Are physical activity interventions in primary care and the community cost-effective?

A systematic review of the evidence

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ABSTRACT

Background

The health and economic burden of physical inactivity is well documented. A wide range of primary care and community-based interventions are available to increase physical activity. It is important to identify which components of these interventions provide the best value for money.

Aim

To assess the cost-effectiveness of physical activity interventions in primary care and the community.

Design of study

Systematic review of cost-effectiveness studies based on randomised controlled trials of interventions to increase adult physical activity that were based in primary health care or the community, completed between 2002 and 2009.

Method

Electronic databases were searched to identify relevant literature. Results and study quality were assessed by two researchers, using Drummond's checklist for economic evaluations. Cost-effectiveness ratios for moving one person from inactive to active, and cost-utility ratios (cost per quality-adjusted life-year [QALY]) were compared between interventions.

Results

Thirteen studies fulfilled the inclusion criteria. Eight studies were of good or excellent quality. Interventions, study populations, and study designs were heterogeneous, making comparisons difficult. The cost to move one person to the 'active' category at 12 months was estimated for four interventions ranging from €331 to €3673. The cost-utility was estimated in nine studies, and varied from €348 to €86 877 per QALY.

Conclusion

Most interventions to increase physical activity were cost-effective, especially where direct supervision or instruction was not required. Walking, exercise groups, or brief exercise advice on prescription delivered in person, or by phone or mail appeared to be more cost-effective than supervised gym-based exercise classes or instructor-led walking programmes. Many physical activity interventions had similar cost-utility estimates to funded pharmaceutical interventions and should be considered for funding at a similar level.

Keywords

costs and cost analysis; exercise; primary health care; review, systematic.

INTRODUCTION

The prevalence of physical inactivity remains high in developed and developing countries.[1] Not only does physical inactivity contribute to increased prevalence of chronic conditions such as cardiovascular disease, obesity, type 2 diabetes, osteoporosis, colon cancers, depression, and fall-related injuries, but it also contributes to between 1.5% and 3.0% of direct healthcare costs in developed countries.[1] A wide range of interventions have been shown to increase physical activity.[2] However, it is essential to identify which components provide the best value for money.

Physical activity counselling in primary health care has been recommended.[3] In some countries at least 80% of the population visit primary health care annually,[4,5] making this an ideal setting for intervening to increase physical activity. Furthermore, patients expect to receive health-related messages in this

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Submitted: 23 March 2010; **Editor's response:** 24 May 2010; **final acceptance:** 27 July 2010.

This is the full-length article (published online 28 Feb 2011) of an abridged version published in print. Cite this article as: *Br J Gen Pract* 2011; DOI: 10.3399/bjgp11X561249.

context and may therefore be more receptive to brief advice or referral to community-based interventions. It is still not known if physical activity interventions in this context are cost-effective, or which types of intervention are the most cost-effective. Nor is it known how cost-effective these interventions are when compared with other interventions in primary health care, such as pharmaceutical interventions that are also aimed at reducing chronic disease.

Physical activity interventions based in primary health care, such as exercise on prescription, have been shown to be effective[6–9] and cost-effective,[10,11] with a cost-utility ratio comparable to many currently-funded pharmaceutical therapies. A systematic review of the cost-effectiveness of physical activity interventions within primary health care was completed in 2002, in which eight studies were identified, published between 1996 and 2002.[12] The review found that there was a trend towards favourable cost-effectiveness of physical activity promotion through primary health care but there were few trials available of mixed study quality. The cost-effectiveness of community-based physical activity promotion in general was assessed by another systematic review which also showed favourable results, but included modelling studies and evaluations of workplace or infrastructural innovations in the community, as well as individual-based interventions to promote physical activity.[13]

The current systematic review assesses the evidence for cost-effectiveness of physical activity interventions in the community, particularly in primary care, and only those based on randomised controlled trials conducted since the previous review of primary care evidence in 2002.[12]

How this fits in

Community- and primary healthcare-based physical activity interventions have been shown to be effective in increasing population physical activity levels. The cost-effectiveness of these interventions varies and it is still not known if physical activity interventions in this context are cost-effective, which types of intervention are the most cost-effective, and how these interventions compare with others delivered in primary health care, such as pharmaceutical interventions. This study found that many interventions to increase physical activity were within the generally accepted range of cost-effectiveness, especially where direct supervision or instruction was not required. Based on the higher-quality studies, it is possible to deliver a physical activity intervention for between €1120 and €15 860 per quality-adjusted life-year gained, which is more cost-effective than many other currently-funded pharmaceutical interventions.

