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Br J Sports Med 1996 30: 84-89

doi: 10.1136/bjasm.30.2.84

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REVIEW ARTICLE

A systematic review of physical activity promotion strategies

Melvyn Hillsdon, Margaret Thorogood

Regular physical activity can play an important role in both the prevention and treatment of cardiovascular disease, hypertension, non-insulin-dependent diabetes mellitus, stroke, some cancers, osteoporosis and depression, as well as improving the lipid profile.¹⁻⁸ A meta-analysis of the relation between physical activity and coronary heart disease reported that the relative risk of coronary heart disease death in the least active compared with the most active was 1.9-fold.⁹ The magnitude of this relative risk is similar to that of the other important cardiovascular disease risk factors, cigarette smoking, hypertension, and hyperlipidaemia.¹⁰

Despite this evidence, it is estimated that 70% of the English population takes inadequate physical activity¹¹ compared to 31% who smoke, 30% with a raised serum cholesterol concentration, and 15% who are hypertensive.¹²

In 1995 the Centers for Disease Control and Prevention (USA) and the American College of Sports Medicine recognised the importance of physical activity and published a public health message recommending that "every adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all days of the week".¹³ In March of this year the Health Education Authority also recognised the public health potential of physical activity, by embarking on a three year national campaign (Active for Life) at promoting the same message.

Although a large body of evidence exists about the health benefits of physical activity, far less is known about the effectiveness of strategies to achieve the increases in physical activity necessary to acquire these benefits.

In this paper we report a revised and updated version of a previous systematic review of randomised controlled trials of physical activity promotion in apparently healthy, free living adults.¹⁴ The aim of the paper is to provide recent and reliable information on the effectiveness of physical activity promotion.

There are randomised, controlled trials using exercise as an intervention to study the physiological effects of exercise and in the management of health problems, notably hypertension, hyperlipidaemia, and overweight. These show the effects of exercise on various physiological and biological outcomes and demonstrate the importance of exercise in the management of disease. However, because

the main outcome of such trials is not physical activity, they do not help us understand the effectiveness of physical activity promotion strategies. For these reasons they were not considered for this review.

Methods

Computerised searches were carried out using Medline, Excerpta Medica, Sport, and SCISearch from 1966-1996. The method described by Dickersin and colleagues¹⁵ was used to search for randomised controlled trials on Medline. Key words for searching included "exercise", "physical activity", and "Randomised-Controlled-Trial". The search was limited to English language journals. Additional searching was carried out using the references from both existing reviews¹⁶⁻¹⁸ and the papers identified during the search. In addition to the studies described previously, a further 10 studies were found. Those studies included in the previous review were reread by both of us independently, as were the new studies identified during this search. Each paper was read and assessed using a shortened version of the EPI-Centre Review Guidelines.¹⁹

The criteria for inclusion of trials in the review were:

- a control group
- subjects assigned to control or intervention by a process of randomisation
- trials testing single factor interventions to increase activity
- interventions tested on apparently healthy, free living adults
- minimum of 12 weeks duration
- exercise behaviour was the dependent variable

Results

Ten new trials were identified, with three meeting the inclusion criteria. Two of the 10 trials in the earlier review were excluded. One of these²⁰ did not meet the new criterion of 12 weeks minimum duration and we decided on rereading that the other did not describe the exercise level of the control group postintervention.²¹ The 11 trials which are included in this review are described in table 1A and B (studies 5 and 6 are from the same paper and are reported separately for convenience). All the trials were from the USA. We did not find any from the United Kingdom

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Accepted for publication
27 March 1996

Key terms: exercise; physical activity; randomised controlled trial; walking

that met the inclusion criteria, although we are aware of some that are in progress. Subjects were mainly white, middle aged, and well educated. Most subjects were volunteers, recruited through local advertisements. The trials include an even mix of males and females with an age range of 18–72 years (mean approximately 49).

