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Cost-effectiveness of physical activity counselling in general practice

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Abstract

Aim To assess the cost-effectiveness of the 'Green Prescription' physical activity counselling programme in general practice.

Method Prospective cost-effectiveness study undertaken as part of a cluster randomised controlled trial with 12-month follow-up of 878 'less-active' patients aged 40-79 years in 42 general practices in the Waikato. The intervention was verbal advice and a written exercise prescription given by general practitioners, with telephone exercise specialist follow-up compared with usual care. Main outcome measures included cost per total and leisure-time physical activity gain from health-funders' and societal perspectives.

Results Significant increases in physical activity were found in the randomised controlled trial. Programme-cost per patient was NZ$170 from a funder's perspective. The monthly cost-effectiveness ratio for total energy expenditure achieved was $11 per kcal/kg/day. The incremental cost of converting one additional 'sedentary' adult to an 'active' state over a twelve-month period was NZ$1,756 in programme costs.

Conclusion Verbal and written physical activity advice given in general practice with telephone follow-up is an inexpensive way of increasing activity for sedentary people, and has the potential to have significant economic impact through reduction in cardiovascular and other morbidity and mortality.

There is now substantial epidemiological evidence to implicate a sedentary lifestyle as a risk factor for obesity, diabetes, cardiovascular disease, depression, bowel and breast cancer, and various other disease states.[1–4] Existing evidence suggests that at least 30 minutes of moderate activity on most days of the week is associated with significant health gains and has led to major position statements such as the 1996 US Surgeon General's report on physical activity and health.[4]

In New Zealand, one-third of adults do not undertake the recommended 2½ hours of moderate-intensity physical activity per week.[5] As a result, the Hillary Commission developed the Green Prescription physical activity counselling programme for New Zealand primary healthcare. A randomised controlled trial to assess the effectiveness of the programme in the Waikato region found that the programme was effective in increasing physical activity and improving quality of life over a 12-month period.[6] However, the cost-effectiveness of the intervention was not known.

The aim of this study was to calculate the incremental cost-effectiveness of the Green Prescription programme in increasing physical activity compared with 'usual care' in general practice, and to compare this with other community-based physical activity interventions reported in the literature.

Methods

Background

The cost-effectiveness analysis of the Green Prescription programme was incorporated prospectively into a cluster randomised controlled trial undertaken from mid-2000 to mid-2002.[6] General practices in the Waikato region of New Zealand were randomised to give the Green Prescription or 'usual care' to patients enrolled in the study. Baseline and 12-month follow-up measurements were taken at each practice by research staff. The cost-effectiveness analysis was undertaken from health funders' and societal perspectives. The Waikato Ethics Committee approved the study in 1999.

Participants

Consecutive 40 to 79 year-old patients were screened at the reception area of 42 rural and urban general practices over a 5-day period. Those not achieving the recommended 2½ hours of at least moderate activity per week were invited to participate in a study involving a lifestyle intervention.

Intervention

Study participants from intervention practices prompted the general practitioner or nurse to give verbal advice to increase physical activity with activity goals written on a Green Prescription. Patients from control practices received usual care. The Green Prescription was then faxed to exercise specialists in Sports Foundations who provided telephone support on three occasions over the following three months to each intervention patient and sent written material including newsletters.

Measures

Primary outcome measures in the clinical trial were change in leisure-time physical activity, total energy expenditure, quality of life (using the SF36 scales), 4-year coronary heart disease risk, and systolic and diastolic blood pressure. A post-hoc analysis comparing the proportion of participants that achieved 2.5 hours of leisure activity was carried out to allow comparison with previous studies carried out in primary care.[7]

Primary outcomes measured for the cost-effectiveness study were the incremental cost of change in self-reported physical activity over 12 months. These outcomes included the cost per total energy expenditure gained, the cost per leisure moderate- and vigorous-intensity energy expenditure gained, and the incremental cost of moving one additional 'sedentary' person into the 'active' category (achieving 2½ hours of at least moderate-intensity leisure activity per week).

