

Effectiveness of general practice-based physical activity promotion for older adults: systematic review

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Aim: To review the effectiveness of physical activity interventions for adults aged 50 and above, delivered through general practice. **Background:** Physical activity has beneficial effects on the common disorders of later life. General practice is a potentially important setting for promotion of physical activity among older adults, but the effectiveness of such interventions is presently unknown. **Methods:** Studies published between January 1998 and July 2011 were identified from electronic databases. We searched for studies of tailored physical activity interventions to older adults through general practice. The search and selection process was not restricted to any outcome measures but only included studies comparing two or more groups prospectively. Two reviewers screened the studies and obtained full texts of eligible studies. Included studies were assessed for their methodological quality and public health impact. **Findings:** Altogether, 4170 studies met the initial search criteria but only six were included in the review, with a total of 1522 participants. The interventions ranged from six weeks to six months. One study showed a statistically significant increase in physical activity in the intervention compared with the control group ($P \leq 0.007$). Four studies measured quality of life using the SF-36, of which three reported inconsistent results. This review shows some evidence of the effectiveness of physical activity promotion for older adults through general practice, but not enough to warrant widespread commissioning and implementation. Large-scale developmental projects with long follow-up (beyond two years), objective measures of physical activity and comprehensive documentation of resource use, should now be conducted.

Key words: general practice; older adults; physical activity

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Introduction

Regular physical activity improves health and well-being. It reduces the risk of type 2 diabetes,

osteoporosis, cardiovascular disease and some cancers, and falls in older adults (Baumann, 2004; Department of Health, 2011). Current recommendations are that each week older adults should do at least 150 minutes of moderate aerobic activity and two sessions of strength and balance activities (Department of Health, 2011). However, the older population in the United Kingdom is largely inactive (Skelton *et al.*, 1999;

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Health Survey for England, 2009). Given population ageing, we need to promote regular physical activity in order to reduce the impact of disease, restore and maintain function, increase quality of life and contain the use of health and social services (Department of Health, 2011). There are both patient-focused and public health reasons for systematically promoting physical activity among older adults.

General practice-based physical activity promotion has the potential to change physical activity habits by addressing barriers to physical activity such as limited money and poor health (Kerse *et al.*, 2005; Lees *et al.*, 2005; Hardy and Grogan, 2009). Promotion of physical activity in general practice currently includes physical activity recommendations, written material and exercise referral schemes often based in local leisure centres, and there is some evidence that these approaches improve self-reported physical activity levels (Orrow *et al.*, 2012). Much less is known about general practice-based tailored programmes that go beyond generalised advice. Therefore, this review evaluates the effectiveness of such general practice-based tailored physical activity interventions in older adults, whereby participants' baseline physical activity levels are assessed to provide individualised physical activity recommendations. This review aims to be able to inform the commissioning and provision of physical activity promotion.

Method

Search strategy

We searched for studies that evaluated physical activity interventions for older adults using the following terms: (exercise* promotion or physical activit* or (strength and balance)) and (general practice or GP or general pract*) and (age* or older). Searches were run for research published from January 1998 to July 2011 in CINAHL Plus, EMBASE, MEDLINE, PUBMED, OT Seeker and Web of Knowledge.

Full texts of eligible studies were found and their reference lists were hand-searched for additional studies. Review papers were hand-searched to find the original articles. The PRISMA diagram shows the process of literature search (Figure 1).

Study selection process

The two authors (Z.S. and C.B.) screened for eligible studies, any uncertainties were discussed between them and disagreements resolved by author S.I. Criteria for inclusion and exclusion were as follows.

Inclusion

- Tailored physical activity interventions including aerobic, strength and balance exercises that recruited participants (aged 50 and over) from and/or were provided in general practice. 'Tailoring' in this review means baseline assessment of current physical activity and functional limitations, and individualised recommendations to increase physical activity.

Exclusion

- Studies with participants with specific conditions (eg, advanced dementia or Parkinson's disease, frequent fallers, people with severe aortic stenosis).
- Studies with participants recruited from care homes or not living independently.
- Studies recruiting single sex populations.
- Publications not in English.
- Studies not comparing two or more groups prospectively.

Studies that involved participants below 50 years old were included if data were reported in separate age bands. Selection was not based on outcome measures.

