31	0	0	7901.25
Hospital costs 6 months post-intervention	312	61.64	283.83	0	0	2938.36
Hospital costs 12 months post-intervention	312	127.02	441.40	0	0	3360.43
Cost of the intervention to the providers	317	185.66	33.23	168.96	88.76	249.16
Cost of the intervention to the participants	88	100.60	103.50	70.45	4.73	771.89
Equipment costs (a component of participants costs)	88	6.68	15.16	0	0	60.00
Walking group						
GP costs pre-intervention	134	125.36	82.45	110	0	374.00
GP costs 6 months post-intervention	134	52.30	43.10	42	0	187.00
GP costs 12 months post-intervention	134	103.49	71.14	84.5	0	323.00
Pharmaceutical costs 12 months pre-intervention	134	148.51	294.78	25.18	0	1788.50
Pharmaceutical costs 6 months post-intervention	134	94.38	161.01	24.26	0	894.25
Pharmaceutical costs 12 months post-intervention	134	169.25	295.62	37.59	0	1609.65
Hospital costs 12 months pre-intervention	308	178.79	761.96	0	0	7610.88
Hospital costs 6 months post-intervention	308	46.16	219.54	0	0	1682.59
Hospital costs 12 months post-intervention	308	162.07	509.17	0	0	4530.51
Cost of the intervention to the providers	310	92.02	11.33	89.16	48.86	129.46
Cost of the intervention to the participants	75	84.40	170.54	35.55	0.76	1460.01
Equipment costs (a component of participants costs)	75	7.78	26.56	0	0	155.00

ref., reference; SD, standard deviation.

a Information on the control group is restricted to the 12 months before intervention and the 6 months following the intervention. After that period patients in the control group were assigned to one of the active interventions.

b Participants costs for the control group are defined as zero.

The mean cost of the leisure centre ERS intervention over 12 months was estimated to be £186 to the providers, with a further £101 being incurred by participants.

Outcomes were measured using the SF-36. The authors' state that their intention was to convert SF-36 score into quality-adjusted life-years (QALYs); however, this was not possible owing to instability in the findings. Incremental cost-effectiveness ratios (ICERs) were generated in the form of the incremental cost per unit change in SF-36 score. A comparison of leisure centre-based interventions with controls resulted in an incremental cost of £19,500 per unit change in SF-36 score at 6-month follow-up.

Parameter uncertainty was explored through probabilistic sensitivity analysis (PSA). The findings suggest that there is a low probability of the leisure centre intervention being dominated by the control group.

The objective of Gusi *et al.*,[70] the only non-UK-based study considered herein, was to examine the cost/utility of adding a supervised walking programme to standard 'best care' in individuals who are obese or depressed. The economic study was conducted alongside a study of the effectiveness of this intervention in four general practices in Spain. Although non-UK, the Gusi *et al.*[70] paper highlights the ERS model and references other ERS studies for comparison.

A cost–utility analysis was undertaken adopting a health-care provider's perspective and a time horizon of 6 months. Costs considered included the costs of staffing the intervention, as well as the costs of medication and consultations. However, no difference was seen between the intervention group and the controls in the latter, so the incremental cost of the intervention group comprised only the staff costs involved in delivery. Outcomes were measured using the EQ-5D utility scale.

The findings show that the exercise programme led to an incremental QALY gain of 0.132 over a 6-month period, at an incremental cost of €41 per participant, generating an ICER of €311/QALY. Sensitivity analyses, including PSAs, were presented. One-way sensitivity analysis showed the findings to be relatively robust to changes in parameter estimates, with the worst-case scenario ICER increasing to €811/QALY. PSA showed a high probability of the intervention remaining cost-effective when extreme parameter values were considered.

Commentary on Isaacs *et al.*[61]

The study is a useful complement to the existing evidence base on the cost-effectiveness of ERS. Particular mention should go to the effort put into generating detailed estimates of the cost of the intervention to providers and participants. (These estimates have been used in the modelling work presented in the later parts of this report.) The main limitation of the study appears to be the inability to convert the findings presented in the form of SF-36 scores into utility scores that might allow for the derivation of QALYs. The authors acknowledge this as a limitation, although there is relatively little explanation given for why this was not possible (e.g. this could be due to missing data in responses). The other major limitation of the study is the relatively short time horizon that was dictated by the trial design. However, this is true of many of the studies considered in this review and reflects the difficulties that are inherent in conducting long-term RCTs of interventions designed to change behaviour. Estimation of long-term outcomes is important as it allows us to verify the main differences among the alternative options with respect to costs and benefits.[83] However, it is important to note that it is often difficult to extrapolate beyond the observed data on health gains because there is lack of evidence surrounding (1) post-intervention effects on PA behaviour (do participation levels stay constant, decline or increase?) and (2) the nature of the relationship between PA and health gains over time.[84]

Commentary on Gusi *et al.*[70]

This study performs well when considered in relation to critical appraisal checklists for economic evaluation and best-practice principles (see *Table 5*). Estimates of cost and outcomes are presented clearly and the study benefits from the use of the EQ-5D, allowing the authors to generate ICERs in the form of cost/QALY. This allows for comparison with other interventions both in the field of public health and beyond, with the findings suggesting the intervention is likely to be highly cost-effective when compared with accepted thresholds. For our own purposes, the main limitation appears to be the degree to which the intervention and the findings are relevant to a UK population. Given the relatively limited information available, it is difficult to determine whether or not this intervention could be easily reproduced in the NHS at a similar cost and effectiveness.

Economic modelling studies

Only one economic modelling study that attempted to estimate the longer-term costs and benefits of exercise referral was identified as part of this search. This NICE[76] study comprised an evaluation of primary care-based interventions designed to promote PA, including exercise referral. The study was commissioned to help inform the development of NICE public health guidance on PA.

A cost–utility analysis was conducted using a decision-analytic model to examine the cost-effectiveness of four interventions. The model considers a cohort of individuals who enter the model in a sedentary state. The individuals are exposed to an intervention (exercise referral) which is assumed to affect their likelihood of becoming physically active.

Physical activity is assumed to have a long-term effect on an individual's likelihood of developing a number of chronic conditions. Conditions included in the model were selected on the basis that there was evidence of a strong causal relationship between PA and evidence on the magnitude of effect of PA on the incidence of these conditions. Conditions included in the analysis were CHD, stroke, type 2 diabetes mellitus and colon cancer.

Estimates of the RR of developing each of these conditions, depending on PA status, were derived from published sources. The conditions are assumed to be independent of one another and individuals are permitted to experience only one condition within the confines of the model. Estimates of mortality rates and life-years lost associated with each condition were derived from published sources and derived by assuming an average age at onset for each condition, dependent on the age of the population under consideration. Utilities and unit costs associated with each condition were synthesised from multiple published sources.

Outcomes are reported both as cost per person who moves from a sedentary state to a physically active state as well as in the form of cost per QALY. The cost of moving an individual from a sedentary state to a physically active state ranged from £90 to £4500, dependent on the cost of the intervention. The incremental cost per QALY ranged from around £20 to approximately £670, dependent on the cost of the intervention.

Further analyses considered the potential savings that may accrue from reductions in future health-care resource consumption as a result of being physically active. This analysis generated even more favourable cost-effectiveness ratios, which, in most cases, were dominant (that is ERS is cheaper and more effective than the control).

One-way sensitivity analysis explored changes in persistence with exercise (i.e. dropouts), intervention costs and effectiveness. The authors report that the intervention remains cost-effective under most scenarios considered in the analysis.

Commentary on the NICE study[76]

Unlike the primary studies conducted alongside trials presented above, this modelling study attempts to estimate the longer-term impacts of PA. Any model should be considered a simplification of the real world and the authors acknowledge many of the weaknesses inherent in their analysis. For example, the model considers only a small number of conditions that have been associated with physical inactivity, while excluding many others, such as musculoskeletal disease and respiratory illness. However, this can be justified on the basis of the available evidence on the relationship between PA and these conditions.

In addition to this, the model adopts a fairly simplistic approach to the long-term effectiveness of interventions designed to promote PA, assuming that around 50% of individuals fail to adhere to any intervention for a long enough period to experience reductions in the risk of future events. This rate is not explored in any depth and further attempts are warranted to estimate the degree to which behaviour change is lasting as this is likely to have a significant effect on the cost-effectiveness of interventions.

Other simplifications in the model include the approach to estimating life-years lost, the assumption of independence of the conditions considered and the assumption that individuals experience only one of the conditions. Clearly, these assumptions are unlikely to apply in real life, particularly the assumption that the incidence of CHD, stroke and diabetes are unrelated. However, as with any model, it is relatively easy to take issue with simplifications and assumptions which have been adopted due to the absence of data. In many of these instances, there are relatively few options for improving the model until further long-term evidence becomes available.

One consideration for future research might be whether or not the simple decision-analytic approach to modelling is warranted in this indication. Given that individuals' behaviours may change over time, it may be that a more dynamic approach to modelling the cost-effectiveness of PA is warranted, although once again this may be limited by the available evidence. In light of this, the model described above provides a useful contribution to the primary evidence on cost-effectiveness presented earlier in this section. The model has also provided a basis for the economic modelling presented in the later stages of this report, although some modifications have been made while further consideration has been given to issues such as uptake and adherence with interventions.

Quality assessment

Studies were reviewed against criteria laid out in critical appraisal checklists for economic evaluations. In general, the studies performed well, particularly with regard to clarity of presentation of the results. There were some deficiencies in relation to the reporting of input parameters, although in many cases these were identified as limitations by the authors. A summary of the characteristics of the economic evaluations is presented in *Table 27*.

Summary of the economic evidence and critical appraisal

A summary of the findings of the economic evidence considered above is presented in *Table 28*. All studies found the ERS interventions to be cost-effective compared with the controls. However, one study[61] attempted to compare an alternative PA intervention with ERS and found that a walking-based intervention is likely to be relatively more cost-effective than leisure centre ERS intervention, with the former leading to a cost saving of £8750 per unit increase in HRQoL scores as measured by SF-36. It would be reasonable to surmise that the available economic evidence on ERS suggests that it appears to be a cost-effective use of health-care resources.

Only one of the economic studies adopted a decision-analytic approach that was suitable for review against best-practice principles for economic modelling. *Table 29* highlights the aspects of the guidelines for decision-analytic modelling that were found not to have been addressed by the study.[76] The problems mainly related to the lack of information on validation of the model against existing evidence and incomplete assessment of uncertainties. Regarding the latter, the study focused on parameter uncertainty tending to ignore the other types of uncertainty such as methodological and structural uncertainty.

TABLE 27 Quality assessment of included ERS economic evaluations

Quality criteria (adapted from ref. 72)	Stevens *et al.* (1998)[50] UK	Isaacs *et al.* (2007)[61] UK	Gusi *et al.* (2008)[70] Spain	NICE (2006)[76] UK
The economic importance of the research question is stated	x	✓	✓	✓
The viewpoint(s) of the analysis are clearly stated and justified	x	✓	✓	✓
The rationale for choosing the alternative programmes or interventions compared is stated	x	?	✓	✓
The choice of form of economic evaluation is justified in relation to the questions addressed	x	✓	✓	✓
Quantities of resources are reported separately from their unit costs	x	✓	✓	x
Methods for the estimation of quantities and unit costs are described	?	✓	✓	✓
An explanation is given if costs or benefits are not discounted	x	✓	✓	✓

x, no; ✓, yes; ?, not clear.

TABLE 28 Summary of the findings of included ERS economic evaluations

Parameter	Stevens *et al.* (1998)[50] UK	Isaacs *et al.* (2007)[61] UK	Gusi *et al.* (2008)[70] Spain	NICE (2006)[76] UK
ICER	1. Cost of inducing one sedentary person to do more PA was £623 2. Cost of moving a person who is active but below the recommended level of PA to that recommended level was £2498 3. Cost of achieving any increase in a person's level of PA was £327 for movement into a higher activity group and less £200 for an absolute increase	1. Cost per unit increase in SF-36 scores for the leisure centre group compared with control group was £19,500 2. Walking programme compared with leisure centre group led to a cost-saving of £8750 per unit increase in SF-36 scores	Cost per QALY gained from intervention compared with control group was €311	1. Cost per person being active via intervention compared with control group was £440.35 2. Cost per QALY gained from intervention compared with control group was £80.96 3. Cost saving per QALY gained from intervention compared with control group was £2388.41
Currency base	UK £ (year not reported)	2002 UK £	2005 €	2005 UK £

TABLE 29 Quality assessment for included ERS decision-analytic model

Quality criteria (adapted from ref. 74)	NICE (2006)[76] UK
Is the cycle length defined and justified in terms of natural history of disease?	x
Have the four principal types of uncertainty been addressed?	x
If not (referring to previous question – our words), has the omission of particular forms of uncertainty been justified?	x
Have methodological uncertainties been addressed by running alternative versions of the model with different methodological assumptions?	x
Is there evidence that structural uncertainties have been addressed via sensitivity analysis?	x
Is there evidence that the mathematical logic of the model has been tested thoroughly before use?	?
Have the results of the model been compared with those of previous models and any differences in results explained?	x

x, no; ?, not clear; ref., reference.

Summary

- Given the lack of standardisation of the ERS definition used by previous systematic reviews and the publication of further recent evidence, we undertook a de novo systematic review of cost-effectiveness of ERS.
- Our systematic review identified only four primary economic evaluations that assessed the cost-effectiveness of ERS – three trial-based economic evaluations and a model-based analysis (commissioned by NICE as part of the development of guidance on brief interventions in primary care for the promotion of PA).
- Broadly, the previous evidence base suggests that ERS is a cost-effective intervention in sedentary, but otherwise healthy populations. However, there is some significant uncertainty around the estimates of cost-effectiveness because of an absence of evidence on the long-term effectiveness of these interventions. Although modelling studies can go some way to exploring this, ultimately these issues can only be resolved through better evidence of effectiveness derived from RCTs or other well-designed observational studies. As such, any criticism of the economic evidence should be considered in light of the evidence on effectiveness available at the time of the analysis.
- Each of the previous economic evaluations has its merits and makes a valuable contribution to the limited evidence base on the cost-effectiveness of ERS. The trial-based studies benefit from a high degree of internal consistency, deriving their estimates of effectiveness from the trial and, in some cases, detailed estimates of the cost of the interventions. Any weaknesses inherent in these analyses are also largely as a result of the limitations of the trials, particularly the degree to which the findings can be considered to be externally valid and the relatively short follow-up that was achievable in a trial setting.
- The NICE economic modelling study overcomes the issue of the short-time horizon inherent in the trial-based analyses. This study allowed for an estimate of the longer-term costs and benefits of PA, taking into account the effects on a number of long-term conditions that are known to be associated with physical inactivity. There are many weaknesses associated with the model although many of these result from an absence of evidence on the effectiveness of ERS (e.g. on the relationship between physical inactivity and long-term conditions, long-term effectiveness of interventions, adherence to interventions etc.). It should also be remembered that any economic model can only ever be a simplification of reality. In an area as complex as PA and behaviour change, and an area characterised by limitations in the evidence base, the need for simplification may be great, leading to a model that fails to meet many of the best-practice criteria.
- A further limitation of previous economic evaluations is their focus on a sedentary, but otherwise healthy population. Few of the studies explicitly consider whether or not ERS can contribute to improved outcomes in populations with underlying conditions (with the exception of Gusi *et al.*,[70] which was conducted outside the UK).
- In light of these findings, we decided to develop a de novo economic model to assess the cost-effectiveness of ERS. Our model builds on the principles of the NICE decision-analytic model, which includes some important further development of the methods and a more robust approach to the incorporation of ERS effectiveness evidence. The findings of this analysis are presented in *Chapter 6*.

Chapter 5

Systematic review of the predictors of exercise referral scheme uptake and adherence

Background

Chapter 3 provides an overview of the effectiveness of ERS. However, if patients do not initially take up an exercise referral then the beneficial effects of increased PA will not occur, or, conversely, greater adherence to ERS will increase the probability of being physically active. Public health impact depends on 'real-world' effectiveness information and is therefore dependent not only on RCT evidence, but also on the external validity of this evidence. With widening health inequalities, those most at need may also be those most likely to have lower uptake and adherence to ERS. Further, the costs related to ERS are 'front loaded', so where patients fail to attend or drop out, this will reduce the cost-effectiveness of ERS. Therefore, it is important to understand the patient-level factors and programme-level factors that might influence uptake and adherence to ERS.

The objectives of this systematic review are to (1) quantify the levels of uptake and adherence to ERS; (2) identify demographic and medical diagnosis variables, programme factors and psychosocial factors (e.g. self-determination) that predict uptake and adherence to ERS; and (3) identify from qualitative studies patient perceptions about recruitment, referral and ERS engagement processes, and associated benefits.

Variation in individual ERS programmes and the variable reporting and monitoring of patients characteristics related to uptake and adherence[85] may explain the lack of standard definitions for ERS uptake and adherence in the literature. For the purposes of this systematic review, the following definitions were used:

- *Uptake* The proportion of those individuals offered entry to ERS who attend an initial consultation with an 'exercise professional' or attend a first exercise session.
- *Adherence* Of those individuals who take up ERS, what proportion experience at least 75% of the programme.

Methods

This review was conducted and reported in accordance with the PRISMA statement.[36]

Search strategy

As described in *Chapter 3*.

Inclusion and exclusion criteria

For inclusion, studies had to meet the population and ERS intervention criteria as described in *Chapter 3*. For this particular review, we broadened the study design criteria to include uncontrolled studies. Included studies were required to report at least one the following:

1. quantitative estimate (or data to allow calculation) of participant uptake and adherence to ERS
2. quantitative estimate of the statistical association/relationship (e.g. correlation or regression coefficient) between participant demographic (e.g. age, medical diagnosis), participant psychosocial factors (e.g. level of motivation, self-efficacy) and programme factors (e.g. centre vs home-based delivery, group vs individual sessions, dose of exercise) and uptake or adherence to ERS
3. qualitative data (e.g. focus groups and interviews with ERS participants) about the factors uptake and adherence to ERS.

Study selection process

Quantitative studies

As described in *Chapter 3*.

Qualitative studies

Potential identified studies were screened for inclusion by two reviewers (AT and Brian O'Regan).

Data extraction

Quantitative studies

Data were extracted by one reviewer (TP) using a standardised data extraction form and checked by another (RT). Discrepancies were resolved by discussion, with involvement of a third reviewer when necessary. Extraction included data on patient-level characteristics (e.g. age, disease diagnosis), intervention (e.g. duration, location, intensity and mode of the exercise intervention delivered), study quality, and reported estimates and qualitative data on the association and mediators of uptake and adherence to ERS.

Qualitative studies

A single reviewer (Brian O'Regan) extracted relevant information from included studies and this was checked by a second reviewer (AT).

Data analysis and synthesis

Quantitative studies

Levels of uptake and adherence across studies were pooled using a random-effects model to take into account the clinical and statistical heterogeneity in studies and the various definitions of uptake and adherence across studies. Given the range of methods of reporting predictors of ERS uptake and adherence, it was not possible to quantitatively pool these data across studies. Instead, we undertook categorised findings in each study based on the strength and direction of association.[86]

Qualitative studies

Qualitative information on the factors influencing ERS uptake and adherence is presented narratively and summarised in a tabularised format.

Results

Identification and selection of studies

Of the 233 full papers retrieved from the *Chapter 3* search and identification through other means (reference list check, author and expert knowledge), five RCTs, 14 observational studies and 10 qualitative studies (28 primary studies in total) and two systematic reviews were judged to meet the inclusion criteria. *Figure 14* summarises the selection process.

Findings of previous systematic reviews

A review of previous systematic reviews of reporting uptake and adherence to ERS was undertaken to gain an initial understanding of the evidence and inform the approach of the systematic review of primary studies.

Two previous systematic reviews addressed the issue of uptake and adherence to ERS[41,87] (*Table 30*). The quality of these systematic reviews is appraised in *Chapter 3*. Williams *et al.*[41] included a small section of their report where the uptake and adherences levels from eight ERS observational studies were presented and discussed. The Gidlow *et al.*[87] review included uptake and adherence data from five observational studies and four RCTs of ERS (*Table 31*).

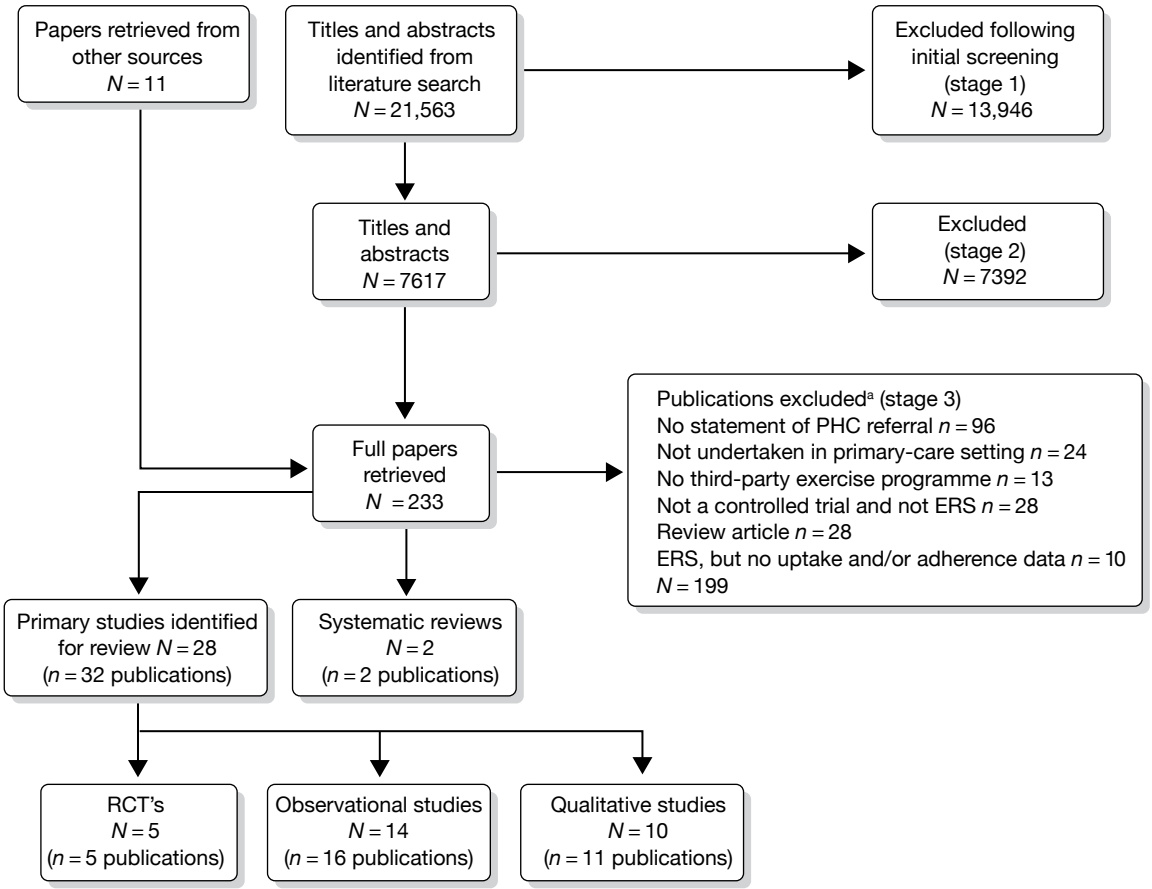

FIGURE 14 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram of study inclusion process for predictors of uptake and adherence to ERS systematic review. PHC, primary health care.

TABLE 30 Summary of previous systematic reviews assessing uptake and adherence to ERS

Authors	Objectives of review (stated by authors)	Databases/end date of searches	ERS definition	Inclusion criteria
Gidlow *et al.* (2005)[87]	Explore attendance of UK ERS, who attends them, why participants drop out of schemes	PubMed; EMBASE; PsycINFO; SPORTDiscus 2003	Interventions based in primary care; interventions involved referral to an exercise professional	Studies were based in the UK; interventions were based in primary care; interventions involved referral to an exercise professional; attendance-related outcomes were measured; studies were published in peer-reviewed journals
Williams *et al.* (2007)[41]	Assess whether ERS are effective in improving exercise participation in sedentary adults, including reference to uptake and adherence of included studies	MEDLINE; AMED; EMBASE; CINAHL; PsycINFO; SPORTDiscus; The Cochrane Library; SIGLE 2007	Referred adults from primary care to intervention where encouraged to increase PA; initial assessment; tailored programme; monitoring	RCT; non-RCT; observational; process evaluation; qualitative Any outcome

AMED, Allied and Complementary Medicine Database; CINAHL, Cumulative Index to Nursing and Allied Health Literature; SIGLE, System for Information on Grey Literature In Europe.

TABLE 31 Summary of studies included in previous systematic reviews assessing uptake and adherence to ERS

Studies	Gidlow *et al.* (2005)[87]	Williams *et al.* (2007)[41]
Observational studies		
Lord and Green (1995)[88]	✓	✓
Hammond *et al.* (1997)[89]		
Cochrane and Davey (1998)[90]		✓
Jackson *et al.* (1998)[91]		✓
Martin and Woolf-May (1999)[92]		✓
Damush *et al.* (2001)[93]		✓
Greater Glasgow Health Board (2004)[94]		✓
Dugdill *et al.* (2005)[95]		✓
Dugdill and Graham (2005)[96]	✓	✓
Dinan *et al.* (2006)[97]		✓
RCTs		
Munro *et al.* (1997)[48]	✓	
Taylor *et al.* (1998)[27]	✓	
Stevens *et al.* (1998)[50]	✓	
Harland *et al.* (1999)[43]	✓	

Table 31 illustrates the lack of consistency in the studies included by these two reviews, reflecting differences in the definition of ERS.

The review by Williams *et al.*[41] concluded that uptake and adherence were low, with 33% of patients not participating in the ERS and between 12% and 42% completing a 10- to 12-week period of ERS (*Table 32*). The Gidlow *et al.*[87] review concluded that uptake and adherence rates were variable and comparable between observational studies and RCTs. Uptake rates varied between 23% and 60%, and around 80% of patients dropped out before the end of the scheme.

TABLE 32 Summary of systematic review findings of uptake and adherence to ERS

Authors	No. of included studies	Method of data synthesis	Key findings as stated by author
Gidlow *et al.* (2005)[87]	*n* = 9 All UK based	Narrative	1. 80% of participants dropped out before end of programme 2. More women than men took up referral (60% vs 40%), but no higher attendance by women 3. Attrition and negative comments related to practical problems associated with facilities 4. Poor patient information monitoring prevented identification of populations most likely to attend or drop out
Williams *et al.* (2007)[41]	*n* = 6 UK	Narrative	1. 33% of patients do not uptake ERS 2. Poor adherence, 12–42% completing a 10- to 12-week programme

Findings of quantitative primary studies

Sample sizes ranged across studies from 30 to 6610 participants in the observational studies, and from 97 to 363 participants in the RCTs. Mean age ranged from 44.9 to 51.9 years across the observational studies and from 53.9 to 59.1 years for RCTs. Across the 19 studies,[27,28,50,61,69,88,91,93,95,97–100,102–107] 12 provided a definition of uptake (*Table 33*).[88,89,93,95,97–100,102–107] Uptake was defined in one of two ways: attendance at the initial consultation with the 'exercise professional' or attendance at at least one exercise session. Thirteen studies[26,60,87,90,91,96,97,99–106] provided a definition of adherence – completion of a set number of exercise sessions, either numerically (e.g. completed 20 sessions[92]) or as a percentage (e.g. > 80% attendance[104]). For four studies,[88,91,92,103] attendance at a post-ERS consultation was also required to meet the definition of adherence.

Exercise referral schemes uptake and adherence levels

The pooled level of ERS uptake across the observational studies was 66.% (95% CI 57% to 75%) compared with 80% (95% CI 61% to 98%) across the RCT (*Figure 15*). There was a high level of statistical heterogeneity for both observational studies ($I^2 = 99.4\%$, $p < 0.0001$) and RCTs ($I^2 = 99.3\%$, $p < 0.0001$). The studies of Stevens *et al.*[50] and Damush *et al.*[93] reported particularly low levels of uptake, i.e. < 35%. Stevens *et al.*[50] hypothesise that the low uptake they experienced may have been reflective of the nature of the invitation letter sent to participants and the point of randomisation (pre-invitation letter). They also hypothesise that a change in the format of the letter (e.g. including a specific date offered for the first ERS appointment) would have improved participation. Similarly, Damush *et al.*[93] used a letter-based recruitment because studies conducted in the USA require a pre-exercise test before the exercise intervention commences, and potentially this could have deterred eligible patients from consenting to the study.

Levels of adherence to ERS were variable across all study types (range 12–93%) (*Table 34*). The pooled level of ERS adherence was 49% (95% CI 40% to 59%) for observational studies and 37% (95% CI 20% to 54%) for the RCTs (*Figure 16*). Again, there was a high level of statistical heterogeneity for both observational studies ($I^2 = 99.1\%$, $p < 0.0001$) and RCTs ($I^2 = 89.0\%$, $p < 0.003$). The observational study by Martin and Woolf-May[92] reported particularly low levels of adherence (12%). Unfortunately, the study publication does not provide sufficient information on the ERS process to allow an appraisal of its contribution to the low adherence rate. The authors stated that 'of the available 490 subjects there were only 60 known finishers', suggesting that some individuals who may have adhered may have been missed.

TABLE 33 Characteristics of studies reporting levels and/or prediction of uptake and adherence to ERS

Study	Population characteristics: mean age (years), gender (% male), medical diagnoses or risk factors (%)	Inclusion/ exclusion criteria of study	Sample size	ERS setting	Uptake definition	Adherence definition
RCTs						
Taylor *et al.* (1998)[27] UK	Mean age: 54.1 Male: 37 Smokers: 43 Overweight: 77 Hypertensive: 46	Smokers, hypertension (at least 140/90 mmHg), overweight (BMI > 25)	97	Three practices	Attended at least one session	Patients who attended at least 15 sessions
Stevens *et al.* (1998)[50] UK	Mean age: 59.1 Male: 40 Smoker: 18	Sedentary: < 20 x 30 minutes of moderate-intensity PA or less than 12 x 20 vigorous-intensity PA in the last 4 weeks	363	One practice	'Attended initial consultation with exercise development officer'	Not reported
Harrison *et al.* (2005)[28] UK	Mean age: not reported Male: 33 Smoker: 24.4 At least one CHD risk factor: 75.3	Scheme related	275	46 practices	'Attended the first exercise consultation'	Not reported
Isaacs *et al.* (2007)[61] UK	Mean age: 57.1 Male: 35 Raised cholesterol: 24.0 Hypertension: 44.5 Obesity: 65.9 Smoking: 10.4 Type 2 diabetes: 12.3/11.3 Family history of MI: 13.9	Not active (no definition reported), raised cholesterol, controlled mild/ moderate hypertension, obesity, smoking, diabetes, family history of MI at early age	317	88 practices	Attended at least one session	The adherence of subjects to the active intervention arms was assessed by the use of handheld diaries and class registers (75–100% adherence)
Sorensen *et al.* (2008)[69] Denmark	Mean age: 53.9 Male: 43 Metabolic syndrome: 36 Type 2 diabetes: 18 CVD: 32 Other diseases: 14	Scheme related	28	14 practices	Correspondence with author	Not reported
Observational studies						
Damush *et al.* (2001)[93] (prospective) USA	Mean age: 64.1 (9.1) Male: 0 COPD: 13.1 Congestive heart failure: 14.9 Coronary artery disease: 17.5 Hypertension: 90.5 Type 2 diabetes: 38.9 History of stroke: 13.1	Female, age ≥ 50 years, not terminally ill, visited health centre in previous 12 months and had a scheduled or walk-in visit during the 6-month enrolment period	404	Two health centres	'Participation in at least one exercise class'	Not reported

TABLE 33 Characteristics of studies reporting levels and/or prediction of uptake and adherence to ERS *(continued)*

Study	Population characteristics: mean age (years), gender (% male), medical diagnoses or risk factors (%)	Inclusion/ exclusion criteria of study	Sample size	ERS setting	Uptake definition	Adherence definition
Dinan *et al.* (2006)[97] (prospective) UK	Aged 75 years and over	Scheme related	242	14 practices	'Took up the referral'	'Completed the cycle of exercise classes'
[a]Dugdill *et al.* (2005)[95] (prospective) UK	Mean age: not reported A – male: 36 B – male: 41 A – overweight: 37 A – hypertension: 13 A – mental illness: 9 B – arthritis: 28 B – back pain: 26 B – overweight: 23	Scheme related	A: 980 B: 1825	Two schemes	Attended first consultation with exercise officer	Not reported
Edmunds *et al.* (2007)[98] (prospective) UK	Mean age: 44.98 (14.61) Male: 16 Medical diagnoses: not reported	Overweight or obese	49	One scheme	Not reported	1–5 scale, an individual was defined as having 'dropped out' if he/she had stopped participating in their prescribed activities at their exercise referral site/facility
Harrison *et al.* (2005)[99] (prospective) UK	Mean age: 51.3 (12.6) Male: 39.2 Musculoskeletal problems: 32.8 CVD: 29.9 Overweight: 10.4 Fitness: 5.8 Mental-health problems: 5.1 Respiratory: 4.1 Other: 0.7	Scheme related	6610	One scheme	Attended first consultation with exercise officer	Not reported
Jackson *et al.* (1998)[91] (retrospective) UK	Mean age: not reported Gender: not reported Medical diagnoses: not reported	Not reported	686	One scheme	Not reported	*Adherers*: exercised at the leisure centre over a 10-week period and attended a 10-week consultation *Non-adherers*: discontinued exercise at the leisure centre within the 10-week period and did not attend a 10-week consultation
Jones *et al.* (2005)[100] (prospective) UK	Mean age: not reported Male: 42.1 Medical diagnoses: not reported	High blood pressure, weight or stress-related problems (or combinations of these)	152	One scheme, seven leisure centres	'Attended their local gym for an initial assessment'	Those who completed 24 sessions in total were considered to be successful

continued

TABLE 33 Characteristics of studies reporting levels and/or prediction of uptake and adherence to ERS *(continued)*

Study	Population characteristics: mean age (years), gender (% male), medical diagnoses or risk factors (%)	Inclusion/ exclusion criteria of study	Sample size	ERS setting	Uptake definition	Adherence definition
Lord and Green (1995)[88] (prospective) UK	Mean age: not reported Male: 25 Overweight: 32.2 Stress/anxiety: 15 Other: 11 Lipids/cholesterol: 6.4 Keep fit: 4.8 Lack of exercise: 4.8 Depression: 4.8 Arthritis: 2.9 Back pain: 2.9 Family history of IHD: 2.4	Scheme related	419	One scheme	'Attended an initial consultation with the community health and fitness officer'	Compliance: 'those participants who returned to attend a 10-week consultation and who were still exercising'
Martin and Woolf-May (1999)[92] (retrospective) UK	Mean age (F): 51.1 (12.3) Mean age (NF): 54.7 (14.4) Male: 35 BMI > 25 (F): 50 Cholesterol > 5.2 mmol/l (F): 16.7 Family history of CVD/CHD (F): 23.8 BMI > 25 (NF): 51.4 Cholesterol > 5.2 mmol/l (NF): 2.9 Family history of CVD/CHD (NF): 17.1	Scheme related, 60 NFs randomly selected to match F's number	490	One leisure centre	Not reported	*Finishers*: completed 20 sessions over the 10-week period and/or completed the final assessment *Non-finishers*: completed less than 20 sessions over the 10-week period
Morton *et al.* (2008)[101] (prospective) UK	Mean age: 51.9 (15.7) Male: 26.7 Medical diagnoses: not reported	Not reported	30	One leisure centre	Not reported	*Adherers*: 'attended at least one session per week for the duration of the study' *Partial adherers*: 'attended intermittent sessions, but specifically stated that they had not dropped out of the scheme' *Dropped out*: 'attended' no sessions or made personal contact with the leisure centre to terminate their involvement with the scheme

Predictors of participant uptake

Six observational[88,93,95,99,103,105] and two RCTs[27,61] reported predictors of uptake, with five studies providing bivariate analysis[27,61,88,95,105] and four studies multivariate analysis[93,99,103,105] in which associations among predictor variables were adjusted for other factors such as age.

TABLE 33 Characteristics of studies reporting levels and/or prediction of uptake and adherence to ERS *(continued)*

Study	Population characteristics: mean age (years), gender (% male), medical diagnoses or risk factors (%)	Inclusion/ exclusion criteria of study	Sample size	ERS setting	Uptake definition	Adherence definition
Roessler and Ibsen (2009)[102] (prospective) Denmark	Mean age: not reported Male 33 BMI > 25: 35 BMI > 30: 37 BMI > 35: 28	Scheme related	1156	One scheme	Not reported	Completed intervention (not defined)
Sowden *et al.* (2008)[103] (retrospective) UK	Mean age: 51 Male: 35 CVD risk: 44.3 Overweight/obese: 30 Musculoskleletal:25.2 Mental health: 19.8 Diabetes: 17.7 Respiratory: 8.1	Scheme related	6101	Six schemes, 317 practices	'Attendance at initial appointment'	'Attends final ERS appointment'
James *et al.* (2009)[104] (prospective) UK	Mean age: not reported Male: 34.6 Metabolic diseases: 36.3 Orthopaedic diseases: 24.7 CHD: 17.5 Pulmonary diseases: 9.9 Mental health: 9.4 Neuromuscular diseases: 1.1 Others: 1.1	Scheme related	1315	One scheme, five leisure centres	Not reported	Completers: 'attended > 80% of scheduled sessions'
[b]Gidlow *et al.* (2007),[105] Crone *et al.* (2008),[106] James *et al.* (2008)[107] (prospective) UK	Mean age: 50.8 (14.4) Male: 39.9 Obesity: 30.3 Musculoskleletal:26.3 CVD: 16 Mental health: 4.6	Scheme related	2864–2958	One scheme	'Attendance of at least one session'	Completers: 'attended > 80% of scheduled sessions'

F, finishers; NF, non-finishers; IHD, ischaemic heart disease; ref., reference.
a Two schemes evaluated: schemes A and B.
b Three publications from one study; for ease of reading ref. 103 will subsequently be adopted.

Demographic

The findings of studies that assessed demographic predictors of ERS uptake are summarised in *Table 35*. Two studies[88,103] reported that females were more likely to take up ERS than men, whereas two studies[99,105] showed no association of gender with uptake. Increasing age was positively associated with increased levels of ERS uptake in three studies,[95,103,105] whereas three studies[61,88,93] found no such association. Gidlow *et al.*[105] found that those who were the most deprived were less likely to uptake. Gidlow *et al.*[105] also found that those individuals living in a more rural location were less likely to take up ERS. Damush *et al.*[93] found no association between ethnicity and uptake.

TABLE 34 Summary of uptake and adherence to ERS levels across studies

	Uptake	Adherence	
Study	**% (*n*/*N*)**	**% (*n*/*N*) of patients who took up ERS**	**% (*n*/*N*) of patients who were referred to ERS**
RCTs			
Taylor *et al.*[27] UK	88% (85/97)	28% (24/85)	25% (24/97)
Stevens *et al.*[50] UK	35% (126/363)	Not reported	Not reported
Harrison *et al.*[28] UK	84% (232/275)	Not reported	Not reported
Isaacs *et al.*[61] UK	92% (293/317)	45% (133/293)	42% (133/317)
Sorensen *et al.*[69] UK	100% (28/28)	Not reported	Not reported
Observational studies			
Damush *et al.*[93] USA	28% (113/404)	Not reported	Not reported
Dinan *et al.*[97] UK	89% (216/242)	82% (178/216)	74% (178/242)
[a]Dugdill *et al.*[95] UK	B: 68% (1825/2696)	A: 34% (336/958) B: 46% (849/1829)	B: 32% (849/2698)
Edmunds *et al.*[98] UK	Not reported	51% (25/49)	Not reported
Harrison *et al.*[99] UK	79% (5225/6610)	Not reported	Not reported
Jackson *et al.*[91] UK	Not reported	70% (466/686)	Not reported
Jones *et al.* [100] UK	78% (119/152)	65% (77/119)	51% (77/152)
Lord and Green[88] UK	60% (252/419)	31% (77/252)	18% (77/419)
Martin and Woolf-May[92] UK	Not reported	12% (60/490)	Not reported
Morton *et al.*[101] UK	Not reported	40% (12/30)	Not reported
Roessler and Ibsen[102] Denmark	Not reported	70% (811/1156)	Not reported

TABLE 34 Summary of uptake and adherence to ERS levels across studies *(continued)*

	Uptake	Adherence	
Study	% (*n*/*N*)	% (*n*/*N*) of patients who took up ERS	% (*n*/*N*) of patients who were referred to ERS
Sowden *et al.*[103] UK	58% (3565/6101)	39% (1404/3565)	23% (1404/6101)
James *et al.*[104] UK	Not reported	57% (750/1315)	Not reported
[b]Gidlow *et al.*,[105] Crone *et al.*,[106] James *et al.*[107] UK	66% (1930/2908)	48% (931/1930)	32% (931/2908)

a Two schemes evaluated: schemes A and B.
b Average of the three publications.

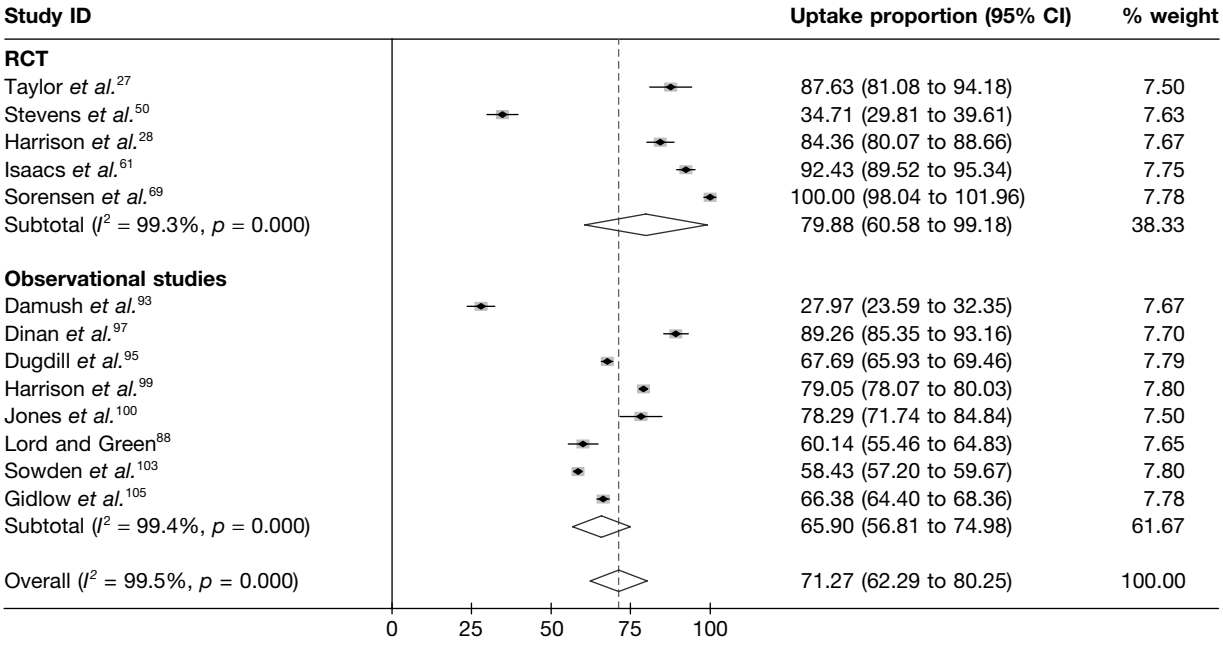

FIGURE 15 Meta-analysis of ERS uptake levels stratified by study design. Overall test for heterogeneity between subgroups: 691.58 [degrees of freedom (df) 1], $p = 0.28$. Note: weights are from random-effects analysis.

Medical diagnosis

Given the variable way in which referral reason (medical history) was analysed and reported, it was not possible to tabularise this in a summary way. Harrison *et al.*[99] showed found that those with mental health problems (OR 1.79, 95% CI 1.24 to 2.39, $p < 0.01$) or fitness needs (OR 10.33, 95% CI 1.44 to 74.3, $p < 0.05$) were more likely to take up ERS than those with no specified referral reason. Harrison *et al.*[99] also reported that those with respiratory problems and most deprived were more likely to take up ERS than those with respiratory problems and least deprived (OR 1.45, 95% CI 1.06 to 1.99, $p < 0.05$). Gidlow *et al.*[105] showed those patients referred with mental-health (OR 0.33, 95% CI 0.27 to 0.57, $p < 0.01$), musculoskeletal (OR 0.75 95% CI 0.58 to 0.99, $p < 0.05$), overweight/obesity (OR 0.63, 95% CI 0.50 to 0.81, $p < 0.01$) or 'other' (not defined) (OR 0.63, 95% CI 0.46 to 0.85, $p < 0.01$) problems were less likely to take up ERS than

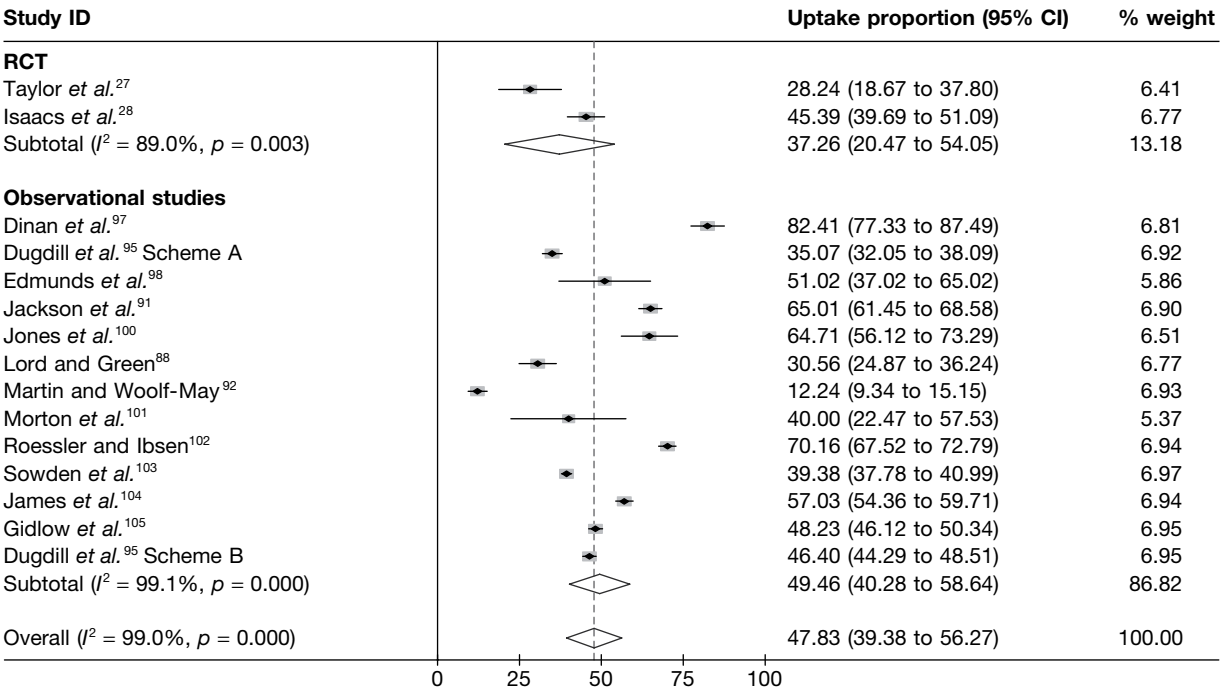

FIGURE 16 Meta-analysis of ERS adherence levels stratified by study design. Overall test for heterogeneity between subgroups: 4.57 (df 1), $p = 0.397$. Note: weights are from random-effects analysis.

patients with cardiovascular disease. In contrast, Sowden *et al.*[103] found that those referred with a musculoskeletal (OR 1.18, 95% CI 1.01 to 1.38, $p < 0.05$) problem were more likely to take up ERS. This was not the case for those with diabetes or CVD. Gidlow *et al.*[105] reported that more patients referred for mental-health problems took up ERS than those referred for physical-health problems (60% vs 69%; $p < 0.001$). Taylor[27] found that more individuals referred for obesity took up ERS than those referred for smoking ($p < 0.01$).

