# A randomised controlled trial of three pragmatic approaches to initiate increased physical activity in sedentary patients with risk factors for cardiovascular disease

Paul Little, Martina Dorward, Sarah Gralton, Louise Hammerton, John Pillinger, Peter White, Michael Moore, Jim McKenna and Sheila Payne

*SUMMARY*

***Background:*** *Physical activity is a major modifiable risk factor for cardiovascular disease, but it is unclear what combination of feasible approaches, using existing resources in primary care, work best to initiate increased physical activity.*

***Aim:*** *To assess three approaches to initiate increased physical activity.*

***Design of study:*** *Randomised controlled (2 X 2 X 2) factorial trial.*

***Setting:*** *Four general practices.*

***Method:*** *One hundred and fifty-one sedentary patients with computer documented risk factors for cardiovascular disease were randomised to eight groups defined by three factors: prescription by general practitioners (GPs) for brisk exercise not requiring a leisure facility (for example, walking) 30 minutes per day, 5 days per week; counselling by practice nurses, based on psychological theory to modify intentions and perceived control of behaviour, and using behavioural implementation techniques (for example, contracting, 'rehearsal'); use of the Health Education Authority booklet* 'Getting active, feeling fit'.

***Results:*** *Single interventions had modest effects. There was a trend from the least intensive interventions (control +/- booklet) to the more intensive interventions (prescription and counselling combined +/- booklet) for both increased physical activity and fitness (test for trend,* P *= 0.02 and* P *= 0.05, respectively). Only with the most intense intervention (prescription and counselling combined) were there significant increases in both physical activity and fitness from baseline (Godin score = 14.4, 95% confidence interval [CI] = 7.8 to 21, which was equivalent to three 15-minute sessions of brisk exercise and a 6-minute walking distance = 28.5 m, respectively, 95% CI = 11.1 to 45.8). Counselling only made a difference among those individuals with lower intention at baseline.*

***Conclusion:*** *Feasible interventions using available staff, which combine exercise prescription and counselling explicitly based on psychological theory, can probably initiate important increases in physical activity.*

***Keywords:*** *cardiovascular disease; counselling; exercise prescription; physical activity; psychological theory.*

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## Introduction

SEDENTARY lifestyle is a major risk factor for cardiovascular disease:[1-6] smoking 20 cigarettes per day increases the risk of events by 36% in males and 61% in females, and being physically active reduces risk by 40%.[5,6] A large cohort study demonstrated that if sedentary patients increase fitness, they halve their risk of coronary heart disease.[7] Despite the similar prevalence of sedentary lifestyle compared with other risk factors — 33% of men in England do not exercise moderately vigorously (brisk walking) once a week,[8,9] 26% smoke, and 29% have untreated high blood pressure (>140/90 mmHg)[10] — there is very little emphasis in primary care on physical activity.

How, then, can primary care staff in everyday practice increase physical activity among their at-risk patients? Leisure centre prescriptions have limited capacity and a high drop out rate.[11] A review,[12] updated recently to include trials since the initial review,[13] concluded that sustained exercise is more likely with home- (rather than facility-) based exercise of moderate intensity (for example, brisk walking), and that an exercise specialist might be more effective than a physician at giving advice.[13] A systematic review of advice given in primary care found mixed evidence, and most trials were based in the United States of America.[14] In New Zealand, advice from a general practitioner (GP) and a 'green prescription' (written exercise advice)[15] increased self-reported exercise, but did not particularly target an at-risk population. The current evidence is limited by: the variety and validity of self-reporting measures;[16] using self-reporting only, i.e. not including measures of performance and/or fitness;[2,17] and limited generalisability to currently available primary care resources. Targeting high-risk groups, given limited resources, is the first priority. A behavioural approach, including a written agreement and goal setting, may be the most successful.[18] It is also unclear whether counselling to modify the antecedents of intention (particularly attitudes and perceived control of behaviour) is effective — on theoretical grounds it would be expected to have the biggest impact (M Johnston, Models of health-related behaviour change, King's Fund Centre Conference, London, 1994) — and, if so, which groups of patients might most benefit. Therefore, there was a need to estimate what intensity of intervention is required and to assess the effectiveness of three pragmatic approaches in those with risk factors for coronary heart disease: prescription for home-based exercise; brief counselling based on psychological

**HOW THIS FITS IN**

*What do we know?*

This is one of the few studies using staff available in primary care that uses both validated self-reporting measures and independent fitness measures to confirm behavioural change, that explicitly uses established psychological theory to inform interventions, and assesses the required intensity of intervention to achieve change.

