Is Physical Activity Counseling Effective for Older People? A Cluster Randomized, Controlled Trial in Primary Care

Ngaire Kerse, MBChB, PhD, C. Raina Elley, MBChB, PhD,‡ Elizabeth Robinson, MSc,† and Bruce Arroll, MBChB, PhD**

OBJECTIVES: To establish the effectiveness of the Green Prescription physical activity counseling program in increasing activity and quality of life in older community-dwelling people.

DESIGN: Post hoc subgroup analysis of a large cluster randomized, controlled trial.

SETTING: One hundred seventeen doctors in 42 primary care practices (74% participation rate) in the Waikato region of New Zealand.

PARTICIPANTS: Two hundred seventy sedentary primary healthcare patients aged 65 and older (67% participation rate).

INTERVENTION: Patients in intervention practices prompted their primary care doctors or practice nurse to deliver brief activity counseling. A "Green Prescription" was written involving the negotiation of activity goals. Trained exercise specialists from a regional sports foundation gave follow-up telephone support over 3 months.

MEASUREMENTS: Leisure moderate and vigorous physical activity, total energy expenditure, systolic and diastolic blood pressure, health-related quality of life, musculoskeletal injuries, falls, and hospitalizations.

RESULTS: After 12 months of follow-up, leisure time moderate activity increased by 0.67 h/wk more in the intervention group than the control group (95% confidence interval (CI) = 0.17–1.17) and energy expenditure increased by 2.67 kcal/kg per week (95% CI = 0.87–4.47) more. For intervention group participants, vitality and general health scales of the 36-item Short Form showed statistically and clinically relevant improvements, and there was a decrease in hospitalizations ($P < .03$). There were no observable changes in blood pressure, injuries, or falls as a result of the Green Prescription program.

CONCLUSION: This physical activity intervention improved activity, energy expenditure, health-related quality of life, and hospitalizations for older primary care patients. Systematic inclusion of the Green Prescription in routine primary health care will probably lead to health gain for older people. **J Am Geriatr Soc 53:1951–1956, 2005.**

Key words: physical activity; primary health care; cluster randomized, controlled trial; older people

Increased physical activity for older people is protective against hip fracture[1] and linked to better quality of life, physical functioning, and independent living.[2] Strong associations exist between increasing physical activity levels in older people and risk of all-cause and cardiovascular mortality after controlling for age, chronic disease, smoking, and alcohol consumption.[3,4] More importantly, levels of physical activity are linked to quality of life and well-being.[5] Physical activity interventions based in primary care may be more effective in older people, because they may be more responsive to their physicians' advice about preventive measures because they expect health advice from their doctors and are likely to take notice of it from that source.[6,7] In addition, older people may respond differently to activity interventions than younger groups by altering their patterns of activity in different ways or responding better to a personal approach.[8] The U.S. Preventive Task Force systematic review[9] highlighted trials involving activity counseling for older people as being particularly effective in affecting activity levels, but uptake of such interventions has not been widespread.

Older people undertake less activity than their younger counterparts and may benefit more from activity interventions, because, in general, they have a higher absolute risk of cardiovascular problems, functional decline, mental health problems, and the adverse effects of inactivity.[5] The benefits

From the Departments of *General Practice and Primary Health Care and †Epidemiology and Biostatistics, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand; and ‡Department of General Practice, Wellington Clinical School, University of Otago, Dunedin, New Zealand.

This work was supported by project grants from the National Heart Foundation, New Zealand; the Waikato Medical Research Foundation; the Royal New Zealand College of General Practitioners' Research and Education Charitable Trust; and a National Heart Foundation Fellowship (RE) and a Harkness Fellowship from the Commonwealth Fund (NK). Presented to the Annual General Practice Academic Meeting, Lake Ohau, New Zealand, September 2004.