Data extraction

Key details from the studies were extracted and entered onto a standard Excel grid with pre-defined headings (Table 1; Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Harrison *et al.*, 2005; Kerse *et al.*, 2005; Kolt *et al.*, 2007). Data were extracted by one reviewer and checked by a second. Discrepancies were discussed and resolved between the two reviewers (Z.S. and C.B.) where necessary, involving reviewer S.I.

Quality assessment and public health relevance

The studies selected for inclusion were assessed using two different sets of criteria, one addressing methodology and the other with relevance to public health.

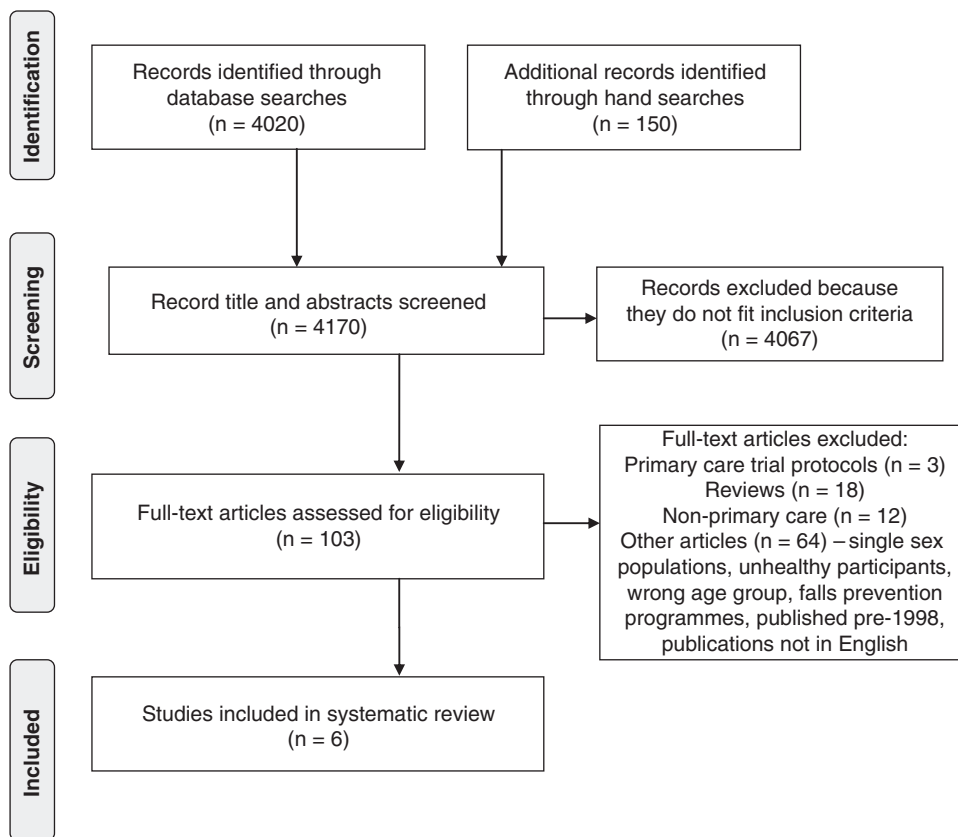


Figure 1 PRISMA diagram. This PRISMA diagram shows the literature search results and the numbers of articles that were included and excluded from the review.

Methodological criteria: the studies were evaluated for quality of controlled trials to assess for internal and external bias (Jüni *et al.*, 2001). Internal bias includes selection bias, performance and detection bias and attrition bias. External bias includes generalisability of participants, treatment and setting.

Public health criteria: the RE-AIM framework allows for an evaluation of the public health impact of health promotion studies using five dimensions (Glasgow *et al.*, 1999): (1) Reach: proportion of the target population reached and the characteristics of participants compared with the target population. (2) Efficacy: how the intervention benefitted the participants. (3) Adoption: characteristics of the settings participating in the study. (4) Implementation: the extent to which the intervention was delivered as intended,

including the adherence to the intervention and the involvement of staff in the setting. (5) Maintenance: long-term maintenance of behaviour change, defined as equal to or more than two years.

Analysis

Meta-analyses were not performed because of the heterogeneity of outcome measures used by the studies.