*What does this paper add?*

It suggests that the assessment process with minimal intervention probably helps initiate increased physical activity in motivated at-risk individuals. More intensive interventions, including exercise prescription combined with counselling based on psychological theory, initiate the most significant changes and have the greatest effect on those who are not already highly motivated. Exercise prescription alone is unlikely to make a significant additional difference to either physical activity or fitness.

and behavioural theory; and the use of an information booklet.[19]

## Method

The study was approved by the Southampton and Salisbury Ethics Committees. Research staff were available to recruit during 2-month periods each winter in the 3 years from 1999 to 2002, in four practice settings: deprived inner city (*n* = 30), rural small town (*n* = 48), market town (*n* = 53), and cathedral city (*n* = 20). Patients were randomly chosen from practice databases if they had one or more risk factors for coronary heart disease: a diagnosis by a GP of hypertension or hyperlipidaemia, a body mass index >25, or diabetes. Patients were excluded if they had coronary heart disease (a 'no advice' control group was felt to be unethical), if they were unable to perform moderate exercise (for example, if they had severe left ventricular failure), if they were unable to complete the questionnaire (for example, because of dementia), or if they were under the age of 18 years. Letters were sent to invite interested, sedentary patients (those taking less than 30 minutes of exercise, defined as 'brisk walking or equivalent', each week) to participate.

### *Data collection*

Assessments lasting approximately 45 minutes were performed by the same person, who was either a research nurse or medical student trained by the nurse, for each patient. The assessors did not take part in the intervention, and made assessments without reference to the intervention group. Full blinding of assessors was not possible, given that this was an open trial, but patients were asked not to say what they had done.

Assessments were carried out at baseline and after 1 month and the following data were collected: height; weight (using digital scales); blood pressure, using a semi-automated validated Omron oscillometric sphygmomanometer; cholesterol level, i.e. non-fasting total cholesterol, high density lipoprotein (HDL), and cholesterol/HDL ratio; the well-validated Godin questionnaire,[16] which multiplies the number of episodes of exercise by relative energy expenditure in each; 'stage of change';[21] the Hospital Anxiety and Depression (HAD) questionnaire,[21] and physical fitness/performance. The two measures of exercise performance used to assess fitness were: the Canadian Home Step Test,[22] which took about 20 minutes to explain and perform; and the 6-minute walking test,[23,24] in which participants are asked to walk or run as fast as they can around a circuit of known distance (200 m on the pavement around the surgery) for 6 minutes, and the distance walked predicts health outcomes. Both the step test and walking test (performance tests) correlate well with formal fitness tests, such as maximal rate of oxygen use ($VO_2$ max). Correlations with $VO_2$ max in both the general population and those with chronic disease were in the range of 0.6 to 0.8.[22-24] Participants used a Caltrac® activity monitor.[16,25] Unfortunately, our sample was predominantly elderly and had some difficulty using the monitor, so the results are not likely to be meaningful.

### *Randomisation*

Patients were randomly assigned to one of eight groups, which were defined by three intervention factors, in a balanced 2 X 2 X 2 factorial design,[26] by opening a sealed opaque numbered envelope that had been prepared previously at the trial centre by the research nurse. The three factors were: booklet or no booklet; a counselling session given by a nurse based on attitudes, perceived control of behaviour and techniques for implementing behaviour, or no counselling session; an exercise prescription by a GP or no exercise prescription (Box 1). Patients could be assigned to no intervention, a single intervention, or any combination of interventions.

### *Sample size*

We used the nQuery program for $\alpha$ = 0.05, $\beta$ = 0.2. One hundred and twenty-six completed records (63 in the intervention group and 63 in the control group for each intervention) would detect a change of 0.5 standard deviations in all main outcomes, i.e. fitness (6-minute walk); reported exercise (Godin score); and other outcomes (blood pressure and cholesterol/HDL ratio). One hundred and twenty-eight patients would detect a 0.25 standard deviation change in outcomes comparing results at 1 month with baseline, i.e. including the changes that occur as a result of participation in the programme.

### *Analysis*

Data were analysed using SPSS and STATA, using ANCOVA for a factorial study to estimate main effects and interactions between interventions for the primary outcomes (Godin score, walking distance) and other outcomes. In each ANCOVA model the estimates were controlled for all factors, i.e. the analysis reflected the design.

To test for trends across groups where increments between groups varied; for example, with increasing intensity of intervention, required the non-parametric test for trend in STATA and required data in the form of changes from baseline.