Address correspondence to Ngaire Kerse, Department of General Practice and Primary Health Care, FMHS, University of Auckland, Private Bag 92019, Auckland, New Zealand. E-mail: n.kerse@auckland.ac.nz

DOI: 10.1111/j.1532-5415.2005.00466.x

0002-8614/05/$15.00

of physical activity change may be measurable after small increases in activity for older people, because they start from a lower baseline and because small increments of change in activity may lead to improvements in quality of life.

Quality of life is important for older people,[5] but few trials have extended outcomes from activity-based interventions to quality of life. One trial of a muscle strengthening, balance, and walking intervention in women aged 80 and older recruited from primary care doctors' offices demonstrated reductions in falls and injuries after 12 months and improvements in balance after 6 months,[10] but little is known about the effectiveness of activity-based interventions over the long term for older people with respect to quality of life, injury, and cardiovascular outcomes. For all these reasons, examination of the effect of physical activity interventions in older age groups is important and can add to the evidence base.

This article presents a post hoc subgroup analysis of subjects aged 65 and older of the effectiveness of the Green Prescription program in a population-based group of those aged 40 to 80.[11,12]

METHODS

Design

This is a post hoc subgroup analysis of a cluster randomized, controlled trial that was conducted from 2000 to 2002 in 878 middle-aged and older adults in 42 primary care doctors' offices in New Zealand to assess the effectiveness of the Green Prescription physical activity intervention over a 12-month period.[11]

Participants

All primary care doctors in the Waikato region were invited to participate, of whom 74% (117/159 primary care doctors from 42 practices) completed the study. Primary care doctors' offices were randomized using distant computer randomization, using stratification by practice size, to deliver the Green Prescription or usual care. Rolling recruitment proceeded over the following 12 months. All patients aged 40 to 80 were screened for physical activity as they entered each practice over a week of recruitment. To be included, patients had to be participating in less than 30 minutes of at least moderate intensity physical activity on 5 or more days per week, be aged 40 to 80, and intend to stay in the region for at least 12 months. Patients were excluded if they were unable to comprehend the informed consent or were suffering from an unstable cardiovascular, debilitating, or progressive illness. The Waikato ethics committee approved the study. Details of methods and overall results are published elsewhere.[11]

Randomization

An independent biostatistician randomized practices to intervention or control groups using a computer-generated randomization schedule at the University of Auckland.

Data Collection and Outcomes

Primary outcome measures include incremental change over 12 months in leisure moderate and vigorous physical activity, total energy expenditure, systolic and diastolic blood pressure, and health-related quality of life. Physical activity variables were obtained from a self-completed validated questionnaire. The questionnaire was based on a questionnaire validated in 113 randomly selected adults, adapted and revalidated for a primary care population before this study.[13,14] It was found to be accurate and reliable compared with a 7-day diary collection and a pedometer measure of activity.[13,14] Blood pressure was measured three times according to a protocol using electronic sphygmomanometers and signed witness statements. Quality of life was assessed using the 36-item Short Form (SF-36) questionnaire, which has been validated in many populations, including older populations.[15,16] Adverse events were measured as falls and musculoskeletal injuries in the previous month and hospitalizations in the previous year. These were determined using self-completion questionnaire at baseline and follow-up. Any reported hospitalizations were validated against hospital records.

Intervention

Patients in intervention practices prompted their primary care doctor or practice nurse to deliver brief activity counseling using motivational interviewing techniques by taking a form into the consultation that the researcher gave them. The practitioner individualized advice to the patient's age, capability, medical condition, and everyday activities and prescribed it on a Green Prescription, which was given to the patient and faxed to exercise specialists at the regional sports foundation. Trained exercise specialists from the regional sports foundation gave telephone support on approximately three occasions over the following 3 months. Written material and newsletters were also sent out quarterly. Training personnel from the Sports and Recreation Commission, the Hillary Commission, and the Goodfellow Unit on Tobacco, Alcohol, and Drugs (TADs) have provided physicians in New Zealand with training for the Green Prescription program over the last 5 years. Before this trial, all intervention physicians in the region of interest were offered a 2-hour refresher training session from the TADs program trainers.