Costs—Green Prescription programme development costs incurred in previous years were obtained from the developers of the programme, the Hillary Commission, and were adjusted for inflation using the December consumer price index from each corresponding year compared with that of December 2001.[8] A discount rate of 5% was used to calculate present equivalent values of programme costs from 1996 to 2001.[9]

Programme delivery costs included general practitioner and practice nurse time, Sports Foundation exercise specialists, and Green Prescription resources. Delivery costs within the general practice were estimated using usual consultation charges for participating practices, national award rates for practice nurses, and the time, estimated as 7 minutes by general practitioners and 13 minutes by practice nurses, for programme delivery.[6] Charges for each general practice in the region were obtained at baseline and average charges calculated for each consultation type.

Actual regional Sports Foundation personnel and overhead costs associated with the programme were obtained from the Sports Foundation's accounting department for the year 2001/2002. Average wage costs rather than marginal costs were used as the exercise specialists were permanent staff of the Sports Foundation.

Offset cost—Self-reported costs to the individual associated with exercise were identified by study participants in a 12-month follow-up questionnaire and included exercise equipment purchased, sports club or exercise group subscriptions, travel expenses to and from exercise, and any other costs associated with exercise over the 12 months of the study.

Costs associated with primary and secondary healthcare utilisation and costs of time off work were also recorded. Primary healthcare offset costs were calculated for each participant for the 12 months prior to study enrolment and compared with the 12 months after study enrolment. Actual number and type of

general practice consultations were obtained from practice records. Actual government subsidies for each type of consultation were used and were adjusted for inflation.

Patient charges and subsidies vary. Average patient part-charges of participating practices were used for consultations of non-subsidised patients (A3) (NZ$35) and low-income (A1) or high-user patients (AZ) (NZ$20), and for accident-related consultations NZ($10). Government subsidies for each consultation were NZ$15 for A1 and AZ visits, and NZ$26 for all accident-related visits. Numbers of accident-related visits to physiotherapists, chiropractors, and osteopaths were obtained from patient questionnaires. These visits were subsidised at a rate of NZ$19 per visit, with an average patient surcharge of NZ$10.

Secondary care costs were established using each participant's national health index, a unique identifier in primary and secondary healthcare allowing tracking of individual's health care utilisation. Actual hospital inpatient, outpatient, and investigation costs for each patient from all public regional and base hospitals were obtained from the local district health board for the year prior to and the year following each patient's enrolment in the study. Costs for private hospital-use could not be obtained. However, self-reported private hospital admission-rates were recorded.

To calculate the cost of loss of productivity due to illness and accident for the year prior to baseline compared with the year after baseline, the change in the number of days of illness- and accident-related leave taken were obtained by self-report. The average wage for the June quarter from wages, salary, and self-employment for those in paid employment was NZ$121.80/day for 2000 and NZ$128.20/day for 2001.[10]

All costs were adjusted for inflation using the 2001/2000 consumer price index ratio to calculate the incremental change. All costs are reported as New Zealand dollars. Where comparisons with programmes from the United States or the United Kingdom were carried out, values were converted to the New Zealand dollar according to the exchange rate of December 2001.[11]

Analysis

Total setup and programme administration costs were obtained to calculate programme cost per patient. Actual offset costs of primary and secondary healthcare utilisation, personal expenditure, and productivity changes were collected wherever possible. The differences in change in offset costs to the patient and health funder for intervention patients compared with control patients, with 95% confidence intervals, were calculated using a random effects generalised least squares regression model, where the general practice was entered as the clustering variable in STATA version 7.0.

Cost-effectiveness ratios were obtained by calculating programme costs per activity gain from a programme-funder perspective. These ratios were compared with those from other physical activity interventions reported in the literature. Sensitivity analyses were conducted using the confidence intervals for calculated physical activity gains as the relevant range.[7,12]

All analyses were carried out using an intention-to-treat approach, where no change from baseline was assumed in those who did not attend follow-up, except personal costs associated with exercise, where costs were assumed to be the mean of those in the equivalent group.