Programme factors

Gidlow *et al.*[105] reported that GP referrals were more likely to lead to uptake than referral by another individual. Sowden *et al.*[103] and Damush *et al.*[93] both observed no association between for scheme and clinic location and uptake.

Predictors of exercise referral scheme adherence

Eight observational[88,95,98,100,101,103–105] and two RCTs[27,61] reported predictors of adherence. Seven studies undertook bivariate statistical analysis[27,61,88,95,100,101,105] and four studies undertook multivariate statistical analysis.[98,103–105]

Demographic

The findings of studies that assessed demographic predictors of ERS adherence are summarised in *Table 36*. Two studies[95,105] reported that men are more likely to adhere than women, while three studies[88,103,104] found no such association. Increasing age was a predictor of increased ERS adherence in five studies,[88,95,103–105] although two studies showed no association with age.[61,88] Deprivation, rurality, referrer, leisure provider[105] and occupation[104] were all found not to be significant predictors of ERS adherence. Dugdill *et al.*[95] found that fewer patients adhered to ERS ($p < 0.01$) when referred by the GP (32%) compared with a practice nurse (45%) or a cardiac nurse (57%). James *et al.*[104] reported that those of mixed ethnicity were more likely to adhere to an ERS.

TABLE 35 Summary of analysis of predictors of ERS uptake

	Multivariate analysis				Bivariate analysis			Overall summary			
Study / Variables	Harrison *et al.*[99] UK	Sowden *et al.*[103] UK	Gidlow *et al.*[105] UK	Damush *et al.*[93] USA	Lord and Green [88] UK	Dugdill *et al.*[95] UK	Isaacs *et al.*[61] UK	No. of studies on this factor	Any significant association		No significant association
Sample size	*n* = 6610	*n* = 6101	*n* = 2958	*n* = 404	*n* = 419	*n* = 2696	*n* = 317				
									+	–	
Demographic factors											
Gender (male vs female)	0	+	0		+			4	2	0	2
Increasing age		+	+	0	0	+	0	6	3	0	3
Deprivation	0	0	–					3	0	1	2
Rurality (urban vs rural)			–					1	0	1	0
Ethnicity (African American vs all other racial groups)				0				1	0	0	1
Programme factors											
Scheme location[a]		0						1	0	0	1
Clinic location[b]				0							
Referrer (GP vs 'other')			–					1	0	1	0

0, no statistically significant association between variable and level of uptake; +, a positive statistically significant ($p < 0.05$) association between variables and level of adherence, e.g. increased age of participants was associated with increased levels of uptake; –, a negative statistically significant ($p < 0.05$) association between variables and level of adherence, e.g. increased age of participants was associated with decreased levels of uptake.

a Six geographical areas of London, UK.

b Two neighbourhood community health centres located in Indianapolis, IN, USA.

TABLE 36 Summary of analysis of predictive factors of ERS adherence

Study / Variables	Multivariate analysis				Bivariate analysis					Overall summary			
	Sowden *et al.*[103] UK	Gidlow *et al.*[105] UK James *et al.*[107] UK	James *et al.*[104] UK	Edmunds *et al.*[98] UK	Lord and Green[88] UK	Dugdill *et al.*[95] UK	Isaacs *et al.*[61] UK	Jones *et al.*[100] UK	Morton *et al.*[101] UK	No. of studies on this factor	Any significant association		No significant association
Sample size	*n* = 3565	*n* = 1996	*n* = 1315	*n* = 49	*n* = 419	*n* = 2696	*n* = 317	*n* = 119	*n* = 30				
											+	–	
Demographic factors													
Gender (male vs female)	0	–	0		0	–				5	0	2	2
Increasing age	+	+	+		0/+[a]	+	0			6	4/5	0	1/2
Deprivation	0	0	0							3	0	0	3
Rurality (urban vs rural)		0								1	0	0	1
Occupation			0							1	0	0	3
Leisure provider		0								1	0	0	1
Referrer (GP vs other health-care professionals)		0				+				2	0	1	1
Ethnicity (white vs mixed)			+							1	1	0	0

Variables \ Study	Multivariate analysis				Bivariate analysis					Overall summary			
	Sowden *et al.*[103] UK	Gidlow *et al.*[105] James *et al.*[107] UK	James *et al.*[104] UK	Edmunds *et al.*[98] UK	Lord and Green[88] UK	Dugdill *et al.*[95] UK	Isaacs *et al.*[61] UK	Jones *et al.*[100] UK	Morton *et al.*[101] UK	No. of studies on this factor	Any significant association		No significant association
Psychosocial factors													
Stage of change								0		1	0	0	1
Self-efficacy								0		1	0	0	1
Expectations of change (health and fitness)								0		1	0	0	1
Expectations of change (personal development)								+		1	1	0	0
Psychological well-being								0		1	0	0	1
Need satisfaction				0						1	0	0	1
Perceived autonomy				0						1	0	0	1
Support													
Self-determination				0					+	2	1	0	1

+, a positive statistically significant ($p<0.05$) association between variables and level of adherence, e.g. increased age of participants was associated with increased levels of adherence; −, a negative statistically significant ($p < 0.05$) association between variables and level of adherence, e.g. increased age of participants was associated with decreased levels of adherence; 0, no statistically significant association between variable and level of adherence.

a Increasing age from 18 to 54 years only, not for ≥ 55 years.

Programme factors

Sowden *et al.*[103] reported variable levels of patient adherence across six different ERS areas in the London area. This finding illustrates the potential influence of programme-level factors on adherence.

Medical diagnosis

In the James *et al.* study,[104] patients with pulmonary problems were less likely to adhere than those with CVD. Sowden *et al.*[103] reported that patients with diabetes were less likely to adhere to an ERS (OR 0.76, 95% CI 0.63 to 0.93, $p < 0.01$) than those with CVD (OR 1.22, 95% CI 1.03 to 1.45, $p < 0.05$) when both compared with those without either condition.

Gidlow *et al.*[105] found that those referred for mental health problems were less likely to adhere to ERS than those referred for physical health problems (22% vs 34%, $p < 0.001$). Taylor *et al.*[27] reported no difference in adherence between those individuals who were referred because they were a smoker, overweight, obese or hypertensive.

Psychosocial

Three studies[98,100,101] assessed the psychosocial predictors of adherence (*Table 36*). Morton *et al.*[101] found participant self-determination to positively predict ERS adherence, whereas Edmunds *et al.*[98] found no such association. An expectation for change in personal development was also found to be positively predictive of ERS adherence.[100]

Programme factors

No programme factors were reported in studies examining associations of ERS adherence.

Qualitative studies of exercise referral scheme uptake and adherence

Our searches identified 10 studies that collected qualitative data from participants who were involved in ERS (*Table 37*).[92,108–117] These studies ranged substantively in their methodological quality. In some studies there was a clear absence of methodological rigour,[11,92,115] for example little or no reference to epistemological issues, single researchers coding transcripts, no clear process described for creating categories, and themes largely emerging from the choice of questions. Other studies had well-described processes for data collection and analysis (e.g. demonstration of trustworthiness, verification and multiple layers of data analysis).[108–114,117] Only a few studies involved repeated interviews with the same participants as they passed through schemes;[110,111] instead most involved retrospective reflection. Both individual and small-group interviews were conducted to collect data.

The participants included in the study were mainly female in all but two studies.[108,117] Some studies were designed to specifically compare particular groups of ERS participants, for example those who adhered to the ERS versus those who dropped out. Others studies involved taking a convenience sample from the whole ERS population. The participants in these studies appeared to reflect the typical age range and medical conditions of those involved in ERS studies described in *Chapters 3–5* of this report. Some studies focused specifically on capturing the voices of ethnic groups,[112] those with specific medical conditions (although most were concerned with patients referred with physical health problems),[116,117] and a specific age band[108,110,111] or gender.[110–112,116,117] All studies were conducted in the UK with the exception of one study, which was based in the Netherlands.[116]

TABLE 37 Characteristics of qualitative studies

Study	Participant characteristics	ERS characteristics	Qualitative methods	Focus	Findings
Stathi *et al.* (2004)[108] UK	13 community-dwelling older adults (eight male and five female; age 63–79 years), with physical health conditions	Standard structured exercise	Individual or group semistructured interviews (< 60 minutes), at various stages of referral (but nine at mid-end)	Successful ageing Contribution of ERS Experience of ERS	ERS increases sense of purpose and social interaction, with better physical and mental function and feelings of accomplishment and success. Success was contingent on the GP recommendations, exercise professional help and support, and attractiveness of the exercise content
Wormald *et al.* (2006)[109] UK	16 white adults (five male and 11 female; age 15–73 years), with wide variety of physical and/or mental health conditions	Up to six monthly consultations with active living advisor. Information and signposting service	Focus groups (one to seven participants; 45–60 minutes), after attending at least one consultation	Referral process Operational aspects of ERS Benefits of the service	Referrer and public had limited awareness of the scheme, leading to anxiety at the first session. Success appeared dependent on qualities and approach of the ERS advisor. Participants began a range of PA options and enjoyed the lack of pressure to exercise, and gentle progression. Range of physical and mental-health benefits reported, and change in other health behaviours
Hardcastle and Taylor (2001)[110] UK	15 women (age 50–80 years) with a range of physical and psychological conditions	Standard structured 10-week ERS	Repeated unstructured interviews throughout ERS and life story technique	The psychological and social meaning and relevance of an ERS for inexperienced gym users, from start to finish	Highlights the importance of a complex interplay of physical, psychological and social factors in the process of experiencing an ERS, and becoming more physically active among older women
Hardcastle and Taylor (2005)[111] UK	15 women (age 43–77 years, with a range of physical and psychological conditions	Standard structured 10-week ERS	Repeated unstructured interviews throughout ERS and life-story technique	Changes in physical self-perceptions and exercise identity in older women	ERS appeared to enhance physical self-perceptions, which in turn contributed to feelings of control, autonomy and the development of an identity as an exerciser over the course of the scheme
Carroll et al. (2002)[112] UK	South Asian Muslim women	Standard ERS (10–12 weeks) at a range of times up to 6 weeks	Informal discussion and semistructured individual or small group interviews	Structural and attitudinal barriers to ERS	Highlighted issues of access, cost, religious, parental and ethnic barriers. Additional notes provided on a range of other schemes involving Muslim women
Crone et al. (2005)[113] UK	18 adults (5 male and 13 female; mean age 55.5 years) with only physical health condition	Standard ERS	Focus groups and individual interviews, some before and after completion of one of three schemes, others just near completion	Individual experiences Important elements Pros and cons Factors influencing experience Role of exercise leader	Highlights emotional and social benefits, within themes of experiencing the ERS, structure and conditions of ERS, actions and interactions, and consequences

continued

TABLE 37 Characteristics of qualitative studies *(continued)*

Study	Participant characteristics	ERS characteristics	Qualitative methods	Focus	Findings
Martin and Woolf-May (1999)[92] UK	42 Fs (16 male and 26 female) and 35 NFs (12 males and 23 females), with physical health condition	Standard 10-week ERS	Semistructured telephone interviews. Not in-depth interviews with all	Attitude to gym, perceptions of ERS, reasons for non completion (NFs only)	Few apparent differences between Fs and NFs. No clear reason for not finishing, other than time, illness, and need for more support
Wormald and Ingle (2004)[114] UK	30 white adults (10 male and 20 female; age 25–84 years, mostly over 55 years)	Standard 10-week ERS	Six focus groups. Completers and non-completers	Role of the referee ERS environment/ staff Perceived effects of ERS	ERS provided support, supervision, structure and social opportunities, thereby enhancing motivation. Range of perceived physical and psychological benefits
Singh (1997)[115] UK	13 (11 female, aged 30–61 years). Conditions not defined but results suggest mainly physical	20 sessions of free ERS	Individual interviews	Not defined	Brief reference to a range of physical and psychological perceived benefits, and motivation. Very limited depth of analysis
Schmidt *et al.* (2008)[116] Netherlands	38 inactive and almost all obese females (age 31–60 years), from broad range of ethnic backgrounds	20-week Dutch ERS, subsidised	Individual interviews	Social, ethnic, personal and environmental factors influencing participation	Support by referee, the exercise environment and fitness instructors were important. Access to ERS in 'unsafe' environment was an issue. Limited depth of analysis
Wiles *et al.* (2008)[117] UK	Nine (of 30 approached) stroke patients (eight males, age 18–78 years	Leisure centre-based fitness instructor-led ERS (post hospital-based stroke rehabilitation)	Individual 30- to 60-minute interviews	Experience of ERS and of having a stroke	ERS was perceived as second best to physiotherapy, but better than nothing, and useful for becoming less dependent on NHS services. More personal and social support was needed in this ERS

F, finisher; NF, non-finisher.

Most studies attempted to maximise the utility of qualitative methods to explore process focused on themes such as:

1. experience of the referral process (from GP to exercise practitioner)[92,108–110,112,113]
2. experiences within the exercise facility and programme (including interactions with fitness instructor/exercise practitioner and support offered)[92,109–114,117]
3. the perceived benefits and challenges of ERS.[92,108–117]

The results of studies are summarised in *Table 37*. The key findings were:

1. Referral process good practice was seen to involve a referrer who explained the process of referral and prepared patients for what to expect, limited delay in the first appointment after referral, and support from the exercise practitioner to reduce anxiety upon arrival. Participants also appreciated a GP who would show an interest in progress, based on feedback from the exercise facility. Reduced-cost or free access to the exercise facilities was often stated as very important, especially in those studies in which there was a focus on

deprived communities. Similarly, availability of child care was mentioned as an important in being to take up, and adhere to, ERS.

2. Ethnicity and social–cultural factors appeared to impact on how participants experienced the exercise setting. Mixing ERS participants with regular gym users was identified as an issue and added to anxiety and a feeling of being out of place. For some, single-sex sessions were an essential for any engagement. Good practice seemed to involve patient-centred exercise programming (to maximise a sense of competence and choice) and an opportunity for developing social networks.
3. Participants reported a range of physical, psychological and social benefits from the ERS, together with impact on other positive health behaviours. Few studies considered the impact of the ERS on a sustainable physically active lifestyle when the programme ended, or taking up other PA options outside the gym.

Summary

There has been little consideration of uptake and adherence in previous systematic reviews of ERS.

- Fourteen observational studies and five RCTs reported their level of ERS uptake (the proportion of those individuals offered entry to ERS who attend an initial consultation with an 'exercise professional' or attend a first exercise session) and/or adherence (of those that uptake ERS, what proportion undertake 75–100% of the programme) (UK, $n = 16$; non-UK, $n = 3$).
- The pooled estimate for ERS uptake across the observational studies (66%) appeared to be lower than the pooled estimate for RCTs (80%). The pooled estimate for ERS adherence in the observational studies (50%) appeared to be higher than the pooled estimate for RCTs (37%). However, it is important to note that there was a high degree of statistical heterogeneity in the levels of uptake and adherence across studies.
- Only 6 of 13 included studies undertook multivariate analysis to assess the association between potential predictors and levels of uptake or adherence, i.e. adjusted for potential confounders. The remaining seven studies undertook bivariate association analysis.
- Although a number of studies reported an association between participant gender or age and ERS uptake and adherence, very few studies reported associations for psychosocial and programme-level factors, for example the time of day ERS is available at the delivery site.
- Women and older people were more likely to take up ERS. Although older people were also more likely to adhere, women were less likely to adhere than men.
- Eleven qualitative studies highlighted the complexity of personal experiences with ERS that might influence uptake and adherence. Several critical factors reflected the importance of individualised support that takes account of low levels of confidence. However, logistic factors such as cost, convenience and child support were also important to some population sectors.

Chapter 6

Economic modelling of cost-effectiveness

Introduction

There is limited evidence on the cost-effectiveness of ERS. The available evidence highlights significant uncertainty, particularly around the effectiveness of ERS. The result is that decision-makers are currently making decisions on the availability of ERS with only limited evidence on its cost-effectiveness.

In light of this, a de novo analysis has been developed to further explore the cost-effectiveness of ERS. The analysis considers a target population of sedentary adults, with further analysis presented to explore the impact of ERS on those with specific pre-existing conditions, where evidence suggests that ERS might improve outcomes. The approach taken uses previous research as a point of departure, and builds on this through use of evidence synthesis (see *Chapter 3*) and through further analysis of the impact of PA on HRQoL.

The approach here comprises three main activities:

1. The development of a cost–utility analysis, similar to earlier analyses, to estimate the impact of ERS on long-term outcomes based on the effectiveness evidence identified herein, including subgroup analysis, to explore the cost-effectiveness of ERS in individuals with pre-existing conditions.
2. The development of methods to quantify and incorporate short-term benefits of PA into this cost–utility framework.
3. A cost–consequence framework that summarises the costs and benefits associated with ERS in a disaggregated fashion.

Cost–utility analysis

Cost–utility analysis is widely considered to be the prevailing approach to economic evaluation in the UK, mainly as a result of the guidance laid out in the NICE reference case for economic evaluations.[118] There are known to be challenges that are inherent in applying cost–utility analyses to public-health interventions,[119] although it has been used previously to estimate the benefits of PA, notably as part of the development of guidance on PA issued by NICE.[120]

In order to generate generalisable findings in the form of an incremental cost per QALY and also allow for comparison of our findings with earlier analyses, we sought to develop a cost–utility analysis of ERS based on the evidence reported in *Chapter 3* of this report.

Methods for cost–utility modelling approach

Modelling approach

Figure 17 illustrates our modelling approach, which is a based on the structure of the model developed by NICE.[76] A decision-analytic model was developed, which followed a cohort of individuals over time to examine the impact of PA on their health. Specifically, the model considered the lifetime risk of developing a series of conditions that are known to be associated

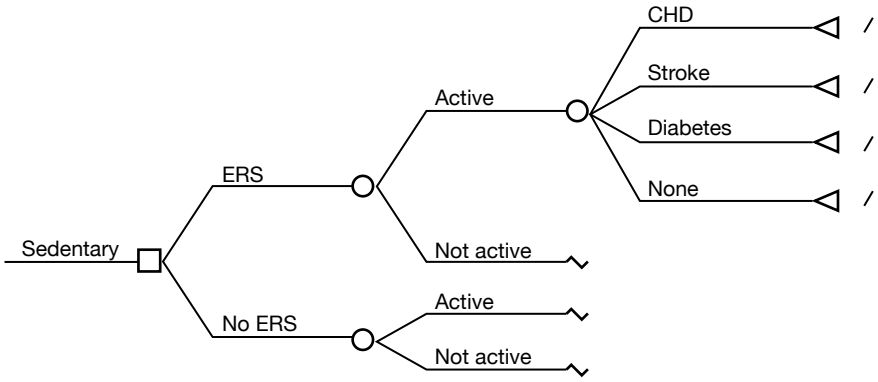

FIGURE 17 Model structure.

with being physically active. The model considered the impact of ERS on coronary heart disease, stroke and type 2 diabetes, because these are considered to be the conditions for which the most robust quantifiable evidence is available on the relationship between PA and incidence of disease. Furthermore, evidence on the QALY losses associated with the development of these conditions is also available from previous research.[84] PA has been associated with a wide range of conditions. Owing to data limitations, no attempt was made to incorporate the effect of PA on other conditions, such as musculoskeletal or respiratory diseases.

The model considers a cohort of individuals, aged between 40 and 60 years, who present in a sedentary state. The age of the population was selected to reflect the evidence on the clinical effectiveness of ERS reported in *Chapter 3*. Individuals enter the model as either exposed to an ERS intervention or not; modelling considers two hypothetical cohorts, comparing costs and outcomes of a cohort exposed to ERS with a control cohort not exposed to ERS. Those exposed to ERS are assumed to have a greater probability of becoming active. A physically active individual is assumed to have both improved life expectancy and quality of life (QoL), as a result of a reduced risk of developing each of the morbidities considered in the model. The primary end point for the analysis was QALYs.

The intervention

The ERS intervention in the model is consistent with the definition used throughout this report (see *Chapter 1*, *Physical activity promotion in primary care*). Effectiveness data for ERS are derived from the meta-analysis presented herein (*Figure 3*). For the purposes of our analysis, we assume that the ERS is leisure centre based, as is the case for the majority of studies considered in *Chapter 3*. Estimates of the cost of the intervention are derived on this basis.

Comparator

The comparator for the analysis is 'usual care', which is specified as no active intervention and as the recognised alternative in a sedentary population. This acknowledges that some sedentary individuals may choose to participate in PA without an intervention, although the probability of doing so is assumed to increase as a result of exposure to an intervention.

Perspective

The model adopts a NHS/Personal Social Services perspective, in line with the NICE reference case for cost-effectiveness analysis.[121] Although it is acknowledged that PA may have important effects on non-health-care costs and benefits, these are excluded from the primary/base-case cost–utility analysis, although these broader considerations are addressed in sensitivity analysis and through the presentation of cost–consequence analyses.

Time horizon

A lifetime horizon is adopted to acknowledge the long-term benefits of PA, with alternative time horizons considered in sensitivity analysis.

Model inputs

Data on costs and effects were synthesised to populate the model. Data were primarily derived from the systematic reviews undertaken in *Chapters 3* and *4*. Further details are provided below.

Effectiveness of exercise referral scheme comparator

Evidence of the effectiveness of ERS/comparator, measured in terms of the probability of moving from a sedentary state to an active state, was derived from the meta-analysis conducted as part of clinical effectiveness review in *Chapter 3*. This was based on ITT analyses, which adjusted for adherence and uptake and showed ERS to be associated with a higher probability (RR 1.11, 95% CI 0.99 to 1.25) of being active compared with usual care (*Figure 3*). The active state is defined in line with the effectiveness literature, i.e. doing 90–150 minutes of at least moderate-intensity PA per week. Thus, a sedentary lifestyle corresponds not only to non-participation in PA but also to participation below the requisite amount. The active state is assumed to last long enough to enable health benefits to be obtained, although this remains undefined given the inadequate evidence on the dose–response relationship between PA and the incidence of long-term outcomes. Previous analyses of behaviour change have referred to this scenario as 'fully engaged'[122] to describe an individual who makes lasting changes to his or her lifestyle following an intervention.

Risks of developing health states associated with inactivity

Evidence of the effect of PA on the development of the outcomes considered in the model (CHD, stroke and type 2 diabetes) is derived from a systematic review of economic evaluations in *Chapter 4* and HSE – 2006.[123] The derivation of the estimates involved a number of steps. First, the probability of developing these conditions among sedentary individuals was generated from the prevalence of these conditions in that population using the HSE – 2006[123] data. Although it is acknowledged that a potential limitation of such univariate analyses is that it does not adjust for confounders, data constraints precluded the inclusion of those confounders. The second step involved estimating the probability of developing the health states among active individuals using RR estimates identified from NICE[76] to adjust the estimates derived from the first step. It must be emphasised that the PA levels and study population used to measure the RR estimates match those identified in our clinical effectiveness review. A number of assumptions were made in generating these estimates. First, the risk estimates were assumed to be equivalent to the risk of developing those conditions over a lifetime. Second, the risk of experiencing any of these health states was assumed to be independent of the risk of experiencing other health states. Third, individuals were assumed to experience only one health state within the model.

Exercise referral scheme intervention costs

The cost of the ERS intervention was derived from previously published research identified as part of the review conducted for this study. The study by Isaacs *et al.*,[61] presenting a detailed bottom-up costing exercise, was identified via a systematic review of the literature, and is regarded here as the best available evidence/estimate for costing of ERS. The estimated cost of the intervention was based on resource use in a health service and/or local authority setting, consistent with the primary perspective taken for analyses here. See *Table 26* for further details (information of the calculation of these costs can be found in Isaacs *et al.*[61] The validity of the costs estimates was assessed by the expert advisory group on this project and judged to be representative of ERS schemes currently in operation. The cost estimates were adjusted for inflation into 2010 prices using the Consumer Price Index. Discounting of the intervention costs was not undertaken as intervention costs were assumed to be wholly incurred in the first

year. No attempt was made to estimate a net cost of the intervention, which subtracts any cost savings that might result from ERS from the cost of the intervention. Where this was explored in the systematic review in *Chapter 4* (Isaacs *et al.*,[61] Gusi *et al.*[70]), there was no clear evidence of a change in health-care utilisation (e.g. medications, hospital or primary care) as a result of the intervention.

Treatment costs and quality-adjusted life-years associated with coronary heart disease, stroke and type 2 diabetes

The model considers three outcomes associated with PA, CHD, stroke and type 2 diabetes. The total lifetime treatment costs and QALYs associated with each condition were estimated based on assumptions relating to the age at onset and the likely life expectancy combined with estimates of the annual cost of treating an individual with the condition. This approach was in line with the earlier analysis conducted by NICE.[76]

It was assumed that the treatment cost of stroke, unlike the other health states was an event cost that occurs once, rather than a recurring cost. This is acknowledged as a simplification in the model, as in reality there are likely to be acute and ongoing costs associated with stroke. Treatment costs were discounted using the prevailing discount rates as determined by the Treasury and/or NICE guidelines (i.e. 3.5% discounting rate).

Primary outcome measure (quality-adjusted life-years)

The primary outcome of the economic evaluation is expressed in terms of QALYs. QALY losses associated with each of the conditions considered in the model are calculated. QALYs were discounted at 3.5% discount rate. The formula for calculating the QALYs is:

$$Q = Q_1(t_s) + Q_2(t_3 - t_4) \qquad \text{[Equation 1]}$$

where Q_1 = mean QoL associated with being in a non-disease health state; Q_2 = mean QoL associated with a particular disease health state; t_s = number of years before onset of the disease health state (average age minus 55 years); t_3 = age at disease health state onset and t_4 = mean age of mortality associated with health state (average age of mortality minus loss of life-years associated with the particular condition). Loss of life-years was calculated by subtracting life-years remaining after onset of the disease health state from the average life-years remaining for the non-disease health state.

Assessment of uncertainty

Uncertainty in parameter estimates was explored through the use of deterministic and probability sensitivity analyses. The deterministic sensitivity analysis, which covered one-way and scenario analysis, explored a number of uncertainties that were recognised at the outset of the analysis. These included uncertainties around the effectiveness of ERS and changes in the cost of ERS to take into account costs incurred by participants as well as providers. The effectiveness of ERS was varied according to estimates of uncertainty reflected in the upper and lower limits of the 95% CI of the RR estimate. Sensitivity analysis also considered how a less intensive form of ERS might look, using evidence on a walking-based intervention (as opposed to a structured leisure centre-based intervention) from Isaacs *et al.*[61] Further sensitivity analyses considered 'best-case' and 'worst-case' scenarios that considered the combined effect of extreme values of effectiveness and cost.

In addition, uncertainties around parameters considered to be key drivers of the cost-effectiveness of ERS were addressed simultaneously using PSAs. The parameters that had different unit values in the two arms of the model (i.e. probability to be active and probability to get the disease conditions) were specified as incremental differences between the two arms

and not absolute values. The intuition is that the distributions of these parameters may be correlated and, hence, representing them as absolute values may overestimate the uncertainty. The distributions and the calculation of alpha and beta calculations were based on Briggs *et al.*[124] In cases where there were no data on standard errors (SEs), the standard approach of using 10% of mean estimates as SE was followed. A total of 10,000 Monte Carlo simulations were generated from the PSA.

Model validation

The following procedures were employed to check the validity of the model (Chilcott *et al.*[125]):

1. *Internal validation* Simulate a series of changes in the input values that are likely to vary the results of the model with checks to see that the impacts on the results are expected. For example, setting all QALY parameters to zero, and checking if the output of the QALYs in each arm is zero. In addition to this, the model was reviewed by an experienced health economist who was not part of the research team.
2. *Peer review* A peer-review process that involved a modeller, who understands the complexities of the model, scrutinising the spreadsheet of the model and the formulae behind it.

Results

Costs of exercise referral schemes

Estimates of the cost of ERS were derived from a detailed, bottom-up costing exercise conducted as part of a previous health technology assessment (Isaacs *et al.*[61]) and inflated to current prices. Estimates of the intervention costs are presented in *Table 38* (see *Table 26* for details).

Effectiveness of exercise referral schemes

Estimates of the effectiveness of ERS on PA levels were derived from the meta-analyses conducted in *Chapter 3*. These are reported in *Table 39*.

Estimates of the outcomes associated with physical activity

Tables 40–42 summarise the derivation of the outcomes associated with PA. Firstly, the probability of experiencing an outcome (CHD, stroke or type 2 diabetes) considered in the model is generated based on the earlier analysis conducted by NICE.[76] This is reported in *Table 40*.

TABLE 38 Intervention costs estimates

Intervention costs	Value (£)[a]	Data source
Cost of the intervention to the providers	222	Isaacs *et al.* (2007)[61]
Cost of the intervention to the participants	120	Isaacs *et al.* (2007)[61]

a In 2010 prices (estimates used in model).

TABLE 39 Inputs used in the model

Inputs	Value	Data source
Probability of becoming active after exposure to ERS	0.336	Meta-analysis in *Chapter 3*
Probability of becoming active after exposure to usual care	0.297	Meta-analysis in *Chapter 3*

TABLE 40 Probability of experiencing an outcome associated with PA

Inputs	Value	Data source
Probability of experiencing CHD when active	0.014	HSE (2006);[123] NICE (2006)[76]
Probability of experiencing CHD when sedentary	0.027	HSE (2006);[123] NICE (2006)[76]
Probability of experiencing stroke when active	0.011	HSE (2006);[123] NICE (2006)[76]
Probability of experiencing stroke when sedentary	0.015	HSE (2006);[123] NICE (2006)[76]
Probability of experiencing type 2 diabetes when active	0.022	HSE (2006);[123] NICE (2006)[76]
Probability of experiencing type 2 diabetes when sedentary	0.044	HSE (2006);[123] NICE (2006)[76]

CHD, coronary heart disease; HSE, Health Survey for England.

TABLE 41 Inputs used in calculating QALYs/treatment costs

Input	Value	Data source
Utility value of being in CHD state	0.55	NICE (2006)[76]
Utility value of being in stroke state	0.52	NICE (2006)[76]
Utility value of being in type 2 diabetes state	0.7	NICE (2006)[76]
Utility value of being in a non-disease health state	0.83	NICE (2006)[76]
Average age of cohort (in years)	50	HSE (2008)[6]
Average age of mortality (in years)	84	ONS (2006–8)[126]
Assumed average age at onset of a disease health state (in years)	55	NICE[76]
Life-years remaining after onset of CHD	18.41	NICE (2006)[76]
Life-years remaining after onset of stroke	5.12	NICE (2006)[76]
Life-years remaining after onset of type 2 diabetes	28.13	NICE (2006)[76]

ONS, Office for National Statistics.

TABLE 42 Lifetime treatment costs/QALYs associated with health states

Health state	Costs per person [2010 prices (£)]	QALYs per person
CHD	17,728	9.94
Stroke	1965	5.15
Type 2 diabetes	50,309	14.18
Sedentary (no CHD, stroke or type 2 diabetes)	–	17.18

Estimates were discounted using 3.5% rate.

Estimates of the QALYs associated with each outcome in the model are derived by multiplying the utility of being in a particular health state with the life expectancy in that health state. Life expectancy is derived by assuming an average age at onset. Assumptions about the average age at onset of a health state and the utility of health states were derived from the model developed by NICE.[76] These are reported in *Table 41*.

The lifetime treatment costs/QALYs for an individual in each health state are summarised in *Table 42*. Among the conditions included in the model, type 2 diabetes incurred the largest treatment cost and stroke the least, although it should be noted that stroke was considered as an event, whereas other chronic outcomes were associated with ongoing treatment costs.

Estimating the cost-effectiveness of exercise referral schemes

Table 43 shows the estimated ICER of the base-case analyses using a cohort of 1000 individuals and a lifetime horizon. Total costs and outcomes are divided by the cohort size (1000) to generate per-person estimates of costs and benefits. The ICER was calculated with respect to the standard comparator 'usual care'. Compared with usual care, ERS is marginally more expensive, with additional costs of £169.54, with an incremental QALY gain of 0.008 (i.e. eight QALYs gained in the total cohort). The base-case cost per QALY of ERS compared with usual care is £20,876. If adopting a willingness-to-pay threshold of £30,000, as used by NICE, these findings indicate a net health gain, and suggest that ERS is a cost-effective use of resources.

Deterministic sensitivity analysis

Deterministic sensitivity analysis was carried out around parameters with known uncertainty. Sensitivity analyses conducted are summarised in *Table 44*. *Table 45* shows the impact of the variation in parameter estimates (one-way analysis) on the cost-effectiveness of ERS. Assuming a less intensive ERS or more effective ERS resulted in an ICER below £30,000 and lower than the base case. On the other hand, including intervention costs to participants led to an ICER above £30,000, although a less effective ERS resulted in ERS being dominated by usual care (negative ICER) – i.e. ERS is more expensive and leads to loss of health gains.

Further analyses were conducted which considered 'best-case' and 'worst-case' scenarios for ERS. These scenarios are summarised in *Table 46*. The findings of the analysis are presented in *Table 47*. In the worst-case scenario, ERS was dominated by the comparator. In the best-case scenario, the ICER fell to under £700 per QALY. These findings of the deterministic sensitivity analysis (excluding the dominated cases) are presented in the form of a tornado diagram (*Figure 18*) to illustrate the relative magnitude of effect of changing each of the parameter values or scenarios. Overall, the cost-effectiveness was found to be most sensitive to changes in the scenarios (best cases of cost and effectiveness).

Probabilistic sensitivity analysis

Probabilistic sensitivity analysis, based on 10,000 simulations, was also conducted. A summary of the distributions adopted in the PSA is presented below in *Table 48*.

A scatterplot of the probabilistic findings, showing simulated estimates of cost difference against QALY difference between ERS and usual care, is provided in *Figure 19*. The scatterplot shows that all the simulations generated an improved effectiveness of ERS, but also a higher cost than usual care (i.e. all points were in the north-east quadrant of the cost-effectiveness plane). This reflects the relatively modest uncertainty around the cost of the intervention and assumptions about the distribution of uncertainty around the estimates of effect size.

The decision as to whether or not these findings can be considered cost-effective depends on the maximum amount decision-makers are willing to spend to obtain an additional unit

TABLE 43 Base-case cost-effectiveness results comparing ERS with usual care

Parameter	ERS	Usual care	Difference	Incremental cost (£) per QALY (ICER)
Lifetime total health-care costs (£) per person[a]	2491.78	2322.24	169.54	20,876.27
Total QALYs per person	16.743	16.735	0.008	

a In 2010 prices.

TABLE 44 Deterministic one-way sensitivity analysis inputs

Parameters	Value	Data source	How data was adjusted for in the model
Intervention costs to participants	£120[a]	Isaacs *et al.* (2007)[61]	Costs of intervention varied from £222 to £342 (including costs to providers and participants)
Less intensive ERS	£110[a]	Isaacs *et al.* (2007)[61]	Costs of intervention was varied from £222 to £110
Effectiveness of ERS (based on lower limit of 95% CI)	0.294	Meta-analysis in *Chapter 3*	Probability of becoming active after exposure to ERS was varied from 0.336 to 0.294
Effectiveness of ERS (based on upper limit of 95% CI)	0.371	Meta-analysis in *Chapter 3*	Probability of becoming active after exposure to ERS was varied from 0.336 to 0.371

a In 2010 prices.

TABLE 45 Cost-effectiveness results (after one-way sensitivity analyses) comparing ERS with usual care

Parameter	Incremental cost per person (£)	Incremental effect per person (QALY)	ICER (£)
Base-case assumptions	169.54	0.008	20,876.27
Intervention costs to participants	289.54	0.008	35,652.46
Less intensive ERS	57.54	0.008	7085.16
Effectiveness of ERS (based lower limit of 95% CI)	226.04	–0.001	Dominated[a]
Effectiveness of ERS (based upper limit of 95% CI)	122.46	0.015	7947.11

a Negative ICERs are not reported to avoid erroneous interpretation.

TABLE 46 Deterministic scenario sensitivity analysis inputs

Scenarios	Description
Worst case	Worst-case cost (£342) and worst-case effectiveness (0.294)
Best case	Best-case cost (£110) and best-case effectiveness (0.371)
Interaction between worst and best cases	(1) Best-case cost (£110) and worst-case effectiveness (0.294) (2) Worst-case cost (£342) and best-case effectiveness (0.371)

TABLE 47 Cost-effectiveness results (after scenario sensitivity analyses) comparing ERS with usual care

Scenarios	Incremental cost per person (£)	Incremental effect per person (QALY)	ICER (£)
Base-case assumptions	169.54	0.008	20,876.27
Worst cases of cost and effectiveness	346.04	–0.001	Dominated[a]
Best cases of cost and effectiveness	10.46	0.015	678.82
Worst-case cost and best-case effectiveness	242.46	0.015	15,734.56
Best-case cost and worst-case effectiveness	114.04	–0.001	Dominated[a]

a Negative ICERs are not reported to avoid erroneous interpretation.

of effectiveness (in this case, a QALY). This can be best presented in the form of a cost-effectiveness acceptability curve, as presented in *Figure 20*. At a threshold of £20,000 there is a 0.508 probability that ERS is cost-effective. This increases to 0.879 when a threshold of £30,000 is considered.

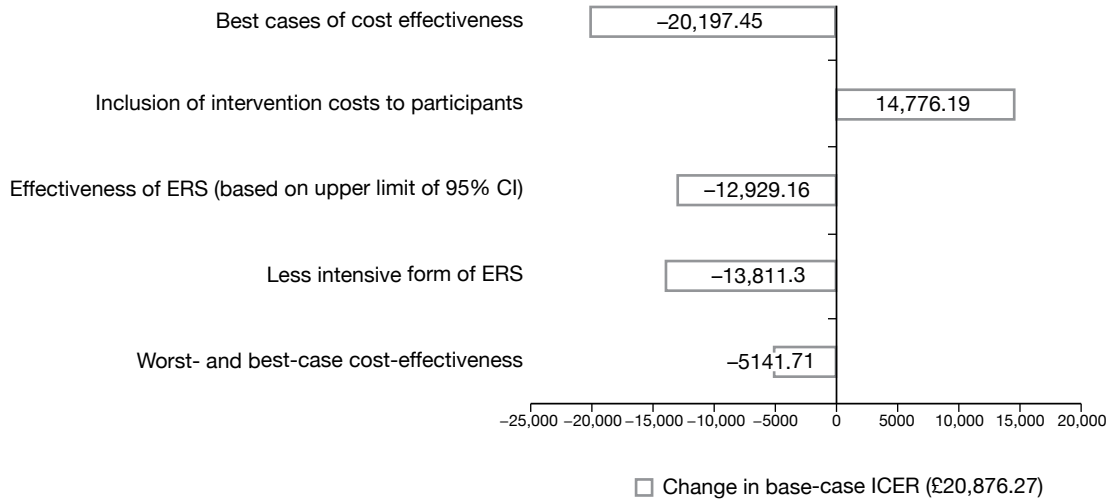

FIGURE 18 Impact of deterministic sensitivity analysis on base case ICER (£20,876.27).

TABLE 48 Probabilistic sensitivity analysis inputs

Parameters	Mean	SE	Distribution	Alpha	Beta
Incremental probability to be active	0.039	0.0039	Beta	96.061	2367.042
Incremental probability to experience CHD	0.013	0.0013	Beta	98.687	7492.621
Incremental probability to experience stroke	0.004	0.0004	Beta	99.596	24,799.4
Incremental probability to experience diabetes	0.022	0.0022	Beta	97.778	4346.677
Treatment discounted cost of CHD	£17,728.03	£1772.803	Gamma	100	177.2803
Treatment discounted cost of stroke	£1965.165	£196.5165	Gamma	100	19.65165
Treatment discounted cost of diabetes	£50,309.43	£5030.943	Gamma	100	503.0943
Discounted QALY for CHD health state	9.942348	0.994235	Gamma	100	0.099423
Discounted QALY for stroke health state	5.148217	0.514822	Gamma	100	0.051482
Discounted QALY for type 2 diabetes health state	14.18193	1.418193	Gamma	100	0.141819
Cost of intervention	£222	£37.9	Gamma	34.31054	6.470315

Subgroup analysis of exercise referral schemes in individuals with pre-existing conditions

The remit of this HTA report was to examine the clinical effectiveness and cost-effectiveness of ERS in individuals with a pre-existing condition. The cost-effectiveness evidence reviewed in *Chapter 4* captured relatively little existing evidence on such individuals. Rather, ERS was used to mitigate against unhealthy behaviours or risk factors for future conditions.

The aim of this section is to evaluate the cost-effectiveness of ERS in people with a diagnosed condition known to benefit from PA. We focused on the top three conditions (*Table 49*) that have been found to benefit most from increases in PA (BHFNC[34]); obesity, hypertension and depression (see *Appendix 1*, *Figure 21*, for full list).

Methods for subgroup analysis in individuals with pre-existing conditions

The subgroup analysis is based on the use of the same framework for cost–utility analysis reported above. The model was adjusted to reflect differences in the underlying risk of developing each of the morbidities in the model (CHD, diabetes and stroke), according to the existence of a

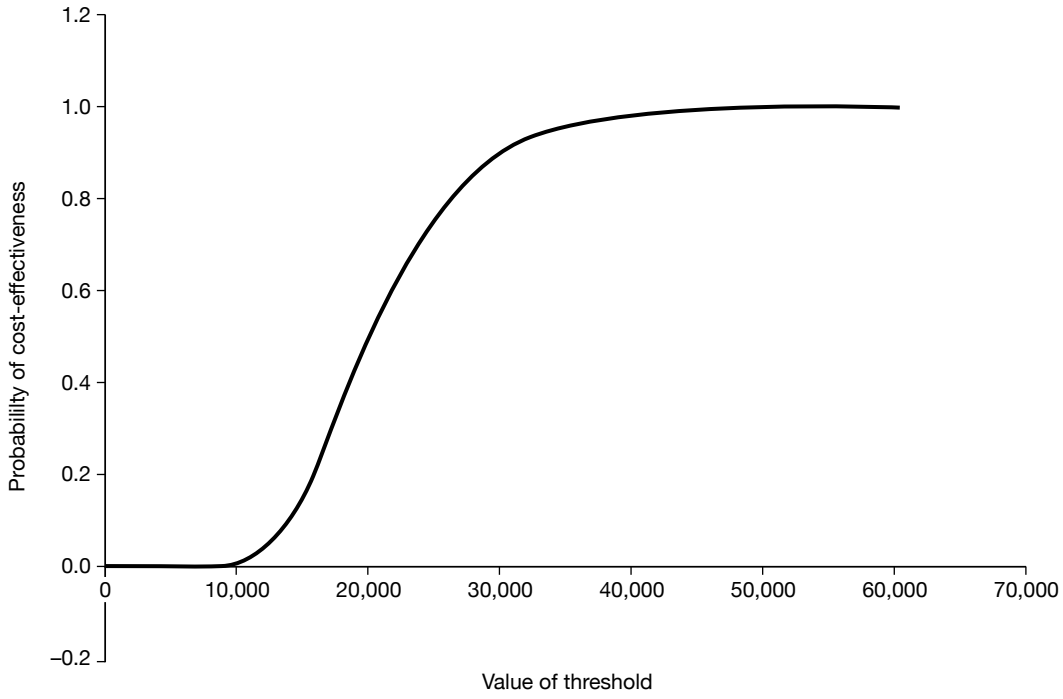

FIGURE 19 Cost-effectiveness plane showing the scatter plot of 10,000 Monte Carlo simulations for ERS compared with usual care.

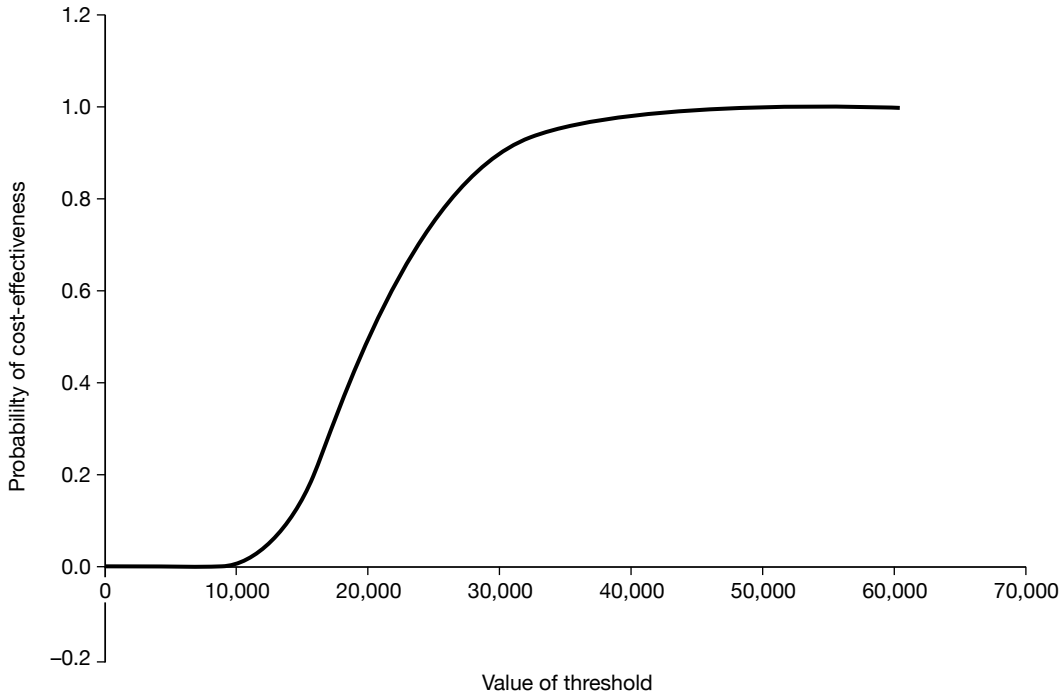

FIGURE 20 Cost-effectiveness acceptability curve showing the probability of cost-effectiveness for ERS at varying levels of threshold.

pre-existing condition. The values (*Tables 38–42*) of other parameters (i.e. efficacy of ERS/control, costs and utilities associated with health events) from the base-case model are assumed to hold for these cohorts. Analysis was run separately for each of the disease specific cohorts. *Table 49* shows the data inputs and the data sources used for the probabilities of experiencing the health states in the respective cohorts. The sources for data were selected based on their relevance to our methodology (e.g. age and gender characteristics) given their methodological rigour. Calculation of these probabilities follows the approach in the base case. Data insufficiency precluded the fitting of different probabilities for all health states in all cohorts. In the absence of incidence data to generate the probabilities (e.g. CHD in the obese cohort), we used mortality data with the caveat that the probability of experiencing that health state was similar to the probability of death related to that condition. Also, in cases where data was observed for cardiovascular disease (in the obese and hypertensive cohorts) it was assumed that those probabilities hold for both stroke, and CHD.