INTERVENTIONS

Table 1 summarises the main exercise components of the trials and table 2 the results. Both tables are sorted by location (home or facility) of exercise and then by outcome. Intervention periods ranged from five weeks to two years. Seven of the trials included postintervention follow up periods which ranged from two months to 12 years. Most outcomes were analysed on an intention to treat basis. In the trials, subjects were asked to exercise between three and five times per week for 20–60 minutes. Few studies described the exercise intensity, but when it was described there was a mixture of moderate and vigorous intensities.

Location of exercise

The location of the prescribed exercise was the home for seven of the trials (table 1). By “home location” we refer to exercise that can take place in proximity to the subjects’ homes rather than within their homes. Five of the home based trials (studies 1–5) reported a positive outcome of the intervention. One of the trials (study 6) not showing a significant difference between groups was a comparison between subjects receiving telephone contact and those not receiving it. All of the subjects were sedentary at baseline and significantly increased their exercise level during the intervention. Those subjects receiving telephone support exercised more than those who did not, but the difference did not reach significance. Study 7, the other home based trial which did not show a significant difference postintervention, did not involve giving specific advice to subjects about increasing their exercise. Subjects in this trial were given either a fitness test, a health appraisal, or both and were given feedback on the results. None of the three intervention groups exercised more than the control group.

Facility based trials normally required the subjects to attend specific sessions or groups at a local fitness centre or indoor track. Only two of the five facility based trials showed a significant difference between intervention subjects and controls.

Study 3 compared home based and facility based exercise. After one year, subjects assigned to the two home based arms completed significantly more of the prescribed exercise sessions than subjects assigned to exercise at a facility (79%, 75%, and 53% respectively), with no significant difference between the two home based arms.

Components of prescribed exercise

In half of the trials in table 1, walking was the prescribed mode of exercise. All of the trials

showed a significant increase in exercise when compared to controls. In one study (study 1), 80% of subjects were walking an average of at least five miles per week, with 61% of subjects adhering to the prescribed level of seven miles per week at two years. Those trials in which walking was not recommended (studies 9–12) included exercise to music classes, gym based “endurance activity”, and jogging. Only one of these trials (study 9) showed an increase in exercise. Subjects were females aged 18–20 years, who may have tolerated the prescribed jogging better than the older groups in the other trials.

Although the prescribed frequency of exercise averaged three to five times per week, most subjects were reporting lower frequency at follow up, with an average two to three times per week. Study 3 assigned subjects to three intervention arms of varying frequencies. One of the two home based arms prescribed three sessions per week for 40 minutes at a high intensity, while the other home based arm prescribed five sessions per week at a low intensity. The third arm, where subjects exercised at a local community hall, prescribed three sessions per week. At one year there was no significant difference between the two home based arms on the percentage of prescribed sessions completed, with both completing significantly more than subjects in the facility based arm. Second year³³ follow up data show that subjects in the three times per week home based arm were able to maintain significantly higher levels of adherence than those in the five times per week home based arm who had reduced to a level similar to that of the facility based arm (68%, 49%, and 36% of prescribed sessions respectively). Although the two home based arms were prescribed differing intensity levels, analysis of heart rate data showed that both arms actually exercised at an intensity normally described as moderate.

Strategies for improving compliance

A range of behavioural methods was employed to improve compliance. It is difficult to measure the effect of some of these as they were often part of multifaceted interventions taught to all groups. Methods included reinforcement (rewarding subjects for successful completion), self monitoring (keeping personal records of exercise performed), and relapse prevention training (learning to cope with situations that prompt inactivity and preventing a missed session leading to a return to preintervention exercise levels). Some trials investigated the impact of such strategies with varying results.

