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Physical activity for the over-65s: could it be a cost-effective exercise for the NHS?

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Abstract

Background There is increasing interest in the health-promoting potential of physical activity in older adults. The objective of this study was to estimate the likely costs, health benefits and consequences for the National Health Service which might result from a publicly funded programme of regular exercise made available to a population of 10 000 people over the age of 65.

Methods Risk reduction data from observational studies were used to calculate the possible impact of a community-based programme of activity on hospital admissions and deaths from coronary heart disease, stroke, diabetes, femoral neck fractures and mental disorders. The avoided costs of health care and net cost per life-year saved were estimated.

Results Providing twice-weekly exercise classes for 10 000 participants would cost approximately £854 700 per year, but would prevent 76 deaths and 230 in-patient episodes, avoiding annual health care costs of approximately £601 000. Assuming the mean expectation of life after 65 to be ten years, the programme would cost about £330 per life-year saved. Under a range of more extreme assumptions, the cost per life-year saved would vary from £100 to £1500.

Conclusions A publicly funded programme of regular moderate exercise for over-65-year-olds could achieve important health benefits at relatively low cost. The estimates provided by this analysis should now be tested in a rigorous randomized trial, and health commissioners should begin to think of purchasing exercise programmes alongside other health-promoting measures.

Keywords: physical activity, health promotion, cost-effectiveness, older adults

Introduction

A large body of evidence associates regular exercise with important health benefits, in particular a reduction in the risk of coronary heart disease, stroke, diabetes, hip fracture and mental disorders.[1–3] Because these conditions become commoner with age and rates of exercise-related injury are much greater in the young than the elderly, the greatest benefit for least cost is likely to come from exercise in older, rather than younger, age groups, in contrast to popular wisdom.[4]

Such evidence from observational studies, together with positive results from intervention trials,[5] suggests that it may be reasonable to think of exercise as a preventive intervention, like vaccination or treatment for hypertension, which could be provided by the health service. But although the available epidemiological evidence is encouraging, it does not in itself provide sufficient information for general practitioners (GPs) or health authority commissioners who wish to compare the costs and benefits of exercise in the elderly with other possible health-promoting interventions – and this is reflected in recent debate over the worth of 'exercise prescription' schemes in primary care.[6] More robust evidence of cost-effectiveness must come from economic evaluations carried out alongside randomized trials of exercise as an intervention. This is especially so given that we do not know whether intervention at any point in the life course can achieve the risk reductions seen in observational studies.

It is well recognized that, in the development and evaluation of new health care technologies, it is important to undertake economic evaluations 'early and often', to concentrate research efforts in those areas most likely to yield affordable interventions.[7] The aim of this study, therefore, is to estimate the likely costs and consequences which could result from a publicly funded programme of regular exercise made available to a population of 10 000 participants over the age of 65.

Methods

An exercise programme currently being provided in Sheffield in the context of a large randomized trial of physical activity in over-65s is taken as the starting point of this analysis. The programme provides twice-weekly aerobic-style exercise classes run by qualified instructors, free of charge and in familiar settings close to participants' homes. Instructors are skilled in leading classes which include activities aimed at providing cardiorespiratory conditioning, developing muscle

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strength and endurance, increasing joint mobility and improving co-ordination and balance. All activities are appropriate for older adults of a wide range of abilities. Locally organized, group-based exercise sessions such as these are a practical and popular way to promote physical activity among elderly people.[8]

Participation

Experience from Sheffield and elsewhere suggests that initial recruitment rates to the programme may vary widely, with between 23 per cent and 44 per cent acceptance reported in two US studies.[9,10] As those who do not participate incur virtually no cost and gain no benefit, variation in the recruitment rate will not alter the overall ratio of costs to consequences significantly, and is not considered further.