Results

The literature search found 4170 studies. After review and exclusion of ineligible studies, six of these studies were included in this review (Figure 1). The six studies are described in detail below and summarised in Tables 1–3. Table 1 shows

Table 1 Key characteristics of included studies

First author, date, country	Trial design	Number of participants and power calculation	Age and sex of participants	Intervention and comparison group	Intervention delivery	Outcomes (time points measured, measured by, results)	Confounders controlled or baseline adjusted
Goldstein G Michael, 1999, USA	RCT	355 No power calculation described.	50+ (mean 65.6, SD 9.1) 76% male	Aim – to produce changes in exercise levels at eight months. Sessions of tailored exercise recommendations, written exercise prescription and manual (containing exercise information and tips). First session during routine visit. Follow-up session four weeks later. Participants then received five monthly mailings containing a manual and newsletters. Comparison group – Treatment as Usual.	At GP surgery and via telephone. By GPs.	Time points – baseline, six weeks, eight months. PASE measured exercise levels – no difference between groups at six weeks or eight months. Motivational Readiness for exercise – at six weeks more intervention participants were in Preparation or Action and 16% more of those who were in Pre-contemplation/Contemplation at baseline were in Preparation or Action compared with controls. At eight months no difference between groups. Results not reported for Quality of Life (SF-36) or psychosocial factors.	No significant differences in demographics of physicians or participants.
Harrison A Roger, 2005, England	RCT	545 (128 age 60+). 440 participants required to detect a 16% increase in exercise with 90% power at 5% statistical significance.	60+ no other information reported, 33% male	Aim – to reach exercise target of ≥ 90 min/week of moderate/vigorous activity at 12 months. Local authority exercise scheme, written information, information pack (importance of exercise, local council run facilities). Initial 1 hour consultation provided advice and information to increase current exercise level, offered 12-week leisure pass, provided reduced entrance fees to local facilities, encouraged to attend \geq two sessions/week. At 12 weeks, participants had exit interview to review progress and identify opportunities for improvements. Comparison group – received information pack.	At leisure centres. By exercise instructors.	Time points – three, six, nine, 12 months. Seven-day exercises recall measured exercise levels – non-significant increase at 12 months but significant increase at six months by intervention participants compared with controls.	Participants stratified by sex, age, (18–44, 45–59, ≥ 60) CHD risk. Data adjusted for baseline stratifying variables.
Kerse Ngaire, 2005, New Zealand	Cluster RCT – sub-group from larger study	270. No power calculation described.	≥ 65 (mean 71, SD 4.1), 37% male	Aim – to increase exercise and quality of life over 12 months. Tailored exercise recommendations and ‘Green Prescription’ that was faxed to regional sports foundation. Follow-up telephone support for three months. Written material and newsletters sent quarterly. Comparison group – Treatment as Usual.	At GP surgery and via telephone. By GPs or nurse. Exercise specialists provided follow-up telephone support.	Moderate/vigorous exercise – non-significant increase (11%) in intervention participants compared with control to reach 2.5 hour/week of moderate/vigorous exercise over 12 months. Quality of Life (SF-36) – significant improvements in vitality and general health scores in intervention group compared with controls. Blood pressure, musculoskeletal injuries, falls – no change. Decrease in hospitalisations.	Adjusted for cluster by GPs and practice size.