**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).

**Counselling session**
Nurses discussed the same issues as with exercise prescription. They also had a detailed motivational discussion (based on the theory of planned behaviour, which addresses attitudes and perceived behavioural control), identifying a precise time and place to start ('behavioural rehearsal'), and agreed and signed a contract.

**Booklet**
The Health Education Authority booklet *Getting active, feeling fit* was used.[19]

*Box 1. Types of intervention. (For additional data see Supplementary box 1.)*

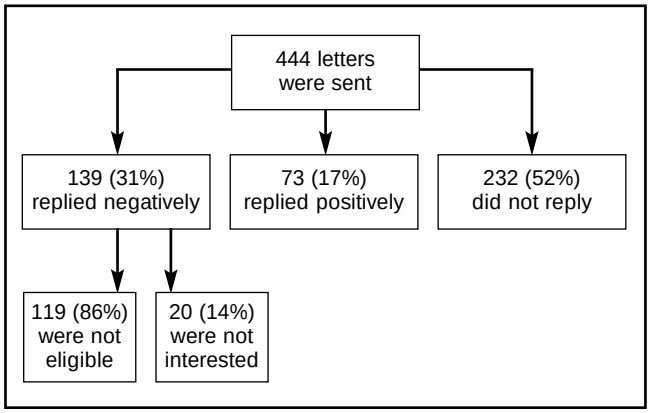


*Figure 1. Response from a sub-sample of consecutive recruitment letters.*

*Table 1. Baseline measurements for each intervention factor.[a] (For additional data see Supplementary table 1.)*

| | No GP prescription | GP prescription | No nurse counselling | Nurse counselling | No booklet | Booklet |
|---|---|---|---|---|---|---|
| Demographics | | | | | | |
| Percentage male | 43.6 | 45.6 | 47.4 | 41.4 | 42.0 | 46.6 |
| Age in years | 57.44 (12.24) | 60.44 (11.59) | 59.72 (10.88) | 59.97 (13.10) | 58.24 (11.57) | 59.52 (12.45) |
| Percentage non-smoking | 96.1 | 91.2 | 93.4 | 94.3 | 93.2 | 98.6 |
| Years of education since age of 10 years | 7.19 (3.01) | 6.53 (2.84) | 7.08 (3.30) | 6.67 (2.49) | 6.75 (2.77) | 7.03 (3.13) |
| Primary outcomes | | | | | | |
| Distance walked (m) | 614.65 (103.37) | 576.36 (106.39) | 608.14 (107.39) | 583.86 (104.21) | 607.60 (105.12) | 585.38 (106.82) |
| Godin Score[b] | 16.12 (13.51) | 18.04 (23.69) | 18.43 (23.13) | 15.47 (12.84) | 16.37 (17.91) | 17.66 (19.95) |
| Secondary variables | | | | | | |
| Systolic BP (mmHg) | 142.95 (19.14) | 145.58 (21.74) | 143.53 (19.72) | 144.89 (21.18) | 142.80 (21.24) | 145.59 (19.53) |
| Cholesterol/HDL ratio | 4.43 (1.31) | 4.56 (1.39) | 4.52 (1.29) | 4.46 (1.42) | 4.76 (1.36) | 4.21 (1.28) |
| Questionnaire outcomes | | | | | | |
| Stage of change[c] | 3.37 (1.47) | 3.27 (1.66) | 3.47 (1.65) | 3.17 (1.44) | 3.40 (1.48) | 3.25 (1.64) |
| Intention, measured by 9-point scale | 7.51 (1.60) | 6.96 (2.12) | 6.95 (2.02) | 7.50 (1.68) | 7.27 (1.80) | 7.14 (1.98) |

[a]Mean values (standard deviation) unless stated. [b]This weights activity according to the energy expenditure: the approximate number of 15-minute sessions of mild, moderate and strenuous activity taken each week are multiplied by the relative energy expenditure in each group (3, 5 and 9 respectively) to obtain the Godin score. [c]This is a scale from 1–6 (1 = 'I don't intend to and have not tried in the last 6 months'; 2 = 'not tried, but thinking about starting'; 3 = 'tried but did not succeed'; 4 = 'I definitely plan to change in the next 30 days'; 5 = 'I have changed for less than 6 months'; 6 = 'for 6 months I have managed to take regular exercise'). BP = blood pressure; HDL = high density lipoprotein.