Results

Table 1 shows the characteristics of the 878 study-participants from 42 practices.[6] Results from the randomised controlled trial, which achieved 85% follow-up at 12 months, showed a mean total energy expenditure increase of 9.4 kcal/kg/week (p=0.001) and leisure exercise increase of 2.7 kcal/kg/week (p=0.02), or 34 minutes/week more in the intervention group than in the control group (p=0.04).[6]

SF-36 scores of self rated 'general health', 'role physical', 'vitality', and 'bodily pain' improved significantly more in the intervention group (5.95, 10.53, 5.36, and 6.51, respectively) compared with the control group (1.60, 4.16, 3.06, and 2.50, respectively) ($p<0.05$).[6]

Table 1. Baseline characteristics of less-active 40–79 year-old patients in general practice, by intervention and control group[6]

Patient Characteristic	Intervention Group Mean (SD) or N (%) [n=451]	Control Group Mean (SD) or N (%) [n=427]
Age, years	57.2 (10.8)	58.6 (11.5)
Systolic BP (mmHg)	135.1 (19.6)	135.4 (17.9)
Diastolic BP (mmHg)	82.4 (12.2)	81.8 (12.1)
Body mass index, kg/m^2	30.0 (6.7)	29.9 (6.4)
CHD 4-year risk*, % risk	5.7 (6.2)	5.5 (5.8)
Total energy expenditure, $kcal.kg^{-1}.day^{-1}$	33.9 (6.0)	33.7 (6.5)
Leisure physical activity[a], $kcal.kg^{-1}.day^{-1}$	0.9 (1.7)	0.9 (1.6)
Leisure exercise[#], $mins.day^{-1}$	11.3 (21.7)	12.0 (20.5)
Female participation: N (%)	301 (67)	281 (66)
Lower economic status:** N (%)	205 (45)	211 (49)
European: N (%)	354 (78)	324 (76)
Smokers: N (%)	78 (17)	76 (18)
Diabetes: N (%)	46 (10)	46 (11)
Hypertensive[$]: N (%)	240 (53)	220 (52)
Previous cardiovascular disease: N(%)	93 (21)	74 (17)

This table is reproduced from: Elley CR, Kerse N, Arroll B, Robinson E. Effectiveness of counselling patients on physical activity in general practice: cluster randomised controlled trial. *BMJ* 2003;**326**:793-6; *Risk of 4-year coronary heart disease risk [13, 14] was carried out on a randomly selected sub-sample to contain costs (n=787) and a further 51 participants declined to have cholesterol testing done. [$]Hypertensive refers to a previous diagnosis of hypertension and taking antihypertensive medication or a mean blood pressure (BP) of greater than 150 mmHg systolic or 90 mmHg diastolic; [a]Leisure physical activity refers to the energy expenditure of all leisure-time physical activity considered moderate or vigorous by the respondent; [#] Leisure exercise refers to time spent in moderate (3.0-4.9 MET) and vigorous (≥5.0 MET) leisure-time activities undertaken at least once per 2 weeks.[15] **Economic status was measured at baseline by qualification for a low-income health subsidy card. (Forty-three percent of adults over 45 years of age in New Zealand qualify for this card.)

Table 2. Offset costs per patient for the intervention group compared with the control group (intention-to-treat analysis)

Cost Variable (NZ$)	Intervention # Change [Yr2-Yr1] (95%CI)	Control Group # Change [Yr2-Yr1] (95% CI)	Between–Group * Difference (95% CI)
Health-funder costs			
Accident-related referrals**	$1.21 (-8.08–10.50)	$1.56 (-9.13–12.20)	-$0.36 (-14.43–13.72)
Non-accident related GP visits	-$4.01 (-7.98–-0.04)	-$0.05 (-7.15–7.05)	-$4.39 (-15.41–6.62)
Accident-related GP visits	$0.34 (-5.05–5.73)	$0.78 (-6.07–7.63)	-$0.45 (-9.09–8.20)
Hospital costs	$320.85 (-69–711)	$495.03 (108–882)	-$174.19 (-722.75–374.38)
Patient costs			
Accident-related referrals	$0.84 (-4.01–5.69)	$1.04 (-4.48–6.56)	-$0.20 (-7.50–7.10)
Non-accident related GP visits	-$7.24 (-16.80–2.37)	$0.89 (-11.00–12.80)	-$8.21 (-27.75–11.32)
Accident-related GP visits	$0.24 (-1.82–2.30)	$0.44 (-2.18– 3.06)	-$0.20 (-3.51–3.11)
Costs of exercise	$236.29 (192–281)	$209.37 (152–267)	$26.95 (-45.08–98.98)
Productivity costs			
Sick-days off work (accident and non-accident-related)	$42.19 (-166–251)	$37.47 (-78.20–153)	$1.21 (-522.06–524.49)