Table 1. *Continued*

First author, date, country	Trial design	Number of participants and power calculation	Age and sex of participants	Intervention and comparison group	Intervention delivery	Outcomes (time points measured, measured by, results)	Confounders controlled or baseline adjusted
Kolt S Gregory, 2007, New Zealand	RCT	186. 184 participants required to detect a 30% change in exercise with 80% power at 5% statistical significance.	≥65 (mean 74.3, SD 5.9), 34% male	Aim – to increase exercise and quality of life. Eight sessions of telephone counselling over 12 weeks. Walking log and pamphlets received via post. Comparison group – Treatment as Usual.	Via telephone. By exercise counsellor.	Time points – baseline, three, six, 12 months. Auckland Heart Study Exercise Questionnaire – Moderate leisure exercise increased significantly in intervention compared with control group. More intervention participants reached 2.5 h of moderate/vigorous leisure exercise per week at 12 months. Quality of Life (SF-36) – no difference between groups at 12 months.	Adjusted for age, sex, study design, effects and baseline effects.
Petrella J Robert, 2003, Canada	RCT	284. 280 participants required to detect a 10% difference in fitness with 90% power.	>65 (mean 73, SD 6), 51% male	Step Test Exercise Prescription included tailored exercise and prescription of an exercise training heart rate. Comparison group – fitness counselling fitness and exercise self-efficacy. Both groups were given list of available community facilities for exercise participation.	At GP surgery. By GPs.	Time points – baseline, three, six, 12 months. Aerobic fitness (VO_{2max}) measured by collecting respired gases after using a treadmill – VO_{2max} was significantly increased in the intervention group compared with controls at six and 12 months. Exercise self-efficacy – increased in intervention group at 12 months. Anthropometric parameters – systolic blood pressures and BMI's decreased in intervention participants but no change in controls. Weekly activity was recorded – more intervention participants did available exercises.	No differences in GPs demographics. Group differences and intervention effect were adjusted for baseline factors.
Halbert A Julia, 2000, Australia	RCT	299. 300 participants required to detect a 5 mmHg difference in systolic blood pressure with 90% power at 5% statistical significance.	60+. Intervention group (67.3 (SD 7.9)), control group (67.8 (SD 5.5)), 44% male	Aim – to increase exercise and quality of life, and reduce CVD risk over 12 months. 20 min session with exercise specialist. Advice about exercise benefits. Three-month exercise plan to include moderate intensity aerobic activities for at least three 20 min sessions per week, self-monitoring heart rate, strategies to overcome barriers and incorporate exercise into usual activities and increase self-efficacy. Comparison group – same 20 min session and pamphlet on good nutrition.	At GP surgery. By exercise specialist (masters in exercise physiology)	Time points – three, six months, plus continuous exercise log. Frequency and duration of walking and vigorous exercise – exercise increased in both groups. More intervention than control participants increased their intention to exercise. Quality of Life (SF-36) – decreased in both groups. CVD risk factors – serum levels of total and low-density lipoprotein cholesterol and triglycerides fell similarly in both groups.	No statistically significant differences between groups in age, sex and past/current medication use.

CHD = coronary heart disease; BMI = body mass index; CVD = cardiovascular disease.

the key characteristics of included studies, Table 2 shows their methodological quality and Table 3 describes their public health impact according to the RE-AIM framework.

Description of studies

The six studies were all randomised controlled trials. Half of the studies were conducted in Australasia, two in New Zealand and one in Australia. The remaining three were based in the United Kingdom, United States and Canada. Five of the studies reported the mean age of participants, which ranged from 65 to 74; four recruited a greater number of females. Numbers of participants in the studies ranged from 168 to 355 and totalled 1522.

Four interventions were delivered through the general practice site (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kerse *et al.*, 2005), one through a local leisure centre and one entirely by telephone (Goldstein *et al.*, 1999; Kolt *et al.*, 2007). Interventions were delivered by general practitioners (Goldstein *et al.*, 1999; Petrella *et al.*, 2003; Kerse *et al.*, 2005), exercise specialists (Halbert *et al.*, 2000; Harrison *et al.*, 2005) and an exercise counsellor (Kolt *et al.*, 2007). The interventions ranged from six weeks to six months. The number of contacts the participants had with the intervention deliverer varied between fortnightly (most frequent) to once in every two months (least frequent) (Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kolt *et al.*, 2007). The frequency of recommended physical activity varied because of the advice being tailored to individual participants: two studies encouraged participants to be active on two to three days per week (Goldstein *et al.*, 1999; Halbert *et al.*, 2000). The studies used a range of different outcome measures. Two studies used specific measures such as the PASE and the Auckland Heart Exercise Questionnaire (Harrison *et al.*, 2005; Kolt *et al.*, 2007). Three studies used self-reported activity and one study used a method of testing aerobic fitness using expired gas after exercising (Petrella *et al.*, 2003). Secondary outcomes included Quality of Life using the SF-36 (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Kerse *et al.*, 2005; Kolt *et al.*, 2007), motivational readiness (Goldstein *et al.*, 1999), blood pressure and falls (Kerse *et al.*, 2005), self-efficacy and cardiovascular risk factors

(Halbert *et al.*, 2000; Petrella *et al.*, 2003). The follow-up periods ranged from six to 12 months; four studies had 12 months follow-up (Halbert *et al.*, 2000; Petrella *et al.*, 2003; Harrison *et al.*, 2005; Kerse *et al.*, 2005).