Missing values at follow-up were replaced with baseline measurements for intention-to-treat analyses, making the most conservative assumption that they would not have changed. For secondary analysis; for example, predictors of intention, factor analysis with varimax rotation was used to identify the scales, and ANOVA was used to assess the predictive value of scales.

## Results

### *Recruitment and response rates*

In a sub-sample, for 444 consecutive recruitment letters that were sent out, we have details of non-participation (Figure 1). One hundred and fifty-one patients were enrolled in the whole study, and their characteristics were similar according to the main randomised factors (Table 1), with the exception of higher intention to exercise in the prescription arm. The effects of including and excluding baseline intention from the ANCOVA models for the main outcomes were documented, and there was no significant change in the estimates or inferences for the randomised interventions. Response rates between the intervention and control arms of each factor were similar (Figure 2).

### *Effect of single interventions*

*ANCOVA: single interventions.* (Table 2). There were no significant changes in main outcomes, but a booklet reduced depression scores (this must be treated with caution, as it is a secondary outcome), and nurse counselling increased the stage of change. The relative increase in the cholesterol/HDL ratio in the prescription group was in part owing to a decrease in cholesterol/HDL ratio (0.34) in the control group (Table 3), which may therefore be a chance finding, since the control group exercised less than the other groups.

*ANCOVA: interactions between interventions.* The counselling and booklet together possibly increased distance walked