By contrast, subsequent adherence is important and may influence the cost-effectiveness of the programme, as it is reasonable to assume that some minimum period of exercise is required before important health benefits accrue. Participants who drop out early will impose a cost without gaining any corresponding benefit. Fortunately, reported adherence rates are high, with rates of 83 per cent at 8 months and between 53 and 75 per cent at 12 months being typical.[8,10] For our analysis, an adherence rate of 80 per cent at 12 months is taken as a central assumption. None the less, variation in this rate must be considered in a sensitivity analysis.

We assume a 'steady state' model in which an exercise programme is already established for 10 000 participants who are constantly replenished as individuals die or drop out. The costs and consequences of exercise may then be thought of as occurring within the same year. It is likely that a new programme would take some years to reach a steady state, during which the costs of the programme would be higher than those assumed here, though not greatly so. Variation in programme costs is considered in the sensitivity analysis. Individuals for whom exercise may be unsafe will have been identified by use of a simple checklist on recruitment, and in doubtful cases referred to their GP for advice.

Identification of costs and benefits

In a social assessment of an intervention, all possible costs and consequences are identified, measured and valued.[11] Table 1 lists the direct costs of the programme, and the likely health and resource consequences. There is unlikely to be a substantial indirect impact on the economy, for example, through time off work, given the age group although there may be some impact (which could be positive or negative) on the voluntary contribution older adults make, including childcare and caring for relatives. On the consequences side, there will be measurable health as well as other intangible benefits such as widened social contacts. There will also be resource consequences for health and social services as a result of avoided health events.

Not all of the items listed in the table are included in our model. For many of the consequences, this is because there is at present little or no evidence on which to base any estimate of benefit. Transport costs are not included because the experience of the Sheffield programme suggests that, with exercise classes provided locally, over 90 per cent of participants regularly walk to the class. Nor are adverse effects on health which might occur as a result of the programme, such as minor injury or sudden cardiac events, included in the analysis. Evidence from cardiac rehabilitation programmes and trials of exercise in elderly populations, together with our experience to date, indicates that important adverse health effects are very rare.[12–14]

Measurement of costs

The direct costs used here are based on the actual costs of running the Sheffield programme, at 1993–1994 prices. Local church halls and community centres are hired at an hourly rate. Qualified exercise leaders are contracted on a sessional basis, at

Table 1 Possible costs and consequences of a programme of exercise for the elderly

Resource costs	Consequences
Hire of halls	**Health consequences:**
Sessional facilitator	*Life prolonged*
Refreshments	*Avoided health events: heart disease, stroke, hip fracture, depression, diabetes*
Programme co-ordinator	Reduction in disability
Publicity and recruitment	Improvement in general health status
Transport to and from sessions	Widened social contacts
	Reduced burden on carers
	Exercise-related injury
	Resource consequences:
	Avoided use of health services: primary care, community health services, out-patient visits, *in-patient stays*
	Avoided use of social care: home care, residential and nursing home care

Those costs and consequences which are included in the analysis are shown in italics in the table above.

the local market rate. A full-time co-ordinator is necessary to administer the programme. Publicity is required only to recruit sufficient *new* participants to replace those 20 per cent of the cohort who begin but drop out each year. Recruitment in our trial has been primarily postal, with one in five of those sent a simple invitation letter and follow-up reminder subsequently joining a class. The recruitment cost is therefore that of sending out 10 000 invitations and a similar number of reminder letters.

In keeping with our experience, we assume that participants attend two exercise classes, each lasting one-and-a-half hours, each week. The classes are provided for 46 weeks per year, and each class accommodates an average of 30 people.

Measurement of consequences

Estimates of the proportion of disease incidence which could be avoided by regular exercise are taken from a recent review by Nicholl *et al.*[4] These proportions are derived from estimates of the relative risk of disease in cohorts of active and non-active individuals, but also depend upon the proportion of the population currently exercising to recommended levels who, we assume, will gain no further benefit from a physical activity programme. Given that 80 per cent of individuals over 65 years are insufficiently physically active,[14] the proportions of disease incidence avoided are applied to the expected numbers of events, based on routine death registration and hospital admission statistics,[15,16] to estimate the potential reduction in deaths and in-patient episodes for the five conditions listed below in Table 3.