*Adjusted for clustering; # Not adjusted for clustering; **Accident-related referrals to physiotherapy, osteopathy or chiropractor.

Ninety-five percent of intervention patients and 2.5% of control patients attending follow-up recalled receiving a Green Prescription in the previous 12 months, indicating a low level of 'contamination' of intervention.

The total discounted and annuitised national set-up and coordinating cost for the Green Prescription programme from mid 1996 to mid 2002 was NZ$2,861,016 (see Appendix 1). Approximately 34,708 patients received Green Prescriptions during that period. The programme set-up and coordinating cost per patient (excluding exercise specialist referral costs) was NZ$82.43 per Green Prescription recipient. The general practice-based delivery cost of the intervention and follow-up over the following 12 months was NZ$19.20 per patient (see Appendix 2). Of the 451 in the study, 410 (91%) were referred to the Sports Foundation exercise specialists. The total exercise specialist direct and overhead costs attributable to study patients was NZ$31,032.65 (see Appendix 3) or NZ$68.81 per intervention patient.

Table 2 shows the decreased healthcare costs per individual in the intervention compared with the control group, particularly in hospital costs, but with wide confidence intervals due to large individual variations in actual costs of hospitalisation. There was no significant difference in change in number or cost of days off work due to illness or accident between the groups for the year before and the year after the intervention. (Changes in rates of health care utilisation and days off work are presented in Appendices 4-6.) Personal exercise-related costs were NZ$26.96 per patient per year more in the intervention group (see Appendix 7).

Table 3 shows the cost from the programme-funders' perspective was NZ$170.43/patient/year. Table 4 shows the cost effectiveness ratios for the Green Prescription with sensitivity analyses compared with those of the 'Lifestyle' and 'Structured' Project Active exercise programmes.[12]

The proportion of participants in the intervention who achieved 2.5 hours of at least moderate activity per week increased by 14.6% (66/451) compared with 4.9% (21/427) in the control group (p=0.003).[6] Therefore, the incremental cost of converting one additional adult in the Green Prescription programme from sedentary to active over 12 months, compared with the control group, was NZ$1,756 in programme costs.

Table 3. Incremental cost per patient of the Green Prescription programme, including programme and offset costs and savings (intention-to-treat analysis)

Description of costs	Incremental costs / patient in NZ$ (95% CI)
Green Prescription set-up and coordinating costs	$82.43
Regional Sports Foundation support costs	$68.81
General practice delivery of intervention costs	$14.59
General practice follow-up support costs	$4.60
Total programme costs	**$170.43**
Total patient offset costs	$18.62 (-55.63–92.88)
Total health funder offset costs	-$178.94 (-728.58–370.70)
Productivity offset costs (accident- and non-accident-related)	$1.21 (-522.06–524.49)

* It was inappropriate to calculate total cost difference estimates taking offset costs into account because of the large confidence intervals and imprecision around the offset costs.