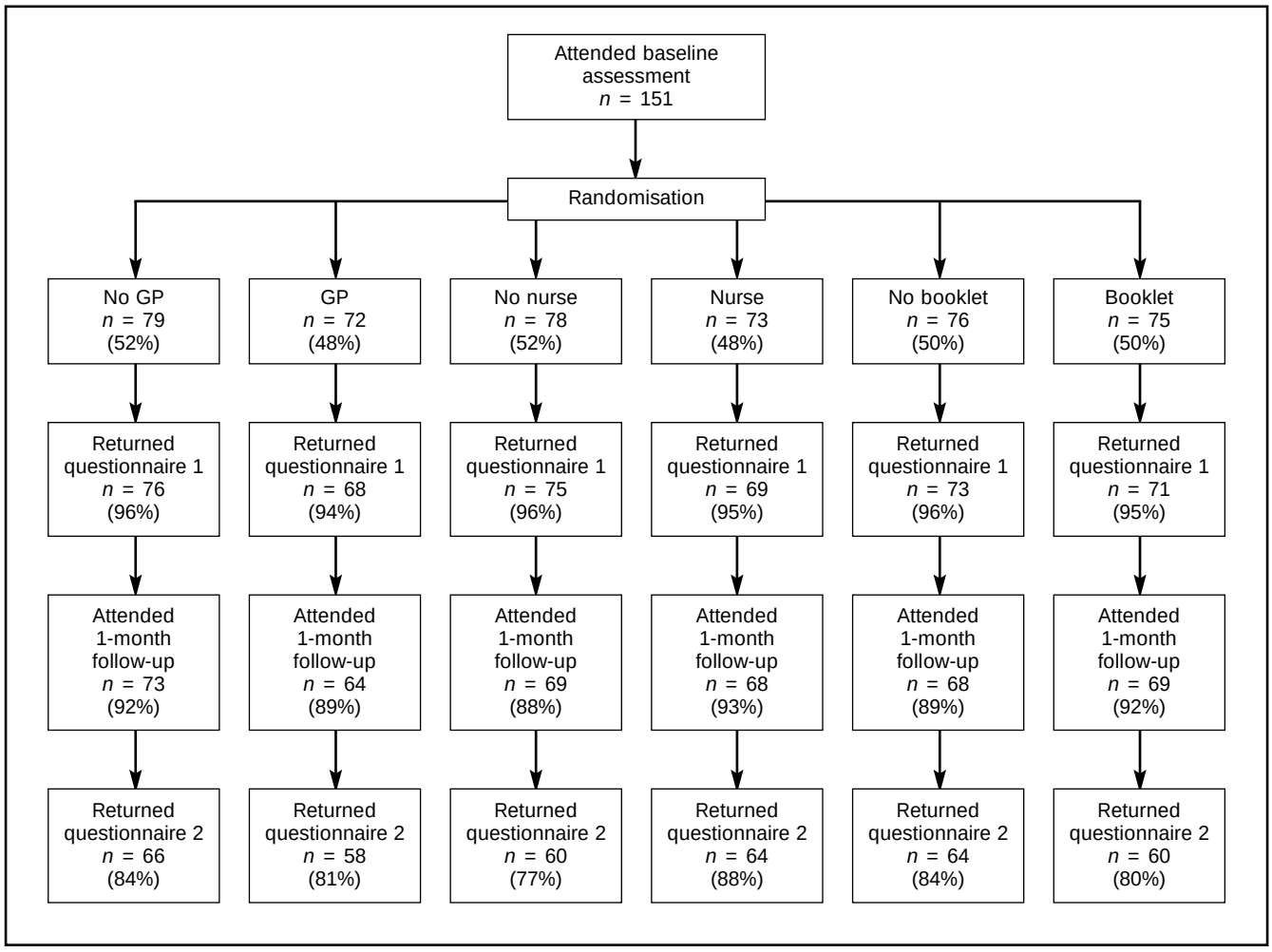


*Figure 2. Flow of participants through the trial for each of three factors (i.e. not for individual randomisation groups).*

more than either alone (interaction = 32.08 m, range = 2.41 to 61.74 m, $P = 0.034$). There was also evidence of a possible interaction between prescription and counselling in reducing cholesterol/HDL ratio (interaction = -0.46, range = -0.93 to 0.005, $P = 0.052$). These are reported cautiously, as they were not *a priori* hypotheses.

*Changes from baseline in whole cohort and control group.* (Table 3 shows overall changes in the whole cohort and in the control group — other groups are also shown for information). In each surgery, patients from random lists were invited to participate over a 2- to 3-month period, and those invited in the second month compared with the first showed no difference in reported exercise; in the whole cohort, the second month Godin score was 3.5 lower, $P = 0.31$. Therefore, the changes over the month observed from baseline in the control group are likely to be owing to participation in the programme and not to changes with time.

## *Secondary analyses*

*Intensity of intervention.* A key secondary *a priori* hypothesis was that fitness and reported physical activity would increase as the intensity of intervention increases (Table 4). Only in the most intensive group (prescription and counselling) were there clearly significant changes from baseline in both physical activity and fitness (walking distance). There was no association between changes in physical activity or fitness and either blood pressure or serum lipids in this short follow-up.

*Intention.* A secondary hypothesis was that there would be an interaction between baseline intention and the effect of counselling, i.e. among those with high baseline intention to exercise (above the median value of 7.0) there might be less benefit from a counselling session that aims at increasing intention and physical activity; this was confirmed (interaction terms intention: $t = 2.92$, $P = 0.009$; physical activity: $t = 2.53$, $P = 0.013$). Therefore, those with high intention to exercise at baseline did not increase their intention as a result of counselling (-0.221; 95% confidence interval [CI] -0.82 to 0.37; $P = 0.46$) or exercise (Godin score = -3.82; 95% CI = -12.8 to 5.24; $P = 0.40$), whereas those with lower intention increased both intention (1.14; 95% CI = 0.26 to 2.01; $P = 0.012$) and exercise (Godin score = 14.1; 95% CI = 3.8 to 24.5; $P = 0.008$). A similar trend, although not significant, was seen in distance walked with counselling, comparing participants with low and high intention (25 m and 40 m, respectively).

*Table 2. ANCOVA for a factorial study: 'main effects' of single interventions at 1 month.[a] (For additional data see Supplementary table 2.)*

| | No GP mean (SD) | GP mean change (95% CI) | No nurse mean (SD) | Nurse mean change (95% CI) | No booklet mean (SD) | Booklet mean change (95% CI) |
|---|---|---|---|---|---|---|
| Primary outcomes | | | | | | |
| Godin score | 26.77 (19.71) | 0.74 (-5.74 to 7.23) | 25.86 (25.39) | 4.96 (-1.5 to 11.44) | 27.01 (19.32) | 0.26 (-6.19 to 6.72) |
| *P*-value | | 0.821 | | 0.133 | | 0.936 |
| Distance walked (m) | 624.81 (105.15) | 5.70 (-9.52 to 20.92) | 617.19 (121.22) | 11.72 (-3.35 to 26.8) | 623.93 (105.13) | -4.48 (-19.51 to 10.55) |
| *P*-value | | 0.460 | | 0.126 | | 0.557 |
| Secondary outcomes | | | | | | |
| Systolic BP (mmHg) | 137.82 (20.22) | 0.16 (-5.17 to 5.49) | 139.40 (23.45) | -2.03 (-7.34 to 3.29) | 136.60 (22.69) | 2.46 (-2.87 to 7.78) |
| *P*-value | | 0.953 | | 0.452 | | 0.363 |
| Cholesterol/HDL ratio | 4.30 (1.15) | 0.25 (0.02 to 0.49) | 4.82 (1.34) | -0.02 (-0.26 to 0.21) | 4.75 (1.49) | -0.14 (-0.38 to 0.10) |
| *P*-value | | | | 0.849 | | 0.237 |
| Questionnaire | | | | | | |
| Depression score | 4.50 (3.36) | -0.06 (-0.52 to 0.41) | 4.39 (3.13) | -0.06 (-0.53 to 0.40) | 4.99 (3.33) | -0.47 (-0.93 to -0.01) |
| *P*-value | | 0.814 | | 0.788 | | 0.046 |
| Stage of change | 4.32 (1.27) | -0.06 (-0.44 to 0.32) | 3.92 (1.61) | 0.79 (0.41 to 1.16) | 4.23 (1.32) | 0.18 (-0.20 to 0.56) |
| *P*-value | | 0.753 | | <0.001 | | 0.348 |

