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Research

Gym-based exercise was more costly compared with home-based exercise with telephone support when used as maintenance programs for adults with chronic health conditions: cost-effectiveness analysis of a randomised trial

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KEY WORDS

Chronic disease
Exercise
Adult
Economic evaluation
Physical therapy

ABSTRACT

Question: What is the comparative cost-effectiveness of a gym-based maintenance exercise program versus a home-based maintenance program with telephone support for adults with chronic health conditions who have previously completed a short-term, supervised group exercise program? **Design**: A randomised, controlled trial with blinded outcome assessment at baseline and at 3, 6, 9 and 12 months. The economic evaluation took the form of a trial-based, comparative, incremental cost-utility analysis undertaken from a societal perspective with a 12-month time horizon. **Participants**: People with chronic health conditions who had completed a 6-week exercise program at a community health service. **Interventions**: One group of participants received a gym-based exercise program and health coaching for 12 months. The other group received a home-based exercise program and health coaching for 12 months with telephone follow-up for the first 10 weeks. **Outcome measures**: Healthcare costs were collected from government databases and participant self-report, productivity costs from self-report, and health utility was measured using the European Quality of Life Instrument (EQ-5D-3L). **Results**: Of the 105 participants included in this trial, 100 provided sufficient cost and utility measurements to enable inclusion in the economic analyses. Gym-based follow-up would cost an additional AUD491,572 from a societal perspective to gain 1 quality-adjusted life year or 1 year gained in perfect health compared with the home-based approach. There was considerable uncertainty in this finding, in that there was a 37% probability that the home-based approach was both less costly and more effective than the gym-based approach. **Conclusion**: The gym-based approach was more costly than the home-based maintenance intervention with telephone support. The uncertainty of these findings suggests that if either intervention is already established in a community setting, then the other intervention is unlikely to replace it efficiently. **Registration**: ACTRN12610001035011. **[Jansons P, Robins L, O'Brien L, Haines T (2018) Gym-based exercise was more costly compared with home-based exercise with telephone support when used as maintenance programs for adults with chronic health conditions: cost-effectiveness analysis of a randomised trial. *Journal of Physiotherapy* 64: 48–54]**

Introduction

Chronic conditions that are related to physical inactivity, such as coronary heart disease, type II diabetes and stroke, are estimated to result in direct healthcare costs of over AUD377 million per year in Australia.[1,2] Implementing strategies to increase physical activity in adults with chronic health conditions may be an effective way of reducing the economic impact in Australia. Short-term (ie, 4 to 6 week) supervised interventions, such as cardiac and pulmonary phase II rehabilitation programs, have been shown to be effective in improving quality of life and reducing morbidity and healthcare costs.[3,4] However, there is evidence to suggest that once the program is completed, adherence to exercise declines along with the health benefits obtained.[5] Hence, there is a need to provide interventions to promote long-term exercise adherence after the completion of a short-term exercise program.

A recent review of this field identified two commonly investigated approaches to improve ongoing exercise adherence for adults with chronic health conditions: home-based exercise programs with telephone follow-up, and gym-based exercise programs.[6] That review and meta-analysis found no difference in exercise adherence rates between these interventions. Furthermore, it identified no economic evaluations examining the comparative efficiency of the two approaches.

There is an ongoing need to identify efficient means of promoting adherence to exercise in the long term, in order to improve the quality of life of adults with chronic health conditions. The aim of the current study was to examine the economic efficiency of home-based maintenance with telephone follow-up

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compared with gym-based maintenance exercise amongst adults with a variety of chronic conditions who had completed a short-term supervised exercise program led by a health professional.

Therefore, the study question for this economic analysis of that randomised trial was:

> What is the comparative cost-effectiveness of a gym-based maintenance exercise program versus a home-based maintenance program with telephone support for adults with chronic health conditions who have previously completed a short-term, supervised group exercise program?

Method

Design

This economic evaluation was a comparative, trial-based, incremental cost-utility analysis conducted from a societal perspective. It used data collected as part of a single-centre, two-arm, comparative effectiveness, randomised, controlled trial with a 12-month follow-up time horizon. A detailed description of trial design, participants, interventions, and outcomes has previously been published.[7] A brief description of these methods is now provided.

Participants

Participants in the trial (n = 105) were recruited from a pool of adults who had completed a 6-week exercise program supervised by exercise physiologists at Cardina Casey Community Health Service, which is a publicly funded, community health service in Melbourne, Australia. The characteristics of the participants are presented in Table 1.