Table 4. Cost-effectiveness ratios for the green prescription compared with project active 'lifestyle' and 'structured' physical activity promotion programmes

	Green Prescription Programme			Project Active	
Monthly Incremental Cost Categories	**Programme funder's perspective[#]**	**Sensitivity analysis[1]**	**Sensitivity analysis[2]**	**'Lifestyle' Program at 24 months***	**'Structured' Program at 24 months***
Cost of programme per participant per month	$14.20	–	–	$41.26	$118.62
Cost of change in energy expenditure per kcal/kg/day	$10.59	$6.57	$24.91	$48.11	$170.80
Cost of change in at least moderate intensity activity per kcal/kg/day	$37.37	$20.46	$205.80	$43.31	$358.43

[#]Offset costs are excluded from this analysis due to the large confidence intervals around the offset costs estimations. [1]Using upper 95% confidence interval estimate of physical activity gain.[6] [2]Using lower 95% confidence interval estimate of physical activity gain'; *Comparisons with the Project Active 6-month results were not used, as these values were even less cost-effective than at 24 months [12]; 95% confidence intervals were not available for Project Active estimates. All costs were converted to New Zealand dollars using the December 2001 exchange rate, $NZ1=$US0.4157 or $US1=$NZ2.4056.

Discussion

This study represents one of the most comprehensive cost-effectiveness analyses of a physical activity programme in primary healthcare to date. The Green Prescription programme cost per patient was NZ$170.45 from a programme funders' perspective. Cost-effectiveness ratios were favourable compared with other physical activity interventions reported in the literature. Cost-effectiveness could not be calculated from a societal perspective because of large confidence intervals around offset costs.

Limitations

Thirteen percent of patients attending their general practitioner during the recruitment phase were too ill to be screened, missed or refused screening for eligibility. In addition, one-third of those eligible declined to participate. There are few details available about those that chose not to participate, which may limit generalisability of results.

'Usual care' may have included some verbal advice about physical activity, 2.5% of control patients received a Green Prescription during the study year, and the control group also increased physical activity participation possibly due to participation in a trial about exercise. This may have diluted the effect of the intervention.

Private hospital cost data was not available. However, of the 337 participants that reported inpatient or outpatient attendance, only 41 used private hospitals (21 intervention and 20 control). When average daily public hospital costs were applied to self-reported days in private hospital for the year following the intervention, the total private hospital costs in the control group were substantially more than those in the intervention group (Appendix

5 footnote). Therefore hospital-related savings in the intervention group may have been greater than reported in this paper.

There are large 95% confidence intervals and imprecision around changes in major offset costs, particularly healthcare utilisation costs to the patient (NZ$18.62 [95% CI: -55.63–92.88]) and to the health funder (-$178.94 [95% CI: -728.58–370.70]), as well as productivity costs ($1.21 [95%CI: -522.06–524.49]). As a result, overall cost-effectiveness from a societal perspective could not be calculated.

Given this degree of variability in actual healthcare utilisation costs, it would take a very large study to have sufficient power to achieve confidence intervals that did not cross zero. Nevertheless, there was no evidence of increased costs in health care utilisation or loss of productivity as a result of the intervention.

Strengths

This cost-effectiveness study was conducted prospectively, costing data collected was comprehensive, follow-up rates were high, and in almost all cases, actual costs, rather than estimated costs, were used. Accordingly, few assumptions were made. This is in contrast to many of the previous cost-effectiveness studies conducted of lifestyle interventions, which estimated costs retrospectively.[12,16]

Implications

The Green Prescription appears to be cost-effective when compared with other physical activity interventions reported in the literature, such as Project Active in the United States.[12] Furthermore, the incremental cost of converting one additional person to an active state was NZ$1,756 using the Green Prescription. Using the United Kingdom the 'Prescription for Exercise' programme in primary care the incremental cost of converting one additional person to an active state was $NZ8,663 (UK£2,500).[7]

Although the costing structures and components may be quite different in these countries, the cost-effectiveness ratios of the Green Prescription appear favourable, as presented in Table 4. However, to allow comparisons with other types of interventions, a cost utility analysis is needed.

Ten percent more intervention patients than control patients went from 'sedentary' to 'active' and maintained this at 12 months. This has potential economic implications. For example, an estimated NZ$55 million could be saved in direct and indirect costs associated with ischaemic heart disease and hypertension if 10% of the population in New Zealand changed from 'sedentary' to 'active'.[17,5] The most recent New Zealand physical activity survey estimates that 878,000 adults over 18 years of age in New Zealand are not achieving 2½ hours of leisure-time activity per week.[18]

If all less-active adults were to receive a Green Prescription, the total programme cost (without offset costs), would be NZ$150 million to save at least NZ$55 million per year in costs associated with cardiovascular disease, alone. If changes detected after 1 year were permanent, then the programme may be cost-saving in approximately 5 years, assuming a 2-year delay[19] before cardiovascular benefits were evident.