METHOD

Search strategy

A literature search was carried out using eight health-related electronic databases (Table 1).

Selection process

To be included in the systematic review, studies had to be economic analyses of lifestyle interventions that included physical activity advice and/or programmes for adults, and were based in either primary care or the community, published in English since 2002, used general study populations or those with disease states known to be improved by physical activity, and had a follow-up period of at least 6 months. Only those cost analyses that had been conducted in association with randomised controlled trials of physical activity interventions were included. The review excluded studies that were based in the workplace, used economic modelling rather than actual costs, were economic analyses based on case-studies, surveys, non-experimental studies, or theoretical scenarios, involved unique disease-state populations (for example cardiac rehabilitation patients), or did not include either cost per physical activity measure or cost per quality-adjusted life-year (QALY) as outcomes.

Data extraction and analysis

Data extraction was undertaken by the primary author and verified by a second author. Type of

Table 1. Literature search strategy of electronic databases, and subject headings used to identify cost-effectiveness studies.

Databases	Physical activity subject headings	Cost-effectiveness headings	Healthcare setting subject headings
MEDLINE (1996–present)	Exercise	Economics	Primary health care
Embase	Physical activity	Health economics	General practice
PsycINFO	Fitness	Cost-minimisation analysis	Family practice
SPORTDiscus	Physical fitness	Cost-benefit analysis	Primary medical care
CINAHL	Exertion	Cost-effectiveness analysis	Family medicine
Cochrane Database of Systematic Reviews services		Cost-utility analysis	Community health
Web of Knowledge		Healthcare costs	
Scopus		Costs and cost analysis	

Table 2. Critical appraisal of selected studies.

Study	Well-defined question posed in answerable form	Comprehensive description of competing alternatives	Effectiveness of programme or service established	All important and relevant costs and consequences for each alternative identified	Costs and consequences measured accurately in appropriate physical units	Costs and consequences valued credibly	Costs and consequences adjusted for differential timing	Incremental analysis of costs and consequences of alternatives performed	Allowance made for uncertainty in the estimates of costs and consequences	Presentation and discussion of study results included all issues of concern to users
UK Beam Trial Team[17]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cochrane *et al*[18]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hurley *et al*[19]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hollinghurst *et al*[20]	✓	✓	✓	Productivity data not included in analysis due to missing values	Missing costs for interventions, labour costs only	✓	✓	✓	✓	Minimal discussion
Gusi *et al*[21]	✓	✓	✓	No secondary healthcare costs included	Unit costs only reported if significant difference between groups	No references cited for unit costs	✓	✓	✓	✓
Handley *et al*[22]	✓	✓	✓	No healthcare costs as no difference between groups	Unit costs not reported, components listed	Sources not reported, inferred but not explicit cost year	✓	✓	Sensitivity analysis carried out; 10% missing values	✓
Sevick *et al*[23]	✓	✓	✓	✓	✓	Sources not identified for unit costs	✓	✓	✓	✓
Munro *et al*[24]	✓	Treatment of control group not explicit	✓	No measure of exercise. Primary care and personal costs not collected, only programme costs	✓	Sources not identified for unit costs; little detail given	✓	✓	✓	Weaknesses not well highlighted; practical (funder) considerations not mentioned
Dzator *et al*[25]	✓	✓	✓	Programme costs only; no quality-of-life measures	Unit costs not reported, components and methods listed	Sources not identified, currency and year not specified	✓	✓	✓	✓
Elley *et al*[11]	✓	✓	✓	✓	✓	Not all sources cited	✓	✓	✓	✓
Dalziel *et al*[10]	✓	✓	✓	✓	✓	Not all sources cited	✓	✓	✓	✓
Isaacs *et al*[26]	Control only followed for 6 months; intervention 12 months	✓	Intervention was not more effective than control	✓	✓	✓	✓	✓	✓	✓
Elley *et al*[27]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