[a]The mean change for each intervention factor is mutually adjusted both for baseline values and for the effect of other factors. The control arm of each factor was the mean value at 1 month (standard deviation). The intervention for each factor was the mean change compared to the control arm of the factor (95% confidence interval) *P*-value. BP = blood pressure; HDL = high density lipoprotein; SD = standard deviation.

*Table 3. Mean changes in outcome measures in control group and other separate groups at 1 month, compared with those at baseline.[a] (For additional data see Supplementary table 3.)*

| | Whole cohort | Control group | Booklet | GP | GP and booklet | Nurse | Nurse and booklet | GP and nurse | GP, nurse and booklet |
|---|---|---|---|---|---|---|---|---|---|
| Primary outcomes | | | | | | | | | |
| Distance walked (m) | 14.31 | 9.3 | 4.8 | 28 | -7.2 | 6.4 | 22.7 | 22.7 | 35.0 |
| (95% CI) | (6.78 to 21.83) | (-2.4 to 21.0) | (-14.3 to 24.0) | (12.0 to 44.0) | (-37.3 to 23.0) | (-15.2 to 28.0) | (-0.1 to 45.5) | (5.6 to 40.0) | (1.6 to 68.0) |
| Godin score | 10.47 | 7 | 9.6 | 7.5 | 6.2 | 12.3 | 15.1 | 16.8 | 11.7 |
| (95% CI) | (6.92 to 14.01) | (0.17 to 13.8) | (-1.6 to 20.7) | (-10.5 to 25.5) | (-1.9 to 14.2) | (-1.8 to 22.7) | (4.7 to 25.4) | (5.1 to 29.0) | (4.8 to 18.7) |
| Secondary outcomes | | | | | | | | | |
| Systolic BP (mmHg) | -5.29 | -3.86 | -4.42 | 1.8 | -6.1 | -6.3 | -6.0 | -13.4 | 0.53 |
| (95% CI) | (-8.04 to -2.55) | (-9.5 to 1.78 ) | (-11.1 to 2.2) | (-12.4 to 8.7) | (-17.1 to 4.9) | (-13.5 to 0.90) | (-14.8 to 2.8) | (-4.2 to -22.5) | (-6.3 to 5.3) |
| Cholesterol/HDL ratio | -0.05 | -0.34 | -0.19 | 0.23 | 0.16 | -0.01 | -0.10 | 0.09 | -0.23 |
| (95% CI) | (-0.17 to 0.07) | (-0.94 to 0.26) | (-0.47 to 0.1) | (-0.22 to 0.68) | (-0.02 to 0.33) | (-0.23 to 0.25) | (-0.34 to 0.14) | (-0.21 to 0.38) | (-0.58 to 0.11) |
| Questionnaire | | | | | | | | | |
| Depression score | -0.11 | 0.10 | -0.53 | 0.17 | -0.11 | 0.33 | -0.33 | -0.27 | -0.47 |
| (95% CI) | (-0.35 to 0.12) | (-0.27 to 0.47) | (-1.4 to 0.30) | (-0.26 to 0.59) | (-0.97 to 0.76) | (-0.26 to 0.92) | (-1.43 to 1.21) | (-1.4 to 0.87) | (-1.2 to 0.25) |
| Stage of change | 0.92 | 0.40 | 0.65 | 0.33 | 0.58 | 1.47 | 1.42 | 1.1 | 1.86 |
| (95% CI) | (0.68 to 1.16) | (-0.20 to 1.0) | (0.10 to 1.2) | (-0.33 to 1.04) | (-0.13 to 1.3) | (0.72 to 2.2) | (0.70 to 2.15) | (0.33 to 1.8) | (0.90 to 2.81) |

[a]If the change in systolic BP and pulse in the whole cohort are adjusted for the effect of habituation to measurement[27]: change in blood pressure: -2.76 (95% CI = -6.51 to -0.02), change in pulse: 0.07 (-0.46 to 0.33). BP = blood pressure; HDL = high density lipoprotein.