The potential savings would be even greater if quality of life benefits (demonstrated in SF-36 score changes), and other potential health benefits associated with increased

physical activity, were considered. In addition, interventions become more cost-effective over time as the proportion of set-up costs declines.[12]

This study represents a cost-effectiveness analysis, using cost per physical activity unit gained as its primary outcome to allow comparison with previous community-based physical activity interventions. Modelling of the potential savings from health outcomes related to the increased proportion of active adults, and a cost-utility analysis are the next step and are underway.

The research will allow future comparison of cost-effectiveness of physical activity counselling in primary care with other lifestyle and pharmacological interventions.[20]

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Appendices

Appendix 1. Costs of set-up and coordination of the Green Prescription programme nationally

Year	Cost# (NZ$)	Adjusted Cost* (NZ$)	Discounted Cost** (NZ$)
1996/97	400,000	430,800	549,822
1997/98	180,000	192,240	233,669
1998/99	390,000	414,960	480,368
1999/00	450,000	476,550	525,396
2000/01	490,000	498,820	523,761
2001/02	548,000	548,000	548,000
Total	**$2,458,000**		**$2,861,016**

[#] Costs associated with intervention and resource development, grants to regional sports foundations, general practitioner training, coordination and resource production and distribution. Figures supplied by the Hillary Commission; * Adjusted for inflation, using the consumer price index (CPI) ratio (December 2001 CPI: annual December CPI ratio).[8]; ** Discounted at a 5% rate.[9]

Appendix 2. Costs of delivery and follow-up of the Green Prescription programme by general practitioners and practice nurses

Green Prescription Delivery	No. of patients	**Mean delivery time (mins)	Mean number of sessions	Hourly cost of personnel	Total cost	Cost per patient
General Practitioner	385	7	1	$140.00	$6,306.30	$16.38
Practice Nurse	66	13	1	$19.12	$273.90	$4.15
Sub-total	451				$6,580.20	$14.59
Practice Follow-up Advice						
General Practitioner	64	2.3	2.9	$140.00	$995.84	$15.56
Practice Nurse	14	7.8	6.1	$19.12	$212.27	$15.16
Not Stated *	9	5.8	4.8	$140.00	$584.64	$64.96
No Practice Follow-up	302					
Sub-total	389#				$1792.75	$4.61
Overall Total					**$8,372.95**	**$19.20**

*Assumed to be a general practitioner (more conservative assumption than assuming the nurse saw them); ** As estimated by GP, nurse and patient participants. # Total cost/389 patients who had received intervention and had returned for follow-up. It was assumed that non-attendees had the same rate of follow-up advice from health professionals.

Appendix 3. Costs of Sports Foundation attributable to the Green Prescription study participants (n=451) for exercise specialist follow-up over 12 months (2001/2002)

Cost Category	Details	Cost per item	Total Cost
Staff Wage Rates:			
Staff 1	$21.27 per hr x 7.2 hrs/ week	$7,965	
Staff 2	$20.19 per hr x 7.2 hrs/ week	$7,560	
Staff 3	$14.00 per hr x 11.25 hrs/ week	$8,190	
Staff training		$900	
Course fees		$900	
Total staff costs			**$25,515**
Office Space	Rental/ Cleaning	$1,512	$1,512
Admin. Support	Reception/Admin	$1,350	$1,350
Tolls	Staff 1	$108	$1,350
	Staff 2	$216	
	Staff 3	$1,026	
Mail-outs	Newsletter	$200	$1,305.65
	Postage	$491.40	
	Envelopes	$122.85	
	Photocopying	$491.40	
Total overheads			**$5,517.65**
Total cost of intervention support			**$31,032.65 ($68.81 per patient)**