economic analysis and perspective, intervention and comparison, participants, follow-up duration, and outcome were recorded from each study that fulfilled the inclusion criteria. Studies were assessed for methodological quality using Drummond's checklist for assessing economic evaluations (Table 2).[14] Based on the extent to which each study met Drummond's criteria, a rating of 'poor', 'fair', 'good', or 'excellent' was assigned and is listed in the first column of Table 3.

To compare the economic results of individual studies, all costs were converted to Euros (€),[15] using

Table 3. Cost-effectiveness studies undertaken of interventions that included physical activity counselling or intervention within primary care or the community (published from 2002 to 2009).

						Outcome		
Study details and quality	Objective; economic perspective	Study type; economic analysis type	Interventions (I) and comparison (C)	Participants, number in each group	Follow-up duration (months)	Annual cost per participant to become active, (€ at time of study) [inflated to June 2008]	Cost of shifting to active category[a], (€ at time of study) [inflated to June 2008]	Cost per QALY (€ at time of study) [inflated to June 2008]
UK Beam Trial Team,[17] UK: Excellent	Primary care, multifaceted intervention for low back pain; health funder, 2000–2001	RCT; CUA	I1: exercise programme; I2: spinal manipulation; I3: combined; C: usual care	Participants consulting GP for low back pain: I1: 297 I2: 342 I3: 322 C: 326	12			£8235[b] (€13 423) [€15 860]
Cochrane *et al*,[18] UK: Excellent	Primary care/ community water exercise programme; societal costs, 2002	RCT; CEA	I1: water-based exercise, C: usual care	Older participants with hip and/ or knee OA: I1: 153 C: 159	12			£5008[c] (€7963) [€9160]
Hurley *et al*,[19] UK: Excellent	Primary care, knee rehabilitation; societal costs, 2003	Cluster RCT; CEA, CUA	I1: individual rehabilitation,[d] I2: group-based rehabilitation,[d] C: usual primary care	Participants ≥50 years attending primary care for mild/ moderate/ severe knee pain, duration >6 months: I1: 146 I2: 132 C: 140	6			Usual care produced greater QALY gain (0.0096) than individual rehabilitation (–0.0034) and group rehabilitation (0.0057), despite 'functional improvements' with exercise interventions
Hollinghurst *et al*,[20] UK: Fair	Primary care; societal perspective, 2005	4 × 2 factorial RCT; CEA	I1: short-course Alexander technique, I2: long-course Alexander technique, I3: massage, C: usual care groups; All also randomised into with or without GP exercise script and practice nurse exercise counselling	Participants with chronic or recurrent low back pain: I1: 144 I2: 144 I3: 147 C: 144	12			£2847 (€4157) [€4577] (exercise counselling and prescription for exercise compared with usual care)
Gusi *et al*,[21] Spain: Poor	Primary care, supervised walking programme; health funder, 2005	RCT; CUA	I1: walking-based, supervised programme (3 x 50 min/week), C: usual care	Women, ≥60 years with moderate depression or overweight: I1: 64 C: 63	6			€311 [€348]

... continued

annual average exchange rates. This method has been used previously.[13] Costs have then been converted to the reference quarter of June 2008 using consumer price index (CPI) adjustments from each country and are presented as such throughout.[16] Indices of consumer prices were used in preference to national indices of healthcare costs, because of the accessibility and international comparability of the

Table 3 continued. Cost-effectiveness studies undertaken of interventions that included physical activity counselling or intervention within primary care or the community (published from 2002 to 2009).