Health gains are measured in terms of lives extended and life-years saved, assuming an average life expectancy for over-65s of 10 years.[17] The avoided costs of in-patient care for each condition are estimated as the product of the average disease-specific length of stay for people over 65 and the specialty cost per day for 1993–1994.[18]

As indicated in Table 1, we have not included a number of important health and resource consequences. This will have the effect of underestimating the potential health benefits and avoided health care costs, and in some cases – for example, nursing home care – such costs may be substantial.

In the analysis, the net public cost of the programme is derived and set against the health consequences. Given the multi-dimensional nature of the outcomes it is not possible to conduct a cost-effectiveness analysis, so the chosen technique is a cost-consequences analysis, in which many of the benefits are presented in natural units.[11] However, a partial comparison of cost-effectiveness with other commonly purchased health care interventions can be made in terms of cost per life-year gained.

Results

Costs of intervention

The annual cost of providing the exercise programme for 10 000 participants is estimated to be £854 700 (Table 2). The main elements in this total are the hire of halls in which to hold classes (£345 000) and the salary costs of exercise session leaders (£368 000).

Benefits

The expected numbers of deaths and hospital episodes for a population of 10 000 people aged 65 and over, as a result of the five conditions listed above, are given in Table 3, together with the mean length of stay for patients aged 65 and over.[16] Multiplied by the average specialty cost per day, these give an estimate of the cost per in-patient episode in this age group for each condition.

The proportions of disease incidence which might be avoided by exercise have been applied to the figures in Table 3 to calculate the potential numbers of deaths and episodes which might be avoided, together with the avoided health care costs, and these are shown in Table 4. It is estimated by this method that 77 deaths and 229 in-patient episodes, with an associated cost of £601 000, might be avoided per 10 000 participants per year.

Table 2 The annual costs of the exercise programme

Item	Unit cost*	Programme cost per 10 000 people per year† (£)
Hire of halls	£7.50 per hour	345 000
Sessional facilitator	£12 per session	368 000
Tea and biscuits	£4 per session	122 667
Programme co-ordinator	£11 231 per annum	11 231
Programme co-ordinator tax and NI	£2808 per annum	2808
Publicity and recruitment	£0.25 per letter	5000
Total		854 706

*Costs are given at 1993–1994 prices.
†Assumes that participants attend two classes per week for 46 weeks per year, and that each session accommodates 30 people.

Table 3 Annual deaths and in-patient episodes per 10 000 persons aged 65 and over

Disease	ICD-9	Deaths per 10 000 persons per year[15]	Episodes per 10 000 persons per year[16]	Mean LOS per episode[16] (days)	Specialty cost per day[18] (£)	In-patient cost per episode (£)
Coronary heart disease and hypertension	390–429	187 84	447.0	9.3	150.00	1395.00
Cerebrovascular disease	430–459	88.89	261.2	19.1	150.00	2865.00
Diabetes	250	6.45	33.3	16.2	150.00	2430.00
Fractured neck of femur	820	5.32*	70.0	20.6	201.00	4140.60
Mental disorders	290–319	8.64	136.7	110.9	117.00	12 975.30

*Estimated from hospital episodes for fractured neck of femur in people over 65, which end in death.[16]
LOS, length of stay.

Cost-consequences analysis

As it is estimated that health care costs of £601 000 could be avoided by a programme costing £854 700, the net public cost of the programme is therefore estimated as £253 700 per 10 000 participants. Assuming the mean expectation of life after 65 to be 10 years, the programme costs approximately £330 per life-year saved, and £1100 per avoided health event.