(Figures supplied by the regional Sports Foundation accounting department)

Appendix 4. Change in primary healthcare use by study participants for the year-before and the year-after baseline

		Intervention			Control			Incremental Change
Description	Unit cost to: patient (health funder)	Yr 1 (n*) [av. no. visits/ patient]	Yr 2 (n) [av. no. visits/ patient]	Yr2-Yr1 av. no. visits/ patient	Yr 1 (n) [av. no. visits/ patient]	Yr 2 (n) [av. no. visits/ patient]	Yr2-Yr1 av. no. visits/ patient	Average no. visits/ patient
'A1'** non-accident visits to general practitioner	$20 ($15)	1227 (n=145) [8.46]	1139 (n=146) [7.80]	-0.66	1294 (n=157) [8.24]	1296 (n=157) [8.25]	0.01	-0.67
'A3'** non-accident visits to general practitioner	$35 ($0)	846 (n=170) [4.98]	808 (n=171) [4.73]	-1.46	858 (n=172) [4.99]	851 (n=170) [5.01]	0.02	-1.48
'AZ'** non-accident visits to general practitioner	$20 ($15)	191 (n=15) [12.73]	189 (n=15) [12.60]	-0.13	233 (n=15) [15.53]	257 (n=15) [17.13]	1.6	-1.73
Total non-accident visits to general practitioner		2264 (n=330) [6.86]	2136 (n=332) [6.43]	-0.43	2385 (n=346) [6.93]	2404 (n=344) [7.03]	0.10	-0.53
Total accident-related visits to general practitioner	$10 ($26)	286 (n=330) [0.87]	299 (n=331) [0.90]	0.03	341 (n=346) [0.99]	360 (n=344) [1.05]	0.06	-0.03
Physio, chiropractor or osteopath[#] visits	$10 ($19)	518 (n=366) [1.42]	602 (n=367) [1.64]	0.22	521 (n=337) [1.55]	577 (n=333) [1.73]	0.18	0.04

* 'n' refers to the number of patients in each category. ** 'A1' refers to 'low income' patients and 'AZ" refers to 'high user' patients, both of whom receive government subsidies for visits to general practice, 'A3' refers to higher income patients who do not qualify for government subsidies for general practice visits. [#] Accident-related visits to a physiotherapist, chiropractor, or osteopath. NB: Data about number of general practice visits were collected on 677 study participants (74% intervention participants [n = 332] and 81% control participants [n = 346]). Eight practices (5 intervention and 3 control) were not able to, or chose not to provide the information on general practice visits. The number of physiotherapy, osteopathy and chiropractic accident-related patient visits for the year prior to baseline and the year following baseline, was available on 750 of the 878 participants because this data were collected at follow-up by self-report. Intention-to-treat analyses were conducted that assumed those for whom data were not available had no change in their rate of visits over the two years.

Appendix 5. Change in costs of public hospital admissions and outpatient use for the year-before and the year-after baseline (costs adjusted for inflation)

	Intervention[#] (N = 451)			Control[#] (N = 427)			Incremental Change * (N=878)
Cost description	**Year 1**	**Year 2**	**Change: Yr2-Yr1**	**Year 1**	**Year 2**	**Change: Yr2-Yr1**	**Intervention-Control**
Total secondary care costs in $NZ (n**)	$370,189 (113)	$514,889 (117)	$144,700 (144)	$267,119 (107)	$478,497 (108)	$211,378 (138)	-$66,678
Mean cost per patient who used secondary care (95%CI)	$3,276 ($2,276–$4,276)	$4,400 ($2,987–$5,813))	$1,005 (-$219–$2,229)	$2,496 ($1,886–$3,106)	$4,431 ($3,009–$5,853)	$1,531 ($341–$2,721)	-$527 (-$2,221–$1,167)
Mean cost including all study patients (95%CI)	$828 ($546–$1110)	$1,142 ($738–$1,546)	$321 (-$69–$711)	$626 ($443–$809)	$1,121 ($721–$1,521)	$495 ($108–$882)	-$174 (-$723–$374)

[#] Calculations are not adjusted for clustering. * Calculations adjusted for clustering using STATA 7.0; ** Number of patients admitted or attended outpatients during each time period and in each group.