In study 4, subjects were randomly assigned to self monitoring, reinforcement, and control arms. After 18 weeks, subjects in the two behavioural treatment arms were exercising significantly more than those in the control arm. Study 11 found no difference in exercise levels between subjects instructed in self monitoring and control subjects. Study 5 took subjects from an earlier trial and randomised them to two “maintenance” groups with different frequencies of self monitoring. Subjects completing daily self monitoring

Table 1A Summary of interventions: home based

Study	Authors, year of publication, stated objectives	Length of intervention	Location of exercise (home or facility)	Authors' description of exercise	Prescribed frequency, intensity, and duration of exercise	Controls
1	Kriska ²² - To examine factors associated with exercise compliance in post menopausal women	2 years	Home following initial 8 weeks	Walking	3 × wk/3 miles per session briskly	Assessment only
2	Lombard ²³ - To determine the effect of frequency and structure of telephone prompts on frequency of walking	12 weeks	Home	Walking (group walking encouraged)	3 × wk at least 20 min per session	Initial instruction
3	King ²⁴ - To determine the effectiveness of group v home based training of higher and lower intensities	1 year	2 groups home, 1 group facility	Walking and jogging	Two groups 3 × wk at 73-88% peak heart rate for 40 min per session, one group 5 × wk at 60-73% peak heart rate for 30 min each session	Assessment only
4	Noland ²⁵ - To assess effects of behavioural techniques on adherence to unsupervised exercise	18 weeks	Home	Walking, jogging and swimming as preferred	3 × wk at 30-40% or 60-70% VO ₂ max for 30 min	Assessment and advice about exercise; no behavioural treatment
5	King ²⁶ - To evaluate strategies for enhancing the maintenance of exercise training by healthy middle aged men and women (also see No 6)	6 months	Home	Walking and jogging	4 × wk at 65-77% peak heart rate for 30 min per session	Same as intervention group but reduced level of self monitoring
6	King ²⁶ - To evaluate strategies for enhancing the adoption of exercise training by healthy middle aged men and women (also see No 5)	6 months	Home	Walking and jogging	4 × wk at 65-77% peak heart rate for 30 min per session	Same as intervention group less regular telephone contact
7	Godin ²⁷ - To investigate the effectiveness of fitness testing and health appraisal on exercise intention and behaviour	3 months	Home	Physical activity lasting 20-30 min per session	None prescribed	Assessment only

forms performed 35% more exercise sessions than subjects completing forms weekly.

Relapse prevention training was compared with reinforcement strategies in a study of females attending exercise classes (study 12). Subjects in the relapse prevention arm attended weekly lessons on relapse prevention immediately following an exercise class, while subjects in the reinforcement group received T shirts and other rewards for successful attendance at a number of classes. Control subjects simply attended the exercise classes. At 18 weeks there was no difference between groups on number of exercise sessions attended, with 72% of subjects attending less than the prescribed three classes per week.

In a trial of jogging alone or in a group, and of jogging with and without relapse prevention training (study 9), the impact of relapse prevention varied. Eighty three per cent (10/12) of subjects with relapse prevention

training who were jogging alone were still exercising at three months, compared with 36% (5/12) of those without such training. By contrast, in the two group jogging arms relapse prevention training did not increase jogging frequency at follow up.

Study 3 investigated the effect of subjects' perceptions of whether they had achieved expected physical or psychological benefits after six months on subsequent exercise adherence.³⁴ Those subjects who reported they had achieved expected benefits completed more exercise sessions in the next six months than those who did not achieve their expectations. It seems that to maintain adherence in the long term, subjects need to perceive a physical or psychological gain from exercise.

Perhaps more important than any of these behavioural methods in achieving high rates of compliance is ongoing follow up.