Handley *et al*,[22] US: Fair	Primary care-based automated telephone support; direct programme costs, June 2003 to December 2004	RCT; CEA, CUA	I1: automated telephone surveillance/ support, nurse care management, C: usual care	Adult English-, Spanish-, Cantonese-speaking primary care participants with type 2 diabetes: I1: 112 C: 114	12	US $558[e] (€463) [€551]		US $65 167 (€54 089), [€64 346]
Sevick *et al*,[23] US: Excellent	Community, physical activity counselling; health funder, 2004	RCT; CEA	I1: telephone-based feedback on PA[f], I2: print-based feedback on PA, C: contact control	Sedentary adults (18–65 years): I1: 80 I2: 81 C: 78	12		$3967 (€3174) [€3673] (phone group); $955 (€764) [€884] (print group)	
Munro *et al*,[24] UK: Poor	Primary care, exercise class; health funder, 2003/2004	Cluster RCT; CUA, CEA	I1: free, 2 x weekly (45 min) community -based exercise class, C: usual care	Participants ≥65 years assessed by survey as being in least-active four-fifths of the population: I1: 2283 C: 4137	24			€17 174 [€19 425]
Dzator *et al*,[25] Australia: Fair	Physical activity/ nutrition programme in community setting; direct programme costs	RCT; CEA	I1: high-level, interactive group sessions, I2: low-level, mailed intervention, C: no intervention	Couples[h] (mean age 28–31 years): I1: 47 couples I2: 47 couples C: 43 couples	12	No significant effect difference between groups observed regarding the activity level: exercise days per week		AUS $460.44 (€267) [€350] (high level); AUS $458.61 (€266) [€349] (low level)
Elley *et al*,[11] New Zealand: Excellent	Primary care exercise counselling/ prescription; societal costs, 2001	Cluster RCT; CEA	I1: Green Prescription, counselling in general practice, C: usual care	Less active primary care participants (40–79 years): I1: 451 C: 427	12	€825 [€957] (activity level 5 × 30 min/week)	NZ $1756[g] (€825) [€957]	
Dalziel *et al*,[10] New Zealand: Excellent	Primary care exercise counselling/ prescription data from Elley's study;[11] 2001 costs	Cluster RCT; CUA	I1: Green Prescription, counselling in general practice, C: usual care	Less-active primary care participants (40–79 years): I1: 451 C: 427	12			NZ$2053 (€965) [€1120]
Isaacs *et al*,[26] UK Good	Primary care referral to exercise programmes; health funder, 2002 costs	RCT; CEA	I1: supervised, gym-based exercise classes,[i] I2: instructor-led walking programme,[i] C: advice and information only	Physically inactive 40–74 year olds with at least one cardiovascular risk factor: I1: 317 I2: 311 C: 315	12			I1: £19 500 (€31 005) [€35 665]; I2: £47 500 (€75 525) [€86 877]
Elley *et al*,[27] New Zealand: Excellent	Primary care exercise counselling/ prescription; societal costs, 2008	RCT; CEA	I1: enhanced Green Prescription, counselling in primary care, C: usual care	Physically inactive 40–74-year-old women	24		NZ $687 [€331] sustained at 12 months; NZ $1407 [€678] sustained at 24 months	

[a]Undertaking at least 150 minutes of at least moderate-intensity physical activity per week. [b]Exercise programme component only. [c]20% (n = 65) missing values for EuroQol-5D (EQ-5D) imputed by regression based on age, sex, and EuroQol-Visual Analogue Scale (EQ-VAS). [d]12 supervised sessions, 2 x weekly for 6 weeks (40 minutes to 1 hour) including information giving and exercises. [e]Cost to achieve a 10% increase in the proportion of participants achieving moderate or vigorous physical activity. [f]No significant difference between phone and control group at 12 months for PA measures. [g]Programme cost of shifting one person from sedentary to active category. [h]Variable proportion of participants reported as sufficiently active at baseline. [i]Ten-week (2–3 times per week). CEA = cost-effectiveness analysis. CUA = cost-utility analysis. OA = osteoarthritis. PA = physical activity. QALY = quality-adjusted life-year. RCT = randomised controlled trial.