Results

Table 50 presents the estimated ICER for the disease-specific cohorts. For each of the conditions considered, the ICER is lower than the base case, reflecting the increased likelihood of developing one of the morbidities considered in the model if the individual has a pre-existing condition. Compared with usual care, ERS in these cohorts remains more costly (albeit less so than in a general population cohort). In terms of effectiveness, ERS (compared with usual care) is more effective, leading to improved QALY gains that are higher than in the base case (ranging from 0.011 to 0.017). The cost per QALY of ERS compared with usual care is between £8414 and £14,618, and thus ERS can be considered cost-effective at the NICE threshold.

TABLE 49 Inputs used in the model

Cohort	Inputs	Value	Data source
Obese	Probability of experiencing CHD when active	0.0259	HSE (2006);[123] Hu *et al.* (2005)[127]
	Probability of experiencing CHD when sedentary	0.0376	HSE (2006);[123] Hu *et al.* (2005)[127]
	Probability of experiencing stroke when active	0.0259	HSE (2006);[123] Hu *et al.* (2005)[127]
	Probability of experiencing stroke when sedentary	0.0376	HSE (2006);[123] Hu *et al.* (2005)[127]
	Probability of experiencing type 2 diabetes when active	0.0756	HSE (2006);[123] Hu *et al.* (2004)[128]
	Probability of experiencing type 2 diabetes when sedentary	0.0986	HSE (2006);[123] Hu *et al.* (2004)[128]
Hypertensive	Probability of experiencing CHD when active	0.060	HSE (2006);[123] Hu *et al.* (2007)[129]
	Probability of experiencing CHD when sedentary	0.074	HSE (2006);[123] Hu *et al.* (2007)[129]
	Probability of experiencing stroke when active	0.060	HSE (2006);[123] Hu *et al.* (2007)[129]
	Probability of experiencing stroke when sedentary	0.074	HSE (2006);[123] Hu *et al.* (2007)[129]
Depressive	Probability of experiencing CHD when active	0.0336	HSE (2006);[123] Surtees *et al.* (2008)[130]
	Probability of experiencing CHD when sedentary	0.0801	HSE (2006);[123] Surtees *et al.* (2008)[130]

TABLE 50 Cost-effectiveness results (disease specific cohorts) comparing ERS with usual care

Cohort	Incremental cost per person (£)	Incremental effect per person (QALY)	ICER (£)
Obese	167.89	0.011	14,618.21
Hypertensive	168.08	0.013	12,834.11
Depressive	146.72	0.017	8414.01

Summary of the cost–utility analysis

Our analysis attempts to estimate the cost-effectiveness of ERS using a cost–utility analysis framework similar to that used in previous analyses (NICE 2006[76]). Our base-case assumptions result in a favourable cost-effectiveness ratio of £20,876 per QALY gained from ERS compared with usual care. It should be acknowledged that our base-case estimate includes some optimistic assumptions with respect to cost and effectiveness. However, our deterministic and PSAs suggest that there is a low possibility of the ICER increasing above £30,000 when these assumptions are relaxed.

Analysis of ERS in groups of individuals with pre-existing conditions suggests that it may be more cost-effective in these groups, than in a sedentary population. ERS is frequently prescribed to individuals with risk factors for CVD. Our subgroup analysis includes populations with obesity and hypertension to reflect these individuals. In these groups, the cost-effectiveness of ERS falls to around £11,000 per QALY. In a population with depression, ERS cost-effectiveness is more favourable, generating an ICER of approximately £8000. Given the higher risk of developing the long-term illnesses considered in the model in these groups, it is not surprising that the subgroup analyses produce more favourable ICERs. This is an encouraging finding and suggests that it might be possible to target ERS to individuals with pre-existing conditions in which the pay-offs/impact may be higher. However, there remain some major uncertainties over whether or not the evidence used to populate the model, derived from the meta-analysis, is applicable to these groups. There may be good reason to believe that uptake, adherence and effectiveness might differ according to the characteristics of the recipients. Although we have attempted to adjust the model to take into account differences in the rate of long-term illnesses, no data were identified as part of the effectiveness review to allow for adjustment of the effect of ERS in different populations. There is a pressing need for better primary evidence to inform these uncertainties.

Although our cost-effectiveness estimates suggest that ERS is a cost-effective use of NHS resources, it should be noted that the individual-level lifetime QALY gains are relatively modest (< 0.01 in our base-case analysis). This estimate is predicated on the evidence of effectiveness derived from the meta-analysis presented earlier in this report. We believe that the meta-analysis has provided the most robust estimate to date of the effectiveness of ERS compared with usual care. However, it should be acknowledged that the cost-effectiveness analysis is attempting to capture lifetime benefits based on evidence of relatively modest effect sizes derived from short-term studies. Any such analysis inevitably involves some assumptions about the degree to which behaviour change is lasting and fails to consider other health behaviours that may impact on long-term outcomes. The result is that the cost-effectiveness analysis estimates that ERS has a modest lifetime cost and a marginal lifetime QALY gain. Even small changes in the source data used to populate the model, particularly evidence of effect size and cost, may lead to significant changes in the resulting ICER. This can best be illustrated through consideration of the net benefit calculation. If we value each QALY gained at £30,000 and accept that our analysis is generating a lifetime QALY gain of approximately 0.008 in most cases, then the value of the benefits generated in monetary terms is approximately £240, which exceeds the cost of the intervention. However, even a modest change in the lifetime QALY gain, to 0.07, would result in the costs exceeding the benefits, making the cost-effectiveness of ERS questionable.

Although sensitivity analysis has sought to address this point, it should be acknowledged that, in many cases, source data were derived from a single study (e.g. cost data from Isaacs *et al.*[61]) and it was necessary to fit distributions to parameters to allow for PSA. Although every effort has been made to explore uncertainty, there is a possibility that the uncertainty around parameter estimates may be greater than predicted within our analysis, which would have a material impact on the ICER.

Although some caution should be taken in interpreting the findings, the authors would wish to emphasise that the estimates of cost-effectiveness generated are believed to be conservative. Our approach generates a partial analysis that considers only the impact of ERS on a number of morbidities known to be associated with PA. The impact on other morbidities was excluded owing to limitations in the available evidence. On this basis, our estimates of cost-effectiveness should be regarded as conservative, as we have made no attempt to quantify these benefits within our analysis.

Limitations of the analysis

The analysis had a number of limitations which should be acknowledged. First, we examine only the long-term impact of PA on selected morbidities. It was not possible to include other morbidities that may be affected by PA owing to uncertainty over the relationship between PA, incidence and quality-adjusted life expectancy. Nor does our model account for potential negative outcomes of PA, such as injuries. Although this may be an important determinant in taking up PA, particularly in the elderly, the evidence on injuries suggests that they are rare (Munro *et al.*[48]), and they are not expected to significantly affect results when considered at a population level. Another set of limitations include assumptions relating to constant and independent risk of experiencing disease health states and age at onset of disease. These assumptions were derived from the NICE 2006 report[76] and were meant to allow our analysis to be comparable with previous research. Although we recognised that these assumptions are limiting, their impact on the ICER, when investigated through sensitivity analysis, was considered minimal.

A number of other weaknesses in the model design were identified which were prioritised for further analysis. These include:

- the potential to capture the short-term improvements in QoL associated with PA (process benefits), which may be particularly important in certain groups, such as those who are prescribed PA for mental-health problems, such as depression
- the wide range of health benefits associated with increases in PA, including mental health, cancer and musculoskeletal conditions, which are currently excluded from the analysis.

These points are addressed in the remaining sections of this chapter, first through further development of the cost–utility analysis and subsequently through the development of a cost–consequence framework that allows for consideration of other health and non-health costs and benefits that might be associated with ERS.

Further development of the cost–utility analysis to include short-term quality-adjusted life-year gains resulting from physical activity

The previous section highlighted the need to consider the short-term improvements in QoL (e.g. improved mental health) that might result from increased PA, as well as longer-term impacts on common conditions. A key step in achieving this is to estimate the HRQoL gain associated with increases in PA. This section seeks to address this point by first estimating the short-term QoL gain associated with PA using econometric models, and, second, incorporating the estimated QoL gains into the base-case model, reported above, to generate a revised ICER.

Participation in PA has been found to lead to enhanced QoL, an effect that is consistent across socioeconomic details.[131] Nonetheless, to date, economic evaluation of exercise interventions have

rarely accounted for these QoL gains. A notable exception is Beale *et al.*,[84] who included QoL gains associated with a unit increase in PA and found a favourable impact on ICERS generated for environmental interventions to promote PA. Therefore, this section attempts to build on previous analyses by demonstrating the impact of the inclusion of QoL gains associated with an active state (via say ERS) on the cost-effectiveness of ERS.

Methods for further development of the cost–utility analysis to include short-term quality-adjusted life-year gains resulting from physical activity

Data

Data from HSE – 2008[6] have been used to conduct econometric analyses to explore and estimate the impact of PA on HRQoL. The HSE is a routine cross-sectional survey that draws a nationally representative sample of persons residing in private households in England. The sample and focus of the survey vary each year. Data from the 2008 survey were used in this study and included a sample of 9191 households with 15,102 adults aged 16 years or over, and a total child sample of 7521. This study draws on data for 5537 observations of 40- to 60-year-olds among the adult sample. Sampling was based on a multistage stratified random sampling design that uses the Postcode Address File as a sampling frame. The primary focus of HSE – 2008[6] was PA and fitness. The method of data collection involved the use of face-to-face interviews, self-completion questionnaires, clinical measurements and physical measurements (including objective measurements of PA via accelerometers). To compensate for seasonal variation in responses, the time period for interviews covered January to December 2008, with the fieldwork spanning from January 2008 to April 2009.

Health-related quality of life

Health-related quality of life is measured in the HSE survey using the EQ-5D, and the summary measure of HRQoL (or health–state utility value) derived from the EQ-5D.[132] These utility scores were generated using the descriptive system of the EQ-5D questionnaire (UK version), a standard HRQoL instrument with preference weights which are attached to combinations of responses. The EQ-5D descriptive system describes HRQoL in five dimensions (i.e. mobility, self-care, usual activities, pain/discomfort and anxiety/depression), with each dimension including three levels: no problems, some/moderate problems, and severe/extreme problems. Different health states are created from the responses to the descriptive system of the EQ-5D by combining one level from each of the dimensions. A tariff is then applied to these health states to generate utility scores.[132] The utility scores usually range from '1' (perfect health) to '0' (death, with states that are perceived to be worse than death having a negative utility score).

Physical activity

As shown in *Table 51*, PA in the HSE – 2008[6] is measured/assessed via (1) specific activities – including walking and sports – and (2) a composite indicator – a combination of different types of PA (i.e. walking, housework, occupational activity and sports/exercise). The composite indicator was captured through either subjective (self-reports) or objective (accelerometers) measurements. Each of these activities is operationalised as a binary variable indicating being 'physically active' or not. The variable takes the value of 1 if PA (defined as a minimum of 90 minutes of at least moderate-intensive PA) was done per week, or defined as zero otherwise (not PA). This definition of 'physically active' is consistent with the approach in the literature on ERS (see *Chapter 3*), and was adopted to allow future modelling of the cost-effectiveness of ERS.

Control variables

A set of sociodemographic, economic, health and other variables that have been found in the literature to be correlates of HRQoL were considered as covariates. *Table 52* lists these variables and a priori expectations about the direction of their correlation with HRQoL (see *Appendix 7*, *Table 62*, for references). In developing the expected signs, consideration was given to the

TABLE 51 Specification of indicators of PA

Variable	Specification of variable
Walking	1 = a minimum of 90 minutes of brisk walking per week[a]
	0 = otherwise
Sports and exercise	1 = a minimum of 90 minutes of at least moderate-intensive sports and exercise activities per week
	0 = otherwise
Objective measurement	1 = a minimum of 90 minutes of at least moderate-intensive PA per week
	0 = otherwise
Subjective measurement	1 = a minimum of 90 minutes of at least moderate-intensive PA per week
	0 = otherwise

a Brisk walking is classified as moderate intensity (Stevens *et al.*[50]).

TABLE 52 Overview of control variables

Variables	Expected sign
Age	–
Gender (female)	
Social class (high)	+
Education (high)	
Ethnicity (white)	–
Marital status (married)	?
Income (high)	+
Employment status (employed)	
BMI (high)	–
House tenure (house owners)	+
Smokers (yes)	–
Drink alcohol (yes)	+
Morbidities (yes)[a]	–
Region of residence	?
Psychosocial well-being (high)	–
Height (increased)	+
General health (favourable)	
Weight (increased)	–
Urbanisation (urban)	?

–, negative association; +, positive association; ?, association unknown.

a Morbidities is being used here for brevity as the studies captured several health conditions (e.g. problems with the heart, muscoskeletal, ear, vision, mental, hypertension, stroke, diabetes).

methodology (e.g. the specification of the dependent variable and the control variable; the origin and characteristics of the sample) used by the studies reporting those findings.

Methods of statistical analysis

Means [(standard deviation (SD)] and proportions were calculated for continuous and categorical data, respectively. The chi-squared and Fischer's exact tests were used to check the association between the HRQoL (dependent variable) and dummy variables representing item non-response for independent variables in order to examine the mechanisms under which the missingness occurred (i.e. missing completely at random or not).[124] If the pattern of missingness did not occur completely at random, a regression-based imputation method was used to replace missing

values of continuous variables and a dummy variable specifying item non-response added. For the categorical variables, item non-response was included in the omitted category and a dummy variable for item non-response created.[133]

Tobit regression with upper censoring at 1.0 and robust SEs were used to model the relationship between HRQoL and indicators of PA controlling for potential confounders (covariates). Separate Tobit regressions were fitted for each of the indicators of PA to avoid unstable estimates resulting from the collinearity among those indicators. In each case, two models were used: (1) a model that excludes missing observations and (2) a model that includes missing observations. The models were estimated with sampling weights that were calculated as the inverse of the probability of being a respondent in a household multiplied by the household weight, which accounts for non-responding households.[134] Reduced models were derived for each of the regression models by identifying and removing independent variables that were not statistically significant via stepwise regression. Categories of significant categorical variables that were dropped by the stepwise regression were added back into the model, after which variables with the largest *p*-value (average *p*-value for categorical variables) were removed one by one, until the reduced model had only significant variables. The Wald test was used to test significance of variable/variables before their removal.[135]

Specification errors and goodness-of-fit of regression models were examined using the linktest[5,136] and penalised log-likelihood values via Akaike information criterion (AIC) and Bayesian information criteria (BIC),[137] respectively. [The idea behind the linktest is that if a regression model is well specified, extra independent variables that are significant should be found by only chance. The linktest works by creating two variables (i.e. the variable of prediction and the variable of squared prediction), after which the model is fitted with these two variables. The null hypothesis is that there is no specification error. This is checked by looking at the statistical significance of the variable of squared prediction, which should not be a statistically significant predictor (at 5%) if the null hypothesis is to be accepted.] In addition, pseudo-R^2 was computed by calculating the R^2 between the predicted and observed values.[138] The existence of multicollinearity among independent variables was assessed to ascertain whether or not they lie within tolerance ranges.[139,140] [This was measured by indicators of variable inflated factor (VIF) (i.e. measures the amount of inflation of the SE that is caused by collinearity) and 'tolerance', which shows the amount of collinearity a regression model can tolerate. A tolerance value of 0.1 or less, and a VIF of 10 or more, shows a variable to be highly collinear and, hence, likely to provide imprecise estimates.] The threshold for statistical significance was set at ≤ 10% in all analyses. All analyses were undertaken using Stata version 10 (StataCorp LP, College Station, TX, USA).

Incorporation in the cost–utility analysis

To generate the ICER, the estimated QoL gain associated with PA is then included in the cost–utility model reported above. Where an individual becomes physically active (with or without ERS) they accrue an additional QALY gain. Given the absence of evidence on the duration of this QALY gain we take a conservative approach by assuming that it is a one-off gain that lasts for 1 year. Sensitivity analysis addresses the impact of this assumption on the cost-effectiveness of ERS by generating ICERs at varying levels of duration, which included 1 day, 1 week, 1 month, 6 months and lifetime.

Results

Description of sample

The mean EQ-5D for the sample was 0.86 (SD 0.23) and few had limiting illness (23.4%). The proportion of the sample that was 'physically active' ranged from 11.5% (via objective

measurement) to 44.4% (via subjective measurement). The sample was predominantly white (90.8%), with the remaining 9% comprising those of mixed race, Asians, Chinese, Black people and those of other race, and had a mean (SD) age of 50 (6.2) years. Of the sample, 54.5% were female and most were married and living with their partners (66.3%), most had an educational qualification (80.8%) and most were in employment (76.1%). Few (25.6%) were classified as obese and smokers (21.8%), although the majority were 'drinkers' (84.9%). Further details are available in *Appendix 7*, *Table 63*.

Missing observations

The dependent variable (EQ-5D) had 84 missing observations (1.5%). All of the independent variables (except walking; sports and exercise; age; marital status; and region of residence and urbanisation) had missing observations (see *Appendix 7*, *Table 63*). Most variables had around 1% of data missing and PA (via objective measurement) had the highest proportion of missing observations (84%). The mean EQ-5D utility scores for individuals who had missing values for the following independent variables were statistically significantly different from those who did not: social class, BMI or smokers. The mean EQ-5D utility scores for proportion of individuals who had missing values for the indicators of PA were not, however, statistically different from those who did not.

Regression models

Table 53 shows the reduced regression models estimating the correlation between indicators of PA and HRQoL, controlling for covariates. Emphasis is placed on the models that exclude missing observations because they provide better fit and specification. Notably, results were similar across models with or without missing observations. Recall that separate models were fitted for each indicator of PA: model 1 (walking); model 2 (sports and exercises); model 3 (objective measurement); and model 4 (subjective measurement). Hereafter, the models will be referred to by these names.

The results indicate that being 'physically active' through walking was statistically significantly associated with better HRQoL (0.026; *p*-value at 10%) compared with being inactive. Similarly, those who were reported to be 'physically active', defined as participation in sports and exercise (0.034), overall PA measured via objective indicators (0.072) or subjective indicators (0.047) were all found to have a statistically significant better HRQoL (*p*-value at 5–10%) than inactive individuals.

Other factors statistically significantly correlated with better HRQoL included high-income earners, having no/non-limiting illness, and residing in town/fringe or village/hamlet/isolated dwelling. Conversely, people with heart problems, musculoskeletal/mental/urinary/blood pressure problems and psychosocial well-being were likely to have worse HRQoL. Being relatively older, a 'non-drinker' of alcohol, economically inactive or obese also had a statistically significant association with worse HRQoL.

Model diagnostics

The specification error tests show that the models had good specification and that additional statistically significant regressors could be found only by chance (see *Appendix 7*, *Table 64*). The models' estimates could be considered stable, as no sign of multicollinearity was found, with average variance inflation factors and tolerance levels at 1.2 and 0.8, respectively. A reasonable proportion (between 10% and 40%) of variation in HRQoL was explained by the models as indicated by the pseudo-R^2-value. Model 3 seems to have the best fit, as it had the lowest AIC and BIC values.

TABLE 53 Estimation results of regression models (reduced models without missing observations)

	Dependent variable (HRQoL)							
	Model 1		Model 2		Model 3		Model 4	
Independent variables	Coefficient	SE[a]	Coefficient	SE[a]	Coefficient	SE[a]	Coefficient	SE[a]
Walking								
Active	**0.026***	**0.014**						
Inactive (reference)								
Sports and exercise								
Active			**0.034****	**0.018**				
Inactive (reference)								
Objective measurement								
Active					**0.072***	**0.044**		
Inactive (reference)								
Subjective measurement								
Active							**0.047*****	**0.013**
Inactive (reference)								
Age	–0.004***	0.001	–0.004***	0.001	–0.004*	0.002	–0.004***	0.001
Income	1.03e-06***	2.12E-07	1.03e-06***	2.13E-07			9.41e-07***	2.52E-07
Employment status								
Unemployed	–0.020	0.036	0.015	0.033	–0.036	0.083	–0.011	0.041
Retired	0.004	0.026	0.019	0.027	–0.090	0.061	0.019	0.029
Other economically inactive	–0.176***	0.016	–0.133***	0.016	–0.313***	0.043	–0.180***	0.019
Employed (reference)								
Education								
Higher education < degree							–0.049**	0.022
NVQ3/GCE 'A' level							–0.041*	0.021
NVQ2/GCE 'O' level							–0.031	0.019
NVQ1/CSE other grade							0.006	0.033
Foreign/other							–0.149**	0.061

	Dependent variable (HRQoL)							
	Model 1		Model 2		Model 3		Model 4	
Independent variables	Coefficient	SE[a]	Coefficient	SE[a]	Coefficient	SE[a]	Coefficient	SE[a]
No qualification							–0.055**	0.021
NVQ4/NVQ5/degree (reference)								
Drink alcohol								
No	–0.077***	0.016	–0.056***	0.016				
Yes (reference)								
Musculoskeletal problems								
Yes	–0.322***	0.013					–0.342***	0.015
No (reference)								
Psychosocial well-being								
Score 1–3	–0.167***	0.013	–0.149***	0.013			–0.153***	0.016
Score 4+	–0.357***	0.015	–0.324***	0.015			–0.350***	0.018
Score 0 (reference)								
Heart problems								
Yes	–0.041**							
No (reference)								
BMI								
Normal (18.5–25)	–0.062	0.074	–0.083	0.078				
Overweight (25–30)	–0.103	0.074	–0.118	0.078				
Obese (30+)	–0.126*	0.074	–0.149*	0.078				
Underweight (<18.5) (reference)								
Limiting illness								
Non-limiting			0.226***	0.016				
No illness			0.333***	0.013				
Limiting (reference)								

continued

TABLE 53 Estimation results of regression models (reduced models without missing observations) *(continued)*

	Dependent variable (HRQoL)							
	Model 1		Model 2		Model 3		Model 4	
Independent variables	Coefficient	SE[a]	Coefficient	SE[a]	Coefficient	SE[a]	Coefficient	SE[a]
Urinary problems								
Yes					–0.256**	0.109		
No (reference)								
Hypertensive								
Yes							–0.054***	0.016
No (reference)								
Mental disorder								
Yes							–0.147***	0.029
No (reference)								
Urbanisation								
Town/fringe					0.100**	0.053		
Village/hamlet/isolated dwelling					0.120**	0.048		
Urban (reference)								
Constant	*1.456****	*0.09*	*1.159****	*0.091*	*1.252****	*0.12*	*1.393****	*0.059*
No. of observations	*3957*		*3957*		*873*		*2859*	

*, significance level of 10%; **, significance level of 5%; ***, significance level of 1%; CSE, Certificate of Secondary Education; GCE, General Certificate of Education; NVQ, National Vocational Qualification.
a Robust SE.

Impact of short-term health gains on the incremental cost-effectiveness ratio

Table 54 shows the estimated ICER following the inclusion of the short-term QALY gains in the base-case model. As expected, the inclusion of short-term QALY gains leads to lower ICERs for ERS. Compared with usual care, ERS is still more expensive, as it incurs additional costs of £169.54, but it is more effective, leading to QALY gains ranging from 0.009 to 0.011 per person. The cost per QALY of ERS compared with usual care is estimated to be between £15,513 and £18,559. This compares with the estimate from our base-case analysis, which excluded consideration of short-term benefits, of about £20,000. The results are, however, sensitive to the duration that the short-term QALY gains last (*Table 55*). Assuming they last for between 1 day and 1 month leads to insignificant improvements in the ICER, albeit at 6 months and lifetime durations there is a significant improvement in the ICER to < £6000 per QALY.

Summary

Results from our econometric analysis support the hypothesis that PA is associated with improved QoL, as measured by the EQ-5D. It is important to note, however, that the analysis in this chapter does not prove causality. In the case of the covariates, a priori expectations formulated, based on the literature with respect to their association with the HRQoL, were all met, hence, providing validity to the models. Further confidence can be drawn from the findings because all regression models had good specification and fit.

The inclusion of short-term QALY gains for individuals who are physically active resulted in reductions in the ICER for ERS, as expected. Assuming that the health gain associated with ERS lasts for 1 year, the base-case ICER is reduced by approximately £1500–4000. If we assume that these 'feel-good' benefits resulting from PA are sustained if an individual remains active over the course of his or her lifetime then the ICER falls significantly to < £5000. These benefits have been referred to as short-term benefits in the current analysis to distinguish them from the longer-term impacts of PA on the development of ill-health. However, they might better be regarded as process benefits that arise from the process of engaging in PA. The degree to which the process benefits resulting from PA are lasting is an issue that warrants further exploration. ERS based on composite measure of PA appears to be associated with the greatest short-term health gain and

TABLE 54 Cost-effectiveness results (after inclusion of short-term QALY gains) comparing ERS with usual care

Type of PA	Incremental cost per person (£)	Incremental effect per person (QALY)	ICER (£)
Walking	169.54	0.009	18,559.01
Sports and exercise	169.54	0.009	17,946.10
Objective measurement	169.54	0.011	15,512.60
Subjective measurement	169.54	0.010	17,032.00

TABLE 55 ICERS (after inclusion of short-term QALY gains) at different duration levels of QALY gains

Type of PA	ICER (£) (1 day)	ICER (£) (1 week)	ICER (£) (1 month)	ICER (£) (6 months)	ICER (£) (lifetime)
Walking	20,869.13	20,826.26	20,661.29	19,649.56	5872.12
Sports and exercise	20,866.94	20,810.92	20,596.03	19,300.60	4084.56
Objective measurement	20,856.51	20,738.37	20,291.60	17,799.13	2157.26
Subjective measurement	20,863.37	20,786.05	20,490.86	18,759.23	3716.96

thus the lowest ICER and walking-based ERS the highest. Further studies are needed to examine how long these short-term QALY gains last, as that is critical to its impact on ICER.

Cost–consequence analysis

In addition to the development of the cost–utility analysis, we also sought to develop a cost–consequence analysis of ERS. This was an attempt to acknowledge that ERS and PA more generally might impact on a number of conditions not considered within the cost–utility analysis because of data constraints. In many cases, these impacts relate to an association between PA and an outcome that has not been shown to be causal or has not been adequately quantified to allow for it to be included in the cost–utility analysis. An attempt was made to capture both positive and negative outcomes of ERS that were excluded from the cost–utility analysis. A cost–consequence approach allows these issues to be explored although acknowledges that in many cases the effect cannot be quantified and no attempt is made to generate a single composite end point (such as a QALY or a cost–benefit ratio).

Methods for cost–consequence analysis

The analysis was conducted from a partial societal perspective, including health- and non-health-care costs and benefits. The intervention and its cost remain unchanged from the cost–utility analysis. However, attempts were made to identify a broader range of benefits and disbenefits that might be associated with ERS and PA more generally. The evidence incorporated into the cost–consequence analysis was derived from the base-case model and the literature reviews conducted as part of this assessment.

Outcomes are presented as a synthesis of the available evidence. Wherever possible, attempts are made to quantify the effects of ERS on the outcome under consideration. For example, based on our cost–utility analysis, it is possible to provide an indication of how many strokes might be avoided as a result of increased participation in ERS. Where quantified outcomes are possible, these are expressed as the number of events per 100,000 population.

However, in many cases it is only possible to indicate the direction of change that might be achieved through increased PA, not the magnitude of effect. As such, outcomes are ultimately presented in a disaggregated fashion.

Results

Impacts of exercise referral schemes/physical activity

Table 56 presents the costs and benefits identified in the cost–consequence analysis and their sources of data. The identification of the benefits of ERS was primarily based on the key conditions where PA has been shown to be beneficial (see *Table 1*).

The majority of the evidence identified suggested that PA could have a positive impact on health outcomes. Excluding the three health outcomes already considered in the cost–utility analysis, our searches identified evidence of an association between PA and improved outcomes in musculoskeletal disease, cancers and mental health. Non-health benefits and disbenefits were also identified. These suggest that ERS might have a positive impact on absenteeism, although it might also induce some injuries that have a countering effect. Relatively few disbenefits were identified within our searches.

Cost–consequence analysis

Table 57 shows the outcomes for ERS. The results are presented as incremental costs and outcomes attributable to ERS (compared with usual care).

TABLE 56 Costs and consequences of ERS

Measures in analysis	Data source	Methodology of study[a]
Costs		
Intervention cost to providers	Base-case model	–
Intervention cost to participants	Base-case model	–
Benefits		
Physically active state	Base-case model	–
Full health state	Base-case model	–
Mental health		
Anxiety	Conn[141]	A meta-analysis that used data synthesised across 3289 adult participants (mean age ranged from 21 to 71 years) from 15 studies based on interventions designed to increase PA delivered to healthy adults without anxiety disorders
Depression	Craft and Perna[142]	A meta-analysis that converted the overall effect sizes of three meta-analyses (which included 37 studies investigating the effect of PA on depression) to a binomial effect size
Metabolic		
Diabetes	Boule *et al.*[143] base-case model	A meta-analysis of 14 controlled studies (11 RCT; findings did not differ according to study design) with synthesised data from 504 type 2 diabetes mellitus patients with mean age of 55.0 (7.2) years; 50% of participants were women. Studies, which examined the impact of PA on diabetes, covered different ethnicities (Northern Europeans, Southern Europeans, black people, Asian, Middle Easterners), age groups and medication status (no medication, oral hypoglycaemic agents, insulin therapy)
Cancer		
Colon cancer	Lee[144]	A narrative systematic review using data sourced from 50 published epidemiological studies that had investigated the relationship between PA and the risk of developing cancer. Studies were conducted in North America, Europe, Asia, Australia and New Zealand
Breast cancer	Lee[144]	Same as previous
Lung cancer		
Cardiovascular		
Hypertension	Whelton *et al.*[145]	A meta-analysis of 54 RCTs (covering 2419 participants) that examined the impact of PA on hypertension. Studies were mainly Europe based. Sample covered both hypertensives and normotensives, diverse ethnic groups, and had a mean age of between 21 and 79 years
CHD	Taylor *et al.*[146] base-case model	A meta-analysis of 48 trials (covering 8940 participants who had CHD) that had observed the impact of PA on CHD. Mean age of participants was 48–71 years. Studies originated from Europe, North American and Asia/Australia
Stroke	Base-case model	–
Musculoskeletal		
Osteoporosis	Moayyeri[147]	A meta-analysis of 13 prospective cohort studies showing association between PA and hip fracture is presented. The cohort was aged between 40 and 93 years
Osteoarthritis	Roddy *et al.*[148]	A systematic review of 13 RCTs showing the impact of PA on pain and disability among patients with knee osteoarthritis. Patients in the aerobic walking trials had mean age of 62 and 74 years

continued

TABLE 56 Costs and consequences of ERS *(continued)*

Measures in analysis	Data source	Methodology of study[a]
Low back pain	Hayden *et al.*[149]	A meta-analysis of 61 RCTs (6390 participants) evaluating exercise therapy for adult non-specific low back pain. Mean age of participants was 41 years
Rheumatoid arthritis	Baillet *et al.*[150]	A meta analysis of 14 RCTs (including 1040 patients). Patients were between 44 and 68 years. Age, disease duration, sex ratio, proportion of completers was same among the two groups. Studies originated from Europe, USA and Canada
Falls prevention	Chang *et al.*[151]	A meta-analysis of 13 RCTs of participants who were 60 years and over
Absenteeism at work	Conn *et al.*[152]	A meta-analysis of worksite PA interventions with 38,231 participants (138 reports)
Disbenefits		
Injury	Hootman *et al.*[153]	A study that investigated the relationship between PA and musculoskeletal injury using longitudinal data for those ≥ 20 years old
Disability	Lamb *et al.*[154]	A cross-sectional analysis of 769 older women (mean age 77.8, range 65–101 years) with physical disability but no severe cognitive impairment

a The intervention and control groups mainly differed only in terms of exercise.

TABLE 57 Results of cost–consequence analysis (a cohort of 100,000)

Measures in analysis	Potential impact of ERS on measures
Costs	
Intervention cost to providers	£22,200,000 (2010 prices)
Intervention cost to participants	£12,000,000 (2010 prices)
Benefits	
Physically active state	3900 additional physically active people
Non-disease health state	152 extra people in non-disease health state
Mental health	
Anxiety	Reduced anxiety in participants with the magnitude of the effect size being 0.219
Depression	Increased the success rate to 67–74% reduction in depressive symptoms
Metabolic	
Diabetes	Avoided 86 extra cases of type 2 diabetes Led to small but significant reduction in HbA_{1c} (0.7%). This amount is likely to reduce diabetes complications
Cancer	
Colon cancer	A 30–40% reduction in the risk of developing colon cancer
Breast cancer	A 20–30% reduction in the risk of developing breast cancer
Lung cancer	A 20% reduction in the risk of developing lung cancer

TABLE 57 Results of cost–consequence analysis (a cohort of 100,000) *(continued)*

Measures in analysis	Potential impact of ERS on measures
Cardiovascular	
Hypertension	Decreased SBP by 3.8 mmHg and DBP by 2.6 mmHg in sample of both hypertensives and normotensives In hypertensives, SBP was reduced by 4.94 mmHg and DBP by 3.73 mmHg In normotensives, SBP was reduced by 4.04 mmHg and DBP by 2.33 mmHg
CHD	Avoided 51 extra cases of CHD Reduced all-cause mortality (OR 0.80; 95% CI 0.68 to 0.93) and cardiac mortality (OR 0.74; 95% CI 0.61 to 0.96)
Stroke	Avoided 16 extra cases of stroke
Musculoskeletal	
Osteoporosis	A hip fracture risk reduction of 45% (95% CI 31% to 56%) and 38% (95% CI 31% to 44%), respectively, among men and women
Osteoarthritis	Pooled effect sizes for pain were between 0.39 and 0.52 For self-reported disability, pooled effect sizes ranged from 0.32 and 0.46
Low back pain	Pooled mean improvement (measured on a scale of 100 points) was 7.3 points (95% CI 3.7 to 10.9 points) for pain and 2.5 points (95% CI 1.0 to 3.9 points) for function
Rheumatoid arthritis	Improved function by 0.24 and pain by 0.31
Falls prevention	Beneficial effect on the risk of falls (adjusted risk ratio 0.86, 0.75 to 0.99)
Absenteeism at work	Lower absenteeism at work (effect size = 0.19)
Disbenefits	
Injury	Increased the risk of musculoskeletal injury by about four times
Disability	Walking (more than three city blocks) increased the risk of walking disability because of severe pain (OR = 4.1–5.0)

DBP, diastolic blood pressure.

In an attempt to present meaningful, population-level outcomes, the analysis considers a cohort of 100,000 individuals who might be eligible for ERS. The cost of ERS for this cohort is estimated to be £22M (2010 prices) to the health-care provider and £12M (2010 prices) to the participants, generating a total cost of £33M. This is based on a leisure centre-based intervention as defined in the cost–utility analysis.

The benefits of ERS, compared with a no active intervention comparator, are summarised below. These include an additional 3900 (3.9%) people becoming physically active, 51 cases of CHD avoided, 16 cases of stroke avoided, 86 cases of diabetes avoided, 152 additional people in health states devoid of illnesses (CHD, stroke and diabetes) and resulting in an expected gain of approximately 800 QALYs. If we assume that each QALY is valued at £30,000 then this generates a positive net benefit of approximately £2M (£24–22M) from a health service perspective and a negative net benefit of approximately £9M from a societal perspective (£24–33M).

In addition to the quantifiable benefits, ERS is also expected to have a positive effect on the prevention or/and management of mental health, metabolic disease, cancer and musculoskeletal conditions. It also had an impact on non-health benefits, leading to an improvement in productivity through a reduction in absenteeism at work. There are potential adverse affects in terms of injuries and pain which are considered rare,[48,61] but could still negate some of the positive impacts of ERS.

Summary of cost–consequence analysis

Our cost–utility analysis found ERS to be a cost-effective intervention. The cost-effectiveness was further improved when short-term benefits in QoL were considered and ERS was targeted at individuals with pre-existing conditions. However, it is recognised that the cost–utility analysis failed to take into account a range of costs, benefits and disbenefits associated with ERS.

The cost–consequence analysis presented above attempts to take into account some of the broader impacts of ERS. In addition to reducing rates of CHD, stroke and diabetes, the evidence also suggests that ERS has the potential to reduce the incidence or severity of a number of other conditions. Although it has not proven possible to estimate the costs and benefits (in terms of QALYs) associated with these conditions, the majority of the evidence reviewed suggests that ERS may have a favourable effect on a number of other health outcomes. In addition to this, there is evidence that ERS may lead to non-health benefits, notably an improvement in productivity.

The only major disbenefit associated with ERS is an increased risk of injury, although this is relatively modest and likely to have only a marginal effect on its cost-effectiveness. However, it could be that there is some degree of publication bias in the evidence identified as the majority indicated positive effects of ERS with relatively few, suggesting that there were any negative effects for participants.

The cost–consequence analysis was conducted as a means of presenting the economic findings generated herein in a manner that might be more easily digested by a broader group of stakeholders. By providing disaggregated benefits, for example in the form of the number of cases strokes avoided per 100,000 population, it is hoped that this makes the outcomes of ERS more easily understood. However, it should be noted that the cost–consequence analysis was entirely based on the cost–utility analysis and literature reviews presented herein. No attempt was made to undertake a systematic review of the literature to identify further evidence on the impacts of ERS and it might be that some evidence has been overlooked.

The findings of the cost–consequence analysis support our hypothesis that the cost-effectiveness estimates generated by our cost–utility analysis are conservative. A more holistic analysis, taking into account the broader range of benefits associated with ERS, is likely to lead to much improved cost-effectiveness ratios compared with those presented earlier in this report. However, there is a pressing need to generate further evidence on both the short- and longer-term impacts of ERS to better determine whether or not it is a cost-effective use of health-care resources.

Comparisons with previous research findings

Previous studies have tended to conclude that ERS is a cost-effective use of resources, although they too have highlighted the uncertainty around many of the estimates of effect and cost-effectiveness. Isaacs *et al.*[61] generated an ICER in the form of the incremental cost per unit change in SF-36 score and concluded that, in comparison with controls, ERS led to an incremental cost of £19,500 per unit change in SF-36 score at 6-month follow-up. Given the outcome measure adopted in the study comparison with our own findings is impossible, although it should be noted that this study also found only a modest change in health status.

In contrast, the study by Gusi *et al.*[70] showed that ERS resulted in an incremental QALY gain of 0.132 over a 6-month period as measured by change in the EQ-5D, at an incremental cost of €41 per participant, generating an ICER of €311/QALY. The individuals in this study were obese and/or depressed and the findings may provide further evidence to suggest that PA can have process benefits far greater than those suggested by our own analysis. However, no attempt was made to ascertain whether or not the benefits might be sustained beyond the study period.

The findings in NICE[76] showed that ERS compared with controls led to an incremental cost per person of £25.10 and a lifetime QALY gain of 0.31 per person, equating to an incremental cost per QALY of £80.96. We are inclined to relate our findings more directly to NICE[76] because of similarities in the methods used in both studies. For example, the model used in our study was based on NICE.[76]

The analysis conducted for NICE showed a greater QALY gain than our own findings. This might be partially explained by the inclusion of colon cancer as an additional outcome in the NICE model. In addition to this, the NICE model adopted higher estimates of the effectiveness of ERS than our analysis (RR of becoming active of 1.60 vs 1.11 herein) and there are differences in the handling of uptake and adherence between the two analyses. Coupled with a lower estimated cost of ERS, this resulted in the NICE analysis generating improved ICERs compared with our own findings. In testing our own model we sought to reproduce the findings of the NICE model by incorporating the improved effectiveness of ERS. Despite slight differences in the modelling approach, it produced relatively consistent findings. Although we have based our approach to modelling the cost-effectiveness of ERS on the original NICE work, we believe that our meta-analysis of effectiveness has resulted in more robust input data and ultimately more accurate estimates of the cost-effectiveness of ERS.

Summary

- The cost–utility analysis presented herein was an attempt to adhere to best practice principles in economic evaluation[119] and also replicate the methods adopted in previous research.[76]
- Using this method our base-case analysis in a sedentary individuals aged 40–60 years shows an indicative ICER for ERS versus usual care of £20,876/QALY. This result was sensitive to changes in key input parameters, particularly the estimate of effectiveness of ERS (change in PA) sourced from our systematic review. There was a 51% probability that ERS was cost-effective at £20,000/QALY and 88% probability that ERS was cost-effective at £30,000/QALY.
- Further developments of this model to incorporate short-term benefits in HRQoL associated with ERS reduced the base-case ICER somewhat to £17,032 to £18,559/QALY.
- The cost-effectiveness of ERS appeared to be improved in disease-specific subgroups compared with base case, i.e. obesity £14,618/QALY, hypertension £12,834/QALY, and depression £8414/QALY.
- The cost–consequence analysis presented above is an attempt to support this hypothesis and reports further benefits of ERS that could not be incorporated into the cost–utility analysis, although, had they been included, they would almost certainly have further improved the cost-effectiveness of ERS.
- The previous sections include some lengthy discussion about the limitations of the approaches adopted, in particular the use of decision-analytic modelling and cost–utility analysis to model ERS. ERS involves a complex process, from the point at which an individual is 'prescribed' ERS, to the point at which he or she accesses the service and then the degree to which he or she adheres in the programme and beyond. Interventions of this sort, which comprise behaviour change, are difficult to simplify into standard economic

evaluation frameworks, and this is exemplified by the analyses presented herein, which include a significant number of assumptions (some of which could fairly be described as heroic) and are partial, capturing only some of the costs and benefits of ERS.

- Consideration needs to be given to the trade-off between developing a simple model (as we have done here) which can be populated and acknowledges its limitations versus a more complex model which may be a better representation of reality but can only be partially populated, which might result in even greater uncertainty. In both cases, the fundamental issue that needs to be addressed is improvements in the source data on the effectiveness of ERS, including evidence on long-term outcomes.

Chapter 7

Discussion

Statement of principal findings

Systematic review of exercise referral scheme effectiveness

In total seven[27,28,50,61,68–70] RCTs (3030 participants) met the review inclusion criteria. Five RCTs compared ERS with usual care (e.g. PA advice),[27,28,50,61,70] two RCTS compared an alternative PA-promoting strategy (i.e. walking programme or PA counselling)[61,69] with usual care and one RCT compared an alternative form of ERS (i.e. ERS plus SDT intervention) with usual care.[68] Although these trials were all judged to meet our definition of ERS (i.e. a referral from a primary health-care professional to an individualised exercise programme designed to meet the needs of the participant) there was considerable heterogeneity in the nature of the exercise/PA intervention across studies. Studies recruited predominantly sedentary middle-aged adults who had evidence of at least one lifestyle risk factor and five of the studies also included individuals with a medical diagnosis (e.g. hypertension, depression). ERS usually took place at a leisure centre and involved 10–12 weeks of exercise intervention and where there was follow-up it took place at 6 and/or 12 months post randomisation. Studies were judged to have a moderate or low overall risk of bias.

The most consistently reported outcome was self-reported PA. In ITT analysis, compared with usual care, there was weak evidence of an increase in the number of ERS participants who achieved 90–150 minutes of at least moderate-intensity PA per week at 6–12 months' follow-up (pooled RR 1.11, 95% CI 0.99 to 1.25). There was no difference in PA between ERS versus alternative PA promotion interventions or ERS versus ERS plus SDT at 6–12 months' follow-up. We found no evidence to support differences across subgroups (e.g. age, gender) in terms of the impact of ERS on PA. There was no consistent evidence for a difference between ERS and any of the comparator groups in the duration of moderate/vigorous intensity and total PA, physical fitness, blood pressure, serum lipids, glycaemic control, obesity indices (body weight, BMI, percentage fat), respiratory function, psychological well-being (perception of self-worth, or symptoms of depression or anxiety) or HRQoL. None of the included trials separately reported outcomes in individuals with medical diagnoses.

Systematic review of predictors of uptake and adherence to exercise referral schemes

We found considerable variation across studies in the level of uptake (i.e. attendance at the first induction visit) and adherence to ERS (i.e. completion of the programme) across the 19 included studies (14 observational studies and five RCTs).Uptake levels were higher, on average, in RCTs than in observational studies, although there was no clear difference in adherence between the two. In bivariate and multivariate analyses, women and older people were more likely to take up ERS. In addition, although older people were also more likely to adhere, women were less likely to adhere than men. Very few studies reported associations between ERS uptake or adherence and participant psychosocial factors or programme-level predictors. However, most qualitative studies found a perception of a range of several short-term physical and psychosocial benefits associated with ERS. As the interviews largely involved females, less is known about these perceptions in males. Less favourable aspects of ERS involved limited involvement from the referrer (e.g. GP), and selected experiences at the exercise facility. However, there were also many

positive comments on how the ERS served to initiate an exercise programme. Few qualitative studies attempted to identify if and how an ERS contributes to a sustainable physically active lifestyle beyond the usual 10- to 12-week facility-based programme.

Systematic review of exercise referral scheme cost-effectiveness

Four economic evaluations that assessed the cost-effectiveness of ERS were identified: three trial-based economic evaluations[50,61,70] and a model-based analysis.[76] Given the limitations (inclusion of studies providing an effectiveness estimate not meeting our definition of ERS; non-UK; lack of cost per QALY estimates) in these previous analyses we undertook a de novo model-based economic evaluation. Indicative incremental cost per QALY estimates for ERS for various scenarios have been provided. Compared with usual care, the base-case ICER for ERS was £20,876/QALY in sedentary individuals with at least one lifestyle risk factor and £14,618/QALY in sedentary obese individuals, £12,834/QALY in sedentary hypertensives and £8414/QALY for sedentary individuals with depression. These ICERs were highly sensitive to plausible variations in the RR for change in PA and cost of ERS. Allowing for short-term gains in QoL associated with ERS resulted in small reductions (£1500–£3000/QALY) in the ICER compared with the base case, although these findings were sensitive to the duration of any short-term benefits.

Strengths and limitations of the assessment

Exercise referral scheme clinical effectiveness

We undertook a comprehensive and systematic review of the literature for the clinical effectiveness of ERS. This systematic review was restricted to controlled trials, to provide a high level of evidence for ERS clinical effectiveness. Unlike some previous systematic reviews in this field,[35,39,41] we carefully selected ERS studies on the basis that there was clear evidence of referral by a primary-care health professional to third-party exercise provider. A central tenet of the ERS intervention is the referral process itself and that is potentially a key motivator and driver for individuals to take up and adhere to exercise interventions.[22] Qualitative studies in the present review also highlighted the importance of the GP in promoting a more active lifestyle. Although this resulted in the exclusion of a number of primary care-based exercise intervention studies [e.g. Elley ('green prescription'),[29,78] Lamb *et al.*,[58] Harland *et al.*,[43] Munro *et al.*[82]], we believe this focus to be consistent with the decision problem of this report.

Predictors of exercise referral scheme uptake and adherence

We extended the scope of this report to undertake a review of quantitative and qualitative literature so as to better understand the potential predictors and drivers of ERS uptake and adherence. Although this review incorporated trial, observational and qualitative evidence, it was not fully systematic in that it was limited to studies primarily identified by our electronic searches for effectiveness studies. Furthermore, we did not incorporate formal methods of qualitative synthesis such as meta-ethnography.