Control Group

Control group patients received usual care from their primary care doctors. These doctors received no prompt to deliver the Green Prescription. On average, 3% of New Zealanders receive the Green Prescription from their primary care physician in any year.

Blinding and Follow-Up

Outcomes were ascertained by self-completion questionnaires at baseline and follow-up. Patients and doctors could not be blinded to group allocation.

Analysis

The difference in change in each outcome measure was estimated using a random-effects generalized least squares regression model in Stata 7.0 (Stata Corp., College Station, TX), adjusting for cluster by primary care doctors' office and controlling for the stratification variable practice size. Effect of the intervention on falls and hospitalizations was estimated using a logistic regression model, regressing

follow-up status on intervention group status and baseline status, controlling for clustering and practice size. Because participants were selected in groups and randomized according to the practice to which they belonged, the cluster variable was the practice. It is possible that clustering by practitioner would have influenced results, but in this study most practices were small, lessening the likelihood of significant clustering effect within the practices. Unequally distributed variables at baseline were tested by including them in outcomes analyses as controlling variables. Because there was no discernible difference in the level of significance of the outcome according to inclusion of sex or smoking status in the models, results of analyses without controlling variables are presented. All outcomes were assessed using intention-to-treat analyses. Participants unable to follow up were assigned their baseline status on follow-up, because this was considered the most conservative estimate. Results from a post hoc subgroup analysis of participants aged 65 and older are presented in this article.

RESULTS

Practices were stratified according to size, being divided into three categories: solo (n = 15), two or three general practitioners (n = 17), and more than three general practitioners (n = 10) practices. Twenty-one practices were situated in rural or semirural towns, and 21 practices were situated in an urban area (Hamilton); 117 physicians in 42 practices completed the study. Twenty-eight percent of participating general practitioners were female (n = 33). Between-group characteristics of the participating general practitioners and practices are presented in Table 1.

Sixty-seven percent of all consecutively screened eligible adults participated in the study, including 608 younger than 65 and 270 aged 65 and older. Eighty-seven percent (n = 233) of patients aged 65 and older attended follow-up. Those who failed to follow up were more likely to be men (19%, vs 10% of women, $P < .03$) but were indistinguishable in terms of age, prior hospitalization, or fall status. More details of participation rates are presented elsewhere.[12]

Baseline results are presented in Table 1 and show that enrolled older participants undertook modest amounts of physical activity. The groups were balanced in terms of demographic and baseline activity characteristics.

Table 2 compares the intervention and control groups. Leisure time moderate activity and energy expenditure increased significantly, total energy expenditure increased but not significantly. There were no significant changes in blood pressure. Self-rated general health improved for those in the older age group, with vitality and general health scales of the SF-36 showing statistically and clinically relevant improvements.

A statistically nonsignificant increase in the proportion of participants reaching health-related activity goals of 2.5 hours of moderate or vigorous activity per week was

Table 1. Baseline Results of Intervention and Control Group Participants Aged 65 and Older in a Trial of Activity Counseling