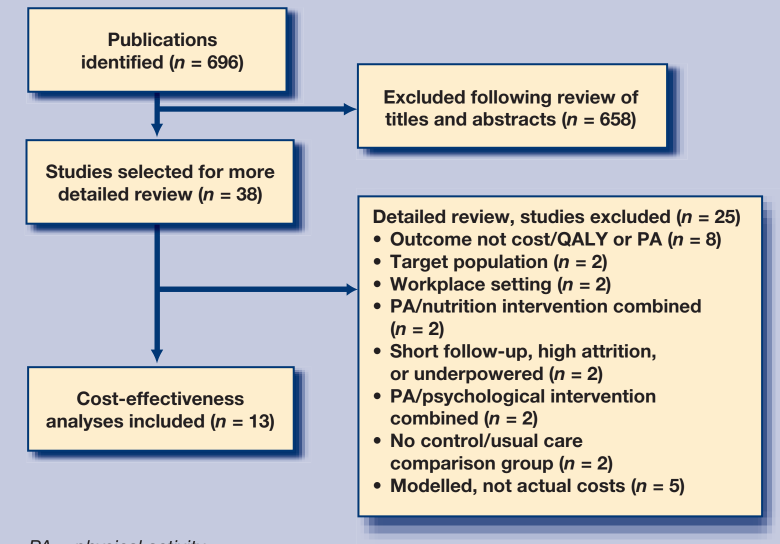
former. The cost of shifting one participant into the 'active' category (achieving 2.5 hours per week of at least moderate-intensity physical activity), the annual cost per participant to become 'active', and the cost per QALY gained are reported where available. The methods used for calculating changes in QALYs are provided in the source papers.

RESULTS

Studies identified

The literature search identified 696 publications, from which 38 were assessed in detail. Of those, 13 studies met the selection criteria and were included in this review (Figure 1). Studies were excluded for the following reasons: eight studies did not use outcome measures that were either cost per QALY gained or a physical activity measure; two studies targeted a very specific population for secondary prevention (for example, cardiac rehabilitation patients); two studies were set in the workplace; four studies included a combined intervention (physical activity plus a nutrition intervention, or physical activity plus a psychological intervention) where the impact of the physical activity intervention could not be isolated; and four analyses were based on inadequate trials, due to short follow-up (3 months), high attrition (45%), insufficient power due to small sample size (*n* = 36), or absence of a comparison group.

The 13 studies that met the inclusion criteria are described in Table 3 and grouped by targeted population or condition (musculoskeletal conditions, obesity or depression, sedentary adults). The descriptions of the interventions, follow-up and incremental cost-effectiveness ratios for instructor-led and supervised exercise, exercise and nutrition programmes, community walking, and brief counselling with exercise on prescription are also presented in Table 3. Community walking, exercise and nutrition programmes, and brief counselling with exercise on prescription (Green Prescription) had more favourable cost-effectiveness ratios than instructor-led or supervised exercise sessions (Figure 2).



PA = physical activity.