Exercise referral scheme cost-effectiveness

A particular strength of our cost-effectiveness analysis was the further development of the economic model used in the NICE evaluation of primary care-based exercise interventions.[76] These further developments included the incorporation of epidemiological data linking PA and the future risk of clinical outcomes (i.e. CHD, stroke, diabetes) in specific medical diagnoses groups (i.e. obesity, hypertension, depression), consideration of short-term gains in HRQoL associated with increased PA, and PSA. Additionally, model effectiveness estimates were based on meta-analysis, in contrast to the previous NICE modelling analysis, which selected effectiveness estimates from specific individual trials.

Two principal limitations of our economic analysis were the dearth of information for a number of key model inputs (detailed in the next section) and the fact that differences in QALYs were often very small, leading to instability of the ICERs. Furthermore, for the purposes of generating a cost per QALY for medical diagnostic groups, we assumed the same benefit in terms of PA gains in those populations as sedentary 'at-risk' individuals.

Uncertainties

Exercise referral scheme clinical effectiveness

Although we have identified seven RCTs that recruited some 1400 ERS participants, because of limitations and gaps in this evidence base there remain at least four key uncertainties regarding the clinical effectiveness of ERS. These include (1) the impact of ERS in people with a medical diagnosis; (2) whether ERS consistently affects prognostic outcomes such as blood pressure and serum lipids; (3) whether the small increases in self-reported PA are clinically significant; and (4) whether these small short-term gains in activity are maintained in the longer term.

Exercise referral scheme cost-effectiveness

Evidence on the cost-effectiveness of ERS needs to be interpreted with some caution. Although the ICERs are relatively favourable, these are derived from findings that show small differences in costs and effects, with effectiveness data that suggest that ERS has a modest effect on QALY gains (typically < 0.01 in our analyses). Sensitivity analyses show that the cost per QALY associated with ERS can change markedly with plausible changes in model input values, which means that robust evidence on whether or not ERS are likely to be cost-effective cannot currently be provided. The cost-effective ratios reported should be treated with caution until more robust effectiveness data become available.

Interventions which involve complex behaviour change components are not well suited to decision-analytic models. Individual-level simulation models that can detect changes in individual behaviours over time may better address questions over the cost-effectiveness of ERS interventions. However, there will be a trade-off between developing a simple model (as in this review) which can be populated and acknowledges its limitations versus a more complex model that may be a better representation of reality but can be only partially populated and may result in greater uncertainty. In both cases, the fundamental issue that needs to be addressed is improvements in the source data on the effectiveness of ERS.

Chapter 8

Conclusions

Implications for service provisions

In 2006, NICE commented that there is insufficient evidence for ERS and recommended that the NHS should make ERS available only as part of a controlled trial. Although we have identified four additional trials since the NICE review, there remains very limited support for the potential role of ERS for impacting on PA and, consequently, public health. Arguably, such an uncertain impact provides a case for the disinvestment in ERS. However, we found little evidence of how the ERS intervention sought to develop a sustainable active lifestyle in participants, as recommended in the NHS NQAF. Although ERS programmes in our review aimed to increase medium- to long-term PA, they were typically based on only a 10- to 12-week leisure centre-based period intervention. With the exception of one trial (by Jolly *et al.*[68]), there was minimal reference to health behaviour change techniques and theories that typically underpin interventions to promote an increase in daily PA.

Suggested research priorities*

In 2006, NICE[35] recommended that ERS should only be part of controlled research studies in order to better determine its clinical effectiveness and cost-effectiveness. Sowden and Raine[33] argue that (formal) evaluation of ERS is no longer a realistic possibility, due to the comprehensive coverage of schemes, widespread assumptions of effectiveness, likely difficulties in obtaining research funding, and indirect adverse consequences of dismantling schemes. Although this may potentially be the case for sedentary populations, there is still scope for an evidence base in diagnostic populations.

Although we have shown that additional RCT evidence has been produced since NICE made its recommendations, we have identified a number of gaps in the evidence base for ERS, some of which may require further trial-based evaluations:

- RCTs assessing the effectiveness and cost-effectiveness of ERS in disease groups that might benefit from PA. In addition, RCTs should seek to incorporate hard-to-reach populations (e.g. ethnic minorities) that are traditionally not represented in trials.
- Such RCTs should be better reported, include long-term data on the effectiveness of ERS and the sustainability of PA change, incorporate objective measures of PA (e.g. accelerometers) and health outcomes (e.g. blood pressure, serum lipids) and incorporate parallel process evaluations to better understand the mediators and barriers to behaviour change.
- Exercise referral scheme programmes vary in their procedures and this may impact on uptake and adherence. Future trials should therefore be designed to better understand the contribution of different programme components (e.g. level of staff training) to the effectiveness and cost-effectiveness of ERS.
- Head-to-head RCTs comparing the effectiveness and cost-effectiveness of different models of primary-care interventions aimed at promoting PA.
- Further quantitative and qualitative studies are needed to determine the moderators of uptake and adherence to ERS.

- Theory-driven interventions should be developed to complement ERS to foster long-term change in PA, and evaluated to enhance our understanding of mediators and processes of behaviour change (e.g. SDT, motivational interviewing).
- The development of improved approaches to modelling the cost-effectiveness of ERS, capturing the potential impact on a wide range of health outcomes.

*Note: While undertaking this report we became aware of a large ongoing cluster randomised trial of ERS funded by the Welsh Assembly Government.[155] A total of 2160 sedentary adult men and women with CHD risk factors and/or mild-to-moderate depression, anxiety or stress from 12 local health boards in Wales, referred directly by health professionals working in a range of health-care settings, were randomised either to a 16-week tailored exercise programme run by qualified exercise professionals at community sports centres (intervention) or to receive an information booklet on PA (usual care control). Despite contacting the authors, we were unable to obtain outcome data from this study to allow its incorporation into our analyses. This trial has now been completed and a brief report has recently been made publicly available.[156] The trial findings appear to be very consistent with those of this report. Compared with control, a small increase in the primary outcome of PA (7-Day Physical Activity Recall Questionnaire) with ERS at 12 months' follow-up (OR 1.19, 95% CI 0.99 to 1.43) was seen. Based on a trial-based economic evaluation and using EQ-5D and cost data collected in the trial, an ICER of £12,111/QALY was reported.

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Contribution of authors

Toby Pavey, Rod Taylor and Adrian Taylor co-ordinated the review.

Tiffany Moxham, information specialist, developed the search strategy in consultation with Rod Taylor, Adrian Taylor, Ken Fox and Melvyn Hillsdon and undertook the searches. Toby Pavey, Rod Taylor, Adrian Taylor, Ken Fox and Melvyn Hillsdon screened abstracts and retrieved papers against the inclusion criteria. Toby Pavey appraised the quality of the papers and abstracted data from them for the effectiveness and predictors of uptake and adherence chapters. Dr Nana Anokye appraised the quality of the papers and abstracted data from them for the cost-effectiveness chapter.

Toby Pavey and Rod Taylor analysed the data for the effectiveness, and uptake and adherence chapters, with Nana Anokye and Paul Trueman analysing the data for the cost-effectiveness and economic modelling chapters. Toby Pavey, Rod Taylor and Adrian Taylor wrote the drafted background and discussion chapters. Toby Pavey and Rod Taylor drafted the clinical effectiveness review chapter. Nana Anokye and Paul Trueman drafted the cost-effectiveness review and economic modelling chapters, with Colin Green reviewing and supporting the economic analysis. Toby Pavey and Adrian Taylor drafted the uptake and adherence chapter.

All authors (including John Campbell, Charlie Foster, Nanette Mutrie and John Searle) provided input to interpretation of findings, commented on various drafts of the chapters and contributed to their editing.

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Appendix 1

Common included conditions in exercise referral schemes

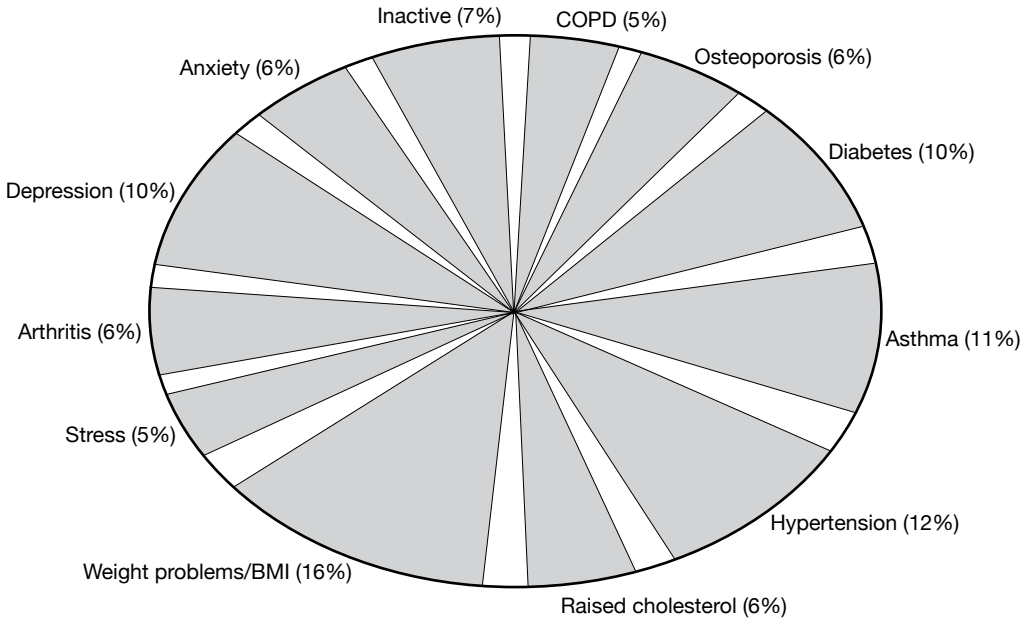

FIGURE 21 The most commonly included conditions in ERS (adapted from British Heart Foundation toolkit[34]).

Appendix 2

Literature search strategies

Note: the ERS search strategy was undertaken in two stages. The first stage used text word terms related to ERS, limited to the title and abstract of articles. The second stage utilised a larger set of terms, but incorporated limits included the type of trial and primary-care terms. The search strategy for the primary care terms was developed by Julie Glanville at the York Health Economics Consortium as part of a project specifically aimed at determining the terminology used within the literature for work about and by primary care practice. This two-stage search strategy was utilised after an extensive scoping study found that utilising all ERS terms without limits produced extremely low specificity in the search results.

Stage 1 Exercise referral terms

Search date for all stage 1 databases: 2 October 2009.

Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R)

1950 to present.

Ovid EMBASE

1980 to 2009 Week 39.

OVID PsycINFO

1967 to September Week 4 2009:

1. physical activity referral*.ti.
2. physical activity referral*.ab.
3. exercise on prescription.ti.
4. exercise on prescription.ab.
5. exercise referral*.ti.
6. exercise referral*.ab.
7. or/1–6
8. supervised exercise.ti.

Note: lines 7 and 8 downloaded in all databases.

Cochrane CENTRAL and Cochrane Database of Systematic Reviews, HTA, NHS EED, DARE via The Cochrane Library version 2009 v3

1. "supervised exercise":ti
2. "physical activity referral*":ti or "physical activity referral*":ab
3. "exercise referral*":ti or "exercise referral*":ab
4. "exercise on prescription*":ti or "exercise on prescription*":ab
5. (#1 OR #2 OR #3 OR #4)

SPORTDiscus via Ebsco

S1 TI physical activity referral* or AB physical activity referral* **Search modes** – Boolean/ Phrase

S2 TI physical activity referral* or AB physical activity referral* **Search modes** – Boolean/Phrase
S3 TI exercise on prescription or AB exercise on prescription **Search modes** – Boolean/Phrase
S4 TI exercise referral* or AB exercise referral* **Search modes** – Boolean/Phrase
S5 S1 or S2 or S3 or S4 **Search modes** – Boolean/Phrase
S6 TI supervised exercise **Search modes** – Boolean/Phrase

ISI Web Of Knowledge: SCIE

1900 to present.

Social Sciences Citation Index (SSCI)

1898 to present.

S1 Title=(supervised exercise) Databases=SCI-EXPANDED Timespan=All Years
S2 TI=TI physical activity referral* or TS= physical activity referral* Databases=SCI-EXPANDED Timespan=All Years
S3 TI=physical activity referral* or TS=physical activity referral* Databases=SCI-EXPANDED Timespan=All Years
S4 TI=exercise on prescription or TS=exercise on prescription Databases=SCI-EXPANDED Timespan=All Years
S5 TI=exercise referral* or TS=exercise referral* Databases=SCI-EXPANDED Timespan=All Years
S6 #5 OR #4 OR #3 OR #2 Databases=SCI-EXPANDED Timespan=All Years

Note: #1 and #6 downloaded.

Stage 2 Expanded term search

Developed from the background and stage 2 searches.

Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R)

1950 to present.

Search date: 19 October 2009.

1. "Referral and Consultation"/
2. (exercise* or physical*).ti,ab.
3. 1 and 2
4. ((physical* or exercise*) adj2 (superv* or subsid* or prescrib*)).ti.
5. ((physical* or exercise*) adj2 (superv* or subsid* or prescrib*)).ab.
6. (exercise* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ti.
7. (exercise* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ab.
8. (physical* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ti.
9. (physical* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ab.
10. ((physical* or exercise*) and referral*).ti.
11. ((physical* or exercise*) and referral*).ab.
12. or/4–11
13. Randomized controlled trial.pt.
14. randomized controlled trial/
15. (random$or placebo$).ti,ab,sh.
16. ((singl$or double$or triple$or treble$) and (blind$or mask$)).tw,sh.

17. or/13–16
18. "controlled clinical trial".pt.
19. (retraction of publication or retracted publication).pt.
20. 18 or 19 or 17
21. family medicine$.ti,ab.
22. family practice$.ti,ab.
23. general practice$.ti,ab.
24. primary care.ti,ab.
25. primary health care.ti,ab.
26. primary health service$.ti,ab.
27. primary healthcare.ti,ab.
28. primary medical care.ti,ab.
29. family medical practice$.ti,ab.
30. family doctor$.ti,ab.
31. family physician$.ti,ab.
32. family practitioner$.ti,ab.
33. general medical practitioner$.ti,ab.
34. general practitioner$.ti,ab.
35. local doctor$.ti,ab.
36. family practice/
37. Primary Health Care/
38. Physicians, Family/
39. Community Health Centers/
40. (community healthcare or community health care).ti,ab.
41. (GP or GPs).ti,ab.
42. general practic*.ti,ab.
43. or/21–42
44. (referral* or promot* or program* or intervent*).ti,ab.
45. 43 or 44
46. Exercise/
47. Exercise Therapy/
48. 46 or 47
49. 45 and 48
50. 49 or 3 or 12
51. (child* or adolescent* or school* or pediatric* or paediatric*).ti.
52. 50 not 51
53. 52 and 20
54. (animals not humans).sh.
55. 53 not 54
56. limit 55 to (english language and yr="1985 -Current")

Cochrane CENTRAL and CDSR, HTA, NHS EED, DARE via The Cochrane Library version 2009 v4

Search date: 22 October 2009.

1. MeSH descriptor Referral and Consultation, this term only
2. (exercise* or physical*):ti,ab
3. (#1 AND #2)
4. ((physical* or exercise*) and (superv* or subsid* or prescrib*)):ti
5. ((physical* or exercise*) and (superv* or subsid* or prescrib*)):ab
6. (exercise* and (fit* or train* or activit* or promot* or program* or intervention*)):ti
7. (exercise* and (fit* or train* or activit* or promot* or program* or intervention*)):ab

8. (physical* and (fit* or train* or activit* or promot* or program* or intervention*)):ti
9. (physical* and (fit* or train* or activit* or promot* or program* or intervention*)):ab
10. ((physical* or exercise*) and referral*):ti
11. ((physical* or exercise*) and referral*):ab
12. (#4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11)
13. randomized controlled trial:pt
14. ((singl* or double* or triple* or treble*) and (blind* or mask*)):ti,ab
15. (random* or placebo*):ti,ab
16. controlled clinical trial:pt.
17. (retraction of publication or retracted publication):pt
18. (#13 OR #14 OR #15 OR #16 OR #17)
19. family medicine*:ti,ab
20. (family practice*):ti,ab
21. (general practice*):ti,ab
22. (primary care):ti,ab
23. (primary health care):ti,ab
24. (primary health service*):ti,ab
25. (primary healthcare):ti,ab
26. (primary medical care):ti,ab
27. (family medical practice*):ti,ab
28. (family doctor*):ti,ab
29. (family physician*):ti,ab
30. (family practitioner*):ti,ab
31. (general medical practitioner*):ti,ab
32. (general practitioner*):ti,ab
33. (local doctor*):ti,ab
34. MeSH descriptor Family Practice, this term only
35. MeSH descriptor Primary Health Care, this term only
36. MeSH descriptor Physicians, Family, this term only
37. MeSH descriptor Community Health Centers, this term only
38. (community healthcare or community health care):ti,ab
39. (GP or GPs):ti,ab
40. (general practic*):ti,ab
41. (#19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR (#26 AND ro AND #27) OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40)
42. (referral* or promot* or program* or intervent*):ti,ab
43. (#41 OR #42)
44. MeSH descriptor Exercise, this term only
45. MeSH descriptor Exercise Therapy, this term only
46. (#44 OR #45)
47. (#43 AND #46)
48. (#47 OR #3 OR #12)
49. (child* or adolescent* or school* or pediatric* or paediatric*):ti
50. (#48 AND NOT #49)
51. (#50 AND #18)
52. (#51), from 1985 to 2009
53. “accession number” NEAR pubmed
54. “accession number” near2 embase
55. (#53 OR #54)
56. (#52 AND NOT #55)

PsycINFO 1806 to October Week 3 2009 via Ovid

Search date: 22 October 2009.

1. (exercise* or physical*).ti,ab.
2. (referral* or scheme*).ti,ab.
3. 1 and 2
4. ((physical* or exercise*) adj2 (superv* or subsid* or prescrib*)).ti.
5. ((physical* or exercise*) adj2 (superv* or subsid* or prescrib*)).ab.
6. (exercise* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ti.
7. (exercise* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ab.
8. (physical* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ti.
9. (physical* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ab.
10. ((physical* or exercise*) and referral*).ti.
11. ((physical* or exercise*) adj3 referral*).ab.
12. ((physical* or exercise*) adj4 prescription program*).ti,ab.
13. ((physical* or exercise*) adj2 scheme*).ti,ab.
14. or/4–13
15. clinical trials/
16. treatment outcome clinical trial.md.
17. (random$or placebo$).ti,ab,sh.
18. ((singl$or double$or triple$or treble$) and (blind$or mask$)).tw,sh.
19. quantitative study.md.
20. or/15–19
21. "Erratum/correction".dt.
22. ((retract* or withdraw*) adj (public* or artcle*)).ti,ab.
23. 21 or 22 or 20
24. family medicine$.ti,ab.
25. family practice$.ti,ab.
26. general practice$.ti,ab.
27. primary care.ti,ab.
28. primary health care.ti,ab.
29. primary health service$.ti,ab.
30. primary healthcare.ti,ab.
31. primary medical care.ti,ab.
32. family medical practice$.ti,ab.
33. family doctor$.ti,ab.
34. family physician$.ti,ab.
35. family practitioner$.ti,ab.
36. general medical practitioner$.ti,ab.
37. general practitioner$.ti,ab.
38. local doctor$.ti,ab.
39. Primary Health Care/
40. (community healthcare or community health care).ti,ab.
41. (GP or GPs).ti,ab.
42. general practic*.ti,ab.
43. or/24–42
44. (referral* or promot* or program*).ti,ab.
45. 43 or 44
46. Exercise/
47. physical treatment methods/
48. intervention/

49. 46 and (47 or 48)
50. 45 and 46
51. 49 or 50 or 14 or 3
52. (child* or adolescent* or school* or pediatric* or paediatric*).ti.
53. 51 not 52
54. 53 and 23
55. limit 54 to (english language and yr="1985 -Current")
56. limit 55 to human

SPORTDiscus via Ebsco

Search date: 23 October 2009.

S1 exercise* n5 referral* or physical* n5 referral* or exercise* n5 scheme* or physical* n5 scheme*
S2 physical* n2 superv* or physical* n2 subsid* or physical* n2 prescrib*
S3 exercise* n2 supervis* or exercise* n2 subsid* or exercise* n2 prescrib*
S4 physical* n2 prescription*
S5 exercise* n2 prescription*
S6 s1 or s2 or s3 or s4 or s5

ISI Web Of Knowledge: SCI-EXPANDED

1900 to present.

Social Sciences Citation Index (SSCI)

1898 to present.

Search date: 26 October 2009.

TI=(exercise* same referral*) or TI=(physical* same referral*) or TI=(exercise*same scheme*) or TI=(physical* same scheme*) AND Language=(English)
Databases=SCI-EXPANDED, SSCI Timespan=1985–2009

EMBASE 1980 to 2009 Week 49 via Ovid

Search date: 8 December 2009.

1. patient referral/(28808)
2. (exercise* or physical*).ti,ab,sh. (473426)
3. 1 and 2 (3083)
4. ((physical* or exercise*) adj2 (superv* or subsid* or prescrib*)).ti. (222)
5. ((physical* or exercise*) adj2 (superv* or subsid* or prescrib*)).ab. (1357)
6. (exercise* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ti. (4427)
7. (exercise* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ab. (13487)
8. (physical* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ti. (10978)
9. (physical* adj2 (fit* or train* or activit* or promot* or program* or intervention*)).ab. (33058)
10. ((physical* or exercise*) and referral*).ti. (51)
11. ((physical* or exercise*) and referral*).ab. (2831)
12. or/4–11 (50545)
13. exp controlled clinical trial/(189887)
14. (random$or placebo$).ti,ab,sh. (562901)

15. ((singl$or double$or triple$or treble$) and (blind$or mask$)).tw,sh. (107112)
16. or/13–15 (588257)
17. RETRACTED ARTICLE/(3212)
18. 16 or 17 (591386)
19. family medicine$.ti,ab. (3531)
20. family practice$.ti,ab. (3856)
21. general practice$.ti,ab. (18378)
22. primary care.ti,ab. (37769)
23. primary health care.ti,ab. (6779)
24. primary health service$.ti,ab. (150)
25. primary healthcare.ti,ab. (914)
26. primary medical care.ti,ab. (447)
27. family medical practice$.ti,ab. (15)
28. family doctor$.ti,ab. (1947)
29. family physician$.ti,ab. (6671)
30. family practitioner$.ti,ab. (950)
31. general medical practitioner$.ti,ab. (161)
32. general practitioner$.ti,ab. (22757)
33. local doctor$.ti,ab. (130)
34. general practice/(23658)
35. exp primary Health Care/(46053)
36. general practitioner/(32101)
37. health center/(9725)
38. (community healthcare or community health care).ti,ab. (352)
39. (GP or GPs).ti,ab. (23498)
40. general practic*.ti,ab. (18469)
41. or/19–40 (137654)
42. (referral* or promot* or program* or intervent*).ti,ab. (890143)
43. 41 or 42 (996006)
44. Exercise/(79613)
45. aerobic exercise/(2106)
46. physical activity/(41024)
47. lifestyle modification/(5486)
48. behavior change/(3709)
49. or/44–48 (120743)
50. 43 and 49 (28109)
51. 50 or 3 or 12 (66466)
52. (child* or adolescent* or school* or pediatric* or paediatric*).ti. (367903)
53. 51 not 52 (60457)
54. 53 and 18 (11024)
55. (animal$not human$).sh,hw. (2056248)
56. 54 not 55 (10612)
57. limit 56 to (english language and yr="1985 -Current") (9901)

Appendix 3

Summary of excluded studies

TABLE 58 Full-text exclusion from all systematic review (electronic literature search)

Paper	Comment
Ackermann RT, Deyo RA, LoGerfo JP. Prompting primary providers to increase community exercise referrals for older adults: a randomized trial. *J Am Geriatr Soc* 2005;**53**:283–9.	No third-party exercise provider
Adachi H, Koike A, Obayashi T, Umezawa S, Aonuma K, Inada M, *et al.* Does appropriate endurance exercise training improve cardiac function in patients with prior myocardial infarction? *Eur Heart J* 1996;**17**:1511–21.	Not primary care based
Agurs-Collins TD, Kumanyika SK, Ten Have TR, Adams-Campbell LL. A randomized controlled trial of weight reduction and exercise for diabetes management in older African-American subjects. *Diabetes Care* 1997;**20**:1503–11.	No primary care referral
Aittasalo M, Miilunpalo S, Kukkonen-Harjula K, Pasanen M. A randomized intervention of physical activity promotion and patient self-monitoring in primary health care. *Prev Med* 2006;**42**:40–6.	No third-party exercise provider
Aittasalo M, Miilunpalo S, Stahl T, Kukkonen-Harjula K. From innovation to practice: Initiation, implementation and evaluation of a physician-based physical activity promotion programme in Finland. *Health Promot Int* 2007;**22**:19–27.	No third-party exercise provider
Aittasalo M, Pasanen M, Fogelholm M, Kinnunen TI, Ojala K, Luoto R. Physical activity counseling in maternity and child health care: a controlled trial. *BMC Womens Health* 2008;**8**:14.	No primary care referral
Albright CL, Cohen S, Gibbons L, Miller S, Marcus B, Sallis J, *et al.* Incorporating physical activity advice into primary care: physician-delivered advice within the activity counseling trial. *Am J Prev Med* 2000;**18**:225–34.	No primary care referral
Albright C, Pruitt L, Castro C, Gonzalez A, Woo S, King AC. Modifying physical activity in a multiethnic sample of low-income women: One-year results from the IMPACT (increasing motivation for physical activity) project. *Ann Behav Med* 2005;**30**:191–200.	No primary care referral
Aldarondo F. *Adherence among individuals in an exercise, nutrition, and weight loss program*. Dissertation Abstracts International, Section B: The Sciences and Engineering; 1999.	Not controlled trial
Allen B. 'Working out' health issues in your local community! *Austr Aquat Recreation* 2004;**57**:20–2.	Not controlled trial
Allen A, Simpson JM. A primary care based fall prevention programme. *Physiother Theory Pract* 1999;**15**:121–33.	
Allen DH, Puddey IB, Morton AR, Beilin LJ. A controlled study of the effects of aerobic exercise on antihypertensive drug requirements of essential hypertensive patients in the general practice setting. *Clin Exp Pharmacol Physiol* 1991 May;**18**:279–82.	No primary care referral
Almeida FA, Smith-Ray RL, Van Den Berg R, Schriener P, Gonzales M, Onda P, *et al.* Utilizing a simple stimulus control strategy to increase physician referrals for physical activity promotion. *J Sport Exerc Psychol* 2005;**27**:505–14.	Not controlled trial
Alves JoG, Gale CR, Mutrie N, Correia JB, Batty GD. A 6-month exercise intervention among inactive and overweight favela-residing women in Brazil: The Caranguejo Exercise Trial. *Am J Publ Health* 2009;**99**:76–80.	No primary care referral
Amigo I, Gonzalez A, Herrera J. Comparison of physical exercise and muscle relaxation training in the treatment of mild essential hypertension. *Stress Med* 1997;**13**:59–65.	No primary care referral
Andersen RE. Exercise, an active lifestyle, and obesity: making the exercise prescription work. *Physician Sports Med* 1999;**27**:41–2;4;7–8;50.	Review article
Anderson D, Mizzari K, Kain V, Webster J. The effects of a multimodal intervention trial to promote lifestyle factors associated with the prevention of cardiovascular disease in menopausal and postmenopausal Australian women. *Health Care Women Int* 2006;**27**:238–53.	No primary care referral
Anderson RT, King A, Stewart AL, Camacho F, Rejeski W. Physical activity counseling in primary care and patient well-being: Do patients benefit? *Ann Behav Med* 2005,**30**:146–54.	No primary care referral
Annesi JJ, Otto LM. Relationship between number of exercise counseling sessions attended and adherence to a new exercise program. *Psychol Rep* 2004;**94**:907–8.	No primary care referral
Appel LJ, Champagne CM, Harsha DW, Cooper LS, Obarzanek E, Elmer PJ, *et al.* Effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. *JAMA* 2003;**289**:2083–9	No primary care referral
Araiza P, Hewes H, Gashetewa C, Vella CA, Burge MR. Efficacy of a pedometer-based physical activity program on parameters of diabetes control in type 2 diabetes mellitus. *Metab Clin Exp* 2006;**55**:1382–7.	No third-party exercise provider
Arbour KP, Ginis KA. Helping middle-aged women translate physical activity intentions into action: combining the theory of planned behavior and implementation intentions. *J Appl Biobehav Res* 2004;**9**:172–87.	No primary care referral

continued

TABLE 58 Full-text exclusion from all systematic review (electronic literature search) *(continued)*

Paper	Comment
Arbour KP, Ginis KA. A randomised controlled trial of the effects of implementation intentions on women's walking behaviour. *Psychol Health* 2009;**24**:49–65.	Not primary care based
Armit CM, Brown WJ, Marshall AL, Ritchie CB, Trost SG, Green A, *et al.* Randomized trial of three strategies to promote physical activity in general practice. *Prev Med* 2009;**48**:156–63.	No primary care referral
Armit CM, Brown WJ, Ritchie CB, Trost SG. Promoting physical activity to older adults: a preliminary evaluation of three general practice-based strategies. *J Science Med Sport* 2005;**8**:446–50.	No primary care referral
Ashworth NL, Chad KE, Harrison EL, Reeder BA, Marshall SC. Home versus center based physical activity programs in older adults. *Cochrane Database Syst Rev* 2005;**1**:CD004017.	Review article
Ayres R, Pocock E. Exercise on prescription. *Br J Gen Pract* 1995;**45**:325–6.	Not controlled trial
Balde A, Figueras J, Hawking DA, Miller JR. Physician advice to the elderly about physical activity. *J Aging Phys Act* 2003;**11**:90–7.	Not controlled trial
Bandinelli S, Lauretani F, Boscherini V, Gandi F, Pozzi M, Corsi AM, *et al.* A randomized, controlled trial of disability prevention in frail older patients screened in primary care: the FRASI study. Design and baseline evaluation. *Aging Clin Exp Res* 2006;**18**:359–66.	No primary care referral
Barclay C, Procter KL, Glendenning R, Marsh P, Freeman J, Mathers N. Can type 2 diabetes be prevented in UK general practice? A lifestyle-change feasibility study (ISAIAH). *Br J Gen Pract* 2008;**58**:541–7.	No primary care referral
Batik O, Phelan EA, Walwick JA, Wang G, LoGerfo JP. Translating a community-based motivational support program to increase physical activity among older adults with diabetes at community clinics: a pilot study of Physical Activity for a Lifetime of Success (PALS). *Prev Chronic Dis* 2008;**5**:A18.	No primary care referral
Bauman A. The role of community programmes and mass events in promoting physical activity to patients. *Br J Sports Med* 2009;**43**:44–6.	Review article
Berlant NE. Increasing adherence to an exercise intervention. Dissertation Abstracts International, Section B: The Sciences and Engineering; 2004.	No primary care referral
Binks M, O'Neil PM. Referral sources to a weight management program. Relation to outcome. *J Gen Int Med* 2002;**17**:596–603.	Not controlled trial
Blair SN, Applegate WB, Dunn AL, Ettinger WH, Haskell WL, King AC, *et al.* Activity Counseling Trial (ACT): Rationale, design, and methods. *Med Sci Sports Exerc* 1998;**30**:1097–106.	No primary care referral
Blanchard CM, Fortier M, Sweet S, O'Sullivan T, Hogg W, Reid R, *et al.* Explaining physical activity levels from a self-efficacy perspective: the physical activity counseling trial. *Ann Behav Med* 2007; **34**:323–8.	No primary care referral
Bolognesi M, Nigg CR, Massarini M, Lippke S. Reducing obesity indicators through brief physical activity counseling (PACE) in Italian primary care settings. *Ann Behav Med* 2006;**31**:179–85.	No third-party exercise provider
Bonet J, Coll R, Rocha E, Romero R. Supervised versus recommended physical exercise in hypertensive women. Is its recommendation enough? *Blood Press* 2003;**12**:139–44.	Not primary care based
Boutelle KN, Dubbert P, Vander Weg M. A pilot study evaluating a minimal contact telephone and mail weight management intervention for primary care patients. *Eat Weight Disord* 2005;**10**:e1–5.	Not primary care based
Bravata DM, Smith-Spangler C, Sundaram V, Gienger AL, Lin N, Lewis R, *et al.* Using pedometers to increase physical activity and improve health: a systematic review. *JAMA* 2007;**298**:2296–304.	Review article
Brawley LR, Rejeski W, Lutes L. A group-mediated cognitive-behavioral intervention for increasing adherence to physical activity in older adults. *J Appl Biobehav Res* 2000;**5**:47–65.	Not primary care based
Bredahl TVG, Puggaard L, Roessler KK. Exercise on Prescription. Effect of attendance on participants' psychological factors in a Danish version of Exercise on Prescription: a study protocol. *BMC Health Serv Res* 2008;8.	Not controlled trial
Brodie DA, Inoue A. Motivational interviewing to promote physical activity for people with chronic heart failure. *J Adv Nurs* 2005;**50**:518–27.	No primary care referral
Brodie DA, Inoue A, Shaw DG. Motivational interviewing to change quality of life for people with chronic heart failure: A randomised controlled trial. *Int J Nurs Stud* 2008;**45**:489–500.	No primary care referral
Brubaker PH, Moore JB, Stewart KP, Wesley DJ, Kitzman DW. Endurance exercise training in older patients with heart failure: results from a randomized, controlled, single-blind trial. *J Am Geriatr Soc* 2009;**57**:1982–9.	Not primary care based
Bull FC, Jamrozik K. Advice on exercise from a family physician can help sedentary patients to become active. *Am J Prev Med* 1998;**15**:85–94.	No third-party exercise provider
Bull FC, Jamrozik K, Blanksby BA. Tailored advice on exercise: does it make a difference? *Am J Prev Med* 1999;**16**:230–9.	No third-party exercise provider
Bull FC, Kreuter MW, Scharff DP. Effects of tailored, personalized and general health messages on physical activity. *Patient Educ Couns* 1999;**36**:181–92.	No primary care referral
Burtscher M, Gatterer H, Kunczicky H, Brandstatter E, Ulmer H. Supervised exercise in patients with impaired fasting glucose: impact on exercise capacity. *Clin J Sport Med* 2009;**19**:394–8.	No primary care referral

TABLE 58 Full-text exclusion from all systematic review (electronic literature search) *(continued)*

Paper	Comment
Calfas KJ, Long BJ, Sallis JF, Wooten WJ, *et al.* A controlled trial of physician counseling to promote the adoption of physical activity. *Prev Med* 1996;**25**:225–33.	No primary care referral
Calfas KJ, Sallis JF, Oldenburg B, Ffrench M. Mediators of change in physical activity following an intervention in primary care: PACE. *Prev Med* 1997;**26**:297–304.	No primary care referral
Campbell AJ, Robertson MC, Gardner MM, Norton RN, Buchner DM. Falls prevention over 2 years: a randomized controlled trial in women 80 years and older. *Age Aging* 1999; **28**:513–8.	No primary care referral
Carnegie Research Institute. *The national evaluation of LEAP: final report on the national evaluation of the Local Exercise Action Pilots.* Leeds: Leeds Metropolitan University; 2007.	Not controlled trial
Carver D. GP exercise referral: improving effectiveness in populations that might benefit most. The number of exercise referral schemes is growing. *Bases World* 2003;10–11.	Review article
Chinn DJ, White M, Howel D, Harland JOE, Drinkwater CK. Factors associated with non-participation in a physical activity promotion trial. *Publ Health* 2006;**120**:309–19.	No primary care referral
Chown M, Whittamore L, Rush M, Allan S, Stott D, Archer M. A prospective study of patients with chronic back pain randomised to group exercise, *Physiotherapy* or osteopathy. *Physiotherapy* 2008 Mar;**94**:21–8.	No primary care referral
Clarke P, Eves F. Applying the Transtheoretical Model to the Study of Exercise on Prescription. *J Health Psychol* 1997;**2**:195–207.	Not controlled trial
Cochrane T, Davey R. Evaluation of exercise prescription for 25 general practices and a large leisure complex in Sheffield. *J Sport Sci* 1998;**16**:17–8.	Not controlled trial
Cochrane T, Davey RC, Matthes Edwards SM. Randomised controlled trial of the cost-effectiveness of water-based therapy for lower limb osteoarthritis. *Health Technol Assess* 2005;**9**:(31).	No primary care referral
Cock D, Adams IC, Ibbetson AB, Baugh P. REFERQUAL: a pilot study of a new service quality assessment instrument in the GP exercise referral scheme setting. *BMC Health Serv Res* 2006;**6**:61.	Not controlled trial
Corbett C, Woodiwiss B. Exercise on prescription. *Prof Nurse* 2003;**18**:666–7	Review article
Craig A, Dinan S, Smith A, Taylor A, Webborn N. The Newcastle exercise project. National quality assurance framework will guide best value and practice in GP exercise referral schemes. *BMJ* 2000; **320**:1474	Review article
Cresswell J. Sand, sea and schemes. *SportEX Health* 2002;**13**:20.	Review article
Crone D, Johnston L, Grant T. Maintaining quality in exercise referral schemes: A case study of professional practice. Primary Health Care Research and Development 2004;**5**:96–103.	Not controlled trial
Daley AJ, Crank H, Mutrie N, Saxton JM, Coleman R. Patient recruitment into a randomised controlled trial of supervised exercise therapy in sedentary women treated for breast cancer. *Contemp Clin Trial* 2007; **28**:603–13.	No third-party exercise provider
Daley A, Winter H, Grimmett C, McGuinness M, McManus R, MacArthur C. Feasibility of an exercise intervention for women with postnatal depression: a pilot randomised controlled trial. *Br J Gen Pract* 2008;**58**:178–83.	Not primary care based
Damush TM, Stump TE, Clark DO, editors. Primary care providers' perceptions of physical activity referrals for inner-city patients. Society of General Internal Medicine, 26th Annual Meeting, Vancouver BC, 30 April to 3 May 2003	Not controlled trial
Danish Centre for Health Technology A. *Exercise on prescription: development and evaluation (brief record).* Copenhagen: Danish Centre for Evaluation and Health Technol Assess; 2007.	Review article
Davies T. National quality assurance framework: medico-legal considerations. *SportEX Health* 2001;**8**:27–8.	Review article
Davies T, Craig A. Developments & opportunities for exercise prescription. *SportEX Med* 1999;**1**:20–2.	Review article
Day F, Nettleton B. The Scottish Borders general practitioners exercise referral scheme (GPERS). *Health Bull* 2001; **59**:343–6.	Not controlled trial
Day R, Mills B, Fairbairn F. Exercise prescription: are practice nurses adequately prepared for this? *NZ J Sports Med* 2001;**29**:32–6.	No primary care referral
Di Loreto C, Fanelli C, Lucidi P, Murdolo G, De Cicco A, Parlanti N, *et al.* Validation of a counseling strategy to promote the adoption and the maintenance of physical activity by type 2 diabetic subjects. *Diabetes Care* 2003;**26**:404–8.	Not primary care based
Drenthen AJM, Assendelft WJJ, Van Der Velden J. Prevention in the general practice: get moving! *Huisarts Wet* 2008;**51**:38–41.	Review article
Duda JL, Jolly K, Ntoumanis N, Eves F, Daley A, Mutrie N, *et al.* A 3-month evaluation of the standard provision and a self-determination theory-based exercise on referral program. *J Sport Exerc Psychol* 2009;**31**:S117.	Not controlled trial (insufficient data)
Dutton GR. *Effects of a primary care weight management intervention on physical activity in low-income African American women.* Dissertation Abstracts International, Section B: The Sciences and Engineering; 2006.	No primary care referral
Dutton GR, Martin PD, Welsch MA, Brantley PJ. Promoting physical activity for low-income minority women in primary care. *Am J Health Behav* 2007;**31**:622–31.	No primary care referral

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TABLE 58 Full-text exclusion from all systematic review (electronic literature search) *(continued)*

Paper	Comment
Eakin EG, Glasgow RE, Riley KM. Review of primary care-based physical activity intervention studies: effectiveness and implications for practice and future research. *J Fam Pract* 2000;**49**:158–68.	No primary care referral
Eakin E, Brown W, Schofield G, Mummery K, Reeves M. General practitioner advice on physical activity: who gets it? *Am J Health Promot* 2007;**21**:225–8.	No primary care referral
Eakin E, Reeves M, Lawler S, Graves N, Oldenburg B, Del Mar C, *et al.* Telephone counseling for physical activity and diet in primary care patients. *Am J Prev Med* 2009;**36**:142	
Eakin EG, Brown WJ, Marshall AL, Mummery K, Larsen E. Physical activity promotion in primary care: bridging the gap between research and practice. *Am J Prev Med* 2004;**27**:297–303.	
Eakin EG, Bull SS, Riley K, Reeves MM, Gutierrez S, McLaughlin P. Recruitment and retention of Latinos in a primary care-based physical activity and diet trial: The Resources for Health study. *Health Educ Res* 2007;**22**:361–71.	No primary care referral
Eakin EG, Bull SS, Riley KM, Reeves MM, McLaughlin P, Gutierrez S. Resources for health: A primary-care-based diet and physical activity intervention targeting urban Latinos with multiple chronic conditions. *Health Psychol* 2007;**26**:392–400.	No primary care referral
Eakin EG, Reeves MM, Lawler SP, Oldenburg B, Del Mar C, Wilkie K, *et al.* The Logan Healthy Living Program: A cluster randomized trial of a telephone-delivered physical activity and dietary behavior intervention for primary care patients with type 2 diabetes or hypertension from a socially disadvantaged community: rationale, design and recruitment. *Contemp Clin Trial* 2008; **29**:439–54.	Review article
Eaton CB, Menard LM. A systematic review of physical activity promotion in primary care office settings. *Br J Sports Med* 1998;**32**:11–16.	Review article
Elley CR, Kerse N, Arroll B, Robinson E. Effectiveness of counselling patients on physical activity in general practice: cluster randomised controlled trial. *BMJ* 2003;**326**:793.	No primary care referral
Elley R, Kerse N, Arroll B, Swinburn B, Ashton T, Robinson E. Cost-effectiveness of physical activity counselling in general practice. *NZ Med J* 2004;**117**:U1216.	No primary care referral
Eriksson MK, Westborg CJ, Eliasson MCE. A randomized trial of lifestyle intervention in primary healthcare for the modification of cardiovascular risk factors. The Bjorknas study. *Scand J Publ Health* 2006;**34**:453	
Eriksson MK, Franks PW, Eliasson M. A 3-year randomized trial of lifestyle intervention for cardiovascular risk reduction in the primary care setting: the Swedish Bjorknas study. *PLoS ONE* 2009;**4**:e5195.	No primary care referral
Fisher KJ, Li F. A community-based walking trial to improve neighborhood quality of life in older adults: a multilevel analysis. *Ann Behav Med* 2004;**28**:186–94.	Not primary care based
Fleming P, Godwin M. Lifestyle interventions in primary care: systematic review of randomized controlled trials. *Can Fam Physician* 2008;**54**:1706–13.	Review article
Fortier MS, Hogg W, O'Sullivan TL, Blanchard C, Reid RD, Sigal RJ, *et al.* The physical activity counselling (PAC) randomized controlled trial: rationale, methods, and interventions. *Applied Physiol Nutr Metab* 2007;**32**:1170–85.	No primary care referral
Foster NE, Thomas E, Barlas P, Hill JC, Young J, Mason E, *et al.* Acupuncture as an adjunct to exercise based *Physiotherapy* for osteoarthritis of the knee: randomised controlled trial. *BMJ* 2007;**335**:436.	No third-party exercise provider
Fritz T, Wandell P, Aberg H, Engfeldt P. Walking for exercise: does three times per week influence risk factors in type 2 diabetes? *Diabetes Res Clin Pract* 2006;**71**:21–7.	No primary care referral
Gidlow C, Murphy R. Physical activity promotion in primary health care. In Dugdilll L, Crone D, Murphy R, editors. *Physical activity and health promotion: evidence-based approaches to practice*; 2009. pp. 87–109.	Review article
Gine-Garriga M, Martin C, Martin C, Puig-Ribera A, Anton JJ, Guiu A, *et al.* Referral from primary care to a physical activity programme: establishing long-term adherence? A randomized controlled trial. Rationale and study design. *BMC Publ Health* 2009;**9**:31.	No primary care referral
Graham RC, Dugdill L, Cable NT. Health professionals' perspectives in exercise referral: Implications for the referral process. *BMC Publ Health* 2005;**48**:1411–22.	Not controlled trial
Greater Glasgow Health Board. *An evaluation report of the Glasgow Exercise Referral Scheme*. Glasgow: Greater Glasgow Health Board Health Promotion Department; 2004.	Not controlled trial
Greaves CJ, Middlebrooke A, O'Loughlin L, Holland S, Piper J, Steele A, *et al.* Motivational interviewing for modifying diabetes risk: a randomised controlled trial. *Br J Gen Pract* 2008;**58**:535–40.	No primary care referral
Green F, Lord J. Prescribing exercise in general practice. Evaluation of scheme exists in Stockport. *BMJ* 1994;**309**:872–3.	Not controlled trial
Halbert J, Crotty M, Weller D, Ahern M, Silagy C. Primary care-based physical activity programs: effectiveness in sedentary older patients with osteoarthritis symptoms. *Arthritis Rheum* 2001;**45**:228–34.	No primary care referral
Halbert JA, Silagy CA, Finucane P, Withers RT, Hamdorf PA. Recruitment of older adults for a randomized, controlled trial of exercise advice in a general practice setting. *J Am Geriatr Soc* 1999;**47**:477–81.	No primary care referral
Hammond JM, Brodie DA, Bundred PE. Exercise on prescription: Guidelines for health professionals. *Health Promot Int* 1997;**12**:33–41.	Not controlled trial

TABLE 58 Full-text exclusion from all systematic review (electronic literature search) *(continued)*