*Predictors of intention and exercise and fitness at 1 month.* Intention to take regular exercise measured at baseline was independently predicted by perceived behavioural control and attitude. Only intention to take regular exercise independently predicted subsequent Godin scoring, whereas intention, the attitude of 'important others', and the help from important others predicted distance walked after 1 month (Table 5).

## Discussion

### *Summary of main findings*

A structured fitness assessment without special facilities is likely to be feasible, and the assessment process probably helps to initiate increased physical activity in motivated individuals. Single interventions have modest effects, but more intensive interventions that include both exercise prescription and behavioural counselling initiate the largest changes in both reported physical activity and fitness, which if maintained are likely to reduce the risk of coronary heart disease. Secondary analysis supports the use of psychological theory in both explaining behaviour change and developing interventions, and suggests that brief counselling based on psychological theory probably has the greatest effect if targeted to those who are not already highly motivated.

### *Strengths and limitations*

*Generalisability.* The study was moderately sized, and sited in several practices from a range of settings, used generalisable recruitment methods, standardised intervention sheets, and several GPs and nurses. Although GPs 'prescribed'

*Table 4. Changes in main outcome measures at 1 month from baseline according to intensity of intervention.*[a]

| | Control +/- booklet | *P*-value | GP +/- booklet | *P*-value | Nurse +/- booklet | *P*-value | GP/nurse +/- booklet | *P*-value | Test for trend |
|---|---|---|---|---|---|---|---|---|---|
| Distance walked (m) (95% CI) | 7.1 (-3.5 to 17.7) | 0.18 | 9.0 (-9.0 to 27.0) | 0.32 | 14.6 (-0.6 to 30.0) | 0.06 | 28.5 (11.1 to 45.8) | <0.002 | Z = 1.93 *P* = 0.05 |
| Godin score (95% CI) | 8.2 (2.1 to 14.3) | 0.01 | 6.8 (-2.4 to 16.0) | 0.14 | 13.7 (6.6 to 20.7) | <0.001 | 14.4 (7.8 to 21.0) | <0.001 | Z = 2.42 *P* = 0.02 |

[a]Rationale for ordered intensity categories: the nurse intervention (20 minutes) is the most intensive single intervention (Box 1), followed by GP prescription (a 5- to 10-minute appointment). *P*-values in the table are based on the paired *t*-test, i.e. the difference from baseline. The test for trend assesses a trend in the differences with greater intensity of intervention using non-parametric test for trend in STATA.

and nurses 'counselled', these roles could potentially be performed by either professional.

*Feasibility and staff requirements to measure fitness.* The step test was least practicable and, from these results, less sensitive to change. Although staff time for the walking test can be minimised, since patients can monitor their own walking distance, nevertheless, a morning is needed to make a rough pavement map with distance markers (for example, trees) every 5 to 10 m. For some surgeries there may be no pavement immediately outside, although other sites could be used.

*Assessing the relationship between psychological variables and outcome.* We have underestimated the association between psychological variables and reported physical activity, since they were measured on different scales, but it was important to use the Godin scale in its original validated format.[16]

## How does this study fit with existing literature?

*Participation in the programme.* The increase in physical activity with assessment cannot be explained by changes with time and is likely to be owing to the assessment process taking place among a well-motivated population.[28]

*Effectiveness of more intensive intervention.* The results are consistent with a review that demonstrated that most single brief interventions do not change physical activity.[13] Since an appointment for an exercise prescription combined with subsequent behavioural counselling is still not very costly (it has a marginal cost of less than £20), then if the changes in physical activity and fitness can be maintained, this intervention is likely to be a cost-effective way of reducing cardiovascular risk.[7]

*Is psychological theory useful in a pragmatic setting?* Counselling based on the theory of planned behaviour,[20] modifying the antecedents of intention, i.e. aiming to modify attitude and perceived behavioural control, was combined with behavioural techniques to increase implementation of behaviour, such as behavioural 'rehearsal' (agreeing times and places to start behaviour), agreeing and signing a contract, and having behavioural cues (a diary).[20] This study supports the use of psychological theory for three reasons: even in a well-motivated study population (i.e. with a relatively narrow range of intention), and using measures that would be expected to reduce the strength of the observed associations, the predictions based on the theory of planned behaviour hold (i.e. intention is predicted by attitudes, perceived behavioural control, and important others, and subsequent behaviour is predicted by intention), changing intention (by counselling) changes subsequent behaviour, and counselling aimed at modifying intention works best in those who do not already have very high intention.