Interventions

Participants allocated to the gym-based intervention were given a 12-month individualised gym-based exercise program and health coaching[8] supervised by an exercise physiologist trained in the Health Coaching Australia model from the Cardina Casey Community Health Service. This exercise physiologist had been involved in providing the short-term, supervised exercise program conducted earlier at Cardina Casey Community Health Service. Participants were required to pay the standard casual entry fee of AUD5 per visit to the gym. The home-based intervention with telephone support group were given a 12-month individualised home-based exercise program and health coaching.[8] The same exercise physiologist who provided the gym-based program also provided the home-based intervention. The participants' home-based exercise program was monitored via five telephone calls over the first 10 weeks, each approximately 30 minutes in duration. The total time in minutes to complete the five phone calls for each participant was intended to be comparable to that spent supervising each participant in the gym over a 12-month intervention period. All participants were encouraged to complete a 1-hour exercise session, as prescribed by the exercise physiologist, three times per week.

Table 1
Baseline characteristics of participants.

Characteristic	Home (n = 49)	Gym (n = 51)	Not included in data set (n = 5)
Age *(yr)*, mean (sd)	66 (13)	65 (11)	70 (11)
Gender, n female (%)	38 (78)	27 (53)	2 (40)
Marital status, n (%)			
married	29 (59)	41 (80)	3 (60)
widowed	12 (24)	2 (4)	0 (0)
divorced	4 (8)	7 (14)	0 (0)
separated	3 (6)	1 (2)	0 (0)
never married	1 (2)	2 (4)	0 (0)
Country of birth, n (%)			
Australia	30 (61)	39 (76)	4 (80)
United Kingdom	4 (8)	3 (6)	0 (0)
other	15 (31)	9 (18)	1 (20)
Medical conditions, n (%)			
congestive heart failure	11 (22)	11 (22)	2 (40)
other heart disease[a]	43 (88)	46 (90)	3 (60)
stroke[b]	8 (16)	10 (20)	3 (60)
cancer	11 (22)	6 (12)	0 (0)
osteoporosis or osteopenia	2 (4)	4 (8)	0 (0)
depression or anxiety	19 (38)	21 (41)	3 (60)
arthritis	19 (39)	20 (39)	2 (40)
diabetes	11 (22)	21 (41)	1 (20)
lung disease[c]	23 (47)	12 (24)	1 (20)
Parkinson's disease	1 (2)	0 (0)	0 (0)
inner ear dysfunction[d]	2 (4)	4 (8)	1 (20)
cataracts	0 (0)	0 (0)	0 (0)
other visual impairment	11 (22)	9 (18)	2 (40)
broken bone since turning 60	10 (20)	6 (12)	3 (60)
joint replacement	15 (31)	16 (31)	2 (40)
Health service indicator, mean (SD)			
hospitalised for $\geq$ 1 night in past 3 months	0 (0)	0 (0)	0 (0)
Health insurance status, n (%)			
private health insurance	11 (22)	14 (27)	0 (0)
Department of Veterans' Affairs	1 (2)	3 (6)	0 (0)

Gym = gym-based exercise, Home = home-based exercise with telephone support.
[a] Includes coronary heart disease, cardiomyopathy, ischaemic heart disease, hypertensive heart disease, inflammatory heart disease, disease affecting one or more valves of the heart, and heart murmur.
[b] Includes stroke, mini-strokes, aneurisms, and transient ischaemic attacks.
[c] Includes asthma, emphysema, chronic obstructive pulmonary disease, and chronic obstructive airways disease.
[d] Affecting balance, eg, dizziness.

Outcome measures

Primary outcome

The primary outcome of the cost-effectiveness analysis was quality-adjusted life years (QALY) lived, derived from repeated assessments every 3 months of health-related quality of life using the European Quality of Life Instrument (EQ-5D-3L).[9] An overall utility score was obtained using the Dolan utility formula.[10]

Secondary outcomes

Health service resource use was measured using Pharmaceutical Benefits Scheme and Medicare Benefits Schedule data extracted by Medicare Australia with participants' consent.[11] Participants kept a logbook detailing direct healthcare costs not captured within these databases, including hospitalisations (including number of days and reason for admission), number of appointments with complementary health professionals, and purchases of over-the-counter medications. The Health and Labour Questionnaire captured data describing indirect costs (productivity) gains or losses.[12]