Paper	Comment
Hardcastle S, Taylor A, Bailey M, Castle R. A randomized controlled trial on the effectiveness of a primary health care based counseling intervention on physical activity, diet and CHD risk. *Patient Educ Couns* 2008;**70**:31–9.	No primary care referral
Harland J, White M, Drinkwater C, Chinn D, Farr L, Howel D. The Newcastle exercise project: a randomised controlled trial of methods to promote physical activity in primary care. *BMJ* 1999;**319**:828–32.	No primary care referral
Hillsdon M. Promoting physical activity: issues in primary health care. *Int J Obes RelatMetab Disord* 1998;**22**(Suppl. **2)**:S52–4.	Review article
Hillsdon M. Recruitment strategies for exercise prescription. *SportEX Med* 2000;**4**:20–3.	Review article
Hillsdon M, Thorogood M, White I, Foster C. Advising people to take more exercise is ineffective: a randomized controlled trial of physical activity promotion in primary care. *Int J Epidemiol* 2002;**31**:808–15.	No primary care referral
Hinrichs T, Bucchi C, Brach M, Wilm S, Endres HG, Burghaus I, *et al.* Feasibility of a multidimensional home-based exercise programme for the elderly with structured support given by the general practitioner's surgery: study protocol of a single arm trial preparing an RCT. *BMC Geriatr* 2009;**9**:37.	Not controlled trial, study protocol
Holtrop JS, Dosh SA, Torres T, Thum YM. The community health educator referral liaison (CHERL): a primary care practice role for promoting healthy behaviors. *Am J Prev Med* 2008;**35**:S365–72.	No third-party exercise provider
Hosper K, Deutekom M, Stronks K. The effectiveness of 'Exercise on Prescription' in stimulating physical activity among women in ethnic minority groups in the Netherlands: protocol for a randomized controlled trial. *BMC Publ Health* 2008;**8**:406.	Not controlled trial
Hughes SL, Seymour RB, Campbell RT, Whitelaw N, Bazzarre T. Best-practice physical activity programs for older adults: findings from the national impact study. *Am J Publ Health* 2009;**99**:362–8.	No primary care referral
Hung DY, Rundall TG, Tallia AF, Cohen DJ, Halpin HA, Crabtree BF. Rethinking prevention in primary care: applying the chronic care model to address health risk behaviors. *Milbank Q* 2007;**85**:69–91.	No third-party exercise provider
Jimmy G, Martin BW. Implementation and effectiveness of a primary care based physical activity counselling scheme. *Patient Educ Couns* 2005; **56**:323–31.	No primary care referral
Johnston LH, Warwick J, De Ste Croix M, Crone D, Sidford A. The nature of all 'inappropriate referrals' made to a countywide physical activity referral scheme: Implications for practice. *Health Educ J* 2005; **64**:58–69.	Not controlled trial
Jolly K, Duda JL, Daley A, Eves FF, Mutrie N, Ntoumanis N, *et al.* Evaluation of a standard provision versus an autonomy promotive exercise referral programme: rationale and study design. *BMC Publ Health* 2009;**9**:176.	Not controlled trial
Jones LW, Courneya KS, Fairey AS, Mackey JR. Effects of an oncologist's recommendation to exercise on self-reported exercise behavior in newly diagnosed breast cancer survivors: a single-blind, randomized controlled trial. *Ann Behav Med* 2004;**28**:105–13.	Not primary care based
Jones LW, Courneya KS, Fairey AS, Mackey JR. Does the theory of planned behavior mediate the effects of an oncologist's recommendation to exercise in newly diagnosed breast cancer survivors? Results From a randomized controlled trial. *Health Psychol* 2005;**24**:189–97.	Not primary care based
Kallings L, Leijon M, Hellenius M, Stahle A. Physical activity on prescription in primary health care: a follow-up of physical activity level and quality of life. *Scand J Med Sci Sports* 2008;**18**:154–61.	No primary care referral
Kallings LV, Leijon ME, Kowalski J, Hellenius M-L, Stahle A. Self-reported adherence: a method for evaluating prescribed physical activity in primary health care patients. *J Phys Act Health* 2009;**6**:483–92.	No primary care referral
Kallings LV, Sierra Johnson J, Fisher RM, Faire Ud, Stahle A, Hemmingsson E, *et al.* Beneficial effects of individualized physical activity on prescription on body composition and cardiometabolic risk factors: results from a randomized controlled trial. *Eur J Cardiovasc Prev Rehabil* 2009;**16**:80–4.	No primary care referral
Kerr J, Calfas KJ, Caparosa S, Stein MB, Sieber W, Abascal LB, *et al.* A pilot study to assess the feasibility and acceptability of a community based physical activity intervention (involving internet, telephone, and pedometer support), integrated with medication and mood management for depressed patients. *Ment Health Phys Act* 2008;**1**:40–5.	No primary care referral
Kinmonth A-L, Wareham NJ, Hardeman W, Sutton S, Prevost A, Fanshawe T, *et al.* Efficacy of a theory-based behavioural intervention to increase physical activity in an at-risk group in primary care (ProActive UK): A randomised trial. *Lancet* 2008;**371**:41–8.	No primary care referral
Klemenc-Ketis Z. Analysis of referrals to Phys Ther at the Topolsica health resort. *Zdravstveno Varstvo* 2009;**48**:33–9.	Not primary care based
Kohl HW, 3rd, Dunn AL, Marcus BH, Blair SN. A randomized trial of physical activity interventions: design and baseline data from project active. *Med Sci Sports Exerc* 1998;**30**:275–83.	No primary care referral
Kolt GS, Oliver M, Schofield GM, Kerse N, Garrett N, Latham NK. An overview and process evaluation of Tele Walk: A telephone-based counseling intervention to encourage walking in older adults. *Health Promot Int* 2006;**21**:201–8.	No primary care referral
Kolt GS, Schofield GM, Kerse N, Garrett N, Oliver M. Effect of telephone counseling on physical activity for low-active older people in primary care: A randomized, controlled trial. *J Am Geriatr Soc* 2007;**55**:986–92.	No primary care referral

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TABLE 58 Full-text exclusion from all systematic review (electronic literature search) *(continued)*

Paper	Comment
Krogh J, Saltin B, Gluud C, Nordentoft M. The DEMO trial: A randomized, parallel-group, observer-blinded clinical trial of strength versus aerobic versus relaxation training for patients with mild to moderate depression. *J Clin Psychiatry* 2009;**70**:790–800.	No primary care referral
Kruidenier LM, Nicolai SP, Hendriks EJ, Bollen EC, Prins MH, Teijink JAW. Supervised exercise therapy for intermittent claudication in daily practice. *J Vasc Surg* 2009;**49**:363–70.	No primary care referral
Lamb S, Bartlett H, Ashley A, Bird W. Can lay-led walking programmes increase physical activity in middle aged adults? A randomised controlled trial. *J Epidemiol Community Health* 2002;**56**:246–52.	No primary care referral
Lawton BA, Rose SB, Elley CR, Dowell AC, Fenton A, Moyes SA. Exercise on prescription for women aged 40–74 recruited through primary care: two year randomised controlled trial. *BMJ* 2008;337.	No primary care referral
Leijon ME, Bendtsen P, Nilsen P, Ekberg K, Stahle A. Physical activity referrals in Swedish primary health care: prescriber and patient characteristics, reasons for prescriptions, and prescribed activities. *BMC Health Serv Res* 2008;8.	No primary care referral
Leijon ME, Bendtsen P, Nilsen P, Festin K, Stahle A. Does a physical activity referral scheme improve the physical activity among routine primary health care patients? *Scand J Med Sci Sports* 2009;**19**:627–36.	No primary care referral
Lister CL, Rae S, Van Blerk C, editors. The effects of a community based exercise referral scheme on the health and wellbeing of people with chronic low back pain. Annual European Congress of Rheumatology, Berlin, Germany, 9–12 June 2004.	Not controlled trial
Litterini AJ, Fieler VK. The change in fatigue, strength, and quality of life following a physical therapist prescribed exercise program for cancer survivors. *Rehabil Oncol*;**26**:11–17.	Not primary care based
Little P, Dorward M, Gralton S, Hammerton L, Pillinger J, White P, *et al.* A randomised controlled trial of three pragmatic approaches to initiate increased physical activity in sedentary patients with risk factors for cardiovascular disease. *Br J Gen Pract* 2004;**54**:189–95.	No third-party exercise provider
Luxmore J, Symons LM. The benefits of an exercise on prescription programme for overweight patients *J Sport Sci* 1998;**16**:24–5.	Not controlled trial
MacEra CA. Weight loss, physical activity, and weight regain in postmenopausal women (commentary). *Clin J Sport Med* 2009;**19**:337–8.	Review article
Markland D, Tobin VJ. Need support and behavioural regulations for exercise among exercise referral scheme clients: The mediating role of psychological need satisfaction. *Psychol Sport Exerc* 2009;**11**:91–99.	Not controlled trial
McKay J, Wright A, Lowry R, Steele K, Ryde G, Mutrie N. Walking on prescription: The utility of a pedometer pack for increasing physical activity in primary care. *Patient Educ Couns* 2009;**76**:71–6.	No primary care referral
Morey MC, Peterson MJ, Pieper CF, Sloane R, Crowley GM, Cowper P, *et al.* Project LIFE; Learning to Improve Fitness and Function in Elders: methods, design, and baseline characteristics of randomized trial. *J Rehabil Res Dev* 2008;**45**:31–42.	No primary care referral
Morey MC, Peterson MJ, Pieper CF, Sloane R, Crowley GM, Cowper PA, *et al.* The Veterans Learning to Improve Fitness and Function in Elders Study: a randomized trial of primary care-based physical activity counseling for older men. *J Am Geriatr Soc* 2009;**57**:1166–74.	No primary care referral
Munro J, Brazier J, Davey R, Nicholl J. Physical activity for the over-65s: could it be a cost-effective exercise for the NHS? *J Publ Health Med* 1997;**19**:397–402.	No primary care referral
Munro JF, Nicholl JP, Brazier JE, Davey R, Cochrane T. Cost effectiveness of a community based exercise programme in over 65 year olds: cluster randomised trial. *J Epidemiol Community Health* 2004; **58**:1004–10.	No primary care referral
Nanchahal K, Townsend J, Letley L, Haslam D, Wellings K, Haines A. Weight-management interventions in primary care: a pilot randomised controlled trial. *Br J Gen Pract* 2009;**59**:349–55.	No primary care referral
O'Toole ML, Sawicki MA, Artal R. Structured diet and physical activity prevent postpartum weight retention. *J Women's Health* 2003;**12**:991–8.	No primary care referral
Ouellette MM, LeBrasseur NK, Bean JF, Phillips E, Stein J, Frontera WR, *et al.* High-intensity resistance training improves muscle strength, self-reported function, and disability in long-term stroke survivors. *Stroke* 2004;**35**:1404–9.	No primary care referral
Pakkala I, Read S, Leinonen R, Hirvensalo M, Lintunen T, Rantanen T. The effects of physical activity counseling on mood among 75- to 81-year-old people: A randomized controlled trial. *Prev Med* 2008;**46**:412–18.	No primary care referral
Peek ME, Tang H, Alexander G, Chin MH. National prevalence of lifestyle counseling or referral among African-Americans and whites with diabetes. *J Gen Int Med* 2008;**23**:1858–64.	Not controlled trial
Peters S, Stanley I, Rose M, Kaney S, Salmon P. A randomized controlled trial of group aerobic exercise in primary care patients with persistent, unexplained physical symptoms. *Fam Pract* 2002;**19**:665–74.	No primary care referral
Petrella R. Cost-effectiveness of a community-based exercise program for older adults (commentary). *Clin J Sport Med* 2006;**16**:191–3.	Review article
Pinto BM, Goldstein MG, Ashba J, Sciamanna CN, Jette A. Randomized controlled trial of physical activity counseling for older primary care patients. *Am J Prev Med* 2005;**29**:247–55	No primary care referral

TABLE 58 Full-text exclusion from all systematic review (electronic literature search) *(continued)*

Paper	Comment
Raine P, Truman C, Southerst A. The development of a community gym for people with mental health problems: influences of psychological accessibility. *J Ment Health* 2002;**11**: 43–53.	Not primary care based
Rejeski W, Shelton B, Miller M, Dunn AL, King AC, Sallis JF. Mediators of increased physical activity and change in subjective well-being: results from the activity counseling trial (ACT). *J Health Psychol* 2001;**6**:159–68.	No primary care referral
Ridsdale L, Darbishire L, Seed P. Is graded exercise better than cognitive behaviour therapy for fatigue? A UK randomized trial in primary care. *Psychol Med* 2004;**34**:37–49.	No primary care referral
Rimmer JH, Rauworth A, Wang E, Heckerling PS, Gerber BS. A randomized controlled trial to increase physical activity and reduce obesity in a predominantly African American group of women with mobility disabilities and severe obesity. *Prev Med* 2009;**48**:473–9.	No third-party exercise provider
Robertson MC, Devlin N, Gardner MM, Campbell AJ. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. **1**: Randomised controlled trial. *BMJ* 2001;**322**:697–701.	No primary care referral
Robertson MC, Devlin N, Scuffham P, Gardner MM, Buchner DM, Campbell AJ. Economic evaluation of a community based exercise programme to prevent falls. *J Epidemiol Community Health* 2001;**55**:600–6.	No primary care referral
Ross R, Blair SN, Godwin M, Hotz S, Katzmarzyk PT, Lam M, *et al.* Prevention and Reduction of Obesity through Active Living (PROACTIVE): rationale, design and methods. *Br J Sports Med* 2009;**43**:57–63.	No primary care referral
Roux L, Pratt M, Tengs TO, Yore MM, Yanagawa TL, Van Den Bos J, *et al.* Cost-effectiveness of community-based physical activity interventions. *Am J Prev Med* 2008;**35**:578–88.	Review article
Schnirring L. Referring patients to personal trainers: Benefits and pitfalls. *Physician Sports Med* 2000;**28**:16.	Review article
Sevick MA, Bradham DD, Muender M, Chen GJ, Enarson C, Dailey M, *et al.* Cost-effectiveness of aerobic and resistance exercise in seniors with knee osteoarthritis. *Med Sci Sports Exerc* 2000;**32**:1534–40.	Not primary care based
Sevick MA, Dunn AL, Morrow MS, Marcus BH, Chen G, Blair SN. Cost-effectiveness of lifestyle and structured exercise interventions in sedentary adults: Results of Project ACTIVE. *Am J Prev Med* 2000;**19**:1–8.	Not primary care based
Sevick MA, Miller GD, Loeser RF, Williamson JD, Messier SP. Cost-effectiveness of exercise and diet in overweight and obese adults with knee osteoarthritis. *Med Sci Sports Exerc* 2009;**41**:1167–74.	Not primary care based
Seymour RB, Hughes SL, Campbell RT, Huber GM, Desai P. Comparison of two methods of conducting the fit and strong! program. *Arthritis Care Res* 2009;**61**:876–84.	No primary care referral
Shepich J, Slowiak JM, Keniston A. Do subsidization and monitoring enhance adherence to prescribed exercise? *Am J Health Promot* 2007;**22**:2–5.	Not controlled trial
Sherman BJ, Gilliland G, Speckman JL, Freund KM. The effect of a primary care exercise intervention for rural women. *Prev Med* 2007;**44**:198–201.	No primary care referral
Simons-Morton DG, Blair SN, King AC, Morgan TM, Applegate WB, O'Toole M, *et al.* Effects of physical activity counseling in primary care: The Activity Counseling Trial: A randomized controlled trial. *JAMA* 2001;**286**:677–87.	No primary care referral
Smale B. Leisure links. The publication of the National Quality Assurance Framework for Exercise Referral Systems highlights the important role that leisure can play in health partnerships but what impact will this guidance have on training for leisure professionals? *Leisure Manager* 2001;**19**:12–13.	Review article
Smeets RJ, Severens JL, Beelen S, Vlaeyen JW, Knottnerus J. More is not always better: Cost-effectiveness analysis of combined, single behavioral and single physical rehabilitation programs for chronic low back pain. *Eur J Pain* 2009;**13**:71–81.	Not primary care based
Smith BJ, Bauman AE, Bull FC, Booth ML, Harris MF. Promoting physical activity in general practice: a controlled trial of written advice and information materials. *Br J Sports Med* 2000;**34**:262–7.	No primary care referral
Sogaard R, Bunger CE, Laurberg I, Christensen FB. Cost-effectiveness evaluation of an RCT in rehabilitation after lumbar spinal fusion: a low-cost, behavioural approach is cost-effective over individual exercise therapy. *Eur Spine J* 2008;**17**:262–71.	Not primary care based
Sowden S, Raine R. Running along parallel lines: How political reality impedes the evaluation of public health interventions. A case study of exercise referral schemes in England. *J Epidemiol Community Health* 2008;**62**:835–41.	Review article
Steptoe A, Doherty S, Rink E, Kerry S, Kendrick T, Hilton S. Behavioural counselling in general practice for the promotion of healthy behaviour among adults at increased risk of coronary heart disease: randomised trial. *BMJ* 1999;**319**:943–7.	No primary care referral
Steptoe A, Rink E, Kerry S. Psychosocial predictors of changes in physical activity in overweight sedentary adults following counseling in primary care. *Prev Med* 2000;**31**:183–94.	
Steptoe A, Kerry S, Rink E, Hilton S. The impact of behavioral counseling on stage of change in fat intake, physical activity, and cigarette smoking in adults at increased risk of coronary heart disease. *Am J Publ Health* 2001;**91**:265–9.	No primary care referral
Stovitz SD, VanWormer JJ, Center BA, Bremer KL. Pedometers as a means to increase ambulatory activity for patients seen at a family medicine clinic. *Journal of the American Board of Fam Pract* 2005;**18**:335–43.	No primary care referral

continued

TABLE 58 Full-text exclusion from all systematic review (electronic literature search) *(continued)*

Paper	Comment
Stuart M, Benvenuti F, Macko R, Taviani A, Segenni L, Mayer F, *et al.* Community-based adaptive physical activity program for chronic stroke: feasibility, safety, and efficacy of the Empoli model. *Neurorehabil Neural Repair* 2009;**27**:726–34.	No primary care referral
Sugden JA, Sniehotta FF, Donnan PT, Boyle P, Johnston DW, McMurdo MET. The feasibility of using pedometers and brief advice to increase activity in sedentary older women: a pilot study. *BMC Health Serv Res* 2008;**8**:169.	No primary care referral
Tanne D, Tsabari R, Chechk O, Toledano A, Orion D, Schwammenthal Y, *et al.* Improved exercise capacity in patients after minor ischemic stroke undergoing a supervised exercise training program. *Israel Med Assoc J* 200;**10**:113.	Not primary care based
Taylor JD, Fletcher JP, Tiarks J. Impact of physical therapist-directed exercise counseling combined with fitness center-based exercise training on muscular strength and exercise capacity in people with type 2 diabetes: a randomized clinical trial. *Phys Ther* 2009;**89**:884–92.	Not primary care based
Taylor KI, Oberle KM, Crutcher RA, Norton PG. Promoting health in type 2 diabetes: nurse-physician collaboration in primary care. *Biol Res Nurs* 2005;**6**:207–15.	No primary care referral
Thurston M, Green K. Adherence to exercise in later life: How can exercise on prescription programmes be made more effective? *Health Promot Int* 2004;**19**:379–87.	Review article
Tulloch H, Fortier M, Hogg W. Physical activity counseling in primary care: who has and who should be counseling? *Patient Educ Couns* 2006 Dec;**64**:6–20.	Review article
Tumiati R, Mazzoni G, Crisafulli E, Serri B, Beneventi C, Lorenzi CM, *et al.* Home-centred physical fitness programme in morbidly obese individuals: a randomized controlled trial. *Clin Rehabil* 2008;**22**:940–50.	Not primary care based
Voutselas V, Sellens MH, Paschali C. Exercise prescribed in general practitioner referral schemes: A case study. *J Hum Mov Stud* 2006;**50**:79–90.	Not controlled trial
Ward M. The science link. *SportEX Health* 2003;**16**:21.	Review article
Williams NH. 'The wise, for cure, on exercise depend': physical activity interventions in primary care in Wales. *Br J Sports Med* 2009;**43**:106–8.	Review article

TABLE 59 Additional studies excluded from ERS effectiveness review (see *Table 58* for other excluded studies)

Paper	Comment
Carroll R, Ali N, Azam N. Promoting physical activity in South Asian Muslim women through 'exercise on prescription'. *Health Technol Assess* 2002;**6**(8).	Not controlled
Crone D, Smith A, Gough B. 'I feel totally at one, totally alive and totally happy': a psycho-social explanation of the physical activity and mental health relationship. *Health Educ Res* 2005;**20**:600–11.	
Crone D, Johnston LH, Gidlow C, Henley C, James DV. Uptake and participation in physical activity referral schemes in the UK: an investigation of patients referred with mental health problems. *Issues Ment Health Nurs* 2008;**29**:1088–97.	Not controlled
Damush TM, Stump TE, Saporito A, Clark DO. Predictors of older primary care patients' participation in a submaximal exercise test and a supervised, low-impact exercise class. *Prev Med* 2001;**33**:485–94.	Not controlled
Dinan S, Lenihan P, Tenn T, Iliffe S. Is the promotion of physical activity in vulnerable older people feasible and effective in general practice? *Br J Gen Pract* 2006;**56**:791–3.	Not controlled
Dugdill L, Graham RC, McNair F. Exercise referral: The *Publ Health* panacea for physical activity promotion? A critical perspective of exercise referral schemes; their development and evaluation. *BMC Publ Health* 2005;**48**:1390–410.	Not controlled
Edmunds J, Ntoumanis N, Duda JL. Adherence and well-being in overweight and obese patients referred to an exercise on prescription scheme: a self-determination theory perspective. *Psychol Sport Exerc* 2007;**8**:722–40	Not controlled
Gidlow C, Johnston LH, Crone D, James D. Attendance of exercise referral schemes in the UK: a systematic review. *Health Educ J* 2005;**64**:168–86.	Not effectiveness systematic review
Gidlow C, Johnston LH, Crone D, Morris C, Smith A, Foster C, *et al.* Socio-demographic patterning of referral, uptake and attendance in physical activity referral schemes. *J Publ Health* 2007;**29**:107–13.	Not controlled
Hardcastle S, Taylor AH. Looking for more than weight loss and fitness gain: psychosocial dimensions among older women in a primary-care exercise-referral program. *J Aging Phys Act* 2001;**9**:313–28.	Not controlled
Hardcastle S, Taylor AH. Finding an exercise identity in an older body: it's redefining yourself and working out who you are. *Psychol Sport Exerc* 2005; **6**:173–188	Not controlled
Harrison RA, McNair F, Dugdill L. Access to exercise referral schemes: a population based analysis. *J Publ Health* 2005;**27**:326–30.	Not controlled
Jackson C, Bell F, Smith RA, Dixey R. Do adherers and non-adherers to a GP exercise referral scheme differ in their long-term physical activity levels? *J Sport Sci* 1998;**16**:84.	Not controlled

TABLE 59 Additional studies excluded from ERS effectiveness review (see *Table 58* for other excluded studies) *(continued)*

Paper	Comment
James D, Mills H, Crone D, Johnston LH, Morris C, Gidlow CJ. Factors associated with physical activity referral completion and health outcomes. *J Sport Sci* 2009;**27**:1007–17.	Not controlled
James DVB, Johnston LH, Crone D, Sidford AH, Gidlow C, Morris C, *et al.* Factors associated with physical activity referral uptake and participation. *J Sport Sci* 2008;**26**:217–24.	Not controlled
Jones F, Harris P, Waller H, Coggins A. Adherence to an exercise prescription scheme: the role of expectations, self-efficacy, stage of change and psychological well-being. British *J Health Psychol* 2005;**10**:359–78.	Not controlled
Lord JC, Green F. Exercise on prescription: does it work? *Health Educ J* 1995;**54**:453–64.	Not controlled
Martin C, Woolf-May K. The retrospective evaluation of a general practitioner exercise prescription programme. *J Hum Nutr Diet* 1999;**12**:32.	Not controlled
Morton KL, Biddle SJH, Beauchamp MR. Changes in self-determination during an exercise referral scheme. *Publ Health* 2008;**122**:1257–60.	Not controlled
National Institute for Health and Clinical Excellence (NICE). Modelling the cost-effectiveness of physical activity interventions. London: NICE; 2006.	
National Institute for Health and Clinical Excellence (NICE). Rapid review of the economic evidence of physical activity interventions. London: NICE; 2006.	Not controlled
Roessler KK, Ibsen B. Promoting exercise on prescription: Recruitment, motivation, barriers and adherence in a Danish community intervention study to reduce type 2 diabetes, dyslipidemia and hypertension. *J Publ Health* 2009;**17**:187–93.	Not controlled
Schmidt M, Absalah S, Nierkens V, Stronks K. Which factors engage women in deprived neighbourhoods to participate in exercise referral schemes? *BMC Publ Health* 2008;**8**:371.	Not controlled
Singh S. Why are GP exercise schemes so successful (for those who attend)? Results from a pilot study. *J Manag Med* 1997;**11**: 233–237	Not controlled
Sowden SL, Raine R. Running along parallel lines: how political reality impedes the evaluation of *Publ Health* interventions. A case study of exercise referral schemes in England. *J Epidemiol Community Health* 2008;**62**:835–41.	Not controlled
Stathi A, McKenna J, Fox KR. The experiences of older people participating in exercise referral schemes. *J R Soc Promot Health* 2004;**124**:18–23.	Not controlled
Wiles R, Demain S, Robison J, Killeff J, Ellis-Hill C, McPherson K. Managing alone: exercise on prescription schemes for stroke patients post-discharge from physiotherapy. *Disabil Rehabil* 2007;**29**:25.	Not controlled
Wormald H, Ingle L. GP exercise referral schemes: Improving the patient's experience. *Health Educ J* 2004;**63**:362–73.	Not controlled
Wormald H, Waters H, Sleap M, Ingle L. Participants' perceptions of a lifestyle approach to promoting physical activity: targeting deprived communities in Kingston-Upon-Hull. *BMC Publ Health* 2006;**6**:202.	Not controlled

TABLE 60 Additional studies excluded from cost-effectiveness review (see *Table 58* for other articles excluded)

Paper	Comment
Carroll R, Ali N, Azam N. Promoting physical activity in South Asian Muslim women through 'exercise on prescription'. *Health Technol Assess* 2002;**6**(8).	No cost data
Crone D, Smith A, Gough B. 'I feel totally at one, totally alive and totally happy': a psycho-social explanation of the physical activity and mental health relationship. *Health Educ Res* 2005;**20**:600–11.	
Crone D, Johnston LH, Gidlow C, Henley C, James DV. Uptake and participation in physical activity referral schemes in the UK: an investigation of patients referred with mental health problems. *Issues Ment Health Nurs* 2008;**29**:1088–97.	No cost data
Damush TM, Stump TE, Saporito A, Clark DO. Predictors of older primary care patients' participation in a submaximal exercise test and a supervised, low-impact exercise class. *Prev Med* 2001;**33**:485–94.	No cost data
Dinan S, Lenihan P, Tenn T, Iliffe S. Is the promotion of physical activity in vulnerable older people feasible and effective in general practice? *Br J Gen Pract* 2006;**56**:791–3.	No cost data
Dugdill L, Graham RC, McNair F. Exercise referral: The *Publ Health* panacea for physical activity promotion? A critical perspective of exercise referral schemes; their development and evaluation. *BMC Publ Health* 2005;**48**:1390–410.	No cost data
Edmunds J, Ntoumanis N, Duda JL. Adherence and well-being in overweight and obese patients referred to an exercise on prescription scheme: a self-determination theory perspective. *Psychol Sport Exerc* 2007;**8**:722–40	No cost data
Gidlow C, Johnston LH, Crone D, James D. Attendance of exercise referral schemes in the UK: A systematic review. *Health Educ J* 2005;**64**:168–86.	No cost data
Gidlow C, Johnston LH, Crone D, Morris C, Smith A, Foster C, *et al.* Socio-demographic patterning of referral, uptake and attendance in physical activity referral schemes. *J Publ Health* 2007;**29**:107–13.	No cost data
Hardcastle S, Taylor AH. Looking for more than weight loss and fitness gain: psychosocial dimensions among older women in a primary-care exercise-referral program. *J Aging Phys Act* 2001;**9**:313–28.	No cost data
Hardcastle S, Taylor AH. Finding an exercise identity in an older body: it's redefining yourself and working out who you are. *Psychol Sport Exerc* 2005; **6**:173–88.	No cost data
Harrison RA, McNair F, Dugdill L. Access to exercise referral schemes: a population based analysis. *J Publ Health* 2005;**27**:326–30.	No cost data
Jackson C, Bell F, Smith RA, Dixey R. Do adherers and non-adherers to a GP exercise referral scheme differ in their long-term physical activity levels? *J Sport Sci* 1998;**16**:84.	No cost data
James DVB, Johnston LH, Crone D, Sidford AH, Gidlow C, Morris C, *et al.* Factors associated with physical activity referral uptake and participation. *J Sport Sci* 2008;**26**:217–24.	No cost data
James D, Mills H, Crone D, Johnston LH, Morris C, Gidlow CJ. Factors associated with physical activity referral completion and health outcomes. *J Sport Sci* 2009;**27**:1007–17.	No cost data
Jolly K, Duda JL, Daley A, Ntoumanis N, Eves F, Rouse P, *et al. An Evaluation of the Birmingham exercise on prescription service: standard provision and a self-determination focused arm*. Final Report; 2009.	No cost data
Jones F, Harris P, Waller H, Coggins A. Adherence to an exercise prescription scheme: The role of expectations, self-efficacy, stage of change and psychological well-being. British *J Health Psychol* 2005;**10**:359–78.	No cost data
Lord JC, Green F. Exercise on prescription: does it work? *Health Educ J* 1995;**54**:453–64.	No cost data
Martin C, Woolf-May K. The retrospective evaluation of a general practitioner exercise prescription programme. *J Hum Nutr Diet* 1999;**12**:32.	No cost data
Morgan O. Approaches to increase physical activity: reviewing the evidence for exercise-referral schemes. *Publ Health* 2005;**119**:361–70.	No cost data
Morton KL, Biddle SJH, Beauchamp MR. Changes in self-determination during an exercise referral scheme. *Publ Health* 2008;**122**:1257–60.	No cost data
National Institute for Health and Clinical Excellence (NICE). A rapid review of the effectiveness of ERS to promote physical activity in adults. London: NICE; 2006.	No cost data
Roessler KK, Ibsen B. Promoting exercise on prescription: Recruitment, motivation, barriers and adherence in a Danish community intervention study to reduce type 2 diabetes, dyslipidemia and hypertension. *J Publ Health* 2009;**17**:187–93.	No cost data
Schmidt M, Absalah S, Nierkens V, Stronks K. Which factors engage women in deprived neighbourhoods to participate in exercise referral schemes? *BMC Publ Health* 2008;**8**:371.	No cost data
Singh S. Why are GP exercise schemes so successful (for those who attend)? Results from a pilot study. *J Manag Med* 1997;**11**:233–37.	No cost data
Sorensen JB, Kragstrup J, Kjaer K, Puggaard L. Exercise on prescription: trial protocol and evaluation of outcomes. *BMC Health Serv Res* 2007;**7**:36	No cost data
Sorensen JB, Kragstrup J, Skovgaard T, Puggaard L. Exercise on prescription: a randomized study on the effect of counseling vs counseling and supervised exercise. *Scand J Med Sci Sports* 2008;**18**:288–97.	No cost data
Sowden SL, Raine R. Running along parallel lines: how political reality impedes the evaluation of *Publ Health* interventions. A case study of exercise referral schemes in England. *J Epidemiol Community Health* 2008;**62**:835–41.	No cost data

TABLE 60 Additional studies excluded from cost-effectiveness review (see *Table 58* for other articles excluded) *(continued)*

Paper	Comment
Stathi A, McKenna J, Fox KR. The experiences of older people participating in exercise referral schemes. *J R Soc Promot Health* 2004;**124**:18–23.	No cost data
Stevens W, Hillsdon M, Thorogood M, McArdle D. Cost-effectiveness of a primary care based physical activity intervention in 45–74 year old men and women: a randomised controlled trial. *Br J Sports Med* 1998;**32**:236–41.	No cost data
Taylor AH. *Evaluating GP exercise referral schemes. Findings from a randomised control study*. Brighton: University of Brighton; 1996.	No cost data
Taylor AH, Fox KR. Effectiveness of a primary care exercise referral intervention for changing physical self-perceptions over 9 months. *Health Psychol* 2005;**24**:11–21.	
Taylor AH, Doust J, Webborn N. Randomised controlled trial to examine the effects of a GP exercise referral programme in Hailsham, East Sussex, on modifiable coronary heart disease risk factors. *J Epidemiol Community Health* 1998;**52**:595–601.	
Wiles R, Demain S, Robison J, Killeff J, Ellis-Hill C, McPherson K. Managing alone: Exercise on prescription schemes for stroke patients post-discharge from physiotherapy. *Disabil Rehabil* 2007;**29**:25.	No cost data
Wormald H, Ingle L. GP exercise referral schemes: Improving the patient's experience. *Health Educ J* 2004;**63**:362–73.	No cost data
Wormald H, Waters H, Sleap M, Ingle L. Participants' perceptions of a lifestyle approach to promoting physical activity: targeting deprived communities in Kingston-Upon-Hull. *BMC Publ Health* 2006;**6**:202.	No cost data

TABLE 61 Additional studies excluded from uptake and adherence review (see *Table 58* for other articles excluded)

Paper	Comment
Gusi N, Reyes MC, Gonzalez-Guerrero JL, Herrera E, Garcia JM. Cost-utility of a walking programme for moderately depressed, obese, or overweight elderly women in primary care: a randomised controlled trial. *BMC Publ Health* 2008;**8**:231.	No uptake and/or adherence data
Morgan O. Approaches to increase physical activity: reviewing the evidence for exercise-referral schemes. *Publ Health* 2005;**119**:361–70.	No uptake and/or adherence data
Jolly K, Duda JL, Daley A, Ntoumanis N, Eves F, Rouse P, *et al. An Evaluation of the Birmingham exercise on prescription service: standard provision and a self-determination focused arm*. Final Report 2009.	No uptake and/or adherence data
National Institute for Health and Clinical Excellence (NICE). *A rapid review of the effectiveness of ERS to promote physical activity in adults*. London: NICE; 2006.	No uptake and/or adherence data
National Institute for Health and Clinical Excellence (NICE). *Modelling the cost-effectiveness of physical activity interventions*. London: NICE; 2006.	
National Institute for Health and Clinical Excellence (NICE). *Rapid review of the economic evidence of physical activity interventions*. London: NICE; 2006.	No uptake and/or adherence data
Sorensen JB, Skovgaard T, Puggaard L. Exercise on prescription in general practice: A systematic review. *Scand J Primary Health Care* 2006;**24**:69–74.	No uptake and/or adherence data
Sorensen JB, Kragstrup J, Kjaer K, Puggaard L. Exercise on prescription: trial protocol and evaluation of outcomes. *BMC Health Serv Res* 2007;**7**:36	No uptake and/or adherence data
Taylor AH. *Evaluating GP exercise referral schemes. Findings from a randomised control study*. Brighton: University of Brighton; 1996.	Uptake and/or adherence data taken from Taylor *et al.* (1998)
Taylor AH, Fox KR. Effectiveness of a primary care exercise referral intervention for changing physical self-perceptions over 9 months. *Health Psychol* 2005;**24**:11–21.	Uptake and/or adherence data taken from Taylor *et al.* (1998)

Appendix 4

Detailed data extraction: effectiveness systematic review

Part 1: background information of study

Study ID	005
Reviewer ID and name	TP
Date of completion of this form	March 2010
Title of report	Cost-utility of a walking programme for moderately depressed, obese, or overweight elderly women in primary care: a randomized controlled trial
Source (journal year;volume:pages)	*BMC Public Health* 2008;**8**:231
Authors	Gusi N, Reyes M C, Gonzalez-Guerrero J L, Herrera E and Garcia J M
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	Spain
Funders of the trial	The study was supported by European Social Funds and the Government of Extremadura, Spain
Date trial was conducted	Not stated
Type of trial design (e.g. parallel or cluster trial)	Parallel
Was the trial multicentre? If so, how many centres were there?	Yes – four general practices
Follow-up	Six months post randomisation

Characteristics of the referral	
Who made the referral	Medical practitioner
Reason for referral	Either moderate depression or were overweight
Format of referral	Not stated
Referred to who	Qualified exercise leaders
Referred to where	Supervised walks with a group in a public park or forest tracks
Single or group sessions	Group
Referral quote from paper	'Medical practitioners spent 2 weeks at each practice referring patients'
	'Medical practitioners did not know which group patients were randomised to prior to their exercise referral'

Characteristics of the intervention	
Components of the intervention	Exercise programme
Total duration	Six months
No. of sessions per week	Three
Duration of sessions	50 minutes
Session intensity	Each session consisted of walking alternating with specific exercises, as follows: 5 minutes of joint mobility (eight to 12 easy rotations at the neck, shoulder, hip and ankle and eight to 12 easy flexions/extensions of the knee, wrist and elbow); 15 minutes of brisk walking; 5 minutes of strengthening (eight to 12 flexions/extensions of arms against a wall, eight to 12 spine flexions with elevation of alternating knees, in a standing position) and stretching [hamstrings and shoulders (trying to touch the fingers on the upper-back)]; 20 minutes of brisk walking including 20 footsteps and 50 hand-claps to provide additional mechanical impact
Session mode	See above
Control group	'Best care in general practice, which consisted of routine care and a recommendation of physical activity'
Other information	

Characteristics of the participants		
	Experimental group	*Control group*
Inclusion criteria	Aged ≥ 60 years and old	
	Moderate depression scored 6–9 points in the 15-item Geriatric Depression Scale	
	Overweight (BMI of 25–39.9 kg/m^2)	
	Capable of walking for > 25 minutes	
Exclusion criteria	Poor health (severe obesity or major depression)	
	A debilitating medical condition or a known unstable cardiac condition	
	Attention or comprehension problems (e.g. Alzheimer's disease, apraxia, global aphasia and other types of dementia or psychopathology)	
	The intention of leaving the region	
Total number of randomised participants	64	63
Information on the age of the participants (mean and SD)	71 (5)	74 (6)
Information on the sex of the participants (%)	100% female	100% female
Information on the ethnicity of the participants (%)	Not reported	Not reported
Specifics of the population (i.e. disease %)	Overweight: 80	Overweight: 86
	Type 2 diabetes: 40	Type 2 diabetes: 39
	Moderately depressed: 33	Moderately depressed: 39

Type of outcomes (What outcomes were assessed in this trial? Which of these outcomes have reported information about the result?)	
Outcome (domain)	**Assessed (measure)**
Effectiveness	
PA	Not reported
Fitness (e.g. VO_{2max})	Not reported
Clinical factors (e.g. blood lipids)	BMI (kg/m^2)
Psychological well-being	Depression by Geriatric Depression Scale
	Anxiety by State Trait Anxiety Inventory
QoL	EQ-5D
Patient satisfaction	Not reported
Adverse events	Not reported
Patient factors	
Uptake	Not reported
Adherence	Not reported

Part 3: extracted results

	ERS (baseline)			Usual care (baseline)		
	Mean	***n***	**SD**	**Mean**	***n***	**SD**
BMI	29.7	64	4.2	30.6	63	4.3
Depression: Geriatric Depression Scale	2.3	64	2.5	2.6	63	2.5
Anxiety: State Trait Anxiety Inventory	19.2	64	11.2	21.2	63	10.4
Anxiety/depression EQ-5D	1.4	64	0.6	1.4	63	0.6

	ERS (6 months)			Usual care (6 months)		
	Mean	***n***	**SD**	**Mean**	***n***	**SD**
BMI	29.4	55	4.2	30.8	51	4.3
Depression: Geriatric Depression Scale	1.8	55	2.3	2.9	51	2.5
Anxiety: State Trait Anxiety Inventory	14.1	55	9	22.2	51	9.8
Anxiety/depression EQ-5D	1.2	55	0.4	1.5	51	0.7

Part 4: study quality (provide comments and quotes where appropriate)

Quality	Yes	Unclear	No
Power calculation reported	'The primary outcome was the EQ-5D utility. The required sample size was calculated with the Spanish EQ-5D data set for a hypothetical study comparing two groups with a significance level alpha (0.05) and 80% of the power needed for a minimal clinically relevant difference of 0.1'		
Method of random sequence generation described?	'A research assistant, who did not participate in the current investigation, randomized participants to either an intervention group or control group, according to a random numbers table'		
Method of allocation concealment described?	See above		
Method of outcome (assessment) blinding described?		Not reported	
Are groups similar at baseline?	'At baseline, the intervention group was slightly less depressed, less overweight and younger than the control group, but these differences were not statistically significant ($p > 0.05$) (Table 1)'		
Was ITT analysis used?	Yes for health outcomes, but not for cost–utility		
Was there any statistical handling of missing data?	'The participants who were lost to follow-up (mainly because they had to care for a relative) were similar to those who completed the trial but a slightly higher percentage of them were moderately depressed. The participants in the control group who dropped out were similar to those who followed the trial but they were mainly living in an urban area'		
Were missing data (dropout and loss to follow-up) reported?	Yes – figure 1		

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Physical activity data

Part 1: background information of study

Study ID	002
Reviewer ID and name	TP
Date of completion of this form	March 2010
Title of report	Does primary care referral to an exercise programme increase PA 1 year later? A randomised controlled trial
Source (journal year;volume:pages)	*Journal of Public Health*
Authors	Harrison RA, Roberts C and Elton PJ
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Bolton Metropolitan Borough Council and Wigan and Bolton Health Authority
Date trial was conducted	March 2000 to December 2001
Type of trial design (e.g. parallel or cluster trial)	Parallel RCT
Was the trial multicentre? If so, how many centres were there?	Borough in the north-west of England, 52 general practices and diabetes centres
Follow-up	Six, 9 and 12 months post randomisation

Characteristics of the referral	
Who made the referral	GP
Reason for referral	Sedentary adults with additional CHD risk factors. These were obesity (as determined by the referrer); previous MI; on the practice CHD risk-management register; or diabetes.
Format of referral	A faxed referral form
Referred to who	Exercise officer
Referred to where	Leisure centre for initial consultation, then any of the council-run PA facilities for the duration of the scheme
Single or group sessions	Not reported
Referral quote from paper	'During the period of the study, all referral forms were faxed by the referring practitioner …' 'After receiving a referral form, the exercise officers telephoned clients …'

Characteristics of the intervention	
Components of the intervention	One-hour consultation, person-specific advice and information taking into account patients' preferences and abilities for different types of activities. All clients offered a 12-week subsidised leisure pass, encouraged to attend at least two sessions a week. Information on non-leisure centre-based activities available. Exit interview to review progress and identify further PA opportunities
Total duration	12 weeks
No. of sessions per week	≥ 2 sessions/week
Duration of sessions	Not reported
Session intensity	Not reported
Session mode	Not reported
Control group	Sent a written information pack
Other information	One primary care locality also funded the scheme to accept sedentary patients, regardless of other risk factors

Characteristics of the participants		
	Experimental group	**Control group**
Inclusion criteria	Sedentary adults with additional CHD risk factors, obesity (as determined by the referrer); previous MI; on the practice CHD risk-management register; or diabetes	
Exclusion criteria	Patients identified by the clinician as having contraindications to PA	
	Hypertension (SBP ≥ 200 mmHg)	
	Aged < 18 years old	
	Not sedentary	
	Not providing consent	
	Additional criteria, imposed for the trial, were that more than one family member could not be knowingly recruited, to minimise contamination, and that the referring practitioner and patient had to give written informed consent	
Total number of randomised participants	275	270
Information on the age (years) of the participants (mean and SD)	18–44 = 111	18–44 = 107
	45–59 = 101	45–59 = 98
	> 60 = 63	> 60 = 65
Information on the sex of the participants (%)	32.7% male	34.1% male
Information on the ethnicity of the participants (%)	71.9% white	74.1% white
Specifics of the population (i.e. disease, %)	24.4% smoker	20.7% smoker
	75.3% ≥ 1 CHD risk factor	75.2% ≥ 1 CHD risk factor

Type of outcomes (What outcomes were assessed in this trial? Which of these outcomes have reported information about the result?)	
Outcome (domain)	**Assessed (measure)**
Effectiveness	
PA	Percentage of people (at 1 year, 9 months and 6 months since randomisation) who were participating in at least 90 minutes per week of moderate/vigorous PA. 7-Day Physical Activity Recall
Fitness (e.g. VO_{2max})	Not reported
Clinical factors (e.g. blood lipids)	Not reported
Psychological well-being	Not reported
QoL	Not reported
Patient satisfaction	Not reported
Adverse events	Yes and 'demand for information', measure not stated
Patient factors	
Uptake	84% (232/275)
Adherence	Not reported

Part 3: extracted results

	ERS (baseline)		**Usual care (baseline)**	
	n	***N***	***n***	***N***
At least 90 minutes of moderate-intensity PA	38	275	22	270

	ERS (9 months)		Usual care (9 months)	
	n	*N*	*n*	*N*
At least 90 minutes of moderate-intensity PA	36	275	31	270

	ERS (12 months)		Usual care (12 months)	
	n	*N*	*n*	*N*
At least 90 minutes of moderate-intensity PA	40	275	32	270

Part 4: study quality (provide comments and quotes where appropriate)

Quality	Yes	Unclear	No
Power calculation reported	To identify this with 90% power and two-sided 5% statistical significance required 264 participants.		
Method of random sequence generation described?	Individual patients were randomised by computer using minimisation software and stratified by sex, age group (18–44 years, 45–59 years, ≥ 60 years old) and CHD risk (yes or no to: post MI/on CHD register)		
Method of allocation concealment described?		Not reported	
Method of outcome (assessment) blinding described?		Not reported	
Are groups similar at baseline?	'The baseline characteristics of the 275 allocated to the intervention group and 270 to the control group were comparable (Table 1)'		
Was ITT analysis used?	The analysis was on the basis of ITT subject to the availability of follow-up data		
Was there any statistical handling of missing data?		'All analyses assumed that levels of physical activity in non-responders to the follow-up questionnaires would be similar in the two allocation groups. Not all participants returned questionnaires at follow-up and some responded to different assessment points. Therefore, to increase statistical power and to make use of all available data, a post-hoc analysis merged data across the 9 and 12 month assessments using robust SEs that adjust for multiple observations'	
Were missing data (dropout and loss to follow-up) reported?	Reported in flow diagram – figure 1		

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

Part 1: background information of study

Study ID	006
Reviewer ID and name	TP
Date of completion of this form	March 2010
Title of report	Exercise Evaluation Randomised Trial (EXERT): a Randomised Trial Comparing GP Referral for Leisure Centre-based Exercise, Community-based Walking and Advice Only
Source (journal year;volume:pages)	*Health Technol Assess* 2007;**11**(10)
Authors	Isaacs AJ, Critchley JA, See Tai S, Buckingham K, Westley D, Harridge SDR, Smith C and Gottlieb JM
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full publication

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	UK HTA programme
Date trial was conducted	October 1998 to April 2002
Type of trial design (e.g. parallel or cluster trial)	Parallel-group RCT 3-group design: 1. Exercise referral scheme; 2. Walking Programme; 3. No exercise (control)
Was the trial multicentre? If so, how many centres were there?	No
	Copthall Leisure Centre, Barnet, outer London
Follow-up	10 weeks, 6 months and 12 months post randomisation

Characteristics of the referral	
Who made the referral	GP or practice nurse
	Referrals were also accepted in some instances (with approval from the patient's GP) from other primary and secondary care professionals, such as dieticians and diabetes nurses
Reason for referral	Any patient meeting the inclusion criteria
	Patients whom the GP considered would improve with regular exercise, who were not already participating in regular exercise and were considered to be at risk from CHD (e.g. with mild or moderate hypertension, overweight, with raised cholesterol levels, or a family history of CHD)
Format of referral	Specially prepared 'prescription pad' – referral form
Referred to who	ERS group: instructor-led exercise classes in a leisure centre
	Walking group: instructor-led community-based walking programmes
	All instructors were qualified to National Vocational Qualification (NVQ) Level 3 standard, consistent with the recommendations of the National Quality Assurance Framework
Referred to where	ERS group: four different leisure centres at different sites in the district
	Walking group: walking – 12 different locations around the borough parks and open spaces
Single or group sessions	ERS: individual and/or group
	Walking: group
Referral quote from paper	'To make a referral, the [primary-care health] professional had to complete and sign the prescription, providing contact information for the patient and information on their cardiovascular risk factors'

Characteristics of the intervention	
Components of the intervention	ERS group: instructor-led exercise classes in a leisure centre setting
	Walking group: instructor-led walks
	Both were designed to increase the participants' general fitness, taking them through a range of exercises and routines. Every class consisted of at least 45 minutes of exercises aimed to increase stamina, strength and flexibility, preceded and followed by a warm-up and warm-down period
Total duration	All groups: 10 weeks
No. of sessions per week	ERS group: 2–3
	Walking group: ≥ 2
Duration of sessions	ERS group: ≥ 45 minutes
	Walking group: 45 minutes
Session intensity	ERS group: not stated
	Walking group: All participants were encouraged 60% and 80% of their maximum (slightly breathless, but able to carry on a conversation)
Session mode	ERS group: aerobics, body conditioning, aqua aerobics, gymnasium and an optional swimming class
	Walking group: walking, strengthening (resistance bands), stretching
Control group	Tailored advice and information on PA, including local exercise facilities
	Put on a waiting list for potential re-randomisation to one of the two active intervention groups after approximately 6–9 months
Other information	

Characteristics of the participants		
	Experimental group	**Control group**
Inclusion criteria	Aged between 40 and 74 years, not currently physically active and with at least one of the following cardiovascular risk factors: raised cholesterol; controlled mild-to-moderate hypertension; obesity; current smoking; diabetes; a family history of MI at an early age	
Exclusion criteria	Major exclusion criterion: pre-existing overt CVD	
	Other exclusion criteria: uncontrolled hypertension, uncontrolled insulin-dependent diabetes, psychiatric conditions, physical disabilities that would prevent participation in an exercise class, conditions requiring a specialist programme (e.g. uncontrolled epilepsy)	
Total number of randomised participants	ERS: $n=317$	$n=315$
	Walking: $n=311$	
Information on the age of the participants (mean and SD)	Exercise: 57.1 (8.7)	57.0 (9.0)
	Walking: 56.9 (8.5)	
Information on the sex of the participants (%)	Exercise: 35 male	31.7 male
	Walking: 31.2 male	
Information on the ethnicity of the participants (%)	Exercise: 75.7 white, 16.7 Asian	76.5 white
	Walking: 75.9 white, 12.2 Asian	14.0 Asian
Specifics of the population (i.e. disease, %):		
Raised cholesterol	ERS 24.0, Walking 21.5	17.1
Hypertension	ERS 44.5, Walking 46.3	43.5
Obesity	ERS 65.9, Walking 58.5	63.5
Smoking	ERS 10.4, Walking 12.2	8.3
Diabetes	ERS 12.3, Walking 11.3	15.6
Family history of MI	ERS 13.9, Walking 12.9	16.2

Type of outcomes (What outcomes were assessed in this trial? Which of these outcomes have reported information about the result?)		
Outcome (domain)	**Assessed (measure)**	
Effectiveness		
PA	7-day recall questionnaires (minutes of light, moderate and vigorous category activity)	
Fitness (e.g. VO_{2max})	Aerobic fitness: submaximal bicycle ergometer exercise test and submaximal shuttle walking test	
	Isometric strength and power of the knee extensor muscles	
	Flexibility – sit and reach, and shoulder abduction	
Clinical factors (e.g. blood lipids)	SBP, DBP (mmHg) and resting pulse rate (b.p.m.)	
	Anthropometry: weight (kg); waist and hip measurements (cm); ankle body fat (%) was estimated by bioimpedance	
	BMI	
	Respiratory function: PEF (l/minute), FEV_1 (l/minute) and FVC (l)	
	Lipids: total cholesterol, HDL, triglycerides, LDL cholesterol	
Psychological well-being:	HADS	
QoL	SF-36	
Adverse events (e.g. injury)	Attendance at the GP surgery, presenting conditions and any medication prescribed	
Patient satisfaction	Participants allocated to ERS and walking groups, were asked to evaluate their exercise programmes at 10 weeks.	
Patient factors		
Uptake	ERS: 92% (293/317)	Walking: 76% (238/311)
Adherence	ERS: 42% (133/317)	Walking: 22% (67/311)

b.p.m., beats per minute; DBP, diastolic blood pressure; FEV_1, forced expiratory volume in 1 second; FVC, forced vital capacity; HDL, high-density lipoprotein; LDL, low-density lipoprotein; PEF, peak expiratory flow.