Variable	Intervention (n = 130)	Control (n = 140)	Total (n = 270)
Age, mean ± SD	71.0 ± 4.1	72.2 ± 4.5	71.6 ± 4.4
Female, n (%)	88 (68)	83 (59)	171 (63)
Smoker, n (%)	17 (13)	25 (18)	42 (16)
Hospitalized, n (%)	89 (22)	104 (24)	148 (20)
Systolic BP, mmHg, mean ± SD	141 ± 20	143 ± 19	142 ± 20
Diastolic BP, mmHg, mean ± SD	79 ± 12	81 ± 13	80 ± 13
Total medications, mean ± SD	3.9 ± 2.7	3.7 ± 2.8	3.8 ± 2.8
Activity level			
Total energy expenditure, kcal/kg per week, mean ± SD	220 ± 32	218 ± 32	219 ± 32
Leisure energy expenditure, kcal/kg per week, mean ± SD	4.7 ± 9.1	5.4 ± 9.7	5.1 ± 9.4
Leisure moderate to vigorous exercise, hours/wk, mean ± SD	1.2 ± 2.5	1.3 ± 2.5	1.3 ± 2.5
>2.5 hours moderate to vigorous activity per week, n (%)	20 (14)	21 (16)	41 (15)
36-Item Short Form quality-of-life score, mean ± SD			
Physical function	59.4 ± 26.0	60.9 ± 24.7	60.2 ± 25.3
General health	59.5 ± 21.3	64.8 ± 20.2	62.2 ± 20.9
Mental health	77.1 ± 16.0	75.3 ± 17.0	77.0 ± 16.5
Bodily pain	60.8 ± 26.1	61.2 ± 27.3	61.0 ± 26.7
Vitality	53.0 ± 19.8	55.9 ± 22.0	54.5 ± 20.9
Role physical	46.6 ± 41.4	47.6 ± 42.3	47.1 ± 41.8
General practices and doctors, n (%)			
Female practitioner	17 (28)	18 (31)	35 (29)
Practitioner in full-time practice	47 (80)	45 (82)	95 (81)
Rural or semirural practice	12 (52)	9 (47)	21 (50)
Solo practice or <3 partners	33 (53)	33 (57)	66 (55)

Note: Although 42 practices comprising 120 family physicians participated, because three physicians worked part time in two practices, the denominator for practice physicians was 120, and the denominator for practitioner characteristics was 117.
SD = standard deviation; BP = blood pressure.

Table 2. Change in Intervention Group Score over 12 Months Compared with Change in Control Group Score over 12 Months for Outcome Variables of Those Aged 65 and Older Receiving the Green Prescription

Variable	Incremental Change (95% Confidence Interval) (n = 270)	*P*-value
SBP mmHg	− 0.56 (− 6.17–5.04)	.82
SBP adjusted for change in antihypertensive medications	− 0.55 (− 6.22–5.11)	.85
DBP mmHg	0.46 (− 3.15–4.07)	.80
DBP adjusted for change in antihypertensive medications	0.57 (− 3.02–4.16)	.80
Activity levels		
Total energy expenditure kcal/kg per week	2.96 (− 2.92–8.85)	.32
Leisure-time energy expenditure kcal/kg per week	2.67 (0.87–4.47)	.004*
Leisure moderate-vigorous hours/wk	0.67 (0.17–1.17)	.008*
36-Item Short Form Quality of Life		
Physical function	1.09 (− 4.10–6.29)	.68
Role physical	9.47 (− 0.36–19.28)	.06
Bodily pain	3.99 (− 2.12–10.10)	.20
General health	5.46 (1.69–9.24)	.005*
Vitality	4.43 (0.31–8.54)	.04*
Social function	0.62 (− 5.67–6.91)	.85
Role emotional	− 5.01 (− 14.76–4.74)	.31
Mental health	2.16 (− 1.14–5.46)	.20

* Significant at $P < .05$ level.
SBP = systolic blood pressure; DBP = diastolic blood pressure.

observed. The proportion of intervention group participants reaching this goal rose from 14% (n = 20) to 31% (n = 40), compared with the control group, in which the proportion of participants increased from 16% (n = 21) to 22% (n = 31) over the 12-month follow-up period ($P = .06$).

There were no major adverse events reported as a result of this intervention. At baseline, 11% of the intervention and control groups reported some form of injury in the previous month. At follow-up, 10 (9%) control group participants and 9 (8%) intervention group participants reported some form of injury. This differential rate of injury was not statistically significantly different. In the intervention group, 15 (12%) reported falls at baseline and 13 (10%) at follow-up. In the control group, 18 (13%) reported falls at baseline and 22 (16%) at follow-up. There was no increase in falls as a result of the program. Thirty-eight (28%) control group participants and 44 (35%) intervention group participants had been hospitalized in the year before the Green Prescription was given. In the year after the intervention, 46 (34%) control participants and 35 (28%) intervention participants were hospitalized. This reduction in hospitalization was statistically significant ($P = .03$).