Outcomes

Effects on self-reported physical activity levels

Two studies report a statistically significant increase in physical activity levels; Kolt *et al.* (2007) report that moderate leisure physical activity increased by 86.8 minutes/week in the intervention participants compared with controls ($P = 0.007$). More intervention participants reached 2.5 hours/week of moderate/vigorous leisure physical activity at 12 months compared with controls (42% versus 23%, OR 2.9, 95% CI 1.33–6.32, $P = 0.007$). Halbert *et al.* (2000) report that physical activity increased in both groups ($P < 0.05$), but more intervention than control participants increased their intention to do physical activity ($P < 0.001$). The increase was greater for the intervention than the control group for all measures except the time spent walking ($P < 0.05$; no odds ratio reported). Two studies showed no significant increase in activity (Goldstein *et al.*, 1999; Kerse *et al.*, 2005).

Effects on self-efficacy and motivational readiness for physical activity

Motivational readiness for behaviour change can be measured by the Transtheoretical Model for Change. Goldstein *et al.* (1999) showed that, at six weeks, 15% more intervention participants were in Preparation for behaviour change or Action phase compared with controls (OR 3.56, 95% CI 1.79–7.08, $P < 0.001$), and 16% more intervention participants improved from Pre-contemplation/Contemplation about behaviour change at baseline to Preparation or Action compared with controls (OR 3.27, 95% CI 1.32–8.07, $P = 0.01$). At eight months, no difference between groups in Preparation or Action was seen. Another study found physical activity self-efficacy significantly increased in intervention participants compared with controls at 12 months ($P < 0.001$; Petrella *et al.*, 2003). Significantly, more intervention participants completed $\geq 80\%$ of available physical activity opportunities than controls ($P < 0.05$; no odds ratio reported).

Table 2 Methodological quality of included studies

First author, date, country	Selection bias	Performance and detection bias	Attrition bias (attrition, control)	Generalisability of participants	Generalisability of treatment	Generalisability to setting
Goldstein G Michael, 1999, USA	No mention of allocation sequence or blinding.	Information tailored for participants. No mention of whether researchers were blind to allocation.	42 (23%) of intervention group lost to follow-up (unknown from control group). Unknown if carried out an Intention to Treat analysis.	Aged 50+, male and female, in the United States. Sedentary (<5 × 30 min moderate activity/week). Demographics of physicians and participants shown. No mention of whether participants had comorbidities or risk factors. Participants represent 13% of patients scheduled for a GP appointment during the intervention period. Participants all understood English, could communicate and consent.	Intervention delivered in general practices by GPs.	Solo and group general practices. GPs received one hour training session.
Harrison A Roger, 2004, England	Randomisation done by computer. Exercise officers blinded pre-allocation.	Information tailored for participants. Researchers not blinded.	121 (44%) interventions and 113 (42%) control groups lost to follow-up. Intention to Treat analysis done. Responses to questionnaires not influenced by age, sex, smoking, CHD.	Aged 60+, male and female, in North West England. Sedentary (<90 min of moderate/vigorous activity per week). Those eligible were eligible for the Exercise Referral Scheme, that is, could have CHD risk factors. Demographics of participants shown.	Intervention delivered in Exercise Referral Scheme leisure centres in form of advice and a leisure centre pass for 12 weeks.	Exercise referral scheme existed since 1997.
Kerse Ngairé, 2005, New Zealand	GPs randomised by distant computer by an independent statistician.	Information tailored for participants. Participants and GPs could not be blinded to allocation. No mention of whether researchers were blind to allocation.	37 (13%) of all participants lost to follow-up, paper does not distinguish between groups. Intention to Treat analysis done.	Aged 65+ in Waikato region in New Zealand. Sedentary (<5 × 30 min moderate activity per week). Demographics of participants shown. No participants had unstable CVD, debilitating, or progressive illness. Participants all understood English, could communicate to consent.	Intervention delivered in general practices by GPs and nurses in form of advice and written material. Trained exercise specialised telephone three times.	Training given for GPs and 2 h refresher was provided to all physicians delivering intervention.
Kolt S Gregory, 2007, New Zealand	No mention of allocation sequence or concealment.	Assessors were blinded to allocation.	10 (11%) interventions and 11 (12%) control groups lost to follow-up. No mention of Intention to Treat analysis.	Aged 65+, male and female, various socio-economic regions of Auckland, New Zealand. Sedentary (<5 × 30 min moderate activity per week). Demographics of participants shown. No unstable major health problems. Participants all understood English, could communicate to consent.	Intervention delivered via telephone by exercise counsellors in form of encouragement for eight weeks.	Delivered via telephone by a trained counsellor.
Petrella J Robert, 2003, Canada	No mention of allocation sequence. Researchers were blinded at baseline before randomisation.	Same GPs who delivered initial consultation saw participants at follow-up. No mention of whether researchers were blinded during detection period.	43 (15%) of all participants were lost to follow-up, paper does not distinguish between groups. Intention to Treat analysis done.	Aged 65+. Demographics of participants shown. No formal participation in a regular exercise training programme. Uncontrolled, unstable, progressive, debilitating illnesses excluded. Excluded living in long-term care.	Intervention delivered by GPs in form of tailored exercise sessions four times over 12 months.	Academic general practice clinics in Ontario Canada. Staff were trained in STEP. Physicians did 30 min workshop to learn STEP.
Halbert A Julia, 2000, Australia	No mention of allocation sequence or concealment.	No blinding of outcome assessors reported.	26 (17%) interventions, 9 (6%) control groups lost to follow-up. Intention to treat analysis done	Aged 60+ in Adelaide, Australia. Sedentary (no regular exercise). Exclusions were cerebrovascular or ischaemic cardiac event in the last six months, malignancy or other life threatening disease, inability to comply with the requirements of the study, a condition where exercise was contraindicated, use of β blockers.	Intervention delivered in general practices by exercise specialists in the form of individual advice, pamphlet with exercise plan.	Exercise specialists had a master's degree in exercise physiology.