Note: Year 1 and Year 2 refer to the year before and the year after baseline (costs adjusted for inflation). Approximately 34% (299/878) of study patients reported being admitted to a public hospital or attending a hospital outpatients clinic in the year prior to baseline or the year between baseline and follow-up. Public hospital costing-data were obtained for 282/299 (94%) of these patients (144 intervention and 138 control patients). These costs were not available on 17 participants (10 intervention patients and 7 control patients). In addition, 37 patients said they had attended a private hospital in the year between enrolment and 12-month follow-up plus four had attended both public and private hospitals (Total: 21 intervention and 20 control patients). Actual costs for private hospital admission could not be obtained. However, number of days of admission had been collected by self-report. When the average daily cost (with associated outpatient costs) from the public hospital figures ($1,605) was applied to private hospital admissions, the total year-2 cost of private admissions in the control group was $97,102 (average cost/patient $4,855, SD$5,464). In comparison, the total year-2 cost of private admissions in the intervention group was $72,225 (average cost/patient $3,439, SD $3,704). Although these calculations assume similar daily costs in public and private, which is unlikely to be the case, they do suggest that the incremental savings in hospital savings within the intervention compared with the control group are likely to be greater than presented in the analysis of public hospital costs only.

Appendix 6. Change in the number of days off work due to sickness or accident during the year-before compared with the year-after study enrolment for intervention and control study participants

Variable		Intervention (n = 204)			Control (n = 178)			Incremental Change [95%CI]
		Yr1	Yr 2	Yr2-Yr1	Yr1	Yr2	Yr2-Yr1	Intervention-Control
Unit cost per day	NZ$	121.8	128.2		121.8	128.2	–	–
Illness-related days leave	Total	842.5	887.5		721.5	749.5	–	–
	Mean (SD)	4.15* (20.5)	4.25 (16.6)	0.17* (26.2)	4.05 (14.9)	4.16 (15.8)	0.08 (9.36)	0.09 [-3.98–4.16]
Accident-related days leave	Total	69.5	153		187	267		–
	Mean (SD)	0.34 (1.94)	0.74 (4.39)	0.41 (4.83)	1.05 (7.26)	1.50 (10.7)	0.45 (11.4)	-0.04 [-1.76–1.68]

Note: Of the 393 (52%) participants in paid employment 382 (97%) gave data on the loss of productivity; * Data were missing on 2/204 participants for illness-related days off in year 1. Therefore, change in illness-related days was calculated from 202 in the intervention group.

Appendix 7. Patient costs associated with exercising for the year between baseline and follow-up

Description	Intervention* (n=389) Total Cost	Average Cost (SD)	Control* (n = 361) Total Cost	Average Cost (SD)	Incremental Difference** Average cost/patient [95%CI]	
Exercise/ sports shoes	$16,823	$43.25 ($65.08)	$12,380	$34.29 ($70.69)	$9.80	[-1.50, 21.11]
Exercise group, sports club or gym membership	$23,004	$59.14 ($166.00)	$17,986	$49.82 ($142.22)	$9.31	[-12.89, 31.52]
Exercise or physical activity equipment	$15,871	$40.80 ($221.86)	$9,673	$26.80 ($182.38)	$14.00	[-15.19, 43.20]
Other costs associated with exercise	$3,991	$10.26 ($70.64)	$3,688	$10.22 ($63.10)	$0.11	[-9.83, 10.05]
Travel cost #	$32,228	$82.85 ($336.33)	$31,843	$88.21 (402.89)	-$5.36	[-58.34, 47.62]
Total	**$91,917**	**$236.30 ($515.14)**	**$75,570**	**$209.34 ($659.41)**	**$26.96**	**[-45.08, 98.98]**

*Calculations not adjusted for clustering; **Calculations adjusted for clustering by practice; # Travel cost equals total km per week x 16.6 cents/km x 52 week=cost per year.