A possible qualification of the model based on this data is that the role of important others may not be confined to the general attitudes as conventionally measured, but also to their practical role in helping and participating in change, which underlines the importance of social context. Maintenance of behavioural change is likely to be linked to both reinforcement of behaviour and habit formation, where walking becomes a routine daily activity; longer-term data is needed to demonstrate to what extent walking behaviours become habitual.

Some caution is needed, since testing the interaction between nurse counselling and intention was a secondary hypothesis, albeit based on theoretical considerations. With this caveat, our study has potentially important implications for saving counselling time, since very highly motivated individuals will change behaviour without counselling, and could therefore make counselling more cost-effective. This study supports previous evidence from other settings about the use of behaviour modification in exercise promotion.[18]

## Implications for clinical practice and further research

To initiate important increases in physical activity, both exercise prescription and counselling should be combined. Further research is needed to clarify the role of fitness assessment, confirm whether baseline intention can be used to target behavioural interventions, and to demonstrate what intensity of follow-up is needed for longer-term maintenance.

## References

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*Table 5. Predictors of baseline intention to exercise, subsequent self-reported exercise (Godin score), and distance walked, using scales derived from factor analysis.*[a]

| | Crude $\beta$ (95% CI) | Adjusted $\beta$[b] (95% CI) | *t*-test (*P*-value) |
|---|---|---|---|
| Baseline intention | | | |
| Perceived behavioural control | 0.62 (0.46 to 0.79) | 0.74 (0.58 to 0.91) | 8.84 (<0.001) |
| Attitude | 0.86 (0.67 to 1.05) | 0.50 (0.37 to 0.64) | 7.25 (<0.001) |
| Attitude of important others | 0.45 (0.30 to 0.59) | -0.08 (-0.22 to 0.05) | 1.23 (0.21) |
| Attitude of important others to practical help | 0.52 (0.26 to 0.78) | 0.03 (-0.17 to 0.23) | 0.29 (0.77) |
| Follow-up: reported physical activity (Godin score) | | | |
| Intention | 2.82 (0.91 to 4.74) | 2.82 (0.91 to 4.74) | 2.92 (0.004) |
| Perceived behavioural control | 2.40 (0.18 to 4.61) | 0.93 (-1.74 to 3.60) | 0.69 (0.49) |
| Attitude | 0.72 (-2.06 to 3.51) | -2.77 (-6.18 to 0.64) | 1.60 (0.11) |
| Attitude of important others | -0.68 (-2.60 to 1.23) | 0.90 (-1.21 to 3.01) | 0.85 (0.40) |
| Attitude of important others to practical help | 2.14 (-1.07 to 5.35) | 0.84 (-2.56 to 4.23) | 0.49 (0.63) |
| Follow-up: distance walked | | | |
| Intention | 8.14 (-1.61 to 17.88) | 12.58 (1.78 to 23.39) | 2.30 (0.023) |
| Perceived behavioural control | 11.84 (0.69 to 23.0) | 5.63 (7.92 to 18.75) | 0.80 (0.42) |
| Attitude | 7.12 (-7.23 to 21.5) | -0.78 (-19.7 to 18.1) | 0.08 (0.94) |
| Attitude of important others | 1.76 (-8.26 to 11.77) | 19.36 (7.24 to 31.5) | 3.16 (0.002) |
| Attitude of important others to practical help | 24.0 (7.67 to 40.3) | 33.3 (14.3 to 52.3) | 3.47 (0.001) |

[a]Scales identified from factor analysis (all items on the 9-point scale unless specified): intention (two items: readiness , intention; Cronbach's $\alpha$ = 0.71); attitude to increasing exercise (three items: pleasure; benefit/harm; need/not need; $\alpha$ = 0.80); perceived behavioural control (two items: how easy to do; confidence in doing; $\alpha$ = 0.66); perceived attitude of important others (single item); perceived attitude of important others to practical help (6-point scale for three items: they would help; make changes too; encourage if going got tough; $\alpha$ = 0.88). [b]Adjusted for other components of model that were significant.


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## Supplementary information

Additional information accompanies this paper at:
http://www.rcgp.org.uk/journal/index.asp

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