CVD = cardiovascular disease; CHD = coronary heart disease.

Table 3 Public health impact of included studies using the RE-AIM criteria

First author, date, country	RE-AIM reach	RE-AIM efficacy	RE-AIM adoption	RE-AIM implementation	RE-AIM maintenance
Goldstein G Michael, 1999, USA	Study was given 2674 patient names from participating practices – 13% of these enrolled in the study. Demographic data were collected for these patients only.	Motivational readiness for exercise improved at six weeks but no difference was found between treatment groups when measured at eight months.	Twenty-four general practices were recruited involving 34 GPs. Demographics were collected about the GPs.	GPs had training to deliver the intervention. 77% of participants who enrolled completed the study.	Absent (study was eight months).
Harrison A Roger, 2004, England	720 people were assessed for eligibility. 545 patients whose GP defined as sedentary consented (23% were older adults). No mention of how many patients the sample was taken from.	At 12 months, no change in the intervention group reaching 90 min moderate/vigorous activity was seen. Patients were satisfied with the intervention.	Local authority borough participated.	Exercise officers in the borough delivered the intervention. 57% of all patients completed the study.	Absent (study was 12 months).
Kerse Ngaire, 2005, New Zealand	67% of eligible sedentary patients participated. Baseline characteristics were gathered and characteristics of patients lost to follow-up were compared with those who completed.	Vitality and general health scales of the SF-36 showed improvements in intervention participants compared with controls.	117 doctors in 42 practices (74% participation rate).	87% participants completed the study.	Absent (study was 12 months).
Kolt S Gregory, 2007, New Zealand	831 patients were invited to participate, 333 agreed to participate and 186 (56%) of these met inclusion criteria (being sedentary). Demographics at baseline were collected. 22% of those invited were eligible.	Moderate activity increased in intervention group more than control. There was no difference in SF-36 between groups.	Three general practices. Demographics of GPs are not available.	89% of participants completed the study.	Absent (study was 15 months).
Petrella J Robert, 2003, Canada	284 healthy patients were recruited. Demographic data were gathered from all participants at baseline.	VO _{2max} and self-efficacy increased in the intervention group at 12 months more than control group.	Four large general practices (three urban and one rural) each with four GPs. Demographics of GPs are available.	85% of all participants completed the study. GPs prescribed the intervention.	Absent (study was 12 months).
Halbert A Julia, 2000, Australia	2878 potentially eligible people were screened, 913 attended and completed a demographics questionnaire, leaving 351 eligible and invited to attend. 299 attended the baseline intervention and were randomised. 10% of those screened were randomised.	Increased self-reported activity. More intervention than control participants increased their intention to exercise. Serum levels of total and low-density lipoprotein cholesterol and triglycerides fell significantly over the 12 months to a similar extent in both groups. QoL scores decreased over the 12 months.	Two general practices in Australia	Intervention delivered by exercise specialist (with masters in exercise physiology). 89% attended 12-month follow-up.	Absent (study was 12 months).