Sensitivity analysis

The cost per unit of health effect for the central assumptions, together with a sensitivity analysis across a range of other assumptions, is shown in Table 5. The cost per life-year gained varies from about £100 to £1500. Because this analysis is intended only to provide an indication of the probable cost-effectiveness on the basis of current evidence, extensive sensitivity analysis at this stage does not seem worth while. However, even large variations in basic assumptions do not seriously harm the apparent cost-effectiveness of the proposed programme.

Discussion

An exercise programme of the sort described, aimed at people over 65, could achieve important health benefits. The likely cost-effectiveness of this programme compares very favourably with other preventive interventions already in routine practice, such as brief advice from a physician on smoking (about £700 per quality adjusted life-year saved), opportunistic screening for cholesterol (about £3700) or treatment of mild to moderate hypertension with β blockers (about £8500),[19] and supports Morris's claim that exercise represents 'today's best buy in public health'.[20]

It should be emphasized that the analysis underestimates the health care costs which might be avoided because it ignores the very substantial consequences which are likely to follow in terms of reducing the need for nursing and residential care, primary care and out-patient services. Neither have we considered improvements in general health status and social functioning as a result of group exercise classes. If these additional health and social care costs were identified and included, the net cost per life-year saved would fall considerably, as the sensitivity analysis suggests.

Our analysis is intended only to be indicative of the scale of costs and consequences of an exercise programme and is clearly limited. Given the uncertainties inherent in the data, we have avoided sophisticated analyses of life-years gained in favour of simpler methods. The estimates of disease incidence avoided depend upon risk ratios derived from observational studies of the benefits of exercise in adult populations and represent the

Table 4 Annual deaths, in-patient episodes and health care costs avoided, per 10 000 persons aged 65 and over

Disease	ICD-9	Relative risk of disease[4]	Proportion of disease incidence avoided[4]*	Deaths avoided†	Episodes avoided†	In-patient costs avoided† (£000)
Coronary heart disease and hypertension	390–429	0.6	0.35	52.27	124.40	173.5
Cerebrovascular disease	430–459	0.67	0.28	20.10	59.05	169.2
Diabetes	250	0.71	0.25	1.27	6.56	15.9
Fractured neck of femur	820	0.4	0.55	2.32	30.56	126.5
Mental disorders	290–319	0.9	0.08	0.56	8.93	115.8
All conditions above				76.53	229.49	601.0

*Assuming 80 per cent of over-65s do not currently exercise to recommended levels.
†Per 10 000 persons per year.

Table 5 Cost per unit of health effect and sensitivity analysis

	Cost per avoided death (£)	Cost per avoided health event (£)	Cost per life-year saved (£)
Central assumptions	3315	1105	332
Cost of intervention 50% greater than expected	8899	2968	890
Incidence reduction 50% less than expected	14484	4830	1448
Life expectancy at 65 falls to 7.5 years	3315	1105	442
Adherence falls to 50%	10016	3340	1002
Add unmeasured savings at 30% of measured	959	320	96
Average health care costs increase by 20%	1744	582	174

greatest source of uncertainty in this analysis. Because of the strong possibility of selection bias the risk ratios, and health consequences, resulting from exercise as an intervention may be either larger or smaller than these. It is also possible that promoting increased physical activity could lead indirectly to an adverse impact on health by encouraging people to take greater risks, or through delaying deaths at the cost of increasing the prevalence of severe disability. Our estimates of cost per life-year gained are therefore very tentative and must be tested in rigorous randomized trials of the cost-effectiveness of exercise in which both the duration and quality of life are measured, such as that currently under way in Sheffield.

If the benefits of exercise in elderly people prove to be as great in practice as this model suggests, then GP and health authority commissioners should consider the potential for exercise programmes to promote health and avoid disease at very reasonable cost. For example, a fundholding practice with a typical list size of 10 000 patients, of whom 1500 are over 65, might expect about 300 of their older patients to participate in such a programme. The net running cost to the practice, if it were in a total purchasing pilot scheme able to realize the avoided costs of health care, would then be £7000–8000 annually. This level of expenditure is by no means unthinkable.