Part 3: extracted results

	ERS group baseline			Advice group baseline			Walking group baseline		
	Mean	*n*	SD	Mean	*n*	SD	Mean	*n*	SD
Minutes of moderate- and/or vigorous-intensity PA		301	0		305	0		305	0
Total activity (minutes)		317	0		153	0		153	0
Energy expenditure (kcal/kg/week)		317	0		153	0		153	0
Weight (kg)	83	317	17.80449	81.8	315	10.64894	82.4	311	17.63519
BMI	30.7	317	5.341348	30.3	315	5.324472	30.6	311	5.290558
Percentage body fat	37.6	317	8.902247	37.8	315	8.87412	37.7	311	8.817596
Waist to hip	0.88	317	0.089022	0.87	315	0.088741	0.87	311	0.105811
Resting heart rate	65.7	316	10.66583	65.8	314	10.63203	64.7	311	10.58112
SBP	136.3	317	19.94103	135.4	314	21.08685	136.1	311	21.51493
DBP	84.2	317	9.792472	84.4	314	10.98643	84.3	311	10.05206
FEV	2.37	313	0.707672	2.33	310	0.704273	2.33	306	0.699714
FVC	2.8	313	0.707672	2.74	310	0.704273	2.76	306	0.699714
FEV/FVC	0.85	313	0.070767	0.86	310	0.070427	0.85	306	0.087464
PEF	410.8	285	128.1339	402.7	280	126.8377	399.9	278	112.8785
Cycle ergometer (minutes)	8.5	142	2.383275	8.9	130	2.280351	9	125	2.236068
Shuttle walk (m)	416.8	127	155.5181	415	139	126.1511	424.8	141	143.6795
IKES (N)	252.7	274	107.5941	263.8	267	107.8449	263.6	265	109.0681
LEP (W)	153.2	310	77.46999	157.9	309	82.61846	157.7	309	75.5871
LEP (W/kg)	1.8	310	0.704273	1.9	309	0.87892	1.9	309	0.703136
Shoulder abduction	143.9	315	15.97342	143.3	312	15.89717	144.2	311	15.87167
Cholesterol	5.76	262	0.971185	5.65	272	0.989545	5.76	258	1.124366
HDL	1.32	258	0.321248	1.37	272	0.329848	1.41	256	0.48
Cholesterol/HDL	4.56	258	1.124366	4.37	271	1.152345	4.37	256	1.44
LDL	3.52	251	0.950579	3.47	264	0.812404	3.44	250	0.948683
Triglycerides	2.17	263	1.297382	1.9	272	0.989545	2.04	258	1.28499

DBP, diastolic blood pressure; FEV, forced expiratory volume; FVC, forced vital capacity; HDL, high-density lipoprotein; IKES, isometric knee extensor strength; LDL, low-density lipoprotein; LEP, leg extension power; PEF, peak expiratory flow.

	ERS group (10 weeks)			Advice group (10 weeks)			Walking group (10 weeks)		
	Mean	*n*	SD	Mean	*n*	SD	Mean	*n*	SD
Minutes of moderate- and/or vigorous-intensity PA	93	157	–115.071	79	153	113.5958	113	154	291.2474
Total activity (minutes)	584	157	479.4629	668	153	555.3571	863	154	1025.698
Energy expenditure (kcal/kg/week)	34	157	25.57136	36	153	31.55438	49	154	56.9832
Weight (kg)	80.53	164	3.2669	80.73	156	3.759744	80.38	160	7.163527
BMI	30.22	164	0.849394	30.11	156	1.465663	30.22	160	1.613407
Percentage body fat	37.41	164	1.894802	37.58	156	1.911734	37.06	160	1.936088
Waist to hip	0.88	164	0.065338	0.89	156	0	0.88	160	0.064536
Resting HR	64.7	164	5.22704	64.7	156	12.10765	65	160	5.808265
SBP	132.9	164	9.8007	132	156	10.19592	134.4	160	10.3258
DBP	82	164	5.88042	82.5	156	6.372447	84	160	6.453628
FEV	2.38	163	0.130277	2.36	152	0.188707	2.38	156	0.127449
FVC	2.78	163	0.195415	2.76	152	0.188707	2.81	156	0.191173
FEV/FVC	0.86	163	0	0.86	152	0.062902	0.85	156	0.063724
PEF	417.6	148	57.72418	409.1	138	57.53799	407.2	144	60.61224
Cycle ergometer (minutes)	9.65	77	1.522188	8.87	63	1.538855	8.92	69	1.652849
Shuttle walk (m)	456.7	62	102.0407	434.2	68	104.3398	436.6	74	99.62897
IKES (*N*)	277.9	140	53.72766	265.1	134	56.10737	275	142	58.36592
LEP (W)	173.6	162	30.52104	164.6	154	31.02418	165.6	160	31.62278
LEP (W/kg)	2.1	162	0.38963	1.98	154	0.379888	1.99	160	0.387218
Shoulder abduction	144.7	162	11.68891	143.6	154	11.39664	146.2	160	12.26189
Cholesterol	5.68	133	0.529556	5.71	136	0.416497	5.69	131	0.52556
HDL	1.35	131	0.175187	1.35	135	0.177841	1.33	129	0.173844
Cholesterol/HDL	4.48	131	0.583955	4.46	135	0.592804	4.52	129	0.57948
LDL	3.41	127	0.459977	3.44	133	0.470717	3.45	126	0.458162
Triglycerides	2.12	134	0.708725	2.14	136	0.713994	2.05	131	0.759142

DBP, diastolic blood pressure; FEV, forced expiratory volume; FVC, forced vital capacity; HDL, high-density lipoprotein; IKES, isometric knee extensor strength; LDL, low-density lipoprotein; LEP, leg extension power; PEF, peak expiratory flow.

	ERS group (6 months)			Advice group (6 months)			Walking group (6 months)		
	Mean	*n*	SD	Mean	*n*	SD	Mean	*n*	SD
Minutes of moderate- and/or vigorous-intensity PA	65	301	106.2205	58	305	98.01364	89	300	150.2289
Total activity (minutes)	692	301	495.6958	647	305	463.3372	759	300	539.0566
Energy expenditure (kcal/kg/week)	38	301	26.55513	35	305	26.73099	42	300	26.51098
Weight (kg)	82.28	317	2.997695	82.17	315	3.078776	82.29	311	3.059166
BMI	30.47	317	1.090071	30.44	315	1.086627	30.48	311	1.079706
Percentage body fat	37.78	317	2.361821	37.83	315	2.354358	37.79	311	2.339362
Waist to hip	0.88	317	0	0.88	315	0	0.88	311	0
Resting HR	65.3	316	6.34871	65.7	314	6.328588	65.2	311	6.298283
SBP	132.5	317	11.8091	133.3	314	11.75309	134.1	311	11.69681
DBP	81.6	317	6.358748	82.3	314	7.232671	82.7	311	6.298283
FEV	2.35	313	0.180529	2.33	310	0.179661	2.35	306	0.178499
FVC	2.74	313	0.270793	2.72	310	0.179661	2.76	306	0.178499
FEV/FVC	0.86	313	0.090264	0.86	310	0.089831	0.85	306	0.089249
PEF	407.3	285	115.4174	410.6	280	116.9617	415.6	278	116.5432
Cycle ergometer (minutes)	8.86	142	1.702339	9.08	130	1.745166	8.97	125	1.825362
Shuttle walk (m)	445.8	124	96.01553	434.1	138	97.09536	448.4	141	95.1159
IKES (N)	264.5	274	58.27312	267.1	267	65.86075	263.8	265	65.61361
LEP (W)	172.7	315	66.10314	167.3	312	68.49121	163.8	311	68.38136
LEP (W/kg)	2.08	315	0.905522	2.03	312	0.9012	1.98	311	0.899755
Shoulder abduction	145.5	315	14.48836	143.4	312	14.4192	145.4	311	14.39608
Cholesterol	5.65	262	0.495502	5.6	272	0.50487	5.56	258	0.573656
HDL	1.37	258	0.245853	1.38	272	0.16829	1.37	256	0.163265
Cholesterol/HDL	4.36	258	0.573656	4.33	271	0.587931	4.31	256	0.653061
LDL	3.4	251	0.484989	3.37	264	0.49739	3.36	250	0.484022
Triglycerides	2.04	263	0.744671	2	272	0.84145	1.95	258	0.737558

DBP, diastolic blood pressure; FEV, forced expiratory volume; FVC, forced vital capacity; HDL, high-density lipoprotein; IKES, isometric knee extensor strength; LDL, low-density lipoprotein; LEP, leg extension power; PEF, peak expiratory flow.

Part 4: study quality (provide comments and quotes where appropriate)

Quality	Yes	Unclear	No
Power calculation reported	'To detect a difference of 5 mmHg in systolic blood pressure, with 90% power and a two sided *p*-value of 0.05. A similar number ($n = 300$) would provide over 90% power to detect a difference of 0.3 mmol/l in total cholesterol'		
Method of random sequence generation described?	'The unit of randomisation was the individual patient. The schedule was designed using the statistical package STATA'		
Method of allocation concealment described?		'The randomisation schedule was concealed from staff carrying out the assessments at all times'	
Method of outcome (assessment) blinding described?			'Ideally, assessors carrying out the postexercise assessments should be blinded to the patient's allocation. However, this was not practicable'
Are groups similar at baseline?	'The three trial arms were well matched in terms of referral criteria and sociodemographic characteristics, as shown in *Tables 13* and *14*. The groups were also well matched by clinical characteristics (*Table 15*)'		
Was ITT analysis used?	'Data were analysed both for trial completers (where data were available both at baseline and at one or more subsequent assessments) and on an ITT basis'		
Was there any statistical handling of missing data?	PA outcome: 'the median of available data at each assessment point for the control group grouped by gender within each age group was used for imputation of missing data' Anthropometry and other outcomes when 10-week data were unavailable, baseline data were used for imputation of missing data		
Were missing data (dropout and loss to follow-up) reported?	Yes – figure 3 (p. 19)		

Do you have any additional comments to make about this study?

Three groups: ERS, walking group and advice-only group.

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

Part 1: background information of study

Study ID	007
Reviewer ID and name	TP
Date of completion of this form	March 2010
Title of report	An evaluation of the Birmingham Exercise on Prescription service: Standard provision and a self-determination focused arm
Source (journal year;volume:pages)	Final report for funders
Authors	Jolly K, Duda J, Daley A, Ntoumanis N, Eves F, Rouse P, Blamey R, Lodhia R, Mutrie N and Williams G
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full report

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Birmingham Wellbeing Partnership and the three Birmingham PCTS (South Birmingham, Birmingham East and North and Heart of Birmingham).
Date trial was conducted	November 2007 to July 2008
Type of trial design (e.g. parallel or cluster trial)	Cluster RCT
Was the trial multicentre? If so, how many centres were there?	13 EoP sites in Birmingham
Follow-up	3 and 6 months post randomisation

Characteristics of the referral	
Who made the referral	Member of the primary care team
Reason for referral	For sedentary patients (< 30 minutes/week of moderate-intensity PA) in order to increase: ■ physical well-being ■ psychological well-being ■ medium- to long-term PA level
Format of referral	Not stated
Referred to who	Health and fitness advisor
Referred to where	Leisure centre
Single or group sessions	Not stated
Referral quote from paper	'Patients are referred from a member of the primary care team according to eligibility criteria (see methods section) and receive an initial consultation and support over a 10-week period with an exit interview' 'People referred to the EoP scheme received the intervention consistent with their HFA [health & fitness advisor]'

Characteristics of the intervention	
Components of the intervention	*ERS group*: ■ Initial consultation: 1 hour ■ Support by health and fitness advisor: contacts negotiated by patients and advisor with option of fitness test ■ Exit interview with final assessment *ERS plus SDT group*: ■ Initial consultation: 1 hour ■ Focused on non-judgemental conveyance of information regarding benefits and risks of increased PA, participants' identification of resources for and barriers to successful behavioural change, mutual goal setting agreed upon by participants and counsellor for future participation in PA, and clarification of participants' desire to become more physically active in concert with their other life values. At this time, participants were also given a booklet designed to encourage self-management of PA initiation ('Empowering your Life with Exercise') *Ongoing support*: ■ At 1 month, the next contact (15–20 min) conducted via telephone to reinforce and further internalise successful PA engagement attempts and providing strategies for enhancing exercise efficacy ■ At 2 months, a brief (5-min) telephone call by the advisor planned to offer encouragement regarding attempts to be physically active ■ At 3 months, primary and secondary outcomes were re-assessed and a final face-to-face 'booster' consultation (20–30 min) was planned, focusing on recognising and reinforcing the internalisation of the participant's PA involvement. A supplemental self-management booklet centred on the monitoring and maintenance of PA was also posted to participants at this time
Total duration	10 weeks
No. of sessions per week	Negotiated by patients and advisor
Duration of sessions	Negotiated by patients and advisor
Session intensity	Negotiated by patients and advisor
Session mode	Group and/or Individual
Control group	Usual ERS programme
Other information	

Characteristics of the participants		
	Experimental group	**Control group**
Inclusion criteria	Two or more major risk factors of coronary heart	
	People suffering from well-controlled chronic medical condition [mild or controlled asthma; chronic bronchitis; controlled diabetes mellitus; mild-to-moderate depression and/or anxiety; onset of osteoporosis may be delayed through regular exercise (i.e. post-menopausal women); borderline for hypertensive drugs: blood pressure ≤ 160/102 mmHg, prior to medication]	
	People exhibiting motivation to change	
Exclusion criteria	Angina pectoris	
	Moderate to high (or unstable) hypertension – 160/102 mmHg or above	
	Poorly controlled insulin-dependent diabetes	
	History of MI within the last 6 months – unless the patient has completed stage III cardiac rehabilitation	
	Established cerebrovascular disease	
	Severe chronic obstructive airways disease	
	Uncontrolled asthma	
Total number of randomised participants	*n* = 184	*n* = 163
Information on the age (years) of the participants (mean and SD)	< 30: 10	< 30: 7
	30–49: 42	30–49: 47
	50–64: 34	50–64: 31
	65+: 14	65+: 15
Information on the sex of the participants (%)	Male 24.4	Male 30.1
Information on the ethnicity of the participants (%)	White British/Irish 74.9	White British/Irish 67.5
	Black Caribbean/African 10.6	Black Caribbean/African 14.9
	South Asian 9.5	South Asian 14.9
	Mixed race/others 5	Mixed race/others 2.6
Specifics of the population (i.e. disease %)	Smoker: 22.1	Smoker: 23.1
	Hypertensive: 38	Hypertensive: 37.5
	Overweight: 25.3	Overweight: 26.3
	Obese: 52.3	Obese: 51.9
	Morbidly obese: 12.1	Morbidly obese: 13.5
	Probable anxiety: 34.2	Probable anxiety: 31.9
	Probable depression: 21.9	Probable depression: 15.3

Type of outcomes (What outcomes were assessed in this trial? Which of these outcomes have reported information about the result?)	
Outcome (domain)	**Assessed (measure)**
Effectiveness	
PA	Self-reported PA (7-Day Physical Activity Recall) (primary outcome)
	Time spent in moderate and vigorous PA (excluding walking)
Fitness (e.g. VO_{2max})	Not reported
Clinical factors (e.g. blood lipids)	BMI, blood pressure
Psychological well-being	Anxiety and depression (HADS)
	Vitality (subjective vitality scale)
	(Other scales embedded in the Dartmouth CO-OP)
QoL	Overall HRQoL (Dartmouth CO-OP charts)
Patient satisfaction	Not reported
Adverse events	Not reported
Patient factors	
Uptake	Not reported
Adherence	Not reported

Part 3: extracted results

	ERS group (baseline)			ERS + SDT group (baseline)		
	n	Mean	SD	*n*	Mean	SD
Minutes PA/week at least moderate intensity	156	134	240	170	132	237
Minutes PA/week walking	156	88	209	169	81	192
Vitality	163	3.63	1.5	178	3.34	1.6
HADS anxiety	163	8.14	4.5	183	9.3	4.4
HADS depression	163	6.58	4	183	7.38	3.91
Dartmouth QoL domains						
Physical fitness	161	2.91	1.2	168	2.68	1.1
Feelings	162	3.19	1.2	176	2.96	1.2
Daily activities	161	3.45	1	177	3.18	1
Change in health	163	3.27	0.7	176	3.1	0.8
Overall health	163	2.58	0.9	177	2.29	0.9
QoL	163	3.25	0.8	178	3.02	0.8
Weight	157	91.9	22.4	173	89.3	18.8
BMI	160	33.1	6.9	173	32.8	6.3
SDP	77	133.6	14.8	73	129.3	13.9
DBP	76	80.5	9.3	73	78.6	10

DBP, diastolic blood pressure.

	ERS group (3 months)			ERS + SDT group (3 months)		
	n	Mean	SD	*n*	Mean	SD
Minutes PA/week at least moderate intensity	156	321	383	170	329	333
Minutes PA/week walking	156	200	312	169	191	258
Vitality	163	3.94	1.5	178	3.71	1.5
HADS anxiety	163	7.72	4.4	183	8.89	4.3
HADS depression	163	5.94	4.2	183	6.68	4.1
Dartmouth QoL domains						
Physical fitness	161	3.01	1.2	168	2.88	1.2
Feelings	162	3.19	1.3	176	3.13	1.1
Daily activities	161	3.49	1.1	177	3.32	1.1
Change in health	163	3.38	0.7	176	3.23	0.9
Overall health	163	2.7	0.9	177	2.48	1.1
QoL	163	3.25	0.7	178	3.16	0.8
Weight	N/A			N/A		
BMI	N/A			N/A		
SDP	N/A			N/A		
DBP	N/A			N/A		

DBP, diastolic blood pressure; N/A, not applicable; SEM, standard error of the mean.

	ERS (6 months)			ERS (6 months)		
	n	Mean	SD	*n*	Mean	SD
Minutes PA/week at least moderate intensity	156	254	362	170	246	346
Minutes PA/week walking	156	161	317	169	142	297
Vitality	163	3.97	1.5	178	3.68	1.6
HADS anxiety	163	7.9	4.8	183	8.86	4.7
HADS depression	163	6.1	4.4	183	6.65	4.3
Dartmouth QoL domains						
Physical fitness	161	2.93	1.2	168	2.83	1.1
Feelings	162	3.12	1.3	176	2.15	1.3
Daily activities	161	3.5	1.1	177	3.38	1.1
Change in health	163	3.27	0.9	176	3.16	0.8
Overall health	163	2.64	0.9	177	2.5	1
QoL	163	3.24	0.9	178	3.14	0.8
Weight	157	91.1	21.9	173	89.2	19.1
BMI	160	32.8	6.9	173	32.8	6.4
SDP	77	130	17.3	73	126.5	15.6
DBP	76	82	10.7	73	79.4	11.4

DBP, diastolic blood pressure.

Part 4: study quality (provide comments and quotes where appropriate)

Quality	Yes	Unclear	No
Power calculation reported	'This sample size would be more than adequate to achieve 90% power and 5% significance to detect a within group change in minutes of self-reported physical activity from 108 to 266 minutes. To take account of the cluster effect, the sample size was doubled to 500 participants, but this number was not achieved due to low recruitment rates and despite an extended recruitment duration from 26th November 2007 until 12th July 2008'		
Method of random sequence generation described?		'Cluster RCT – an independent statistician undertook the allocation with stratification by PCT'	
Method of allocation concealment described?	As both intervention and usual care arms were given an active treatment, participants didn't know which arm they were in		
Method of outcome (assessment) blinding described?	'The primary outcome was self-reported physical activity using the 7-Day Physical Activity Recall assessed via telephone to maintain blinding'		
Are groups similar at baseline?	Table 1 shows the baseline characteristics appear to balanced across groups		
Was ITT analysis used?	'When the missing data were replaced with last value carried forward (i.e. ITT analysis)'		
Was there any statistical handling of missing data?	'Baseline values of missing process or outcomes variables were carried forward and a secondary analysis undertaken using these imputed data'		
Were missing data (dropout and loss to follow-up) reported?	Figure 2 (p. 26) flow of participants No follow-up data 3 months ERS: 36/163 (82%) ERS + SDT: etc.		

Do you have any additional comments to make about this study?

ERS versus ERS plus SDT: the aim of the study was to compare standard provision of ERS with a SDT ERS intervention

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Details of the EoP exercise programme.

Part 1: background information of study

Study ID	001
Reviewer ID and name	TP
Date of completion of this form	March 2010
Title of report	EoP: a randomized study on the effect of counseling vs counseling and supervised exercise
Source (journal year;volume:pages)	*Scand J of Med Sci* 2008;**18**:288–97
Authors	Sorensen JB, Kragstrup J, Skovgaard T and Puggaard L
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	Denmark
Funders of the trial	Danish Medical Research Council, The Ministry of the Interior and Health, The National Board of Health, the counties of Ribe and Vejle
Date trial was conducted	2005–6
Type of trial design (e.g. parallel or cluster trial)	RCT-parallel
Was the trial multicentre? If so, how many centres were there?	14 clinics, two regions – Ribe and Vejle
Follow-up	4 and 10 months post randomisation

Characteristics of the referral	
Who made the referral	GP
Reason for referral	'Having medically controlled lifestyle diseases or at risk of developing lifestyle diseases'
Format of referral	Not stated
Referred to who	Physiotherapist – trained prior to evaluation and each clinic received several visits during the study
Referred to where	Counselling sessions and group-based activities – not stated where these took place
Single or group sessions	Group
Referral quote from paper	'The eligibility of the patients with regard to the EoP scheme was evaluated by the GPs, who could refer patients'
	'All patients referred to the EoP scheme were eligible for the study and were offered participation in the randomized study'

Characteristics of the intervention	
Components of the intervention	ERS: aerobic conditioning (e.g. Nordic walking and aerobics), light strength conditioning (primarily using light weights and a high number of repetitions), stretching and games
	Motivational counselling: motivational counselling [based on the Transtheoretical Model (Prochaska and DiClemente 1983[157])] aimed at increasing daily PA at baseline and after 4 and 10 months (45- to 60-min session)
Total duration	4 months – 24 sessions
No. of sessions per week	First 2 months, two sessions
	Second 2 months, one session
Duration of sessions	1 hour
Session intensity	> 50% of heart rate reserve for a minimum of 20 minutes
Session mode	Group and/or individual
Control group	Motivational counselling
Other information	

Characteristics of the participants		
	Experimental group	**Control group**
Inclusion criteria	1. Having medically controlled lifestyle diseases or at risk of developing lifestyle diseases 2. Motivated to change of lifestyle 3. Believed by the GP to be able to improve health from an increased PA level 4. Willing to pay 750 DKK (€100) for the intervention	
Exclusion criteria	None stated	
Total number of randomised participants	$n=28$	$n=24$
Information on the age of the participants (mean and SD)	53.9	52.9
Information on the sex of the participants (%)	Male 43%	Male 47%
Information on the ethnicity of the participants (%)	Not stated	Not stated
Specifics of the population (i.e. disease, %)	Metabolic syndrome: 36% Diabetes: 18% Heart disease: 32% Other diseases: 14%	Metabolic syndrome: 25% Diabetes: 21% Heart disease: 42% Other diseases: 13%

Type of outcomes (What outcomes were assessed in this trial? Which of these outcomes have reported information about the result?)		
Outcome (domain)	**Assessed (measure)**	
Effectiveness		
PA	METs/hour/day – self-report Amount, intensity, 30-minute guidelines – self-report	
Fitness (e.g. VO_{2max})	VO_{2max}, physical fitness – self-report	
Clinical factors (e.g. blood lipids)	HbA_{1c} Body weight BMI	
Psychological well-being	Not reported	
QoL	SF-12 physical SF-12 mental	
Adverse events (e.g. injury)	Not reported	
Patient satisfaction	Not reported	
Patient factors		
Uptake	ERS: 28/28 (100%) started exercise training	Control: 24/24 (100%) started motivational counselling
Adherence	Participants attended an average of 18 of the 24 supervised group-based training sessions (25% percentile 14.8 and 75% percentile 21.3) Participation rate in counselling sessions 76% 8/28 (29%) discontinued intervention	Participation rate in counselling sessions: 91% 4/24 (17%) discontinued control group

MET, metabolic equivalent.

Part 3: extracted results

	ERS (baseline)			Alternative PA intervention (baseline)		
	Mean	***n***	**SD**	**Mean**	***n***	**SD**
PA minutes/week	124	28	113.3893	109	24	104.9781
PA intensity	2.2	28	0.809924	2.4	24	0.749844
PA 30 minutes/day/week	4.6	28	2.699746	4.2	24	2.749427
Self-reported present physical fitness	3.4	28	0.809924	3.9	24	0.749844
Self-reported physical fitness compared with 4 months ago	3	28	1.349873	3.2	24	0.499896
Self-reported physical fitness compared with people of own age	3.6	28	1.079898	3.8	24	0.999792
HbA_{1c} (%)	6.2	15	1.383208	5.8	11	0.846078
Body weight (kg)	94.3	28	19.43817	88.7	24	18.49615
BMI (kg/m^2)	32.3	28	5.399492	30.3	24	4.749011
VO_{2max}	21.5	28	5.669467	21.1	24	7.998334
PA METs/hour/day	40.5	28	5.399492	38.7	24	3.999167
SF-12 physical	47	28	10.25904	42.6	24	11.24766
SF-12 mental	39	28	9.989061	36.4	24	10.24787

MET, metabolic equivalent.

	ERS (4 months)			Alternative PA intervention (4 months)		
	Mean	***n***	**SD**	**Mean**	***n***	**SD**
PA minutes/week	63	19	113.4203	23	19	106.7485
PA intensity	–0.5	19	0.667178	–0.3	19	0.889571
PA 30 minutes/day/week	0.7	19	1.334357	0.7	19	3.113499
Self-reported present physical fitness	–0.7	19	0.889571	–0.8	19	1.111964
Self-reported physical fitness compared with 4 months ago	–0.6	19	1.55675	–0.5	19	0.889571
Self-reported physical fitness compared with people of own age	–0.7	19	1.334357	–0.7	19	0.889571
HbA_{1c} (%)	–0.26	10	0.855106	–0.23	8	0.360769
Body weight (kg)	–1.1	19	4.00307	–1.1	19	3.558285
BMI (kg/m^2)	–0.3	19	1.334357	–0.4	19	1.55675
VO_{2max}	23.8	19	7.11657	21.7	18	11.03952
PA METs/hour/day	42.6	19	2.446321	41.1	18	4.762148
SF-12 physical	48.97	19	17.63575	46.01	18	13.18249
SF-12 mental	40.29	19	10.69709	36.62	18	11.86208

MET, metabolic equivalent.

	ERS (10 months)			Alternative PA intervention (10 months)		
	Mean	*n*	SD	Mean	*n*	SD
PA minutes/week	20	21	123.9166	20	21	151.9732
PA intensity	–0.3	21	0.724795	–0.4	21	0.701415
PA 30 minutes/day/week	0.7	21	1.870439	0	21	3.039463
Self-reported present physical fitness	–0.6	21	0.701415	–0.5	21	1.145644
Self-reported physical fitness compared with 4 months ago	–0.2	21	1.169024	–0.4	21	1.169024
Self-reported physical fitness compared with people of own age	–0.6	21	0.93522	–0.3	21	0.818317
HbA_{1c} (%)	–0.27	10	0.87124	0.28	8	0.750399
Body weight (kg)	–0.3	21	4.442293	–2	21	9.11839
BMI (kg/m^2)	–0.1	21	1.870439	–0.6	21	2.805659
VO_{2max}	23	19	8.228534	22.4	20	12.77753
PA METs/hour/day	40.91	21	2.080863	40.1	20	5.019744
SF-12 physical	50.71	21	11.66686	44.5	21	15.43112
SF-12 mental	40.76	21	10.84855	39.49	21	12.88265

MET, metabolic equivalent.

Part 4: study quality (provide comments and quotes where appropriate)

Quality	Yes	Unclear	No
Power calculation reported	'Sample size calculations were performed for expected changes and variations in VO_{2max}'		
Method of random sequence generation described?	'Randomization was carried out by the first author by means of concealed envelopes containing the name of the group'		
Method of allocation concealment described?	'Randomization was carried out by the first author by means of concealed envelopes containing the name of the group'		
Method of outcome (assessment) blinding described?		Not reported	
Are groups similar at baseline?	Yes, the baseline characteristics reported for the two groups in table 1 look balanced between groups		
Was ITT analysis used?	'The analyses were performed according to the ITT principle'		
Was there any statistical handling of missing data?	'Missing data were replaced in the physical activity questionnaire and in the two SF-12 component scores'. Missing data section in methods		
Were missing data (dropout and loss to follow-up) reported?	Yes, flow chart – figure 1 *Intervention group* 2–4 months: loss to follow-up, $n=1$ Discontinued intervention, $n=8$ 7–10 months: loss to follow-up, $n=0$ Discontinued intervention, $n=0$ *Control group* 2–4 months: loss to follow-up, $n=0$ Discontinued control, $n=4$ 7–10 months: loss to follow-up, $n=1$ Discontinued control, $n=0$		

Do you have any additional comments to make about this study?

Both groups received counselling, not a 'no-intervention' model.

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	003
Reviewer ID and name	TP
Date of completion of this form	March 2010
Title of report	Cost-effectiveness of a primary care based physical activity intervention in 45–74 year old men and women: a randomised controlled trial
Source (journal year;volume:pages)	*Br J Sports Med* 1998;**32**:236–41
Authors	Stevens W, Hillsdon M, Thorogood M and McArdle D
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	This trial was supported by West London Health Promotion Agency through a grant awarded by North Thames NHS Executive Responsive Funding Programme
Date trial was conducted	Not reported
Type of trial design (e.g. parallel or cluster trial)	Parallel
Was the trial multicentre? If so, how many centres were there?	Yes, two practices
Follow-up	8 months post randomisation

Characteristics of the referral	
Who made the referral	GP
Reason for referral	Inactive
Format of referral	letter
Referred to who	Exercise development officer
Referred to where	Local leisure centre
Single or group sessions	Not stated
Referral quote from paper	'The intervention subjects were sent a letter from their GP inviting them to attend a consultation with an exercise development officer at a local leisure centre'
	Letter states: 'I have arranged a consultation with an exercise specialist for you' (see appendix, letter)

Characteristics of the intervention	
Components of the intervention	Initial consultation: (a) full explanation of the scheme (b) a medical/lifestyle questionnaire/consent form (c) physical measurements (height/weight/body mass index) (d) assessment of present activity level (e) options available to be more physically active (f) introduction to the PA diary. 'Exercise Programme': At the end of the exercise programme, patients are invited back for a second consultation
Total duration	10 weeks
No. of sessions per week	Not reported
Duration of sessions	Not reported
Session intensity	Not reported
Session mode	Not reported
Control group	Sent exercise promotion materials
Other information	

Characteristics of the participants		
	Experimental group	**Control group**
Inclusion criteria	Not reported	
Exclusion criteria	Active: a minimum of either 20- to 30-minute episodes of moderate intensity exercise or 12- to 20-minute episodes of vigorous intensity exercise. medical reason for excluding them	
Total number of randomised participants	363	351
Information on the age of the participants (mean and SD)	59.1	59.2
Information on the sex of the participants (%)	40% (male)	44% (male)
Information on the ethnicity of the participants (%)	White: 87 Black: 5 Asian: 4 Other: 4	White: 83 Black: 4 Asian: 8 Other: 5
Specifics of the population (i.e. disease, %)	BMI > 25: 46% Smoker: 18%	BMI > 25: 42% Smoker: 17%

Type of outcomes (What outcomes were assessed in this trial? Which of these outcomes have reported information about the result)	
Outcome (domain)	**Assessed (measure)**
Effectiveness	
PA	PA levels, self-report (type not stated)
Fitness (e.g. VO_{2max})	Not reported
Clinical factors (e.g. blood lipids)	Not reported
Psychological well-being	Not reported
QoL	Not reported
Patient satisfaction	Not reported
Adverse events	Not reported
Patient factors	
Uptake	35% (126/363)
Adherence	Not reported

Part 3: extracted results

	ERS (8 months)		Control (8 months)	
	n	*N*	*n*	*N*
150 minutes moderate/vigorous PA/week	204	363	174	351

Part 4: study quality (provide comments and quotes where appropriate)

Quality	Yes	Unclear	No
Power calculation reported		Not reported	
Method of random sequence generation described?	'Eligible subjects were randomised using a random number generator'		
Method of allocation concealment described?		Not reported	
Method of outcome (assessment) blinding described?		Not reported	
Are groups similar at baseline?	See table 2: 'the groups were broadly similar, with no significant difference'		
Was ITT analysis used?	'Unless otherwise stated, results are described on an "ITT" ' basis'		
Was there any statistical handling of missing data?	'those subjects for whom there was no outcome measure, being assigned to the activity level they reported at the start of the study'		
Were missing data (dropout and loss to follow-up) reported?	Figure 1 – study design diagram		

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

More details of the exercise programme.

Part 1: background information of study

Study ID	004
Reviewer ID and name	TP
Date of completion of this form	March 2010
Title of report	Randomised controlled trial to examine the effects of a GP exercise referral programme in Hailsham, East Sussex, on modifiable coronary heart disease risk factors
	Effectiveness of a Primary Care Exercise Referral Intervention for Changing Physical Self-Perceptions Over 9 Months
Source (journal year;volume:pages)	*J Epidemiol Community Health* 1998;**52**:595–601
	Health Psychol 2005;**24**:11–21
Authors	Taylor AH, Doust J and Webborn N
	Taylor AH and Fox K
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	The South Thames Regional Health Authority Primary Care Development Fund
Date trial was conducted	Not stated
Type of trial design (e.g. parallel or cluster trial)	Parallel RCT
Was the trial multicentre? If so, how many centres were there?	Yes, two primary health-care centres
Follow-up	8, 16, 26 and 37 weeks post randomisation

Characteristics of the referral	
Who made the referral	GP
Reason for referral	Smokers, hypertensive (that is, SBP/DBP at least 140/90 mmHg) or overweight (BMI > 25)
Format of referral	Signed prescription card
Referred to who	Trained assessor initial assessment
Referred to where	Health centre initial assessment
	Leisure centre for ERS
Single or group sessions	Not stated
Referral quote from paper	'Patients were given a signed prescription card, with a reason for referral'
	'Up to 30 new patients per week were being referred to the scheme by over 70 GPs during the study'

DBP, diastolic blood pressure.

Characteristics of the intervention	
Components of the intervention	Initial assessment: blood pressure and anthropometric measures, a questionnaire was used to assess smoking behaviour, PA, and medication use, and open-ended perceptions of the exercise programme (only at 8 weeks)
	Exercise programme
Total duration	10 weeks – 20 sessions
No. of sessions per week	Two
Duration of sessions	30–40 minutes
Session intensity	'Moderate intensity'
Session mode	'Usual gym equipment'
Control group	All assessments (see above, but no exercise programme)
Other information	Both exercise and control group subjects were given Health Education Authority leaflets on preventing CHD but were given assessments at mid-intervention, and post intervention, and 3 and 6 months later

Characteristics of the participants		
	Experimental group	**Control group**
Inclusion criteria	Smokers	
	Hypertensive (i.e. SBP/DBP at least 140/90 mmHg)	
	Overweight (BMI > 25) on medical records	
Exclusion criteria	SBP > 200 mmHg	
	A history of MI or angina pectoris	
	Diabetes mellitus	
	A musculoskeletal condition that restricted PA	
	Anyone who had previously been referred on the exercise prescription scheme	
Total number of randomised participants	97	45
Information on the age of the participants (mean and SD)	54.1 (0.8) SEM	54.4 (1.3)
Information on the sex of the participants (%)	35% men	17 men
Information on the ethnicity of the participants (%)	Not stated	Not stated
Specifics of the population (i.e. disease %)	Smokers: 43	Smokers: 40
	Overweight: 77	Overweight: 71
	Hypertensive: 46	Hypertensive: 58

DBP, diastolic blood pressure; SEM, standard error of the mean.

Type of outcomes (What outcomes were assessed in this trial? Which of these outcomes have reported information about the result?)	
Outcome (domain)	**Assessed (measure)**
Effectiveness	
PA	Blair's 7-day recall method, energy expenditure was determined from minutes spent in light, moderate and vigorous activity
Fitness (e.g. VO_{2max})	Mean predicted heart rate at a workload of 150 W
Clinical factors (e.g. blood lipids)	SBP and DBP, body weight, BMI, sum of four skinfolds
Psychological well-being	Physical self-perceptions, PSPP (Fox and Corbin 1989,[158] Fox 1990[159])
QoL	Not reported
Patient satisfaction	Satisfaction with characteristics of the scheme, comments from participants
Adverse events	Not reported
Patient factors	
Uptake	88% (85/97)
Adherence	28% (24/85)
DBP	

DBP, diastolic blood pressure.

Part 3: extracted results

	ERS baseline			Control baseline		
	Mean	***n***	**SD**	**Mean**	***n***	**SD**
Moderate (minutes/week)	231.3	40	282.7076	116.8	31	203.2234
Vigorous (minutes/week)	7.8	40	28.4605	4.6	31	15.03296
Energy (kcal/kg/day)	34.3	40	1.897367	33.5	31	1.670329
SBP	136.7	40	14.54648	136.9	31	19.48718
DBP	86.8	40	10.11929	88.4	31	12.24908
BMI (kg/m^2)	28.7	40	3.794733	26.7	31	3.340659
Sum of skinfolds	85.1	40	29.72541	66.9	31	18.9304
PSW	2.1	97	0.984886	2.4	45	0.67082
Physical condition	2	97	0.984886	2.5	45	0.67082
Physical appearance	2.2	97	0.984886	2.3	45	0.67082
Physical health	2.4	97	0.984886	2.7	45	0.67082

DBP, diastolic blood pressure.

	Exercise (8 weeks)			Control (8 weeks)		
	Mean	*n*	SD	Mean	*n*	SD
Moderate (minutes/week)	247	36	282.7076	145	31	178.1685
Vigorous (minutes/week)	49	36	28.4605	21	31	61.24541
Energy (kcal/kg/day)	34.6	36	1.897367	33.7	31	1.670329
SBP (mmHg)	N/A	40	14.54648	N/A	31	0
DBP	N/A	40	10.11929	N/A	31	0
BMI (kg/m^2)	N/A	40	3.794733	N/A	31	0
Sum of skinfolds	N/A	40	29.72541	N/A	31	0

N/A, not applicable.

	ERS (16 weeks)			Control (16 weeks)		
	Mean	*n*	SD	Mean	*n*	SD
Moderate (minutes/week)	226	36	252	160	31	261.6849
Vigorous (minutes/week)	59	36	72	21	31	72.38094
Energy (kcal/kg/day)	34.6	36	1.2	33.9	31	1.670329
SBP	130	40	14.54648	129.6	31	14.47619
DBP	83.9	40	7.589466	83.8	31	8.351647
BMI (kg/m^2)	27.5	40	0.632456	27.6	31	0.556776
Sum of skinfolds	70.3	40	8.221922	75.7	31	7.79487
PSW	2.31	97	0.787909	2.31	45	0.67082
Physical condition	2.34	97	0.787909	2.49	45	0.603738
Physical appearance	2.37	97	0.787909	2.36	45	0.737902
Physical health	2.55	97	0.68942	2.69	45	0.603738

DBP, diastolic blood pressure.

	Exercise (26 weeks)			Control (26 weeks)		
	Mean	*n*	SD	Mean	*n*	SD
Moderate (minutes/week)	183	36	234	206	31	250.5494
Vigorous (minutes/week)	56	36	108	34	31	111.3553
Energy (kcal/kg/day)	34.4	36	1.8	34.3	31	2.227106
SBP	129.7	40	13.91402	130.6	31	14.47619
DBP	83.6	40	8.221922	83.5	31	8.351647
BMI (kg/m^2)	27.3	40	1.264911	27.5	31	1.113553
Sum of skinfolds	69.9	40	11.3842	74.9	31	11.13553

DBP, diastolic blood pressure.

	Exercise (37 weeks)			Control (37 weeks)		
	Mean	*n*	SD	Mean	*n*	SD
Moderate (minutes/week)	158	36	228	162	31	244.9816
Vigorous (minutes/week)	42	36	96	23	31	105.7875
Energy (kcal/kg/day)	34.1	36	2.4	33.9	31	2.227106
SBP	129.7	40	17.0763	131.3	31	17.81685
DBP	84.7	40	9.486833	83.3	31	9.465199
BMI (kg/m^2)	27.5	40	1.264911	27.6	31	1.113553
Sum of skinfolds	71	40	13.28157	76.3	31	12.80586
PSW	2.41	97	0.787909	2.42	45	0.536656
Physical condition	2.45	97	0.787909	2.52	45	0.603738
Physical appearance	2.39	97	0.787909	2.42	45	0.67082
Physical health	2.57	97	0.68942	2.58	45	0.536656

DBP, diastolic blood pressure.

Part 4: study quality (provide comments and quotes where appropriate)

Quality	Yes	Unclear	No
Power calculation reported	The study sample was large enough to detect a difference in blood pressure of 4 mmHg systolic with a power of 0.90 and a two-sided *p*-value of 0.05		
Method of random sequence generation described?	Randomisation, using a random numbers table, took place at the end of the first assessment		
Method of allocation concealment described?	Correspondence with author		
Method of outcome (assessment) blinding described?		Not reported	
Are groups similar at baseline?	Randomisation of 142 subjects to the exercise ($n=97$) and control ($n=45$) groups established comparable baseline measures (see table 2)		
Was ITT analysis used?			No
Was there any statistical handling of missing data?		Not stated	
Were missing data (dropout and loss to follow-up) reported?	Throughout results section		

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Taylor AH. Evaluating GP exercise referral schemes Findings from a randomised controlled study. Chelsea School Research Centre, Brighton, UK.

Is further information required from the authors?	YES	NO

If YES, give details:

Appendix 5

Detailed data extraction: cost-effectiveness systematic review

Part 1: background information of study

Reference number	01
Reviewed by	N/A
Date of review	11 February 2010
Title	Cost-effectiveness of a primary care based physical activity intervention in 45–74 year old men and women: a randomised controlled trial
Author(s)	Stevens *et al.*
Aim	To assess the cost-effectiveness of a primary care-based intervention aimed at increasing levels of PA in inactive people aged 45–74 years
Year of publication	1998
Origin of study	England

N/A, not applicable.

Part 2: information about the study

Characteristics of patients	
Diagnosed condition	N/A
Definition of 'sedentariness'	Fewer than four 20-minute sessions of moderate or vigorous activity during the last 4 weeks Between 4 and 11 20-minute sessions of moderate or vigorous activity during the last 4 weeks Twelve or more 20-minute sessions of moderate or vigorous activity during the last 4 weeks, but less than either of the current recommendations
Gender	Males and females
Age	45–74 years
Ethnicity	White, Black, Asian, other
Sample size	714
Description of intervention	
Design	RCT
Setting	Local leisure centre located within the ward (primary care)
Country	England
Duration	10 weeks
Exercise program	It consisted of: ■ First consultation with an EDO who assessed the activity levels of participants; explained the exercise scheme to them, took physical measurements, explained options available to them to be PA, told them about the existing recommendations on PA and health, introduced them to a PA diary and asked them to fill a consent form and a medical/lifestyle questionnaire ■ Second consultation to discuss progress
Type of supervision delivered	The EDO discussed the progress of participants in terms of doing exercise
Comparator	The control group were sent information through the post about local leisure centres and health clubs as well information on PA and health

EDO, exercise development officer; N/A, not applicable..