Effects on aerobic fitness

VO_{2max} is a measure of aerobic fitness. In one study, VO_{2max} significantly increased in the intervention group compared with controls at six (11% versus 4%, $P < 0.001$) and 12 months (17% versus 3%, $P < 0.001$) (Petrella *et al.*, 2003).

Effects on quality of life

One study found no differences on quality-of-life measures between the groups at 12 months (no odds ratio reported) (Kolt *et al.*, 2007). Alternative research found a statistically significant decrease in the quality-of-life scores in both groups for body pain ($P < 0.001$), physical functioning ($P < 0.001$) and vitality ($P = 0.04$; no odds ratio reported; Halbert *et al.*, 2000). Another study found that the intervention group showed significant improvements in vitality (OR 4.43, 95% CI 0.31–8.54) and general health (OR 5.46, 95% CI 1.69–9.24) scales compared with control (Kerse *et al.*, 2005).

Other outcomes

One study reported that consultation time with participants was significantly longer with the intervention compared with control participants ($P < 0.02$) (Petrella *et al.*, 2003).

Methodological quality

The methodological quality of the studies is summarised in Table 2. In terms of internal validity, only two studies describe the method for generating their randomisation sequence; one used a computer-generated sequence (Harrison *et al.*, 2005), the other stated that it had been generated by an independent statistician (Kerse *et al.*, 2005). Only two studies report on concealment of allocation (Petrella *et al.*, 2003; Harrison *et al.*, 2005). In five studies, those who delivered the interventions also assessed outcomes (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kerse *et al.*, 2005; Kolt *et al.*, 2007), thus blinding was not possible. Four studies did an intention to treat analysis (Halbert *et al.*, 2000; Petrella *et al.*, 2003; Harrison *et al.*, 2005; Kerse *et al.*, 2005), four studies controlled for confounding variables (Petrella *et al.*, 2003; Harrison *et al.*, 2005; Kerse *et al.*, 2005; Kolt *et al.*, 2007) and three studies reported no differences between treatment groups at baseline (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003).

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In terms of external validity, all studies took place in English-speaking countries, and half required participants to have a good understanding of English in order to participate (Goldstein *et al.*, 1999; Kerse *et al.*, 2005; Kolt *et al.*, 2007). All studies aimed to exclude those who were regularly active and recruit sedentary participants. Four studies excluded people with unstable, progressive or debilitating illnesses (Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kerse *et al.*, 2005; Kolt *et al.*, 2007). Four interventions were delivered in general practice, mainly by general practitioners but also by nurses and exercise specialists (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kerse *et al.*, 2005). The interventions lasted from three to 12 months and were individualised for participants. Those who delivered the interventions had training for their role to provide participants with standardised information. One study provided participants with a leisure pass to attend a local Exercise Referral Scheme leisure centre for 12 weeks (Harrison *et al.*, 2005).

Public health impact

The studies were evaluated using the RE-AIM criteria (Table 3):

- *Reach*: Four studies report how many people were screened for eligibility or invited to participate and the percentage that consented, ranging from 10% to 67% (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Harrison *et al.*, 2005; Kolt *et al.*, 2007). The variation between studies could be partly because of the studies' inclusion/exclusion criteria, determining the proportion of people who are included in these studies. The remaining two studies only report the number of participants who consented, hence the reach, and therefore the characteristics of participants compared with the target population is unknown (Petrella *et al.*, 2003; Kerse *et al.*, 2005).
- *Efficacy*: The most common primary and secondary outcomes were physical activity level (Halbert *et al.*, 2000; Harrison *et al.*, 2005; Kerse *et al.*, 2005; Kolt *et al.*, 2007) and quality of life, respectively (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Kerse *et al.*, 2005; Kolt *et al.*, 2007). The results are varied; however, some interventions may have benefitted the participants

in terms of their physical activity levels and quality of life. See outcomes in the 'Results' section.