DISCUSSION

This study showed that a routinely used physical activity intervention set in the primary care doctor's office was effective at improving leisure time moderate and vigorous physical activity and health-related quality of life and decreasing hospitalizations for older people. There was no effect on blood pressure and no increase in adverse events. This report underlines the potential gains for older people from physical activity interventions provided in primary care. The increase in leisure time activity was modest in this subgroup of older people but was greater than that observed in the main study (37 minutes vs 33 minutes), as was the corresponding change in energy expenditure (increase of 2.93 kcal/kg per week for older group vs 2.67 kcal/kg per week for the whole group).

Reviews of physical activity interventions for older people have questioned the long-term benefit in terms of functional status.[17,18] Quality of life is closely related to functional status for older people, and results from this trial should reassure readers not only of the benefits of activity for older people[5,19] but also of the potential positive effect of simple interventions delivered within primary health care on quality of life. The increase in perceived self-rated general health of the SF-36 shows that the perceived improvements in quality of life related to increasing physical activity are significant for older people.

The increase in amount of moderate and vigorous activity observed in this trial is modest–an average of 40 minutes per week. Other studies specifically designed for older people and involving more resources have shown improvements in intention to exercise without increased participation[20] or failed to show any effect.[21] More-extensive medically based interventions have shown similar levels of increase in activity,[22] and a systematic practice-based educational, physician-prompting intervention without a direct approach to the patient has shown about half this level of increase (in walking).[23] These results suggest that a systematic process of screening and counseling is an effective strategy for health improvement. A community support and reinforcement component, along with goal-related activity counseling designed to activate and empower the patient, enhances the practice-based delivery of the Green Prescription program. Perhaps this successful public health activity intervention puts emphasis on the importance of multifaceted interventions set in primary health care.[8,24] This trial

added a patient prompt (to activate the physician) for counseling and applied the process systematically within primary health care, both potentially important parts of successful change to improve health.

In other settings, interventions delivered by a nurse, individually and via telephone, have been shown to be effective in increasing walking after 10 months.[25] Physical activity interventions delivered by nurses to people aged 75 and older in the community have been shown to be cost-effective.[26] Variations on delivery of the Green Prescription need to be further evaluated to increase the availability of the intervention and its efficacy. The resulting decrease in hospitalizations observed in this trial is promising and needs replication to ensure that it is a consistent effect of activity promotion.

This intervention was safe. No increases in falls or injury were observed as a result on the intervention. In fact, there was a trend observed toward this amount of activity reducing injury and protection from an increase in falls. Participants in the control group increased their level of activity (16% at baseline and 22% at follow-up reported 2.5 hours of activity per week) but did not have as favorable trends in falls and injury levels as their intervention group counterparts. This suggests that the Green Prescription ensured that safe activity was undertaken, whereas usual care, where the participant may have increased activity levels because of research participation, resulted in increases in activity without comparable safety.

Perhaps improved balance and gait mediated the positive effects of physical activity on hospitalizations and quality of life observed in this study. Other trials of modest levels of activity designed to reduce falls also resulted in improvements in balance.[10] Further research is needed to specifically explore pathways of benefit from physical activity.

This program was cost effective overall compared with other primary care counseling interventions[27] and was delivered systematically without additional staff or resources during usual primary care. Currently in New Zealand, the program is available and being actively implemented. This report should reinforce efforts to emphasize activity to older people.

This study is one of the first randomized, controlled trials of physical activity counseling in primary care to add a patient prompt to physician-based activity counseling.[28,29] Systematic screening for physical activity levels from a large number of primary care doctors' offices and high participation and follow-up rates for patient participants increase generalizability of these results. Although the trial was not blinded, self-reported measures and objective blood pressure measures were used to minimize measurement bias.

Even so, self-reported physical activity outcomes may be subject to social desirability bias. In addition, characteristics of the 33% of patients who declined to participate were not known. The most common reason for declining was lack of time on the day of recruitment.