Part 3: extracted results

Scope	
Form of economic evaluation	Cost-effectiveness
Perspective of analysis	Not explicitly stated though a health-care provide perspective could be inferred given analysis
Time horizon of analysis	8 months
Outcomes	
What outcomes were reported? (i.e. measures of effectiveness/ efficacy, patient/programme factors that may moderate behavioural outcomes)	Change in reported levels of PA (i.e. number of occasions of physical done in last 4 weeks), which was operationalised as: ■ inducing sedentary people to do more PA (the difference between decrease in the proportion of sedentary people in the intervention group after the intervention and the decrease in the proportion of sedentary people in the control group) ■ moving a person who is active, but not meeting the recommended level to meet that level after the intervention (proportionate increase net of the control group for the number attaining the top group classification) ■ achieving any increase in the PA levels of participants
Data sources for outcome measures	Questionnaire that elicited self-reports of PA levels
Discount rate	N/A
Costs	
What costs were reported?	Costs of recruitment covering cost of questionnaire design and production, mailing, processing of data, labour (include both institution and wage costs), equipment, and follow-up of people who did not reply initially
Data sources for costs measures	Records of the scheme, salary records of exercise development officer
Discount rate?	N/A
Year of costing	N/A
Currency	UK pounds sterling
How was cost reported? (average cost/marginal cost/ incremental cost/total cost/other – describe)	Total costs, average cost
Sensitivity analysis	
Type of sensitivity analysis	It involved gauging the cost impact of variations in the response rates to recruitment at the main stages of the scheme. These stages were: stage 1 – initial recruitment to the scheme; stage 2 – invitation to the exercise consultation; and stage 3 – intervention itself
What variables were used in sensitivity analysis?	Response rates to recruitment of participants at different stages (multiway analysis/one way)
Findings from sensitivity analysis	Recruitment strategy is an important aspect of cost-effectiveness of exercise promotion programmes as a high uptake rate maximises the cost-effectiveness of the intervention. It indicates that unit costs could be reduced by 50% if there is better recruitment strategy
Main results	
Findings on the cost-effectiveness	Cost of inducing one sedentary person to do more PA was £623 Cost of moving a person who is active but below the recommended level of PA to that recommended level was £2500 Cost of achieving any increase in a person's level of PA was £327 for movement into a higher activity group and < £200 for an absolute increase

N/A, not applicable.

Part 4: study quality

Challenges	
Author-stated limitations	The lack of objective measures for PA
Author-stated strengths	N/A
Useful ideas from this study	N/A

N/A, not applicable.

Quality assessment for economic evaluation (checklist from Drummond and Jefferson, 1996)[74]	Yes	No	Not clear	Not appropriate
Study design				
1. The research question is stated	✓			
2. The economic importance of the research question is stated		✓		
3. The viewpoint(s) of the analysis are clearly stated and justified		✓		
4. The rationale for choosing the alternative programmes or interventions compared is stated		✓		
5. The alternatives being compared are clearly described	✓			
6. The form of economic evaluation used is stated	✓			
7. The choice of form of economic evaluation is justified in relation to the questions addressed		✓		
Data collection				
8. The source(s) of effectiveness estimates used are stated	✓			
9. Details of the design and results of effectiveness study are given (if based on a single study)	✓			
10. Details of the method of synthesis or meta-analysis of estimates are given (if based on an overview of a number of effectiveness studies)				✓
11. The primary outcome measure(s) for the economic evaluation are clearly stated	✓			
12. Methods to value health states and other benefits are stated				
13. Details of the subjects from whom valuations were obtained are given				
14. Productivity changes (if included) are reported separately				✓
15. The relevance of productivity changes to the study question is discussed				✓
16. Quantities of resources are reported separately from their unit costs		✓		
17. Methods for the estimation of quantities and unit costs are described				
18. Currency and price data are recorded	✓			
19. Details of currency of price adjustments for inflation or currency conversion are given				✓
20. Details of any model used are given				✓
21. The choice of model used and the key parameters on which it is based are justified				✓

continued

continued

Quality assessment for economic evaluation (checklist from Drummond and Jefferson, 1996)[74]	Yes	No	Not clear	Not appropriate
Analysis and interpretation of results				
22. Time horizon of costs and benefits is stated	✓			
23. The discount rate(s) is stated				✓
24. The choice of rate(s) is justified				✓
25. An explanation is given if costs or benefits are not discounted		✓		
26. Details of statistical tests and CIs are given for stochastic data				
27. The approach to sensitivity analysis is given	✓			
28. The choice of variables for sensitivity analysis is justified	✓			
29. The ranges over which the variables are varied are stated	✓			
30. Relevant alternatives are compared	✓			
31. Incremental analysis is reported	✓			
32. Major outcomes are presented in a disaggregated as well as aggregated form	✓			
33. The answer to the study question is given	✓			
34. Conclusions follow from the data reported	✓			
35. Conclusions are accompanied by the appropriate caveats	✓			

Did the economic evaluation use a decision-analytic modelling framework?	Response: yes (✓), no (×), not applicable (N/A) Instruction: if 'no', end

Part 1: background information of study

Reference number	02
Reviewed by	N/A
Date of review	13 February 2010
Title	Exercise evaluation randomised trial: a randomised trial company GP referral for leisure centre-based exercise, community-based walking and advice only
Author(s)	Isaacs *et al.*
Aim	To evaluate and compare the effectiveness and cost-effectiveness of a leisure centre-based exercise programme, an instructor-led walking programme and advice only in patients referred for exercise by their GPs
Year of publication	2007
Origin of study	UK

N/A, not applicable.

Part 2: information about the study

Characteristics of patients	
Diagnosed condition	Cardiovascular risk factor (at least one of these: high cholesterol, controlled mild-to-moderate hypertension, obesity, current smoking, diabetes, a family history of MI at an early age)
Definition of 'sedentariness'	Not physically active (but could not see explicit definition on this)
Gender	Males and females
Age	40–75 years
Ethnicity	White, Asian
Sample size	932
Description of intervention	
Design	RCT
Setting	Leisure centres
Country	UK
Duration	10 weeks
Exercise programme	1. Supervised exercise classes occurring two to three times a week at a local leisure centre 2. Instructor-led walking programme occurring two to three times a week
Type of supervision delivered	Exercise programmes were instructor led
Comparator	Advice-only control group who received tailored advice and information on PA including on local exercise facilities

Part 3: extracted results

Scope	
Form of economic evaluation	Cost-effectiveness analysis
Perspective of analysis	Societal view point
Time horizon of analysis	12 months
Outcomes	
What outcomes were reported? (i.e. measures of effectiveness/ efficacy, patient/programme factors that may moderate behavioural outcomes)	Health outcomes (via SF-36 scores)
Data sources for outcome measures	Data from participants
Discount rate	N/A
Costs	
What costs were reported?	Costs to public sector: cost incurred by health service and local authority in terms of provision of facilities, exercise trainers, and administrative support) Costs to the participants: time costs, travel costs, money costs (i.e. child-care fees, purchase of equipment) Costs averted: reduced use of health services (pharmaceutical costs, health admissions, visits to the GP)
Data sources for costs measures	Department of Transport (for time cost) AA database (for cost per mile of travel using cars) Local district health authority NHS database *British National Formulary* PSSRU
Discount rate?	N/A
Year of costing	2002
Currency	UK pounds sterling
How was cost reported? (average cost/marginal cost/ incremental cost/total cost/other-describe)	Average cost, incremental cost, total cost
Sensitivity analysis	
Type of sensitivity analysis	Bootstrapping was used to account for uncertainty around cost-effectiveness ratios.
What variables were used in sensitivity analysis?	Costs, health outcomes
Findings from sensitivity analysis	The findings were consistent with original findings
Main results	
Findings on the cost-effectiveness	Cost per unit increase in SF-36 score was £19,500 for leisure centre intervention group compared with control (at 6 months) At 12 months, walking compared with leisure centre group could lead to a cost saving of £8750 per unit improvement in SF-36 score. Walking intervention seemed as effective as leisure centre-based intervention but less costly

N/A, not applicable; PSSRU, Personal Social Services Research Unit.

Part 4: study quality

Challenges	
Author-stated limitations	The information from the SF-36 was not sufficiently stable to afford a specification of outcomes in terms of QALYs
	Potential contamination of control group
	Study may not be generalisable to other populations
Author-stated strengths	
Useful ideas from this study	Data sources for costing particularly time and travel costs

Quality assessment for economic evaluation (checklist from Drummond and Jefferson, 1996)[74]	Yes	No	Not clear	Not appropriate
Study design				
1. The research question is stated	✓			
2. The economic importance of the research question is stated	✓			
3. The viewpoint(s) of the analysis are clearly stated and justified	✓			
4. The rationale for choosing the alternative programmes or interventions compared is stated		✓		
5. The alternatives being compared are clearly described	✓			
6. The form of economic evaluation used is stated	✓			
7. The choice of form of economic evaluation is justified in relation to the questions addressed	✓			
Data collection				
8. The source(s) of effectiveness estimates used are stated	✓			
9. Details of the design and results of effectiveness study are given (if based on a single study)	✓			
10. Details of the method of synthesis or meta-analysis of estimates are given (if based on an overview of a number of effectiveness studies)				✓
11. The primary outcome measure(s) for the economic evaluation are clearly stated	✓			
12. Methods to value health states and other benefits are stated	✓			
13. Details of the subjects from whom valuations were obtained are given	✓			
14. Productivity changes (if included) are reported separately				✓
15. The relevance of productivity changes to the study question is discussed				✓
16. Quantities of resources are reported separately from their unit costs	✓			
17. Methods for the estimation of quantities and unit costs are described	✓			
18. Currency and price data are recorded	✓			
19. Details of currency of price adjustments for inflation or currency conversion are given	✓			
20. Details of any model used are given	✓			
21. The choice of model used and the key parameters on which it is based are justified	✓			
Analysis and interpretation of results				
22. Time horizon of costs and benefits is stated	✓			
23. The discount rate(s) is stated				✓
24. The choice of rate(s) is justified				✓
25. An explanation is given if costs or benefits are not discounted	✓			
26. Details of statistical tests and CIs are given for stochastic data				
27. The approach to sensitivity analysis is given	✓			
28. The choice of variables for sensitivity analysis is justified	✓			

continued

continued

Quality assessment for economic evaluation (checklist from Drummond and Jefferson, 1996)[74]	Yes	No	Not clear	Not appropriate
29. The ranges over which the variables are varied are stated	✓			
30. Relevant alternatives are compared	✓			
31. Incremental analysis is reported	✓			
32. Major outcomes are presented in a disaggregated as well as aggregated form	✓			
33. The answer to the study question is given	✓			
34. Conclusions follow from the data reported	✓			
35. Conclusions are accompanied by the appropriate caveats	✓			

Did the economic evaluation use a decision-analytic modelling framework?	Response: yes (✓), no (×), not applicable (N/A) Instruction: if 'no', end

Part 1: background information of study

Reference number	03
Reviewed by	N/A
Date of review	15 February 2010
Title	Cost–utility of a walking programme for moderately depressed, obese or overweight elderly women in primary care: a randomised controlled trial
Author(s)	Gusi *et al.*
Aim	To assess the cost–utility of adding to the standard 'best care' of a supervised walking programme that also included strengthening and stretching
Year of publication	2008
Origin of study	Spain

N/A, not applicable;

Part 2: information about the study

Characteristics of patients	
Diagnosed condition	Obesity (obese type I or II that was expressed as BMI between 25 and 39.9 kg/m^2); depression (moderate depression that was expressed as a score of 6–9 in a 15-item Geriatric Depression Scale)
Definition of 'sedentariness'	N/A
Gender	Females
Age	60 years and older
Ethnicity	N/A
Sample size	106
Description of intervention	
Design	RCT
Setting	Primary care
Country	Spain
Duration	6 months
Exercise programme	Walking in public park or forest tracks. The walks were interspersed with stretching and strengthening exercise. Each session lasted for 50 minutes and occurred three times per week
Type of supervision delivered	Walks were supervised and led by an exercise instructor
Comparator	Best care in general practice: consisted of routine care and recommendation of PA

N/A, not applicable;

Part 3: extracted results

Scope	
Form of economic evaluation	Cost–utility analysis
Perspective of analysis	Health service
Time horizon of analysis	6 months
Outcomes	
What outcomes were reported? (i.e. measures of effectiveness/efficacy, patient/programme factors that may moderate behavioural outcomes)	QALY (vía EQ-5D scores)
Data sources for outcome measures	Questionnaires (see above)
Discount rate	N/A
Costs	
What costs were reported?	Salary of exercise instructor
Data sources for costs measures	2005 bulletin of regional government
Discount rate?	N/A
Year of costing	2005
Currency	Euros
How was cost reported? (average cost/marginal cost/incremental cost/total cost/other – describe)	Incremental cost
Sensitivity analysis	
Type of sensitivity analysis	Scenario analysis; one-way analysis
What variables were used in sensitivity analysis?	Rate of participation in the programme; cost of a permanent timetable for consultation, assessment and recruitment; salary of technician; effectiveness of programme; sampling variation
Findings from sensitivity analysis	Results were consistent with original results on cost-effectiveness
Main results	
Findings on the cost-effectiveness	Cost per QALY gained from intervention compared with control group was €311 (95% CI €143 to €394). The addition of walking programme to best primary care was cost-effective

N/A, not applicable;

Part 4: study quality

Challenges	
Author-stated limitations	Small sample size
	Results cannot be generalised to private care or more widespread services
	Potential selection bias in favour of low-income, less-educated people
Author-stated strengths	First study to conduct cost–utility analysis of walking exercise intervention with elderly females
Useful ideas from this study	

Quality assessment for economic evaluation (checklist from Drummond and Jefferson, 1996)[74]	Yes	No	Not clear	Not appropriate
Study design				
1. The research question is stated	✓			
2. The economic importance of the research question is stated	✓			
3. The viewpoint(s) of the analysis are clearly stated and justified	✓			

Quality assessment for economic evaluation (checklist from Drummond and Jefferson, 1996)[74]	Yes	No	Not clear	Not appropriate
4. The rationale for choosing the alternative programmes orb interventions compared is stated	✓			
5. The alternatives being compared are clearly described	✓			
6. The form of economic evaluation used is stated	✓			
7. The choice of form of economic evaluation is justified in relation to the questions addressed	✓			
Data collection				
8. The source(s) of effectiveness estimates used are stated	✓			
9. Details of the design and results of effectiveness study are given (if based on a single study)	✓			
10. Details of the method of synthesis or meta-analysis of estimates are given (if based on an overview of a number of effectiveness studies)				✓
11. The primary outcome measure(s) for the economic evaluation are clearly stated	✓			
12. Methods to value health states and other benefits are stated	✓			
13. Details of the subjects from whom valuations were obtained are given	✓			
14. Productivity changes (if included) are reported separately				✓
15. The relevance of productivity changes to the study question is discussed				✓
16. Quantities of resources are reported separately from their unit costs	✓			
17. Methods for the estimation of quantities and unit costs are described	✓			
18. Currency and price data are recorded	✓			
19. Details of currency of price adjustments for inflation or currency conversion are given	✓			
20. Details of any model used are given	✓			
21. The choice of model used and the key parameters on which it is based are justified	✓			
Analysis and interpretation of results				
22. Time horizon of costs and benefits is stated	✓			
23. The discount rate(s. is stated				✓
24. The choice of rate(s) is justified				✓
25. An explanation is given if costs or benefits are not discounted	✓			
26. Details of statistical tests and CIs are given for stochastic data				
27. The approach to sensitivity analysis is given	✓			
28. The choice of variables for sensitivity analysis is justified	✓			
29. The ranges over which the variables are varied are stated	✓			
30. Relevant alternatives are compared	✓			
31. Incremental analysis is reported	✓			
32. Major outcomes are presented in a disaggregated as well as aggregated form	✓			
33. The answer to the study question is given	✓			
34. Conclusions follow from the data reported	✓			
35. Conclusions are accompanied by the appropriate caveats	✓			

Did the economic evaluation use a decision-analytic modelling framework?	Response: Yes (✓), no (×), not applicable (N/A) Instruction: if 'no', end

Part 1: background information of study

Reference number	04
Reviewed by	N/A
Date of review	12 July 2010
Title	Modelling the cost-effectiveness of physical activity interventions
Author(s)	NICE (we focused on the aspect on ERS intervention)
Aim	To determine the cost-effectiveness of four types of intervention aimed at increasing PA levels
Year of publication	2006
Origin of study	England

N/A, not applicable;

Part 2: information about the study

Characteristics of patients	
Diagnosed condition	Sedentary
Definition of 'sedentariness'	Doing < 120 minutes (4–30 minutes) of moderate-intensity exercise per week
Gender	Male and female
Age	40–60 years
Ethnicity	N/A
Sample size	206
Description of intervention	
Design	RCT
Setting	Primary care
Country	England
Duration	12 months
Exercise programme	Advice seminar supplemented with general written guidance about exercise, and verbal and written information about health walk programmes. Participation in local health walks, community-based led walking programme
Type of supervision delivered	Led walking programmes
Comparator	Advice and written guidance about the benefits, recommended levels of PA

N/A, not applicable;

Part 3: extracted results

Scope	
Form of economic evaluation	Cost–utility analysis
Perspective of analysis	Public sector perspective in addition to NHS and personal social services perspective
Time horizon of analysis	Lifetime
Outcomes	
What outcomes were reported?	Physically active: doing at least 120 minutes (4–30 minutes) of moderate-intensity exercise per week
(i.e. measures of effectiveness/ efficacy, patient/programme factors that may moderate behavioural outcomes	QALYs (via EQ-5D scores to determine the loss in QoL avoided by avoiding health states, i.e. CHD, stroke, type 2 diabetes and colon cancer)
Data sources for outcome measures	National dataset (i.e. HSE – 1996) Harvard cost-effectiveness analysis registry Literature reviews ONS database British Heart Foundation database Diabetes UK database
Discount rate	3.5%
Costs	
What costs were reported?	Cost of treating health states: ■ Costs of intervention: cost of telephone follow-ups, cost of telephone interviewer's time, cost of mailers and brochures, input of exercise programme coordinator, value of investigator's time ■ Cost savings: total health care costs saved due to health states avoided
Data sources for costs measures	Literature review British Heart Foundation database Diabetes UK database
Discount rate?	3.5%
Year of costing	2005
Currency	UK pounds sterling
How was cost reported? (average cost/marginal cost/ incremental cost/total cost/other-describe)	Average cost/incremental cost
Sensitivity analysis	
Type of sensitivity analysis	One-way sensitivity analysis
What variables were used in sensitivity analysis?	Values of RRs, cost of intervention, adherence rates of PA
Findings from sensitivity analysis	The conclusion that intervention is cost-effective is not altered
Main results	
Findings on the cost-effectiveness	Cost per person being active: £440.35 Cost per QALY gained: £80.96 Cost saving per QALY gained: £2388.41

ONS, Office for National Statistics.

Part 4: study quality

Challenges	
Author-stated limitations	The assumptions surrounding the parameters for the model may have underestimated or overestimated the cost per QALY gained estimates
Author-stated strengths	N/A
Useful ideas from this study	1. The model structure could be adapted for future analysis 2. Rich data which could be used to populate future models

N/A, not applicable.

Quality assessment for economic evaluation (checklist from Drummond and Jefferson, 1996)[74]	Yes	No	Not clear	Not appropriate
Study design				
1. The research question is stated	✓			
2. The economic importance of the research question is stated	✓			
3. The viewpoint(s) of the analysis are clearly stated and justified	✓			
4. The rationale for choosing the alternative programmes or interventions compared is stated	✓			
5. The alternatives being compared are clearly described	✓			
6. The form of economic evaluation used is stated	✓			
7. The choice of form of economic evaluation is justified in relation to the questions addressed	✓			
Data collection				
8. The source(s) of effectiveness estimates used are stated	✓			
9. Details of the design and results of effectiveness study are given (if based on a single study)	✓			
10. Details of the method of synthesis or meta-analysis of estimates are given (if based on an overview of a number of effectiveness studies)	✓			
11. The primary outcome measure(s) for the economic evaluation are clearly stated	✓			
12. Methods to value health states and other benefits are stated	✓			
13. Details of the subjects from whom valuations were obtained are given	✓			
14. Productivity changes (if included) are reported separately				
15. The relevance of productivity changes to the study question is discussed				✓
16. Quantities of resources are reported separately from their unit costs				
17. Methods for the estimation of quantities and unit costs are described	✓			
18. Currency and price data are recorded	✓			
19. Details of currency of price adjustments for inflation or currency conversion are given	✓			
20. Details of any model used are given	✓			
21. The choice of model used and the key parameters on which it is based are justified	✓			
Analysis and interpretation of results				
22. Time horizon of costs and benefits is stated	✓			
23. The discount rate(s) is stated	✓			
24. The choice of rate(s) is justified	✓			
25. An explanation is given if costs or benefits are not discounted	✓			
26. Details of statistical tests and CIs are given for stochastic data				
27. The approach to sensitivity analysis is given	✓			
28. The choice of variables for sensitivity analysis is justified	✓			
29. The ranges over which the variables are varied are stated	✓			

30. Relevant alternatives are compared	✓
31. Incremental analysis is reported	✓
32. Major outcomes are presented in a disaggregated as well as aggregated form	✓
33. The answer to the study question is given	✓
34. Conclusions follow from the data reported	✓
35. Conclusions are accompanied by the appropriate caveats	✓

Did the economic evaluation use a decision-analytic modelling framework?	Response: yes (✓), no (×), not applicable (N/A) Instruction: if 'yes', assess paper using the questions in block 6

Quality assessment for decision-analytic models (checklist from Philips *et al.*, 2004)[75]

Quality criterion	Question(s)	Response (✓, ×, N/A)	Comments
S1	Is there a clear statement of the decision problem?	✓	
	Is the objective of the evaluation and model specified and consistent with the stated decision problem?	✓	
	Is the primary decision-maker specified?	✓	
S2	Is the perspective of the model stated clearly?	✓	
	Are the model inputs consistent with the stated perspective?	✓	
	Has the scope of the model been stated and justified?	✓	
	Are the outcomes of the model consistent with the perspective, scope and overall objective of the model?	✓	
S3	Is the structure of the model consistent with a coherent theory of the health condition under evaluation?	✓	
	Are the sources of data used to develop the structure of the model specified?	✓	
	Are the causal relationships described by the model structure justified appropriately?	✓	
S4	Are the structural assumptions transparent and justified?	✓	
	Are the structural assumptions reasonable given the overall objective, perspective and scope of the model?	✓	
S5	Is there a clear definition of the options under evaluation?	✓	
	Have all feasible and practical options been evaluated?	✓	
	Is there justification for the exclusion for the exclusion of feasible options?	✓	
S6	Is the chosen model type appropriate given the decision problem and specified causal relationships within the model?	✓	
S7	Is the time horizon of the model sufficient to reflect all important differences between options?		
	Are the time horizon of the model, the duration of treatment and the duration of treatment effect described and justified?	✓	
S8	Do the disease states (state-transition model) or the pathways (decision-tree model) reflect the underlying biological process of the disease in question and the impact of interventions?	✓	
S9	Is the cycle length defined and justified in terms of natural history of disease?	N/A	
D1	Are the data identification methods transparent and appropriate given the objectives of the model?	✓	
	Where choices have been made between data sources, are these justified appropriately?	✓	
	Has particular attention been paid to identifying data for the important parameters in the model?	✓	
	Has the quality of the data been assessed appropriately?	✓	
	Where expert opinion has been used, are the methods described and justified?	N/A	

continued

continued

Quality assessment for decision-analytic models (checklist from Philips *et al.*, 2004)[75]

Quality criterion	Question(s)	Response (✓, ×, N/A)	Comments
D2	Is the data modelling methodology based on justifiable statistical and epidemiological techniques?		
D2a	Is the choice of baseline data described and justified?	✓	
	Are transition probabilities calculated appropriately?	✓	
	Has a half-cycle correction been applied to both cost and outcome?	N/A	
	If not, has this omission been justified?	N/A	
D2b	If relative treatment effects have been derived from trial data, have they been synthesised using appropriate techniques?	✓	
	Have the methods and assumptions used to extrapolate short-term results to final outcomes been documented and justified?	✓	
	Have alternative extrapolation assumptions been explored through sensitivity analysis?	✓	
	Have assumptions regarding the continuing effect of treatment once treatment is complete been documented and justified?	✓	
	Have alternative assumptions regarding the continuing effect of treatment been explored through sensitivity analysis?	✓	
D2c	Are the costs incorporated into the model justified?	✓	
	Has the source for all costs been described?	✓	
	Have discount rates been described and justified given the target decision-maker?	✓	
D2d	Are the utilities incorporated into the model appropriate?	✓	
	Is the source for the utility weights referenced?	✓	
	Are the methods of derivation for the utility weights justified?	✓	
D3	Have all data incorporated into the model been described and referenced in sufficient detail?	✓	
	Has the use of mutually inconsistent data been justified (i.e. are assumptions and choices appropriate)?	✓	
	Is the process of data incorporation transparent?	✓	
	If data have been incorporated as distributions, has the choice of distribution for each parameter been described and justified?	N/A	
	If data have been incorporated as distributions, is it clear that second order uncertainty is reflected?	N/A	
D4	Have the four principal types of uncertainty been addressed?	×	Only parameter uncertainty was addressed
	If not, has the omission of particular forms of uncertainty been justified?	×	
D4a	Have methodological uncertainties been addressed by running alternative versions of the model with different methodological assumptions?	×	
D4b	Is there evidence that structural uncertainties have been addressed via sensitivity analysis?	×	
D4c	Has heterogeneity been dealt with by running the model separately for different subgroups?	×	
D4d	Are the methods of assessment of parameter uncertainty appropriate?	✓	
	If data are incorporated at point estimates, are the ranges used for sensitivity analysis stated clearly and justified?	✓	
C1	Is there evidence that the mathematical logic of the model has been tested thoroughly before use?	?	Not mentioned
C2	Are any counterintuitive results from the model explained and justified?	N/A	
	If the model has been calibrated against independent data, has any differences been explained and justified?	N/A	
	Have the results of the model been compared with those of previous models and any differences in results explained?	×	

N/A, not applicable.

Appendix 6

Detailed data extraction: predictors of uptake and adherence systematic review

Part 1: background information of study

Study ID	U013
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Access to ERSs – a population based analysis
Source (journal year;volume:pages)	*J Publ Health* 2005;**27**:326–30
Authors	Harrison RA, McNair F and Dugdill L
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Not reported
Date trial was conducted	January 1998 to December 2002
Type of trial design (e.g. parallel or cluster trial)	Population-based analysis
Was the trial multicentre? If so, how many centres were there?	For example, one scheme (name) and *x* practices or *x* leisure providers

Characteristics of the referral	
Who made the referral	GPs and their staff
Reason for referral	Participating in no or only a little PA a week and had no clinical contraindications to PA, as determined by the clinician
Format of referral	Referral form
Referred to who	Exercise officer
Referred to where	Leisure centre
Single or group sessions	Both
Referral quote from paper	'One hundred and twenty-five GPs and their staff were able to refer sedentary patients to the exercise scheme'

Reported uptake and adherence rates	
Uptake rates	79% (5225/6610)
Adherence rates	Not reported
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Sociodemographics/medical history prediction analysis of uptake and adherence		
Uptake (multivariate: ORs)		
Gender: (male vs female)	(adjusted for age) 0.91, $p=0.64$ (adjusted for age and sex) 1.37, (1.15 to 1.64)	
Referral reason	**Adjusted for age and sex**	**Adjusted for age, sex and IMD**
None specified	1.00 (ref.)	1.00 (ref.)
Mental health	1.72 (1.24 to 2.39) 0.001	2.36 (1.48 to 3.82) 0.001
Other	1.73 (0.79 to 3.78) 0.170	1.29 (0.89 to 1.86) 0.174
CVD	1.55 (1.26 to 1.90) 0.001	1.03 (0.77 to 1.38) 0.828
Fitness	1.55 (1.14 to 2.10) 0.005	10.33 (1.44 to 74.3) 0.020
Overweight	1.37 (1.07 to 1.75) 0.014	1.22 (0.86 to 1.74) 0.257
Musculoskeletal	1.21 (1.00 to 1.47) 0.053	1.22 (0.95 to 1.55) 0.115
Respiratory	1.07 (0.78 to 1.48) 0.664	0.91 (0.73 to 1.15) 0.428
Socioeconomic status (IMD)	All patients (IMD) (adjusted for age and sex) 1.02 (0.97 to 1.06)	
	Least deprived (IMD 1) vs most deprived (IMD 5) (age/sex adjusted)	
None specified	1.08 (0.92 to 1.27)	
Mental health	1.20 (0.94 to 1.54)	
Other	Not calculated	
CVD	1.03 (0.94 to 1.14)	
Fitness	0.81 (0.60 to 1.09)	
Overweight	1.11 (0.94 to 1.30)	
Musculoskeletal	0.99 (0.92 to 1.08)	
Respiratory	1.45 (1.06 to 1.99) $p=0.021$	

IMD, Index of Multiple Deprivation.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? Yes

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U010
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Uptake and participation in physical activity referral schemes in the UK: An investigation of patients referred with mental health problems
Source (journal year;volume:pages)	*Issues Ment Health Nurs* 2008;**29**:1088–97
Authors	Crone D, Johnston L, Gidlow C, Henley C and James D
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Not reported
Date trial was conducted	2000–3
Type of trial design (e.g. parallel or cluster trial)	Observational
Was the trial multicentre? If so, how many centres were there?	One county-wide scheme

Characteristics of the referral	
Who made the referral	Primary-care health professional: GP, practice nurse, physiotherapist, 'other'
Reason for referral	Cardiovascular, overweight/obese, diabetes, musculoskeletal, mental health, unfit/sedentary, other
Format of referral	Not reported
Referred to who	PARS co-ordinator
Referred to where	Local authority, local education authority, private or individual provider
Single or group sessions	Both
Referral quote from paper	'Participants are referred by a health professional to the PARS and are offered eight to twelve weeks of either weekly or biweekly supervised exercise sessions at local leisure facilities'

PARS, Physical Activity Referral Scheme.

Reported uptake and adherence rates	
Uptake rates	68.7% (1996/2901)
Adherence rates	48.3% (964)
Was uptake and/or adherence reported in subgroups? If YES then detail:	
Uptake:	Adherence:
■ physical health – 1917 (96%)	■ physical health – 935 (49%)
■ mental health – 79 (4%)	■ mental health – 29 (37%)

Part 3: extracted results

Sociodemographics/medical history prediction analysis of uptake and adherence	
Adherence (univariate – chi-squared test)	
Scheme completion (>80% attendance):	Mental health vs physical health 22% vs 34%; $p<0.001$

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? No

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U011
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Is the promotion of physical activity in vulnerable older people feasible and effective in general practice?
Source (journal year;volume:pages)	*B J Gen Pract* 2006;**56**:791–3
Authors	Dinan S, Lenihan P, Tenn T and Iliffe S
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Brief report

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Camden & Islington Health Action Zone
Date trial was conducted	Not reported
Type of trial design (e.g. parallel or cluster trial)	Evaluation
Was the trial multicentre? If so, how many centres were there?	14 practices

Characteristics of the referral	
Who made the referral	GP or practice nurse
Reason for referral	Frailty based on 'Timed Up and Go' test
Format of referral	Not stated
Referred to who	Class instructor
Referred to where	General practices
Single or group sessions	Group
Referral quote from paper	'GPs had access to exercise prescription schemes, delivered in community-based classes in local leisure centres' 'Patients were referred for exercise by the GPs and practice nurses'

Reported uptake and adherence rates	
Uptake rates	89% (216/242)
Adherence rates	82% (178/216)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Not reported.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? No

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U003
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Socio-demographic patterning of referral, uptake and attendance in Physical Activity Referral Schemes
Source (journal year;volume:pages)	*J Publ Health* 2007;**29**:107–13
Authors	Gidlow C, Johnston LH, Crone D, Morris C, Smith A, Foster C and James DVB
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	University of Gloucestershire, Sheffield Hallam University and Taunton Deane PCT
Date trial was conducted	2000–3
Type of trial design (e.g. parallel or cluster trial)	Evaluation
Was the trial multicentre? If so, how many centres were there?	One county-wide scheme

Characteristics of the referral	
Who made the referral	Primary-care health professional: GP, practice nurse, physiotherapist, 'other'
Reason for referral	Cardiovascular, overweight/obese, diabetes, musculoskeletal, mental health, unfit/sedentary, other
Format of referral	Not reported
Referred to who	PARS co-ordinator
Referred to where	Local authority, local education authority, private or individual provider
Single or group sessions	Both
Referral quote from paper	'Details of all referred participants were sent by referring health professionals to the PARS coordinator'

PARS, Physical Activity Referral Scheme.

Reported uptake and adherence rates	
Uptake rates	65% (1861/2864)
Adherence rates	50.3% (936/1861)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Sociodemographics/medical history prediction analysis of uptake and adherence		
	Uptake (multivariate: ORs)	**Adherence (multivariate: ORs)**
Gender		
(male vs female)	0.94 (0.79 to 1.12), $p=0.496$	0.82 (0.68 to 0.99), $p=0.046$
Age		
Continuous	1.01 (1.01 to 1.02), $p<0.001$	1.02 (1.01 to 1.02), $p<0.001$
Age group (years)	$p<0.001$	$p<0.001$
≤29	1 (ref.)	1 (ref.)
30–39	1.35 (0.96 to 1.90), $p=0.085$	2.02 (1.28 to 3.20), $p=0.003$
40–49	1.48 (1.06 to 2.07), $p=0.021$	1.46 (0.93 to 2.28), $p=0.100$
50–59	2.00 (1.35 to 2.78), $p<0.001$	1.90 (1.24 to 2.91), $p=0.001$
60–69	2.41 (1.70 to 3.42), $p<0.001$	2.44 (1.57 to 3.79), $p<0.001$
≥70	1.57 (1.05 to 2.36), $p=0.029$	3.22 (1.93 to 5.39), $p<0.001$
Deprivation		
Townsend (continuous)	0.94 (0.91 to 0.96), $p<0.001$	0.98 (0.95 to 1.01), $p=0.116$
Townsend (quartiles)	$p<0.001$	$p=0.194$
Q4 (least)	1 (ref.)	1 (ref.)
Q3	0.85 (0.66 to 1.10), $p=0.211$	1.10 (0.85 to 1.42), $p=0.478$
Q2	0.75 (0.59 to 0.97), $p=0.026$	0.88 (0.68 to 1.15), $p=0.346$
Q1 (most)	0.57 (0.45 to 0.74), $p<0.001$	0.83 (0.63 to 1.09), $p=0.186$
IMD 2004	0.97 (0,96 to 0.99), $p<0.001$	0.99 (0.98 to 1.01), $p=0.441$
Rurality		
Rural vs urban	1.30 (1.09 to 1.55), $p=0.004$	1.00 (0.83 to 1.22), $p=0.984$
Settlement type	$p<0.01$	$p=0.939$
Urban	1 (ref.)	1 (ref.)
Hamlet/isolated	0.84 (0.60 to 1.18), $p=0.323$	0.95 (0.67 to 1.37), $p=0.794$
Village	0.67 (0.53 to 0.85), $p=0.001$	1.06 (0.82 to 1.38), $p=0.655$
Small town/fringe	0.81 (0.65 to 1.01), $p=0.060$	0.98 (0.77 to 1.25), $p=0.852$

IMD, Index of Multiple Deprivation; OR, odds ratio; ref., reference.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? Yes

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES give details:

Part 1: background information of study

Study ID	U014
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Do adherers and non-adherers to a GP ERS differ in their long-term physical activity levels?
Source (journal year;volume:pages)	*J Sports Sci* 1991;**16**:84
Authors	Jackson C, Bell F, Smith RA and Dixey R
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Conference abstract

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Not reported
Date trial was conducted	January 1993 to March 1996
Type of trial design (e.g. parallel or cluster trial)	Cross-sectional
Was the trial multicentre? If so, how many centres were there?	One scheme: exercise by prescription GP referral scheme in North Yorkshire

Characteristics of the referral	
Who made the referral	Not reported
Reason for referral	Not reported
Format of referral	Not reported
Referred to who	Not reported
Referred to where	Leisure centre
Single or group sessions	Not reported
Referral quote from paper	'A questionnaire was mailed to 1254 individuals who had attended a gym-based exercise programme on the Exercise by Prescription GP referral scheme in North Yorkshire'

Reported uptake and adherence rates	
Uptake rates	Not reported
Adherence rates	70% (466/686)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Not reported.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? No

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U001
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Factors associated with physical activity referral uptake and participation
Source (journal year;volume:pages)	*J Sports Sci* 2008;**26**:217–24
Authors	James DVB, Johnston LH, Crone D, Sidford AH, Gidlow C, Morris C and Foster C
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Not reported
Date trial was conducted	2000–3
Type of trial design (e.g. parallel or cluster trial)	Observational prospective cross-sectional survey
Was the trial multicentre? If so, how many centres were there?	Not reported

Characteristics of the referral	
Who made the referral	Primary-care health professional: GP, practice nurse, physiotherapist, 'other'
Reason for referral	Cardiovascular, overweight/obese, diabetes, musculoskeletal, mental health, unfit/sedentary, other
Format of referral	Not reported
Referred to who	PARS co-ordinator
Referred to where	Local authority, local education authority, private or individual provider
Single or group sessions	Both
Referral quote from paper	'Details of all referred participants were sent by referring health professionals to the PARS coordinator'

PARS, Physical Activity Referral Scheme.

Reported uptake and adherence rates	
Uptake rates	65.4% (1934/2958)
Adherence rates	48.4% (936/1934)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Sociodemographics/medical history prediction analysis of uptake and adherence		
	Uptake (multivariate: ORs)	**Adherence (multivariate: ORs)**
Gender	Not significant	
Male		1.00 (ref.)
Female		0.823 (0.681 to 0.994), $p=0.043$
Age	Not available	1.016 (1.010 to 1.023), $p<0.001$
Referral reason	$p<.001$	Not significant
CVD	1.00 (ref.)	
Over/obese	0.639 (0.501 to 0.814), $p<0.001$	
Diabetes	1.003 (0.659 to 1.525), $p=0.990$	
Musculoskeletal	0.759 (0.582 to 0.990), $p=0.042$	
Mental health	0.339 (0.275 to 0.579), $p<0.001$	
Unfit/sedentary	0.758 (0.533 to 1.079), $p=0.124$	
Other	0.630 (0.462 to 0.858), $p=0.003$	
Referrer	$p=0.006$	Not significant
GP	1.00 (ref.)	
Practice nurse	1.032 (0.817 to 1.304), $p=0.790$	
Physiotherapist	1.218 (0.919 to 1.615), $p=0.170$	
Other	0.540 (0.369 to 0.792), $p=0.002$	
Leisure provider	Not available	
Local authority		Not significant
Local education		
Private		
Individual		

OR, odds ratio; ref., reference.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? Yes

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Herman S, Blumenthal JA, Babyak M, Khatri P, Craighead WE, Krishnan KR, *et al*. Exercise therapy for depression in middle-aged and older adults: predictors of early dropout and treatment failure. *Health Psychol* 2002;**21**,553–63.

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U0015
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Factors associated with physical activity referral completion and health outcomes
Source (journal year;volume:pages)	*J Sports Sci* 2009;**27**:1007–17
Authors	James D, Mills H, Crone D, Johnston L, Morris C and Gidlow C
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Healthwise consortium, which included: Greenwich Leisure Limited (GLL); Greenwich Teaching Primary Care Trust (GTPCT) and Greenwich Council
Date trial was conducted	April 2005 to March 2007
Type of trial design (e.g. parallel or cluster trial)	Cross-sectional
Was the trial multicentre? If so, how many centres were there?	One scheme: metropolitan PARS, five leisure centres

PARS, Physical Activity Referral Scheme.

Characteristics of the referral	
Who made the referral	Primary-care health professional
Reason for referral	■ They had an existing condition that would benefit from regular exercise ■ They were at increased risk of developing a condition that might be prevented by regular exercise ■ They were a member of a community that would be less likely to access existing exercise opportunities
Format of referral	Not reported
Referred to who	Exercise professional
Referred to where	Leisure centre
Single or group sessions	Both
Referral quote from paper	'All participants were referred by a primary-care health professional to one of five leisure centres'

Reported uptake and adherence rates	
Uptake rates	Not reported
Adherence rates	57% (750/1315)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Sociodemographics/medical history prediction analysis of uptake and adherence	
	Adherence (multivariate: ORs)
Gender	
Male	1.000 (ref.)
Female	0.923 (0.72 to 1.18), $p=0.526$
Age	
Continuous	1.019 (1.00 to 1.03), $p=0.001$
Ethnicity	$p=0.038$
White	1.000 (ref.)
Asian	1.383 (0.94 to 2.20), $p=0.094$
Black	0.866 (0.64 to 1.17), $p=0.352$
Chinese	0.795 (0.224 to 2.82), $p=0.723$
Mixed	6.310 (1.388 to 28.69), $p=0.017$
Occupation	$p=0.408$
Unemployed	1.000 (ref.)
Retired	1.300 (0.88 to 1.90), $p=0.176$
Unskilled	0.874 (0.52 to 1.44), $p=0.600$
Partly skilled	1.238 (0.78 to 1.95), $p=0.375$
Skilled manual	1.018 (0.591 to 1.72), $p=0.950$
Skilled non-manual	1.324 (0.93 to 1.87), $p=0.114$
Managerial	1.610 (0.95 to 2.72), $p=0.077$
Professional	1.328 (0.76 to 2.31),$p=0.317$
Referral reason	$p=0.065$
Cardiovascular	1.000 (ref.)
Pulmonary	0.546 (0.346 to 0.86),$p=0.009$
Metabolic	0.755 (0.53 to 1.06), $p=0.106$
Orthopaedic	0.724 (0.50 to 1.04), $p=0.081$
Neuromuscular	2.670 (0.70 to 10.05), $p=0.147$
Mental	0.919 (0.57 to 1.47), $p=0.728$
Miscellaneous	0.635 (0.21 to 1.85), $p=0.406$

OR, odds ratio; ref., reference.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? Yes

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U007
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Adherence to an exercise prescription scheme: The role of expectations, self-efficacy, stage of change and psychological well-being
Source (journal year;volume:pages)	*Br J Health Psychol* 2005;**10**:359–78
Authors	Jones F, Harris P, Waller H and Coggins A
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Hertfordshire Health Agency
Date trial was conducted	Not reported
Type of trial design (e.g. parallel or cluster trial)	Cross-sectional
Was the trial multicentre? If so, how many centres were there?	One scheme, Hertfordshire GP ERS, seven leisure centres

Characteristics of the referral	
Who made the referral	Medical practitioner or practice nurse
Reason for referral	High blood pressure, weight or stress-related problems (or combinations of these)
Format of referral	Not reported
Referred to who	Gym staff
Referred to where	Leisure centre
Single or group sessions	Both
Referral quote from paper	'Referred by either their medical practitioner or practice nurse for a course of 24 exercise sessions. These were to be spread over a 12-week period and provided at a standard reduced rate'

Reported uptake and adherence rates	
Uptake rates	78% (119/152)
Adherence rates	65% (77/119)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Psychosocial prediction analysis of uptake and adherence

Completers vs dropouts	**Adherence (ANOVA)**
GHQ	$F=3.33$, $p=0.07$
Self-efficacy	$F=0.49$, $p=0.48$
Expectations of change (health and fitness)	$F=1.81$, $p=0.18$
Expectations of change (personnel development)	$F=4.20$, $p=0.04$
Stage of change (chi-squared test)	Not significant

ANOVA, analysis of variance; GHQ, General Health Questionnaire.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? No

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U004
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Exercise on prescription: does it work?
Source (journal year;volume:pages)	*Health Educ J* 1995;**54**:453–64
Authors	Lord JC and Green F
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	North Western Regional Health Authority Look After Your Heart grant, a joint finance allocation and contributions from Leisure Services and Stockport Health Commission.
Date trial was conducted	1992
Type of trial design (e.g. parallel or cluster trial)	Evaluation
Was the trial multicentre? If so, how many centres were there?	One scheme (Stockport)

Characteristics of the referral	
Who made the referral	GP
Reason for referral	CHD prevention programme
Format of referral	Not reported
Referred to who	Community health and fitness officer
Referred to where	Differing local leisure and recreational facilities
Single or group sessions	Both
Referral quote from paper	'This evaluation of Stockport's Exercise on Prescription Scheme'

Reported uptake and adherence rates	
Uptake rates	60% (252/419)
Adherence rates	31% (77/252)
Was uptake and/or adherence reported in subgroups? If YES then detail:	
Uptake:	*Adherence*:
■ Male: 53/105 (50.5%)	■ Male: 14/53 (26.4%)
■ Female: 198/287 (69%): >35 years 68/115 (59.1%), 35–54 years 108/205 (52.7%), 55+ years 41/63 (65.1%)	■ Female: 61/198 (30.8%): >35 years 10/68 (14.7%), 35–54 years 35/108 (32.4%), 55+ years 18/63 (28.5%)
■ Overweight: 77/135 (57%)	■ Overweight: 20/77 (25.9%)
■ Stress/anxiety: 33/63 (52.4%)	■ Stress/anxiety: 11/33 (33.3%)
■ Other: 23/46 (50%)	■ Other: 8/23 (34.7%)
■ Lipids/cholesterol: 12/27 (44.4%)	■ Lipids/cholesterol: 3/12 (25%)
■ Keep fit: 10/20 (50%)	■ Keep fit: 6/10 (60%)
■ Lack of exercise: 11/20 (55%)	■ Lack of exercise: 4/11 (36.3%)
■ Depression: 11/20 (55%)	■ Depression: 4/11 (36.3%)
■ Arthritis: 7/12 (58.3%)	■ Arthritis: 2/7 (28.5%)
■ Back pain: 7/12 (58.3%)	■ Back pain: 0/7 (0%)
■ Family history IHD: 3/10 (30%)	■ Family history IHD: 0/3 (0%)

IHD, ischaemic heart disease.