Overall, the promotion of physical activity in the elderly has considerable potential to contribute to the achievement of *Health of the nation* targets for coronary heart disease, stroke and mental health.[21] The provision of locally based exercise facilities paid for by the health service would certainly be an innovative, and possibly controversial, extension of current purchasing activity. However, this analysis suggests that it may be entirely defensible in terms of achieving worthwhile health gain at relatively low cost.

References

1 Fentem PH, Bassey EJ, Turnbull JB. *The new case for exercise*. London: Sports Council and Health Education Authority, 1988.

2 Royal College of Physicians. *Medical aspects of exercise: benefits and risks*. London: Royal College of Physicians, 1991.

3 Elward K, Larson EB. Benefits of exercise for older adults: a review of existing evidence and current recommendations for the general population. *Clin Geriat Med* 1992; **8**(1): 35–50.

4 Nicholl JP, Coleman P, Brazier JE. Health and healthcare costs and benefits of exercise. *Pharmacoeconomics* 1994; **5**(2): 109–122.

5 Buchner DM, Beresford SA, Larson EB, LaCroix AZ, Wagner EH. Effects of physical activity on health status in older adults. II: Intervention studies. *Ann Rev Publ Hlth* 1992; **13**: 469–488.

6 Iliffe S, Tai SS, Gould M, Thorogood M, Hillsdon M. Prescribing exercise in general practice: look before you leap. *Br Med J* 1994; **309**: 494–495.

7 Sculpher M, Drummond M, Buxton M. *Economic evaluation in health care research and development: undertake it early and often*. HERG Discussion Paper No. 12. Uxbridge: Brunel University, 1995.

8 McMurdo MET, Burnett L. Randomised controlled trial of exercise in the elderly. *Gerontology* 1992; **38**: 292–298.

9 Elward KS, Wagner EH, Larson EB. Participation by sedentary elderly persons in an exercise promotion session. *Clin Res Meth* 1992; **24**(8): 607–612.

10 King AC, Haskwell WL, Taylor CB, Kraemer HC, DeBusk RF. Group vs. home-based exercise training in healthy older men and women: a community based clinical trial. *JAMA* 1991; **266**: 1535–1542.

11 Drummond MF, Stoddart GL, Torrance GW. *Methods for the economic evaluation of health care programmes*. Oxford: Oxford University Press, 1987.

12 Van Camp SP, Peterson RA. Cardiovascular complications of outpatient cardiac rehabilitation programs. *JAMA* 1986; **256**: 1160.

13 Willhelmsen L, Sanne H, Elmfeldt D, *et al*. A controlled trial of physical training after myocardial infarction: effects on risk factors, nonfatal infarction and death. *Prev Med* 1975; **4**: 491.

14 Allied Dunbar National Fitness Survey. *A report on activity patterns and fitness levels. Main findings*. London: Sports Council and Health Education Authority, 1992.

15 Office of Population Censuses and Surveys. *Mortality statistics 1993, series DH2 no. 20*. London: HMSO, 1995.

16 Department of Health. *Hospital episode statistics, England. Financial year 1993/94*. London: Government Statistical Service, 1995.

17 Office of Population Censuses and Surveys. *Health and personal social services statistics for England, 1995*. London: HMSO, 1995.

18 Healthcare Financial Management Association. *Health services financial database 1993/94*. London: HFMA, 1994.

19 Department of Health Economics and Operational Research Division. *Register of cost-effectiveness studies*. London: Department of Health, 1994.

20 Morris JN. Exercise in the prevention of coronary heart disease: today's best buy in public health. *Med Sci Sports Exerc* 1994; **26**: 807–814.

21 Secretary of State for Health. *The health of the nation*. London: HMSO, 1992.

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