- **Adoption:** Five studies report the settings that hosted the interventions, which may be useful for future studies when assessing how interventions are adopted by settings. The number of general practice practices engaged in the studies varied from two to 42 (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kerse *et al.*, 2005; Kolt *et al.*, 2007). Three studies report the number of general practitioners who participated, ranging from 12 to 117 (Goldstein *et al.*, 1999; Petrella *et al.*, 2003; Kerse *et al.*, 2005).
- **Implementation:** All studies report the percentage of participants who completed the studies, ranging from 57% to 89%. Studies with lower participant attrition rates were delivered as intended more so than studies with higher attrition rates. All studies report who delivered the intervention; four studies report that the deliverer had training, background experience or qualification making them suitable for the position (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kerse *et al.*, 2005).
- **Maintenance:** None of the studies could be assessed for long-term behaviour maintenance because of follow-up periods of less than two years.

Discussion

Summary of main findings

The six studies included in this review were heterogeneous in design and difficult to compare. The most common outcome measures were of physical activity levels and quality of life. One study, providing three months of physical activity fortnightly counselling over the telephone, found a statistically significant increase in physical activity in the intervention participants compared with controls (Kolt *et al.*, 2007). A study found statistically significant increases in quality of life scores for vitality and general health in participants who received a 'Green prescription' (exercise on prescription) and telephone follow-up (Kerse *et al.*, 2005). One study showed a statistically significant increase in aerobic capacity in the intervention participants compared with controls (Petrella *et al.*, 2003). Four studies

used general practitioners or nurses to deliver interventions (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kerse *et al.*, 2005); however, methods of assessing outcomes and follow-up periods differ. Half of the studies gave participants practical encouragement for increasing physical activity, either by providing a membership to a health centre (Harrison *et al.*, 2005), by providing a step monitor (Petrella *et al.*, 2003) or by giving specific physical activity plan (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kerse *et al.*, 2005). All interventions left participants to motivate and organise their own physical activity, and the quantity of physical activity undertaken was not monitored, making it difficult to know whether the dose of the intervention affected the results.

The methodologies of studies were not well reported, making it difficult to replicate the interventions and determine their quality. The risk of selection bias is high in the four studies that have no mention of allocation concealment (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Kerse *et al.*, 2005; Kolt *et al.*, 2007). The risk of detection and reporting bias is high in five studies where blinding was not possible (Goldstein *et al.*, 1999; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Kerse *et al.*, 2005; Kolt *et al.*, 2007). The risk of attrition bias is low in three studies that controlled confounders and performed intention to treat analyses (Petrella *et al.*, 2003; Harrison *et al.*, 2005; Kerse *et al.*, 2005). The studies were undertaken in different countries, in rural and urban settings. Follow-up was less than two years, making it difficult to know which interventions have sustained effects.

Strengths and limitations of the review

This is the first systematic review to contextualise physical activity promotion for older adults using the RE-AIM framework, to provide a public health perspective.

This review has a narrow scope. Only studies set in general practice that recruited healthy participants were included, and all eligible studies only recruited English-speaking participants in developed countries. The review excluded studies that concentrated on physical activity as therapy for specific medical conditions or syndromes, for example, falls. Because of limited research in this area, no restrictions were put on outcome

measures in selected studies. Inevitably, a main limitation is heterogeneity in the interventions and outcome measurements. All studies had self-reported physical activity outcomes, sometimes captured using a standard instrument; self-report may overestimate levels of physical activity (Hillsdon *et al.*, 2005).

Participants who choose to take part in physical activity studies are likely to be more active or over-report their physical activity levels compared with the wider population (Goldstein *et al.*, 1999). This potential selection bias may have occurred in these studies, but the inclusion criteria minimised this by excluding regularly active people. It is impossible to blind participants to their given physical activity intervention. Reporting bias, therefore, may have occurred in the reviewed studies, which would make the interventions appear more effective than they actually are. Despite small sample sizes, four studies reported their power calculation and recruited enough participants to detect differences (of varying levels) with 80% or 90% power at a 5% statistical significance (Table 1; Halbert *et al.*, 2000; Petrella *et al.*, 2003; Harrison *et al.*, 2005; Kolt *et al.*, 2007).

Implications for future research and clinical practice

The evidence for the effectiveness of general practice-based physical activity promotion aimed at older adults is too limited to support wide-spread commissioning of such interventions. It does suggest that large-scale developmental projects with follow-up periods exceeding two years, objective measures of physical activity and evaluation of service used to determine the implications for clinical practice should now be considered.

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Ethical body: Not required for review, but undertaken as part of work on ProAct65+ randomised *Primary Health Care Research & Development* 2014; **15**: 190–201

controlled trial, which had ethical approval from Nottingham Research Ethics Committee 2 (08/H0408/72).

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