Data for cost and clinical outcomes were collected by a blinded research assistant at a face-to-face interview at baseline, 6 months and 12 months, and via a telephone interview at 3 and 9 months. Reliability of using telephone approaches for collecting the EQ-5D-3L and related outcomes in similar populations has previously been established.[13]

Valuation of cost

All costs were calculated in Australian dollars (AUD) using 2011 as a base year. The value of medications purchased through the Pharmaceutical Benefits Scheme were contained within this database. The value of pathology, radiology, general practitioner, allied health, nurse, specialised physicians, dentists, therapeutic and diagnostic procedures purchased through the Medical Benefits Scheme were contained within this database. The value of paid work productivity was calculated using the participants' individual wage rate multiplied by 1.3 to cover employment on-costs (for sick leave and superannuation entitlements). Unpaid productivity was valued using market wage rates and on-costs for the private sector services to be employed to complete activities of daily living normally undertaken by each participant. The cost of acute day and overnight hospitalisation during the intervention period was valued using the Victorian Weighted Inlier Equivalent Separation case mix funding system at 2011 using patient recall of length of stay and reason for admission as inputs.[14] Other direct health costs such as complementary treatments, over-the-counter medications and health practitioner costs not captured by Medicare Australia, as well as home nursing, meals on wheels and home help, were valued using local market prices.

Costs specific to the receipt of each intervention were also included. The cost to the participant of completing the gym intervention was the casual gymnasium entry fee of AUD5 per session. The investigators included an additional AUD5 per session value for transportation costs of travelling to and from the gym that the participant was likely to have encountered. There was no cost to the participant to complete the home-based exercise program. Health service costs related to provision of each intervention were valued using local wage rates (exercise physiologist Grade 2, year 4, which is equivalent to a Victorian public allied health professional with 4 years of experience) multiplied by 1.3 to cover employment on-costs.

Data analysis

A comparative, incremental cost-utility analysis was conducted. The base analysis was conducted from a societal perspective. Healthcare costs over the 12-month follow-up period were summed within individual participants. Productivity measures were converted to an overall change in productivity relative to productivity at baseline using an area under the curve approach. A total cost variable was calculated for each participant by summing all costs across a 12-month time horizon for both intervention groups. All costs were compared between groups using the non-parametric rank sum test and t-test (Table 2). Health effects measured using the EQ-5D-3L were converted to QALYs gained (relative to baseline utility levels) using an area under the curve approach. Within this area under the curve approach, participants who missed follow-up appointments (25 participants, 38 assessments) had their missing data imputed using a last observation carried forward approach. There was also one participant whose measurements of direct healthcare costs were not provided due to administrative error. The study average was imputed for this participant.

The incremental cost-effectiveness formula used was:

$$\frac{Costs\,(home) - Costs\,(gym)}{QALY\,(home) - QALY\,(gym)}$$

The difference in costs was calculated using linear regression, while the difference in QALY was also calculated using linear regression.

Uncertainty in this incremental cost-utility analysis was investigated using bootstrap resampling; 2000 replications of the analysis dataset size (n = 100) were conducted. These bootstrap replications were plotted on a cost-effectiveness plane and a 95% confidence ellipse was constructed.

Sensitivity analyses were conducted by changing the perspective of the economic evaluation to be from the patient perspective and health service perspective. For the patient perspective, public subsidies for access to health services and medications were not included. For the health service perspective, patient out-of-pocket costs and productivity costs were not included. An alpha criterion level was set at $p = 0.05$ for all analyses. All analyses were conducted using commercial software.[a]

Results

Characteristics of participants

A summary of the sample demographics is presented in Table 1. Participants in the two groups appeared to be broadly similar across the outcomes collected.

Incremental cost-effectiveness using randomised, controlled trial data

The total cost of providing the gym-based follow-up approach was approximately AUD4,000 greater per participant than the home-based approach (Table 2). This was not predominantly caused by differences in the comparative cost of delivering the interventions, but appeared to be largely driven by hospital overnight costs (approximately AUD1,200 difference per patient) with this cost being higher in the gym-based group. The difference between groups in this line item was not significant when considered in isolation, possibly given the highly skewed nature of this data; medians and IQR values for both groups were all AUD0, indicating that a relatively small number of patients contributed large cost values to the overall evaluation of this outcome. The primary analysis using a societal perspective identified that an additional AUD491,572 at 2011 values would need to be spent in order to gain 1 QALY using the gym-based follow-up approach compared with the home-based approach. Investigation of uncertainty in this finding identified that 54% of the bootstrap replications of this data had a point estimate where the gym-based intervention was both more effective and costlier than the home-based intervention. There was a 5% probability that the gym-based intervention was both more effective and less costly than the home-based intervention, while there was a 37% probability that

Table 2
Between-group comparison of costs in AUD at 2011, accrued over 12-month follow-up.