Table 2A Summary of results: home based

Study	Data analysed by "intention to treat"	No in Study	Subjects	Post intervention follow up	Actual frequency, intensity, and duration of exercise intervention group	Main outcomes P < 0.05	Outcome + or 0
1	Yes	229	Post menopausal women aged 50-65	Annually	Mean miles walking/wk = 8.4	Self reported walking level significantly higher at years 1 and 2 compared to controls	+
2	Yes	135	University staff and faculty members, mean age 40, mainly female	12 weeks	46% of frequent prompt groups walking 3 × 20 min per week; 13% of low frequency prompts; 4% controls	Frequent telephone contact improved adherence to walking programme	+
3	Yes	357	160 women and 197 men aged 50-65. Predominantly white and well educated	Ongoing	Mean frequency = HIG ~ 1.2 × wk, HIH ~ 2 × wk, LIH ~ 3 × wk	Significant difference between intervention and control groups plus significant difference between home based and facility based groups	+
4	No	77	28 men (mean age 40) and 49 women (mean age 36)	Nil	Self monitoring group = mean of 2.4/week for 26 min Reinforcement group = mean of 2.5/week for 29 min	Behavioural interventions increased frequency of exercise compared to controls	+
5	Yes	51	Male and female middle aged subjects	Nil	11.4 sessions/month for daily self monitoring group; 7.5 sessions/month for weekly self monitoring group	Significant difference in number of exercise sessions/month between groups	+
6	Yes	52	Male and female middle aged subjects	Nil	12.4 sessions/month for 32 min in telephone group; 9.8 sessions/month for 28 min in comparison group	No significant difference in mean number of exercise sessions/month between groups. Both groups increased exercise frequency over baseline	0
7	No	200	Average age 39 (±9)	None	~2-3 sessions/month	No difference between groups	0

+, positive significant difference; 0, no significant difference.

Table 1B Summary of interventions: facility based

Study	Authors, year of publication, stated objectives	Length of intervention	Location of exercise (home or facility)	Authors' description of exercise	Prescribed frequency, intensity, and duration of exercise	Controls
8	McAuley ²⁸ – To determine the utility of an efficacy based intervention on exercise participation	20 weeks	Facility	Walking	3 × wk, 40 min	Initial instruction + exercise information classes
9	King ²⁹ – To study the effect of two low cost methods of increasing the number of participant controlled jogging episodes	5 weeks	Facility	Jogging	4 × wk, individualised time and distance goals	Instructed to jog alone
10	MacKeen ³⁰ – To study the effects of an 18 month exercise intervention on adherence	18 months	Facility and Home	Jogging, swimming, games	3 × wk minimum, 35–75 minutes per session	Assessment only
11	Reid ³¹ – To assess the effectiveness of physician prescribed exercise programme with health education and self monitoring components	1 hour	Facility	Endurance activity	Advice about frequency, intensity, duration given but not described	Assessment and written exercise advice
12	Marcus ³² – To assess effectiveness of a relapse prevention programme and reinforcement programme in increasing exercise adherence and short term maintenance	18 weeks	Facility	Exercise to music class	35–50 minutes 3 × wk	Attendance at exercise group, no behavioural technique

Follow up

Telephone calling was a common method for following up clients in home based trials after an initial instruction session. All of the home based trials where researchers maintained contact with clients by telephone reported positive outcomes. Studies 2 and 6 investigated the effect of telephone prompting. Study 2 randomised subjects to four levels of telephone prompting or to a control arm. All subjects received 15 minutes of instruction on walking. At six months there was a significant difference in numbers of subjects still walking between the three prompted arms and the control arm, and between prompt frequency (once per week versus once every three weeks). Study 6 randomly assigned subjects who were waiting list controls from a previous trial³⁵ to two interventions, one of which received telephone contact (10 times during six months). All subjects received instructions in behavioural methods to improve compliance. Subjects in the telephone prompting arm exercised more frequently and for longer than those in the control arm (12.4 sessions/month for 32 minutes versus 9.8 sessions/month for 28 minutes). This difference did not achieve significance. Only subjects in the telephone arm significantly increased their fitness.

Discussion

We have not attempted a formal meta-analysis of the trials in this review since this would be

inappropriate in view of the incompatible data and varying quality of the trials described. This is in accordance with the criteria for attempting a meta-analysis described by Eysenck.³⁶ The important public health question is whether evidence exists to guide policy makers considering strategies to increase the activity levels of a sedentary population. Trials that were able to demonstrate significant increases in activity involved exercise that was home based, of moderate intensity, involved walking, and had regular follow up.

Walking from home was more successful than exercise which relied on attendance at structured exercise sessions. Only two facility based trials reported increases in exercise, compared with six of the home based trials. All those trials prescribing walking reported increases in activity. Moderate intensity activity was also associated with higher compliance rates. Walking on level ground at a brisk pace would be a moderate intensity activity for most people.