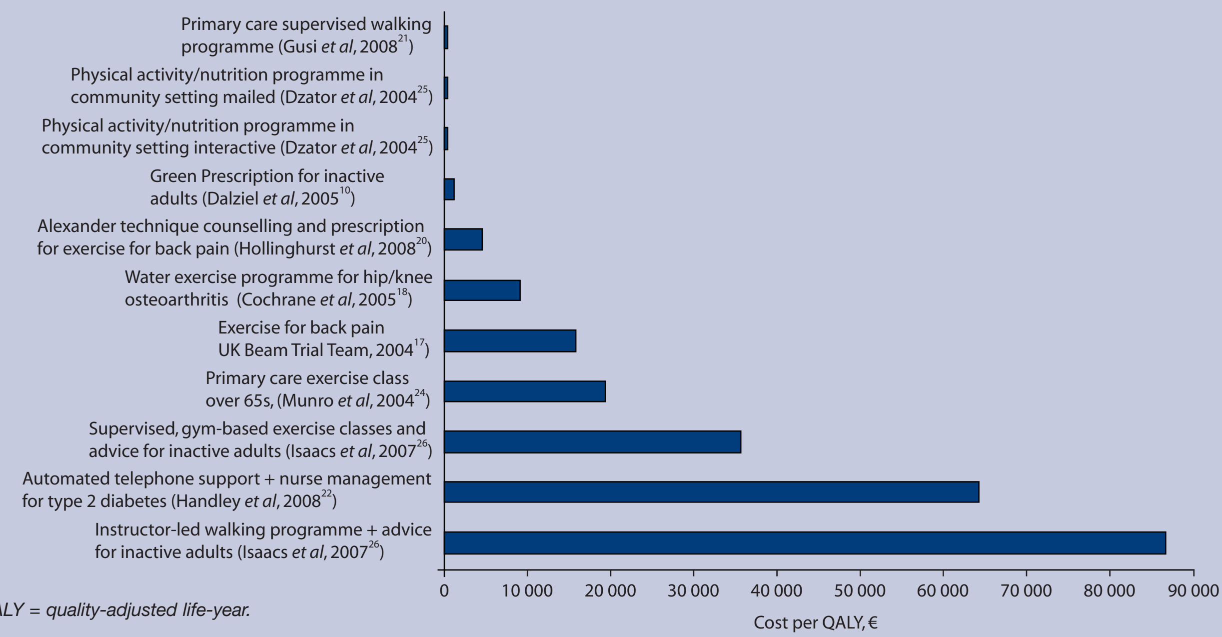
Figure 1. Flowchart of study selection.

DISCUSSION

Summary of main findings

Most interventions to increase physical activity were cost-effective when compared with international thresholds for acceptable value for funded interventions,[28] especially where direct supervision or instruction were not required. Walking, exercise

Figure 2. Cost-utility (cost per QALY) for different physical activity interventions (2008 equivalent €).



QALY = quality-adjusted life-year.

groups, or brief exercise advice on prescription delivered in person, or by phone or mail, had a lower cost per QALY compared with supervised gym-based exercise classes or instructor-led walking programmes. Many physical activity interventions had similar estimates of cost-utility to funded pharmaceutical interventions.

Costs per QALY gained varied substantially between the studies. The cost of moving one person from 'inactive' to 'active' at 12 months was estimated for four interventions, and ranged from €331 to €3673. Cost-utility was estimated in nine studies and varied from €348 to €86 877 per QALY. Community walking,[21] exercise and nutrition programmes,[25] and brief advice with exercise on prescription (Green Prescription)[10] were the most cost-effective with respect to cost-utility. The Green Prescription,[6] enhanced Green Prescription,[27] and printed material or phone-delivered advice[23] had similar cost-effectiveness ratios for moving one sedentary person to an active state.

When considering interventions for specific disease-based populations, the exercise prescription given by the GP and exercise counselling by the practice nurse for people with chronic or recurrent low back pain[20] was more cost-effective (€4577 per QALY) than the water-based exercise intervention for older participants with osteoarthritis of the hip and/or knee (€9160 per QALY).[18] A weekly exercise class for sedentary people aged 65 years and older[24] was more cost-effective (€19 425 per QALY) than both the supervised gym-based exercise classes and the instructor-led walking programme for sedentary 40–74 year olds (€35 665 and €86 877 per QALY).[26] The findings suggest that advice interventions, such as exercise on prescription and some group-based exercise programmes, are more cost-effective than individualised gym-based or instructor-led walking groups.

There is no universal threshold of cost per QALY gained to determine whether an intervention should be funded. However, most of the cost per QALY values from studies reviewed here were below the threshold reported by the National Institute for Health and Clinical Excellence (NICE) (£20 000–30 000),[28] and lower than values reported for many funded pharmaceutical and other interventions for conditions such as diabetes (cholesterol control: €58 882 per QALY gained; intensive glucose control: €32 610 per QALY gained; case management: €41 452 per QALY gained).[29–32]

It should be noted that one study found exercise interventions were effective for functional improvements compared with 'usual care'.[19] However, greater gains in quality-of-life measures were found in the 'usual care' group than in the 'exercise' intervention groups (negative cost per QALY), so the cost per QALY was difficult to interpret.[19]