Generalizability of these results to other countries with differing health systems may be limited. The New Zealand family physician workforce is organized into relatively small groups of practitioners, generally fewer than four, providing services to reasonably well-defined populations of patients. Collaboration is high in New Zealand, with practice nurses working alongside doctors. There was a high out-of-pocket payment for primary care services at the time of this trial, with government subsidies (about half the cost of a consultation) for those with entitlement cards related to ill health or low income. This trial asked family physicians to deliver the Green Prescription opportunistically, during the process of addressing whatever the patient brought for attention that day, and about 7 minutes were spent delivering the Green Prescription. The regional sports foundations providing follow-up telephone counseling are well established and staffed by trained counselors. In other countries where there are comparable services available, such as some large health maintenance organizations in the Pacific northwest of the United States, it may be possible to implement a similar activity-promotion program.

Sustainability of the process of systematic screening of patients arriving for primary care consultations and prompting of physicians to give activity advice is theoretically straightforward. Usual practice in New Zealand sees less than 13% of all patients receiving Green Prescriptions, so the systematic process of identifying sedentary patients increased uptake markedly. This trial recruited for 1 week only, and it is possible that implementation would decrease over time. In Australia, a similar Active Script process had lower levels of uptake and effect,[30] but a lower level of attention was paid to proactive processes of identification of the target audience in the Australian trial, and Australia has few practice nurses and no follow-up counseling processes available. Further research evaluating the sustainability of the screening and delivery process in differing systems is needed to better understand the best way of implementing such an intervention widely, taking into consideration aspects of differing health systems.

In contrast to the main study, in which increases in occupational activity were noted, older people increased moderate and vigorous leisure time activity by about 40 minutes per week. This increase is likely to improve cardiovascular health.[3] Changes in activity in other areas, such as domestic or transport, may have resulted in no change in net total energy expenditure. For older people, the leisure time portion of activity is modest, and although a modest increase was observed, this was related to improvement in quality of life and hospitalizations, underlining the importance of activity to overall health. Clinicians could be well advised to consider physical activity advice given as part of routine practice.

ACKNOWLEDGMENTS

The willing participation of the practice staff and patients is acknowledged. James LoGerfo and Roger Rosenblatt provided useful comments on previous drafts of the paper.

Financial Disclosure: None of the authors have received any financial support for research, consultantships, or speakers forum.

Author Contributions: Ngaire Kerse's roles were study concept and design, analysis and interpretation of data, and preparation of manuscript. C. Raina Elley's roles were study concept and design, acquisition of subjects and data, analysis and interpretation of data, and preparation of manuscript. Elizabeth Robinson took part in the study concept and design, analysis and interpretation of data, and

preparation of manuscript. Bruce Arroll assisted with the study concept and design, interpretation of data, and the preparation of manuscript.

Sponsor's Role: No sponsors of this research contributed to any aspect of the research (design, methods, subject recruitment, data collections, or analysis or preparation of the manuscript).