In Britain, walking is the most popular leisure time physical activity.³⁷ Approximately half the subjects in a recent national survey¹¹ walked continuously for at least a mile at least once in the past week. However, only 26% of men and 21% of women walked at a brisk or fast pace, and only 14% of men and 17% of women aged 55–74 walked at this pace. The 1993 Health Survey for England¹² confirmed these findings, reporting that 20% of women

Table 2B Summary of results: facility based

Study	Data analysed by "intention to treat"	No in Study	Subjects	Post intervention follow up	Actual frequency, intensity, and duration of exercise intervention group	Main outcomes $P < 0.05$	Outcome + or 0
8	Yes	125	Previously sedentary, 45–64 year olds	None	Not stated	Intervention subjects exercised more frequently and for longer than controls	+
9	Yes	58	18–20 year old previously sedentary female psychology students	2 months	Mean frequency JAR and G = 2.4/week; GR = 1.4/week	83% of jogging alone + relapse subjects still exercising at follow up compared to 36% of control subjects	+
10	No	171	Males aged 40–59 with CHD risk factors	12 years	Mean hours jogging/week at year 13 = 0.3 hours	No difference between exercise and control conditions at follow up on jogging hours per week	0
11	No	124	Male firefighters aged 24–56	6 months	Not stated	No significant difference between groups at follow up	0
12	Yes	120	Previously sedentary, female university employees with a mean age of 35 years	2 months	Percentage of classes attended during the 18 weeks RP = 51%, R = 49%, Controls = 44%	No significant difference in attendance at 18 weeks or 2 month follow up	0

HIG, high intensity group; HIH, high intensity home; LIH, low intensity home; JAR, jogging alone + relapse prevention; G, group jogging; GR, group jogging + relapse prevention; RP, relapse prevention; R, reinforcement.

and 30% of men were classified as moderate walkers (fast or brisk pace), and 38% of women and 32% of men classified as light intensity walkers (slow or average pace). Brisk walking is recommended for improving population activity levels by the American College of Sports Medicine and the Centres for Disease Control and Prevention (USA).¹³ In England, the Health Education Authority's Active for Life campaign emphasises the importance of brisk walking for improving one's health.

A United States survey has shown that people in lower income groups, older people, women, blacks and Hispanic people participated in less exercise.³⁸ These differences were not seen in the numbers who were walking, which indicates that walking may be more universally accessible than other types of physical activity. In England, physical activity participation is lower in older people, women, those living in council properties, lower education groups,¹¹ and lower socio-economic groups.³⁹

Walking is also associated with a lower injury rate than other forms of physical activity.⁴⁰ Injuries are reported as a barrier to exercise particularly in older age groups.¹¹ Reviews of the determinants of physical activity report fewer barriers to walking than other types of physical activity.⁴¹

Some younger men and most other adults would improve their physical fitness if they took up regular brisk walking (fig 1).⁴² Increases in cardiovascular fitness have been associated with reductions in cardiovascular and all-cause mortality.⁴³ A report on the health benefits of walking which reviewed the impact of walking on various cardiovascular disease risk factors concluded that "regular walking has the potential to lower blood pressure, improve the lipid profile, reduce body fat, enhance mental well-being and reduce the risk of coronary heart disease."⁴⁴

This review has shown that when walking is recommended and attendance at a facility is not required, significant increases in activity

can be achieved. When subjects are followed up regularly the increases can be maintained.

Our findings do not support the current trend in physical activity promotion in this country. There has been a rapid growth in general practitioner (GP) prescription for exercise schemes. Estimates suggest that hundreds of such schemes exist in all parts of the country. A 1994 report⁴⁵ found that a large proportion of such schemes are leisure centre managed, and involve GPs referring patients at reduced or no cost for an average period of 10 weeks. The report estimated that less than 1% of a GP's patient list was referred into the schemes and also highlighted the fact that "no examples of good evaluation" were found, preventing any conclusions about effectiveness. Although we have been informed of ongoing trials of such schemes, we were unable to find any results published in the scientific literature. The emphasis placed on attending a leisure facility and the neglect of walking as a form of exercise is inconsistent with the findings of this review.