Comparing the annual cost per participant to become active is difficult due to the different definitions and analytical approaches used. Handley *et al* used the cost to achieve a 10% increase in the proportion of participants achieving recommended moderate or vigorous physical activity levels in a study involving adults with type 2 diabetes.[22] The annual cost to increase activity by 10% for the automated telephone surveillance and nurse care management was estimated to be €551 per participant. In contrast, two studies by Elley *et al*[11,27] used a threshold of 5 x 30 minutes of activity per week and found the cost per person to be €957 when predominantly doctor delivered,[11] and €331 when nurse delivered.[27] Most studies followed up participants for only 6–12 months, with only two cost-effectiveness studies undertaken on the basis of a 2-year trial.[24,27]

Strengths and limitations of the study

A strength of the current review is the inclusion of cost-effectiveness analyses that were based on randomised controlled trials. Accordingly, the quality of evidence included is high. However, estimates of cost-effectiveness are likely to be conservative because not all long-term benefits are accounted for in short-term randomised controlled trials. Modelled economic analyses suggest the cost-effectiveness of physical activity interventions may be even more favourable when long time horizons are taken into account.[33] The variability of outcome measures, interventions, target population groups, costs measured, and health-system variations in cost makes comparison of these cost-effectiveness studies difficult. With different infrastructures, funding models, and cost structures, it is also difficult to make comparisons between different countries. Furthermore, some studies included funder costs only,[17,21–26] while others presented societal perspectives that also included costs to the participant.[11,18–20,27] Consequently, there was a wide variation in costs per QALY gained between the studies. For example, the study of Gusi *et al*, involving a walking programme for older women who were overweight or had moderate depression, had the lowest cost per QALY of €348.[21] By comparison, the intervention with the highest cost per QALY of €86 877 was an instructor-led walking programme (10 weeks, 2–3 times per week) for physically inactive 40–74-year-old adults.[26] Even so, all interventions had cost-utility (cost per QALY) values within the range of pharmaceutical interventions that are currently considered for funding by governmental funding agencies.

Comparison with existing literature

A previously published systematic review included eight studies involving interventions promoting physical activity,[13] but included workplace and environmental interventions and economic modelling rather than actual costs. The previous review found that interventions directly targeting individual behaviour were able to promote the recommended levels of physical activity at a cost of about €800 per participant shifted to an active category over a 12-month period. Interventions within general practices had the most favourable cost-effectiveness ratios (€106 per participant to reach at least 3300 kJ expended per week); however, the study was based on modelled rather than actual costs.[34]

Gordon *et al* reviewed the cost-effectiveness of a number of lifestyle interventions for smoking cessation, physical activity, diet, and alcohol reduction.[35] The findings for physical activity interventions generally indicated favourable cost-effectiveness: less than €55 860 per QALY, and two studies showed net cost savings.[36,37] Using a lifetime cost-effectiveness analysis from a societal perspective on a simulated cohort, Roux *et al* examined seven types of community-based physical activity interventions.[33] All of the interventions evaluated were found to be cost-effective, with costs per QALY gained ranging from €9763 to €46 853.

Implications for clinical practice

Due to the variability in study design and differences in outcome variables between the studies reviewed, it is difficult to draw firm conclusions about which types of interventions are most cost-effective. However, it appears that interventions such as 'exercise on prescription' delivered by primary care doctors or nurses, or brief advice delivered by mail-out or telephone are more cost-effective than intensive gym-based or instructor-led interventions. Furthermore, group exercise programmes appear to be more cost-effective than instructor-led walking programmes. Interventions delivered by nurses may be more cost-effective than when delivered by GPs.

Based on the higher-quality studies, it is possible to deliver a physical activity intervention for between €1120 and €15 860 per QALY gained, which is more cost-effective than many other currently-funded pharmaceutical interventions. Therefore, physical activity interventions delivered in primary health care should be considered for funding at similar levels to currently-funded pharmaceutical interventions.

Funding body

The systematic review was funded by Sport and Recreation New Zealand (SPARC).

Ethics committee

Ethical approval was not required.

Competing interests

The authors have stated that there are none.

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