REFERENCES

1. Norton R, Galgali G, Campbell AJ et al. Is physical activity protective against hip fracture in frail older people? Age Ageing 2001;30:262–264.
2. Spirduso WW, Cronin DL. Exercise dose–response effects on quality of life and independent living in older adults. Med Sci Sport Exerc 2001;33:S598–S608, S609–S610.
3. Bijnen FC, Caspersen CJ, Feskens EJ et al. Physical activity and 10-year mortality from cardiovascular diseases and all causes. The Zutphen Elderly Study. Arch Intern Med 1998;158:1499–1505.
4. Morgan K, Clarke D. Customary physical activity and survival in later life: A study in Nottingham, UK. J Epidemiol Community Health 1997;51:490–493.
5. Elward K, Larson E. Benefits of exercise for older adults. A review of existing evidence and current recommendations for the general population. Clin Geriatr Med 1992;8:35–50.
6. Richmond DE. Older adults and healthy lifestyle issues: Results of a community study. N Z Med J 1996;109:122–125.
7. Garcia-Palmieri MR. Primary and secondary prevention of cardiovascular disease in the elderly. Bol Asoc Med PR 2000;92:3–8.
8. King AC, Rejeski WJ, Buchner DM. Physical activity interventions targeting older adults. A critical review and recommendations. Am J Prev Med 1998;15:316–333.
9. Eden KB, Orleans CT, Mulrow CD et al. Does counseling by clinicians improve physical activity? A summary of the evidence for the U.S. Preventive Services Task Force. Ann Intern Med 2002;137:208–215.
10. Campbell AJ, Robertson MC, Gardner MM et al. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. BMJ 1997;315:1065–1069.
11. Elley C, Kerse N, Arroll B. Why target sedentary adults in primary health care? Baseline results from the Waikato Heart, Health and Activity Study. Prev Med 2003;37:342–348.
12. Elley C, Kerse N, Arroll B et al. Effectiveness of counselling patients on physical activity in general practice: Cluster randomised controlled trial. BMJ 2003;326:793–796.
13. Arroll B, Jackson R, Beaglehole R. Validation of a three-month physical activity recall questionnaire with a seven-day food intake and physical activity diary. Epidemiology 1991;2:296–299.
14. Elley C, Kerse N, Swinburn B et al. Measuring physical activity in primary health care research. Validity and reliability of two questionnaires. N Z Fam Phys 2003;30:171–180.
15. Hayes V, Morris J, Wolfe C et al. The SF-36 health survey questionnaire: Is it suitable for use with older adults? Age Ageing 1995;24:120–125.
16. McHorney CA, Ware JE Jr, Lu JF et al. The MOS 36-item Short-Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. Med Care 1994;32:40–66.
17. Buchner D, Beresford S, Larson E et al. Effects of physical activity on health status in older adults. II. Intervention studies. Annu Rev Public Health 1992;13:469–488.
18. Keysor JJ, Jette AM. Have we oversold the benefit of late-life exercise? J Gerontol A Biol Sci Med Sci 2001;56A:M412–M423.
19. Blumenthal J. Cardiovascular and behavioural effects of aerobic exercise training in healthy older men and women. J Gerontol A 1989;44: M147–M157.
20. Halbert J, Crotty M, Weller D et al. Primary care-based physical activity programs: Effectiveness in sedentary older patients with osteoarthritis symptoms. Arthritis Rheum 2001;45:228–234.
21. Burton LC, Paglia MJ, German PS. The effect among older persons of a general preventive visit on three health behaviors: Smoking, excessive alcohol drinking, and sedentary lifestyle. The Medicare Preventive Services Research Team. Prev Med 1995;24:492–497.
22. Leveille SG, Wagner EH, Davis C et al. Preventing disability and managing chronic illness in frail older adults: A randomized trial of a community-based partnership with primary care. J Am Geriatr Soc 1998;46:1191–1198.
23. Kerse NM, Flicker L, Jolley D et al. Improving the health behaviours of elderly people: Randomised controlled trial of a general practice education programme. BMJ 1999;319:683–687.
24. Kerse N, Walker S. The Newcastle exercise project: Conclusions are misleading. BMJ 2000;320:1470.
25. Dubbert PM, Cooper KM, Kirchner KA et al. Effects of nurse counseling on walking for exercise in elderly primary care patients. J Gerontol A Biol Sci Med Sci 2002;57A:M733–M740.
26. Robertson MC, Devlin N, Gardner MM et al. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 1: Randomised controlled trial. BMJ 2001;322:697–701.
27. Elley C, Kerse N, Arroll B et al. Cost-effectiveness of physical activity counselling in general practice. N Z Med J 2004;117:U1216–U1231.
28. Calfas KJ, Sallis JF, Oldenburg B et al. Mediators of change in physical activity following an intervention in primary care: PACE. Prev Med 1997;26: 297–304.
29. The Writing Group for the Activity Counseling Trial Research Group. Effects of physical activity counseling in primary care. JAMA 2001;286:677–687.
30. Sims J, Huang N, Pietsch J et al. The Victorian Active Script Programme. Promising signs for general practitioners, population health, and the promotion of physical activity. Br J Sport Med 2004;38:19–25.