Part 3: extracted results

Not reported.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? No

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U016
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	The retrospective evaluation of a GPs exercise prescription programme
Source (journal year;volume:pages)	*J Hum Nutr Diet* 1999;**12**:S32–42
Authors	Martin C and Woolf-May K
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Not reported
Date trial was conducted	Not reported
Type of trial design (e.g. parallel or cluster trial)	Retrospective evaluation
Was the trial multicentre? If so, how many centres were there?	One leisure centre

Characteristics of the referral	
Who made the referral	GP, practice nurse, self
Reason for referral	Not reported
Format of referral	Not reported
Referred to who	Exercise advisor
Referred to where	Leisure centre
Single or group sessions	Not reported
Referral quote from paper	'This study aimed to evaluate a GP exercise prescription programme that had been running in Margate, Kent, for 3 years'

Reported uptake and adherence rates	
Uptake rates	Not reported
Adherence rates	12% (60/490)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Not reported.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? No

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U005
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Changes in self-determination during an ERS
Source (journal year;volume:pages)	*Publ Health* 2008;**122**:1257–60
Authors	Morton KL, Biddle SJH and Beauchamp MR
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Short communication

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	None declared
Date trial was conducted	Not reported
Type of trial design (e.g. parallel or cluster trial)	Observational
Was the trial multicentre? If so, how many centres were there?	One leisure centre

Characteristics of the referral	
Who made the referral	Not reported
Reason for referral	Not reported
Format of referral	Not reported
Referred to who	Not reported
Referred to where	Not reported
Single or group sessions	Not reported
Referral quote from paper	'This study involved 30 patients enrolled in an ERS at a leisure centre in the UK'

Reported uptake and adherence rates	
Uptake rates	Not reported
Adherence rates	40% (12/30)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Psychosocial prediction analysis of uptake and adherence	
	Adherence (ANOVA/*t*-tests)
Self-determination	$F(2, 3) = 9.19$, $p = 0.001$ Post hoc adherers significantly higher self-determination ($p < 0.05$) than non-adherers and partial adherers

ANOVA, analysis of variance.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? No

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U008
Reviewer ID and name	July 2010
Date of completion of this form	Promoting exercise on prescription: recruitment, motivation, barriers and adherence in a Danish community intervention study to reduce type 2 diabetes, dyslipidemia and hypertension
Title of report	*J Publ Health* 2009:**17**:187–93
Source (journal year;volume:pages)	Roessler KK and Ibsen B
Authors	English
Language of publication	Full paper
Type of report (e.g. full paper/ abstract/unpublished)	July 2010

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	Denmark
Funders of the trial	Ministry of Social Affairs and Administration of Public Health of the City of Copenhagen
Date trial was conducted	2004–7
Type of trial design (e.g. parallel or cluster trial)	Evaluation
Was the trial multicentre? If so, how many centres were there?	One scheme, Copenhagen

Characteristics of the referral	
Who made the referral	GP
Reason for referral	Physically inactive, have a BMI < 35, be mobile enough to participate in supervised physical training and have at least one of the following diagnoses: type 2 diabetes, above-normal cholesterol level (dyslipidaemia) or above-normal blood pressure (hypertension)
Format of referral	Not stated
Referred to who	Physiotherapist
Referred to where	Not stated
Single or group sessions	Group
Referral quote from paper	'There are data from the GP who referred the patient to the Exercise and Diet on prescription programme'
	'Patients received 4 months of supervised physical training in groups'

Reported uptake and adherence rates	
Uptake rates	Not reported
Adherence rates	70% (811/1156)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Not reported.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? No

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U002
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Do general practices provide equitable access to physical activity interventions?
Source (journal year;volume:pages)	British Journal of General Practice 2008 October;**58**:699–702
Authors	Sowden SL, Breeze E, Barber J and Raine R
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	ESRC/MRC PhD studentship
Date trial was conducted	April 2004 to March 2006
Type of trial design (e.g. parallel or cluster trial)	Cross-sectional
Was the trial multicentre? If so, how many centres were there?	Six schemes (Greater London) 317 practices

Characteristics of the referral	
Who made the referral	Health professionals
Reason for referral	Not reported
Format of referral	Not reported
Referred to who	Not reported
Referred to where	Not reported
Single or group sessions	Not reported
Referral quote from paper	'Each exercise referral scheme was located within a primary care trust (PCT) and every general practice within each of these PCTs was able to refer patients to the scheme'

Reported uptake and adherence rates	
Uptake rates	58% (3565/6101)
Adherence rates	39% (1404/3565)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Sociodemographics/medical history prediction analysis of uptake and adherence

	Uptake (multivariate: ORs)	Adherence (multivariate: ORs)
IMD quintiles	$p=0.85$	$p=0.06$
1 (most deprived)	1 (ref.)	1 (ref.)
2	1.05 (0.93 to 1.21)	0.89 (0.71 to 1.11)
3	0.94 (0.77 to 1.15)	0.92 (0.63 to 1.34)
4	0.99 (0.78 to 1.25)	1.47 (0.96 to 2.24)
5 (least deprived)	1.05 (0.83 to 1.33)	1.23 (0.84 to 1.79)

continued

continued

Sociodemographics/medical history prediction analysis of uptake and adherence		
	Uptake (multivariate: ORs)	**Adherence (multivariate: ORs)**
Age (years)	$p>0.001$	$p>0.001$
16–29	1 (ref.)	1 (ref.)
30–44	1.67 (1.34 to 2.08)	1.30 (0.96 to 1.77)
45–59	2.09 (1.68 to 2.61)	1.77 (1.27 to 2.46)
60–74	2.67 (2.14 to 3.33)	2.91 (2.04 to 4.16)
≥75	2.43 (1.70 to 3.46)	2.71 (1.65 to 4.46)
Gender	$p<0.001$	Did not improve model
Male	1 (ref.)	
Female	1.33 (1.18 to 1.49)	
Scheme area	Did not improve model	$p>0.001$
1		1 (ref.)
2		0.43 (0.32 to 0.58
3		4.45 (3.28 to 6.03)
4		NI
5		13.49 (8.78 to 20.72)
6		0.45 (0.29 to 0.70)
Referred for musculoskeletal reasons	$p=0.036$	Did not improve model
No	1 (ref.)	
Yes	1.18 (1.01 to 1.38)	
Referred for diabetes reasons	Did not improve model	$p<0.007$
No		1 (ref.)
Yes		0.76 (0.63 to 0.93)
Referred for CVD reasons	Did not improve model	$p=0.020$
No		1 (ref.)
Yes		1.22 (1.03 to 1.45)

IMD, Index of Multiple Deprivation; NI, not included; OR, odds ratio; ref., reference.

Part four: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? Yes

Do you have any additional comments to make about this study?

Uptake and adherence subgroup rates available from PhD thesis.

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U012
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Exercise referral: the public health panacea for physical activity promotion? A critical perspective of exercise refferral schemes; their development and evaluation
Source (journal year;volume:pages)	*Ergonomics* 2004:**48**:1390–410
Authors	Dugdill L, Graham R and McNair F
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Not reported
Date trial was conducted	2000–3
Type of trial design (e.g. parallel or cluster trial)	Case study
Was the trial multicentre? If so, how many centres were there?	Two schemes

Characteristics of the referral	
Who made the referral	Health professional
Reason for referral	Not reported
Format of referral	Not reported
Referred to who	Exercise referral officer
Referred to where	Leisure setting
Single or group sessions	Not reported
Referral quote from paper	'The opportunity to become involved in the evaluation of two ERS's presented itself to the authors in 2000'

Reported uptake and adherence rates

Uptake rates	Scheme B: 68% (1825/2696)
Adherence rates	Scheme A: 34% (336/958)

Was uptake and/or adherence reported in subgroups? If YES then detail:

Uptake: not reported

Adherence – Scheme A:

- Gender (2001–3): male 150 (44%), female 198 (32%)
- Age (2001–3): 18–30 years 13/56 (23%), 31–45 years 45/204 (22%), 46–60 years 129/356 (36%), 61–70 years, 97/229 (42%), 71+ years 60/126 (48%)
- Referral reason (2001–2): post MI 49/80 (61%), asthma 12/21 (58%), diabetes 36/65 (55%), angina 25/48 (52%), arthritis 8/16 (50%), overweight 262/671 (39%), sedentary 58/170 (34%), mental illness 69/209 (33%)

Part 3: extracted results

Not reported.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? No

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U009
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Predictors of Older Primary Care Patients' Participation in a Submaximal Exercise Test and a Supervised, Low-Impact Exercise Class
Source (journal year;volume:pages)	*Prev Med* 2001;**33**:485–94
Authors	Damush TM, Stump TE, Saporito A and Clark DO
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	USA
Funders of the trial	National Institute on Ageing
Date trial was conducted	Not reported
Type of trial design (e.g. parallel or cluster trial)	Cross-sectional
Was the trial multicentre? If so, how many centres were there?	Two community health centres

Characteristics of the referral	
Who made the referral	Health-care provider
Reason for referral	Not reported
Format of referral	Not reported
Referred to who	Exercise physiologist
Referred to where	Local community buildings
Single or group sessions	Group
Referral quote from paper	'Providers screened and referred eligible patients to complete a submaximal exercise test and participate in a group-based community exercise program'

Reported uptake and adherence rates	
Uptake rates	28% (113/404)
Adherence rates	Not reported
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Sociodemographics/medical history prediction analysis of uptake and adherence	
	Uptake (multivariate: ORs)
Age	0.98 (0.95 to 1.01)
Ethnicity (African American vs all other racial groups)	0.88 (0.44 to 1.79)
Clinic location	0.68 (0.34 to 1.38)
Current smoker	0.38 (0.19 to 0.76)

OR, odds ratio.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? Yes

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Part 1: background information of study

Study ID	U016
Reviewer ID and name	TP
Date of completion of this form	July 2010
Title of report	Adherence and well-being in overweight and obese patients referred to an EoP scheme: a SDT perspective
Source (journal year;volume:pages)	*Psychol Sport Exerc* 2007;**8**:722–40
Authors	Edmunds J, Ntoumanis N and Duda JL
Language of publication	English
Type of report (e.g. full paper/abstract/unpublished)	Full paper

Part 2: information about the study

Characteristics of the trial	
Country of the principal investigators, where the trial was conducted	UK
Funders of the trial	Not reported
Date trial was conducted	Not reported
Type of trial design (e.g. parallel or cluster trial)	Cross-sectional
Was the trial multicentre? If so, how many centres were there?	One scheme (West Midlands)

Characteristics of the referral	
Who made the referral	GP
Reason for referral	CHD risk factors
Format of referral	Prescription card
Referred to who	EoP advisor
Referred to where	Leisure centre
Single or group sessions	Both
Referral quote from paper	'EoP schemes are designed for individuals between 15 and 74 years of age who display specific Coronary Heart Disease risk factors. Upon referral to the scheme, an EoP advisor (i.e., a health and fitness instructor who has received specialized training to deliver exercise prescriptions) develops a 3-month exercise routine to suit each patient's/client's condition'

Reported uptake and adherence rates	
Uptake rates	Not reported
Adherence rates	51% (25/49)
Was uptake and/or adherence reported in subgroups? If YES then detail:	

Part 3: extracted results

Quote from paper (p. 732): 'Participants who adhered more to their 3-month prescriptions did not report significantly different baseline levels of any of the study variables, compared with those who adhered less'.

Part 4: study quality

Statement of inclusion/exclusion of participants: Yes

Power calculation: No

Was the analysis multivariate? Yes

Do you have any additional comments to make about this study?

Does the reference list of this paper contain additional studies that should be considered for inclusion?

Is further information required from the authors?	YES	NO

If YES, give details:

Appendix 7

Economic modelling: supplementary information

TABLE 62 Overview of control variables (with references)

Variables	Evidence base	Expected sign
Age	Solli *et al.* (2010), Winter *et al.* (2010), Muller-Vahl *et al.* (2010), Berg *et al.* (2010), Soltoft *et al.* (2009), Lou *et al.* (2009), Heyworth *et al.* (2009), Sorensen *et al.* (2009), Iglesias *et al.* (2009), Winter *et al.* (2009), Konig *et al.* (2009), Petrous and Kupek (2008), Shimizu *et al.* (2008), Jerant *et al.* (2008), Pettersen *et al.* (2008), Wang *et al.* (2008), Kralove (2007), Christensen *et al.* (2007), Boye *et al.* (2007), Masunari *et al.* (2007), Dodel *et al.* (2007), Monz *et al.* (2007), Sullivan *et al.* (2007), Saarni *et al.* (2006), Jia and Lubetkin (2005), Andersen *et al.* (2004), Hazel *et al.* (2003), Koopmanschap (2002), Burstrom *et al.* (2001) and Kind *et al.* (1998)	–
Gender (female)	Muller-Vahl *et al.* (2010), Gordeev *et al.* (2010), Berg *et al.* (2010), Solli *et al.* (2010), Winter *et al.* (2010), Lou *et al.* (2009), Heyworth *et al.* (2009), Sorensen *et al.* (2009), Reed *et al.* (2009), Winter *et al.* (2009), Konig *et al.* (2009), Jerant *et al.* (2008), Pettersen *et al.* (2008), Petrous and Kupek (2008), Wang *et al.* (2008), Imai *et al.* (2008), Christensen *et al.* (2007), Boye *et al.* (2007), Masunari *et al.* (2007), Dodel *et al.* (2007), Sullivan *et al.* (2007), Saarni *et al.* (2006), Lubetkin *et al.* (2005), Sendi *et al.* (2005), Jia and Lubetkin (2005), Andersen *et al.* (2004), Hazel *et al.* (2003), Koopmanschap (2002) and Burstrom *et al.* (2001)	–
Social class (high)	Soltoft *et al.* (2009), Petrous and Kupek (2008), Christensen *et al.* (2007), Genazzani *et al.* (2002), Guest and Gupta (2002), Burstrom *et al.* (2001) and Kind *et al.* (1998)	+
Education (high)	Soltoft *et al.* (2009), Lou *et al.* (2009), Heyworth *et al.* (2009), Sorensen *et al.* (2009), Konig *et al.* (2009), Ariza-Ariza *et al.* (2009), Reed *et al.* (2009), Petrous and Kupek (2008), Jerant *et al.* (2008), Pettersen *et al.* (2008), Wang *et al.* (2008), Kralove (2007), Boye *et al.* (2007), Sullivan *et al.* (2007), Saarni *et al.* (2006), Lubetkin *et al.* (2005), Sendi *et al.* (2005) and Kind *et al.* (1998)	+
Ethnicity (white)	Lou *et al.* (2009), Petrous and Kupek (2008), Lubetkin *et al.* (2005), Jia and Lubetkin (2005) and Sullivan *et al.* (2007)	–
Marital status (married)	Gordeev *et al.* (2010), Lou *et al.* (2009), Konig *et al.* (2009), Petrous and Kupek (2008), Wang *et al.* (2008), Dodel *et al.* (2007), Saarni *et al.* (2006) and Kind *et al.* (1998)	?
Income (high)	Muller-Vahl *et al.* (2010), Winter *et al.* (2010), Lou *et al.* (2009), Winter *et al.* (2009), Konig *et al.* (2009), Petrous and Kupek (2008), Sullivan *et al.* (2007), Saarni *et al.* (2006), Lubetkin *et al.* (2005), Jia and Lubetkin (2005) and Haacke *et al.* (2005)	+
Employment status (employed)	Muller-Vahl *et al.* (2010), Winter *et al.* (2010), Reed *et al.* (2009), Konig *et al.* (2009), Petrous and Kupek (2008), Wang *et al.* (2008), Leslie *et al.* (2007), Dodel *et al.* (2007), Monz *et al.* (2007), Haacke *et al.* (2005) and Kind *et al.* (1998)	+
BMI (high)	Solli *et al.* (2010), Soltoft *et al.* (2009), Reed *et al.* (2009), Petrous and Kupek (2008), Wee *et al.* (2008), Sach *et al.* (2007), Monz *et al.* (2007), Sendi *et al.* (2005), Jia and Lubetkin (2005), Hickson and Frost (2004) and Koopmanschap (2002)	–
House tenure (house owners)	Petrous and Kupek (2008) and Kind *et al.* (1998)	+

continued

TABLE 62 Overview of control variables (with references) *(continued)*

Variables	Evidence base	Expected sign
Smokers (yes)	Lou *et al.* (2009), Heyworth *et al.* (2009), Iglesias *et al.* (2009), Petrous and Kupek (2008), Wang *et al.* (2008), Kralove (2007), Sullivan *et al.* (2007), Sendi *et al.* (2005), Jia and Lubetkin (2005), Haacke *et al.* (2005), Guest and Gupta (2002) and Kind *et al.* (1998)	–
Drink alcohol (yes)	Petrous and kupek(2008), Saarni *et al.* (2008) and Lou *et al.* (2009)	+
Morbidities (yes)*	Muller-Vahl *et al.* (2010), Winter *et al.* (2010), Gordeev *et al.* (2010), Unsar and Sut (2010), Berg *et al.* (2010), Solli *et al.* (2010), Soltoft *et al.* (2009), Lou *et al.* (2009), Heyworth *et al.* (2009), Reed *et al.* (2009), Cho *et al.* (2009), Moberg *et al.* (2009), Winter *et al.* (2009), Ariza-Ariza *et al.* (2009), Shimizu *et al.* (2008), Jerant *et al.* (2008), Wang *et al.* (2008), Xie *et al.* (2008), Saarni *et al.* (2007), Christensen *et al.* (2007), Boye *et al.* (2007), Masunari *et al.* (2007), Dodel *et al.* (2007), Monz *et al.* (2007), Sobocki *et al.* (2007), Sullivan *et al.* (2007), Saarni *et al.* (2006), Xie *et al.* (2006), Sendi *et al.* (2005), Jia and Lubetkin (2005), Lubetkin *et al.* (2005), Andersen *et al.* (2004), Haacke *et al.* (2005), Hickson and Frost (2004), Andersen *et al.* (2004), Hazel *et al.* (2003), Genazzani *et al.* (2002), Guest and Gupta (2002), Koopmanschap (2002) and Burstrom *et al.* (2001)	–
Region of residence	Genazzani *et al.* (2002)	?
Psychosocial well-being (GHQ scores) (high)	Soltoft *et al.* (2009)	–
Height (increased)	Christensen *et al.* (2007) and Masunari *et al.* (2007)	+
General health (favourable)	Solli *et al.* (2010) and Burstrom *et al.* (2001)	+
Weight (increased)	Christensen *et al.* (2007) and Iglesias *et al.* (2009)	–
Urbanisation (urban)	Jelsma *et al.* (2007)	?

CSE, Certificate of Secondary Education; GHQ, General Health Questionnaire.

TABLE 63 Descriptive statistics of variables (adjusted for missing observations)

Variables	Observations	Mean (SD)/%
Dependent variable (HRQoL)		
EQ-5D	5453	0.86 (0.23)
Missing	84	1.5
Independent variables (PA)		
Walking		
Active	873	15.8
Inactive	4664	84.2
Sports and exercise		
Active	660	11.9
Inactive	4877	88.1
Objective measurement[a]		
Active	102	11.5
Inactive	783	88.5
Missing	4652	84

TABLE 63 Descriptive statistics of variables (adjusted for missing observations) *(continued)*

Variables	Observations	Mean (SD)/%
Subjective measurement[b]		
Active	2452	44.4
Inactive	3067	55.6
Missing	18	0.3
Independent variables (covariates)		
Age	*5537*	*50(6.2)*
Gender		
Male	2519	45.5
Female	3018	54.5
House tenure		
Own it outright	1467	26.5
Mortgage	2864	51.7
Renters	1123	20.3
Part rent/mortgage	24	0.4
Rent free	38	0.7
Missing	21	0.4
Marital status		
Other	30	0.5
Married (living with partner)	3618	65.3
Single	735	13.3
Separated	208	3.8
Divorced	816	14.7
Widowed	135	2.4
Income	4535	35591.2 (29210)
Missing	1002	18.1
Income (missing observations imputed for)	5537	35008.3 (26987.7)
Weight	4867	79.1 (17)
Missing	670	12.1
Weight (missing observations imputed for)	5537	78.1 (16.3)
Height	4948	168 (9.3)
Missing	589	10.6
Height (missing observations imputed for)	5537	168(9.2)
Drink alcohol		
Yes	4702	84.9
No	823	14.9
Missing	12	0.2
Smokers		
Yes	1206	21.8
No	1926	34.8
Missing	2405	43.4

continued

TABLE 63 Descriptive statistics of variables (adjusted for missing observations) *(continued)*

Variables	Observations	Mean (SD)/%
BMI		
Underweight (< 18.5)	30	0.5
Normal (18.5–25)	1487	26.9
Overweight (25–30)	1885	34
Obese (30+)	1418	25.6
Missing	717	13
General health		
Very good	1859	33.6
Good	2338	42.2
Fair	959	17.3
Bad	287	5.2
Very bad	90	1.6
Missing	4	0.1
Limiting illness		
Limiting	1293	23.4
Non limiting	1158	20.9
No illness	3084	55.7
Missing	2	0.04
Psychosocial well-being		
Score 0	3639	65.7
Score 1–3	1078	19.5
Score 4+	771	13.9
Missing	49	0.9
Hypertensive		
No	2717	49.1
Yes	704	12.7
Missing	2116	38.2
Mental disorder		
No	5263	95.1
Yes	272	4.9
Missing	2	0.04
Vision problems		
No	5252	98.5
Yes	83	1.5
Missing	2	0.04
Ear problems		
No	5443	98.3
Yes	92	1.7
Missing	2	0.04
Musculoskeletal problems		
No	4558	82.3
Yes	977	17.6
Missing	2	0.04

TABLE 63 Descriptive statistics of variables (adjusted for missing observations) *(continued)*

Variables	Observations	Mean (SD)/%
Heart problems		
No	4911	88.7
Yes	624	11.3
Missing	2	0.04
Respiratory problems		
No	5083	91.8
Yes	452	8.2
Missing	2	0.04
Urinary problems		
No	5437	98.2
Yes	98	1.8
Missing	2	0.04
Ethnicity		
White	5029	90.8
Mixed	44	0.8
Asian	260	4.7
Black	140	2.5
Chinese	28	0.5
Other	17	0.3
Missing	19	0.3
Education		
NVQ4/NVQ5/degree or equivalent	1228	22.2
Higher education below degree	746	13.5
NVQ3/GCE 'A' level equivalent	749	13.5
NVQ2/GCE 'O' level equivalent	1404	25.4
NVQ1/CSE other grade equivalent	239	4.5
Foreign/other	53	1.0
No qualification	1102	19.9
Missing	16	0.3
Employment status		
Employed	4215	76.1
Unemployed	163	2.9
Retired	259	4.7
Other economically inactive	884	16
Missing	16	0.3
Social class		
Professional	284	5.1
Managerial/technical	1975	35.7
Skilled non-manual	1098	19.8
Skilled manual	915	16.5
Semi-skilled manual	828	15.0
Unskilled manual	285	5.2
Other	15	0.3
Missing	137	2.5

continued

TABLE 63 Descriptive statistics of variables (adjusted for missing observations) *(continued)*

Variables	Observations	Mean (SD)/%
Region of residence		
North-east	370	6.7
North-west	751	13.6
Yorkshire	602	10.9
East Midlands	513	9.3
West Midlands	610	11
East	653	11.8
London	594	10.7
South-east	450	8.1
South Central	422	7.6
South-west	572	10.3
Urbanisation		
Urban	4309	77.8
Town/fringe	542	9.8
Village, hamlet and isolated dwellings	686	12.4

GCE, General Certificate of Education; NVQ, National Vocational Qualification.
a The distribution of objective measurement (missing observations imputed for) is: active (111; 2%) inactive (5426; 98%).
b The distribution of subjective measurement (missing observations imputed for) is: active (2465; 44.5%) inactive (3072; 55.5%). If restricted to observations with values for objective measurement, the distribution of subjective measurement (missing observations imputed for) is: active (408; 46.1%) inactive (477; 53.9%).

TABLE 64 Model diagnostics

	Multicollinearity tests		Specification test			
Models	VIF	Tolerance	$p>\|t\|$	Pseudo-R^2-value	AIC	BIC
1	1.05 to 1.45	0.68 to 0.97	0.063	0.429	3247.5	3360.6
2	1.04 to 1.55	0.65 to 0.95	0.084	0.430	2697.7	2798.3
3	1.00 to 1.22	0.82 to 0.99	0.845	0.092	841.7	889.5
4	1.06 to 1.23	0.81 to 0.94	0.205	0.446	1936.9	2050.1

Appendix 8

Protocol

The following text is extracted from the original application proposal. In addition to our original proposal of undertaking systematic reviews of both the effectiveness and cost-effectiveness of ERS and an economic model-based economic analysis, we also undertook a systematic review of ERS uptake and adherence.

Title

The effectiveness and cost-effectiveness of exercise refferal schemes: a systematic review and economic evaluation.

Investigation plan

Research objectives

- To assess the effectiveness of exercise referral schemes (ERSs) in people with a diagnosed condition known to benefit from physical activity (PA).
- To assess the cost-effectiveness of ERSs in people with a diagnosed condition known to benefit from PA.
- To explore the factors that might influence the effectiveness and cost-effectiveness of ERSs in people with a diagnosed condition known to benefit from PA.
- To formulate guidance for the future use of ERSs in the NHS and to identify priorities for future primary research in this area.

Background

Health benefits

Physical activity contributes to the prevention and management of over 20 medical conditions and diseases, including coronary heart disease (CHD), stroke, type 2 diabetes mellitus, chronic back pain, osteoporosis, cancer, falls in the elderly, chronic obstructive pulmonary disease (COPD), and depression, as summarised in the Chief Medical Officer's report '*At Least Five a Week*'.[1] The efficacy evidence varies in quality across conditions, but the contribution of physical inactivity to ill health and different disease processes has become clearer each year over the past 50 years.

Current recommendations are for adults to achieve at least 30 minutes of at least moderate-intensity (5.0–7.5 kcal/minute) PA on at least 5 days of the week for health benefit, particularly for reducing risk of cardiovascular disease (CVD).[2] Emerging evidence on the effects of time spent in sedentary activities (e.g. TV viewing) on obesity, metabolic processes and type 2 diabetes, independent of PA, suggests that reducing time spent in sedentary activities may be an additional useful indicator of the effectiveness of interventions. Over 20% of worldwide ischaemic heart disease (IHD)[3] has been attributed to physical inactivity, and the most active are at 30% lower risk for developing CHD than the least active,[4] with a stepped reduction. The dose for reducing risk for other diseases, and promoting positive well-being are less clear, but the minimum target has been recommended widely for general health benefit.[2]

Promoting physical activity

The 2006 Health and Safety Executive (HSE) report[5] revealed that 40% of men and 28% of women meet the 5 × 30 minutes per week public health target with variations across age, sex, class and ethnicity. The proportion achieving the targets for PA has increased from 32% in 1997 to 40% in 2006 for men, and from 21% to 28% for women. Nevertheless, there is a clear need to promote PA, particularly among the least active who may have most to gain in terms of health. For adults, efforts have focused on changes in the environment,[6] mass media campaigns, web- and IT-based communications at population and individual level,[7] corporate and workplace initiatives,[8] community programmes,[9] and provision of individualised professional support[10] and new health-care structures.[11] Reviews have also focused on the effectiveness of different interventions among specific groups in the population, such has the elderly and[12] workers.[13] Systematic reviews suggest that no single approach can be wholly effective[7] in helping sedentary people to maintain a physically active lifestyle, and that a wide variety of approaches can each facilitate small behaviour change. The Foresight report on obesity[14] reflected the multiple influences on expenditure and intake and government policy reflects this in its investment and initiatives across different departments and cross-departmental efforts.

Theories of behaviour change also support the need for multiple-level (e.g. targeting attitudes of both recipients and providers of health-promotion messages) and multicomponent approaches (e.g. targeting different belief and attitudinal dimensions such as importance or salience of new behaviours, confidence to change, expectancy of benefits, and beliefs of others.[15] Interventions that fail to provide appropriate support and create barriers for the intended recipients to initiate and maintain target behaviours are unlikely to succeed in the long term. The past 15 years has seen a growth in understanding of physically active behaviour and how to promote it with strategies matched to individual needs.[16] Achieving and maintaining a physically active lifestyle may require numerous and diverse changes in how individuals interact with the environment and others. In terms of evaluating the effectiveness of interventions it is important to understand both what the intervention was intended to involve and whether this was achieved (i.e. treatment fidelity) and also what process or mediating variables were implicated in changes in primary outcomes (i.e. behavioural and health outcomes). Many reviews and individual studies report the behavioural outcomes; virtually none describe the intervention or processes involved in behaviour change.[17]

Development and current practice of exercise referral schemes

One setting where increases in PA may be facilitated is in primary health care.[18] Over 85% of the population in the UK visit their general practitioner (GP) at least once a year and almost 95% do so over a 3-year period,[19] suggesting an opportunity to promote PA. Taylor and Fox (2005)[20] identified, in a review of literature, several barriers that GPs perceived in promoting PA: (1) lack of time; (2) a lack of desire to pressure patients; (3) a belief that it may not be as beneficial as other therapies or other behaviour changes (e.g. smoking); (4) that patients would not follow advice; and (5) that PA promotion often seemed irrelevant for the needs of patients at the time of consultation. To maximise opportunities, practice nurses have been central to many primary care initiatives to promote PA and several qualitative systematic reviews have focused on office-based PA interventions in primary care.[21] The intensity of the intervention can be described along a continuum from 'Ask', 'Assess', 'Advise' and more prolonged counselling. The reviews highlighted the limited effect of advice giving and the lack of research in the UK primary care setting. In contrast, patients may be referred to a specialist with a role to promote PA, for prevention or treatment.

Fox *et al.* (1997)[18] identified only a few schemes in the UK in which exercise sessions took place within GP practices, delivered by health and exercise professionals, to meet the needs of patients with specific needs (e.g. weight loss, chronic low back pain). In contrast, new opportunities

began to emerge in the late 1980s to mid-1990s when patients were referred to leisure centres for individual or group 'exercise on prescription' (EoP) (now referred to as ERSs). Growth in the number of ERSs was rapid in response to new legislation (i.e. Compulsory Competitive Tendering[22]) in the operation of such facilities the first evaluation was commissioned by the Health Education Authority in 1994.[24] Leisure centres with swimming pools and other exercise facilities have the opportunity to offer diverse options, as well as social facilities. In the 1990s, however, GP ERSs had a number of limitations:[25] (1) there were few of them so they had little potential to impact on public health; (2) staff lacked the training to adapt exercise programmes to the specific health needs of patients; (3) there was little interest in the broader promotion of a more physically active lifestyle, but more interest in creating new leisure centre members; (4) GPs were reluctant to refer patients to exercise professionals who had unknown expertise and credentials; and (5) there was only limited reference in key NHS policy documents to the promotion of PA. These limitations probably limited the effectiveness of such schemes for impacting on long-term sustainable change in PA. As a result, after broad consultation with health and exercise professionals, leisure industry operators, and exercise scientists, a National Quality Assurance Framework (NQAF) was launched in the UK to guide best practice and best value from ERSs.[11] The document was aligned with the emerging range of NHS National Service Frameworks (e.g. for CHD, older people) that prioritise PA promotion.

A report[26] identified a huge growth in ERS from 157 in 1994[24] to 816 in 2004, with probably over 100,000 patients passing through them each year. Referral is largely for CVD prevention (e.g. weight management), but patients with a wide variety of conditions are offered specialist support to increase PA. Some schemes identify specific medical conditions and work closely with exercise therapist to maximise the benefits for referred patients. A survey of 200 GPs found that 22% of GPs now prescribe exercise therapy as one of their three most common treatments for depression compared with only 5% 3 years ago (Mental Health Foundation 2008: see: www.mentalhealth.org.uk), with an increase from 41% to 61% now believing that a supervised programme of exercise would be 'very effective' or 'quite effective' in treating mild to moderate depression. However, barriers do remain among GPs for the general referral of patients.[27]

Exercise referral schemes clearly operate in diverse ways, although the most common approach involves a 10- to 12-week 'prescription' with subsidised attendance costs for two visits per week, at specific times in the week. Other approaches involve referral to a PA facilitator, who may act as gatekeeper, to prevent inappropriate referrals and engage with patients to identify the preferred options for increasing PA (e.g. centre- or home-based, group or individual sessions, active commuting, other community-based options such as walking groups). Alternatively, referral may be directly to one of these options. The NQAF[11] recommended a service level agreement to drive the operational links between the primary care referrer and the exercise or leisure provider, with exercise professionals on the Register for Exercise Professionals (www.exerciseregister.org/) at least at a level (Level 3 – Instructing Physical Activity and Exercise; Level 4, Specialist Exercise Instructor) compatible with the needs of their clients. National Occupational Standards for level 4 in Health and Physical Activity were developed in 2007, with core units for CHD, mental health, obesity/diabetes, frailer older adults/falls prevention, after-stroke care, back pain. Many of the 800+ schemes in the UK do not meet the NQAF guidelines[28] due to a lack of investment in staff and a focus on short-term patient adherence to centre-based exercise rather than sustained lifestyle PA.

In summary, ERSs have evolved in different ways, involve a variety of exercise and health professionals, and a wide range of clients with different needs. Although variation in the ERS model of delivery exist, common features include: (1) referral of sedentary individuals at risk of lifestyle diseases by a health-care professional within primary health care setting; (2) referral to an exercise professional who seeks to develop a programme of exercise that meets the needs of

that patient; (3) monitoring of progress throughout the programme with appropriate feedback to the referring health-care professional; (4) auditing to ensure adherence to quality assurance processes (e.g. appropriate staffing, health and safety procedures, ethical and data protection consideration). The NQAF recommended that ERSs should formally involve referral from primary care and should have a service level agreement between referrer and service provider. ERS (or equivalent) interventions have been used in general practice in several other countries in an attempt to promote PA.[29]

Effectiveness of exercise referral schemes

The first review of the effectiveness of ERSs included a range of study designs and sources of information.[30] Stakeholders were also interviewed in several case studies. The general view was that ERSs were popular among clients and practitioners but that there was only limited evidence for any lasting effects on PA and health. Recent systematic reviews identify variation in respect of the range of evidence reviewed, the definition of what constitutes an ERS, and the scope of studies reviewed (geographical location, outcomes measures and study design[29,31–34]). These systematic reviews have consistently concluded that ERSs have a small effect in enhancing short-term PA and with little or no evidence of long-term sustainability. One review undertook a meta-analysis of five UK-based RCTs and reported an overall RR of 1.20 (95% CI 1.06 to 1.35) in favour of ERS versus a control group.[34] Those in the ERS were more likely to be moderately physically active per week (i.e. doing 90–150 minutes). The reviewers did not state at which time point in the trials the effects were derived, but it is likely that these were short-term effects (i.e. < 6 months). As an example, the recent study of Isaacs *et al.*[35] reported a 6% net effect (13.8% vs 7.5%) meeting the public health guidelines of 5 × 30 minutes per week in favour of the leisure centre group (compared with an advice-only group) at 6 months.[35]

The NICE review of ERS undertook a qualitative assessment of the effects of different moderating and mediating factors on PA outcomes among the four included RCTs.[33] This assessment produced a rather limited analysis and answers to many of the questions concerning the additional effects of the characteristics of the intervention, the professionals involved, the setting, and participant characteristics could be better answered by searching for and reviewing a more diverse literature. For example, Harrison *et al.*[36] and Gidlow *et al.*[37] have reported how some of these factors prospectively influence uptake and participation in schemes involving 6610 and 3711 patients referred over 5 and 3 years, respectively. Other factors were identified among the Gidlow cohort by James *et al.*[38] An analysis of which factors moderate PA outcomes is important as the few RCTs conducted have not been powered to investigate moderator effects of patient characteristics for example. Also, data from other studies, albeit in other countries, may be useful in the absence of UK data. For example, Ashworth *et al.*[39] reviewed evidence on the effects of home-based versus centre-based exercise interventions.

Cost effectiveness of exercise referral schemes

Three systematic reviews[29,32,34] considered the economic outcomes of ERS, identifying three UK-based randomised controlled trial (RCT) economic analyses. Two of these analyses were limited to reporting of the costs.[36,40,41] The most detailed economic analysis to date is the RCT of Isaacs.[35] The authors attributed a £100 cost to the patient and £186 cost to the leisure centre, and noted no additional health gain [in terms of quality of life (QoL)] for the ERS, compared with a walking and passive control group. Non-RCTs may provide valuable evidence on the economics of ERS. For example, Project Active, in the USA, reported that at both 6 months and 24 months, the lifestyle intervention[42] was more cost-effective than the structured intervention for most outcome measures.[43] Other evidence (e.g. Cochrane 2005 – trial on the effectiveness of water-based therapy for lower limb osteoarthritis) from the UK may also be useful to estimate the potential cost benefits should such a programme be part of an ERS.

Summary

- Physical activity contributes to the prevention and management of a numerous medical conditions and diseases. UK data suggest that < 40% of men and 30% of women meet the 5 × 30 minutes per week public health target, with variations across age, sex, class and ethnicity.
- In UK since the early 1990s there has been a rapid development of ERSs, where individuals at risk of lifestyle diseases are referred in the primary care setting to an exercise professional who then prescribes a programme of exercise delivered in a public leisure facility with follow-up checks of adherence and progression. A NQAF for ERS has been published.
- A number of recent systematic reviews have concluded that ERS has small effect on enhancing short-term PA with little or no evidence of long-term sustainability.
- These previous reviews have a number of limitations in the terms of addressing the current UK policy question of effectiveness and clinical effectiveness of ERS in people with diagnosed conditions, i.e. lack consistency in definition of ERS, limited consideration of diseased population and outcomes outside of PA and programme attendance, little exploration of the factors that might influence the effectiveness of ERS and limited cost-effectiveness analysis.

Decision problem

Based on our knowledge of the area, and our review of current practice of the ERS in the UK (Section 2) we propose to address the decision problem set out below, which covers the scope of the proposed research. We use the definitions for exercise referral as set out in the recent National Institute for Health and Clinical Excellence (NICE) guidance.[33]

Population

Sedentary adults who present in primary care with a diagnosed condition known to benefit from any combination of supervised and unsupervised PA. Conditions that will be specifically considered include CHD, stroke, peripheral vascular disease, cancer, obesity, type 2 diabetes, osteoporosis, low back pain and clinical depression. Where evidence is identified for ERSs associated with other conditions this will be included in the review. Currently active adults are less likely to benefit from exercise and will therefore not be considered [consistent with the Health Technology Assessment (HTA) commissioning brief].

Exercise referral schemes

An ERS *should* comprise three core components:

- referral by a primary care health-care professional to a service designed to increased PA or exercise.
- physical activity programme tailored to individual needs.
- initial assessment and monitoring throughout the programme.

An ERS is more intensive than simple advice and could include additional counselling, written material, telephone phone-up and supervised training. Programmes or systems of exercise referral initiated in secondary or tertiary care, such as conventional comprehensive cardiac or pulmonary rehabilitation programmes, will not be considered here.

Although primary consideration will made as to the evidence base for ERS, we will also include a secondary review of the evidence of secondary prevention programmes (e.g. smoking cessation, obesity management), where PA/exercise promotion is an stated component of a multicomponent programme. Given the time and resource constraints of this project, we anticipate that we have to limit this secondary review to published literature on UK-based secondary prevention programmes initiated in primary care.

Comparator

Usual ('brief') advice, no intervention, attention control or alternative forms of ERSs.

Outcomes

Four outcome domains will be considered:

1. Efficacy/effectiveness – primary outcome: PA (self report or monitored); secondary outcomes: physical fitness (e.g. VO_{2max}), health outcomes (e.g. blood lipids, blood lipids), patient satisfaction, psychological well-being, health-related quality of life (HRQoL); adverse events (e.g. skeletomuscular injury).
2. Patient factors that may moderate behavioural outcomes (e.g. uptake and adherence to programme).
3. Programme factors that may moderate behavioural outcomes (e.g. programme length and intensity).
4. Economics – resource use, costs and cost-effectiveness.

Report methods for identification and synthesis of evidence of effectiveness and cost-effectiveness

A review of the evidence for effectiveness of ERSs will be undertaken systematically following the general principles recommended in Centre for Reviews and Dissemination (CRD) Report 4[44] and the Quality of Reporting of Meta-analyses (QUOROM) statement.[45] The systematic review will be registered with the newly formed Cochrane Public Health Collaborative Group. A review of the cost-effectiveness evidence will be undertaken, drawing on CRD Report 6,[46] and using accepted formats for the review of economic evaluations.[47,48]

Search strategy

The search strategy will comprise the following main elements.

Searching of electronic databases An experienced information specialist (TM) based at Peninsula Technology Assessment Group (PenTAG) will undertake searches of the following databases: Cochrane Central Register of Controlled Trials (CENTRAL), EMBASE, MEDLINE, MEDLINE In-Process, PsycINFO, SPORTDiscus and Science Citation Index (SCI). Economic studies will be identified from EconLit, IDEAS and NHS Economic Evaluation Database (NHS EED). In addition, systematic reviews will be identified using clinical evidence, Cochrane Database of Systematic Reviews (CDSR), Database of Abstracts of Reviews of Effects (DARE), HTA Database, NICE website, National Library for Health (NLH) Guidelines Finder, and SIGN Guidelines. These reviews will be used to identify primary studies. No country or language restrictions will be placed on the search. The search will combine topic-specific indexed terms and text words – *exercise*, *physical activity*, *physical fitness*, *primary health care*, *referral*, *prescription* [and synonyms] – and a controlled study design and human filter. An example search strategy is shown in Section 11.

Contact with experts in the field The topic specific expert co-applicants and two external experts will provide input on the existing research in this field.

Scrutiny of bibliographies of reviews and retrieved papers The bibliographies of all relevant reviews and guidelines and all included studies will be checked for further potentially relevant studies. In addition, citation searching will be undertaken for selected papers.

Study selection

Studies reporting effectiveness and cost-effectiveness will be considered for inclusion based on the previously defined decision problem (Section 3). Individual or cluster randomised controlled

trials (RCTs) and non-randomised controlled studies will be sought. ERS publications (e.g. annual reports) not published in a peer review journal, non-systematic reviews, editorials, opinions and reports published as meeting abstracts only (where insufficient methodological details are reported to allow critical appraisal of study quality) will be excluded. For cost-effectiveness, full economic evaluations will be included (as defined in CRD Report 6[46]) and the review will include economic evaluations presented in reports of HTA agencies (e.g. NICE, Health Technology Board Scotland). Where abstracts are identified that report on cost-effectiveness, these will be identified in the review, but critical appraisal will be dependent on the level of detail available.

Titles and abstracts will be examined for relevance by two reviewers independently; all potentially relevant papers will be ordered. All full papers will be screened by two reviewers independently, relevance to the review and the decision to include studies or not will be made according to the decision problem detailed above. Disagreement will be resolved by consensus.

Data extraction strategy

Data will be extracted independently by one reviewer using a standardised data extraction form and checked by another. Discrepancies will be resolved by discussion, with involvement of a third reviewer when necessary. Extraction will include data on: patient characteristics (e.g. age, disease diagnosis), intervention (e.g. duration, location and level of supervision of exercise intervention delivered), comparison (e.g. brief advice), study quality and reported outcomes pertinent to the review (see Section 3.4).

Quality assessment strategy

Quality assessment instruments will be derived from published criteria, relevant to controlled studies (CRD Report 4[43]). These will be adapted to incorporate topic-specific quality issues (e.g. PA outcome assessed in a standard, valid and reliable way, the results were adjusted baseline PA). If appropriate, an overall quality rating will be developed and incorporated into the synthesis. An assessment of applicability will also be made based on the nature of intervention and population studied. As above, economic evaluations will be assessed using accepted critical appraisal methods. Where economic evaluations have used a decision-analytic modelling framework, these will be critically appraised using published guidance on good practice in decision-analytic modelling in HTA.[49]

Methods of analysis/synthesis

Effectiveness and cost-effectiveness data will be tabulated and discussed in a narrative review. The heterogeneity of the form and delivery of interventions, their settings and the study population will be assessed in a detailed qualitative way.

Where appropriate, meta-analysis (e.g. RCTs reporting change in PA levels) will be employed to estimate a summary measure of effect on relevant outcomes based on intention-to-treat analyses. Meta-analysis will be carried out using fixed or random effects models, using appropriate software. Heterogeneity will be explored through consideration of the study populations, methods and interventions, by visualisation of results and, in statistical terms, by the chi-squared test for homogeneity and the I^2-statistic. Evidence of publication bias will examined using funnel plots.

We will explore specific characteristics of ERS and how these relate to effectiveness and cost effectiveness, for example duration and 'dose' of exercise programme, and, where possible, the quality of supervision and assessment, setting, timing of programme relative to diagnosis of index condition.

Decision-analytic modelling

A decision-analytic modelling framework will be developed to explore the cost-effectiveness of ERS. The modelling framework will synthesise research findings on the effectiveness of ERS, consistent with the scope of the research proposed, and data from other sources (e.g. resource use, cost, HRQoL and epidemiological data).

The modelling framework, will extrapolate findings from controlled trials on ERSs, using trial outcomes, to predict longer-term outcomes (i.e. costs and consequences) associated with the impact of ERSs.

Members of the research team have contributed to the development of NICE public health guidelines on PA, environmental interventions to promote PA, workplace interventions to promote PA and PA in children.[6,8] The economic modelling undertaken as part of this prior research has included development of an economic model to estimate the cost-effectiveness of ERSs. The model used to inform the NICE public health guidance[33] has been developed and extended by members of the research team (Trueman and colleagues, in York Health Economics Consortium (YHEC)], and it will form the foundation for the modelling of cost-effectiveness proposed here.

The specific objectives of the cost-effectiveness analyses are:

- To provide policy relevant estimates of the cost-effectiveness of ERSs.
- To develop the existing models on PA and populate the models using the most appropriate data identified from the clinical effectiveness systematic review, related literature searching and routine data sources.
- To relate intermediate PA outcomes (i.e. participation rates, duration of activity) to final health outcomes, expressed in terms of events avoided, and quality-adjusted life-years (QALYs). This is necessary to provide decision-makers with an indication of the health gain achieved by an ERS, relative to its additional cost, in units that permit comparison with other uses of health service resources.
- To use the modelling framework to explore areas of uncertainty in the data used to populate the model, and the subsequent results. Uncertainty in results will be characterised, and summarised in a manner useful to decision-makers. Assuming the quality and appropriate form of data are available, a probabilistic model will be developed, which will consider simultaneously uncertainty in a range of parameter inputs
- To inform future research priorities in the NHS. Assuming the quality and appropriate form or data are available, the model will be used to undertake analyses of the expected value of information. These take the decision uncertainty associated with analysis and quantify the cost of this uncertainty in terms of health gain forgone and resources wasted by making the wrong decision. This cost of uncertainty represents the value of perfect information, and this can be estimated for the model overall and for individual parameters.

The model is expected to adopt a lifetime time horizon, to reflect the potential long-term benefits of sustained PA. Results will also be reported at an intermediate time horizon(s) that more directly reflect(s) the data sources. The perspective will be that of the National Health Services and Personal Social Services, although there may be scope for exploring other broader perspectives (e.g. inclusion of indirect costs and benefits), depending on the findings of the literature review. Future costs and outcomes will be discounted at 3.5% in line with accepted practice in the UK.

The modelling of cost-effectiveness, consistent with the model currently available, will quantify the impact of PA on a number of health conditions (e.g. diabetes, CVD, colon cancer).

Effectiveness data, to populate the model, will be derived from the literature review undertaken as part of the proposed research. Other data on resource use, costs, and on the prediction of health outcomes from effectiveness data on exercise referral, will be from systematic searching of the relevant literature, and from other sources where appropriate. All data sources will be explicitly stated, model structure will be clearly described and a rationale/justification for the model structure will be presented. Modelling will be undertaken in accordance with guidelines on good practice for decision modelling within HTA,[49] and all modelling methods and data will be fully transparent.

Results from the modelling of cost-effectiveness will be presented in a disaggregated format (outcomes, resource use, costs), and also in the form of a cost-effectiveness ratio. Results will include estimation of incremental cost per life-year gained, and cost per QALY (cost per QALY). Where appropriate, results will include presentation of cost-effectiveness consistent with the reference case used by NICE.[50] Where probabilistic modelling is undertaken, probabilistic sensitivity analysis will be presented. Results will include presentation of cost-effectiveness planes, and cost-effectiveness acceptability curves. Sensitivity analysis will also explore structural uncertainty, and further parameter uncertainty, through extensive one-way and multiway sensitivity analyses.

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We look forward to hearing from you.

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