Most of the studies used volunteers responding to advertisements to take part in a physical activity programme. One study (study 3) that used random digit dialling as a method of recruitment only randomised 27% of those actually contacted, suggesting a high degree of self selection.⁴⁶ These recruitment methods tell us little about how to increase the physical activity levels of the vast majority of people who are unlikely to respond to advertisements.

The findings of this review should be viewed with caution as they are based on only 12 trials all of which were carried out in the USA.

FUTURE RESEARCH

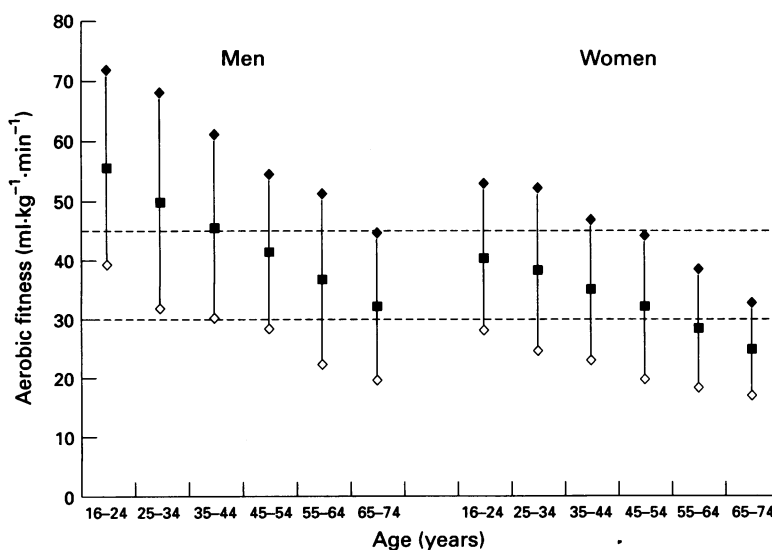
There is an urgent need for experimental research. In particular:

- there should be trials undertaken in the United Kingdom;
- trials should include groups other than the middle aged, middle class, and white;
- there is a need for trials specifically dealing with physical activity in the over 75s;
- there is a need for evaluation of GP prescription schemes by randomised controlled trials;
- there is a need to evaluate the effect of GPs advising their patients to exercise.

CONCLUSION

Levels of physical activity can be increased and the increase can be maintained for at least two years. Interventions that encourage walking and do not require attendance at a facility are most likely to lead to sustainable increases in overall physical activity. Regular follow up, which need not be time consuming and expensive, improves the proportion of people able to maintain initial increases.

Brisk walking has the greatest potential for increasing the overall activity levels of a sedentary population and meeting current public health recommendations. It is also the kind of exercise most likely to be adopted by a range of ages, socioeconomic, and ethnic groups as well as both sexes.



Lines A and B correspond to $45 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ and $30 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$. They define the range of values for aerobic fitness which would permit individuals to perform activities costing between 5 and $7.5 \text{ kcal} \cdot \text{min}^{-1}$ (moderate intensity) at about 50% of their $\text{VO}_{2\text{max}}$.

In order to increase the attractiveness of walking for recreational purposes or as a mode of transport, attention will need to be paid to environmental factors which influence personal safety and convenience.

Summary

We have reviewed randomised controlled trials of physical activity promotion to provide recent and reliable information on the effectiveness of physical activity promotion. Computerised databases and references of references were searched. Experts were contacted and asked for information about existing work. Studies assessed were randomised controlled trials of healthy, free living, adult subjects, where exercise behaviour was the dependent variable. Eleven trials were identified. No United Kingdom based studies were found. Interventions that encourage walking and do not require attendance at a facility are most likely to lead to sustainable increases in overall physical activity. Brisk walking has the greatest potential for increasing overall activity levels of a sedentary population and meeting current public health recommendations. The small number of trials limits the strength of any conclusions and highlights the need for more research.

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