Cost domain	Gym (n = 51)	Home (n = 49)	t-test	Rank sum
	mean (SD) median (IQR)	mean (SD) median (IQR)	*p*	*p* [a]
Medicine costs contributed by patient	234 (127) 230 (133 to 331)	207 (142) 177 (89 to 329)	0.32	0.27
Net benefit medicine costs extracted by the Pharmaceutical Benefits Scheme	2,018 (2,914) 1,433 (735 to 2,397)	1,474 (1,459) 1,096 (392 to 2,056)	0.24	0.19
Pathology, benefit paid	347 (394) 212 (103 to 485)	364 (403) 238 (155 to 512)	0.83	0.29
Pathology, patient out of pocket	20 (71) 0 (0 to 0)	43 (169) 0 (0 to 0)	0.37	0.54
Radiology, benefit paid	382 (579) 255 (26 to 475)	424 (474) 322 (135 to 492)	0.70	0.10
Radiology, patient out of pocket	13 (49) 0 (0 to 0)	62 (188) 0 (0 to 0)	0.07	0.59
General practitioner, benefit paid	728 (464) 715 (355 to 946)	890 (686) 757 (484 to 1,118)	0.17	0.25
General practitioner, patient out of pocket	22 (58) 0 (0 to 19)	28 (74) 0 (0 to 0)	0.63	0.39
Allied health, benefit paid	201 (297) 107 (0 to 266)	159 (189) 106 (0 to 289)	0.40	0.68
Allied health, patient out of pocket	14 (59) 0 (0 to 0)	7 (21) 0 (0 to 0)	0.41	0.69
Nurse, benefit paid	4 (8) 0 (0 to 12)	3 (7) 0 (0 to 0)	0.42	0.43
Nurse, patient out of pocket	0 (0) 0 (0 to 0)	0 (0) 0 (0 to 0)	0.00	0.00
Specialised physician, benefit paid	308 (413) 145 (0 to 371)	336 (662) 200 (32 to 389)	0.66	0.47
Specialised physician, patient out of pocket	99 (169) 30 (0 to 106)	181 (508) 44 (0 to 179)	0.28	0.41
Dentist, benefit paid	288 (959) 0 (0 to 0)	143 (654) 0 (0 to 0)	0.39	0.56
Dentist, patient out of pocket	19 (117) 0 (0 to 0)	6 (36) 0 (0 to 0)	0.45	0.74
Therapeutic procedure, benefit paid	200 (381) 0 (0 to 294)	336 (714) 0 (0 to 436)	0.23	0.42
Therapeutic procedure, patient out of pocket	106 (333) 0 (0 to 0)	202 (608) 0 (0 to 31)	0.32	0.14
Diagnostic, benefit paid	52 (93) 0 (0 to 58)	43 (90) 0 (0 to 58)	0.64	0.37
Diagnostic, patient out of pocket	3 (13) 0 (0 to 0)	14 (61) 0 (0 to 0)	0.20	0.40
Paid occupation	324 (1,699) 0 (0 to 0)	−106 (1,986) 0 (0 to 0)	0.25	0.71
Unpaid occupation	−370 (12,295) −807 (−6,855 to 3,428)	−922 (14,286) −807 (−8,216 to 4,637)	0.84	0.79
Hospital day admission	1,080 (2,657) 0 (0 to 1,017)	631 (1,393) 0 (0 to 709)	0.29	0.70
Hospital overnight	2,555 (6,854) 0 (0 to 0)	1,283 (2,679) 0 (0 to 1,373)	0.23	0.86
Complementary	687 (1,757) 274 (104 to 719)	263 (367) 51 (0 to 487)	0.10	0.10
Nursing	7 (35) 0 (0 to 0)	13 (94) 0 (0 to 0)	0.65	0.60
Meals on wheels	28 (198) 0 (0 to 0)	86 (447) 0 (0 to 0)	0.39	0.53
Home help	189 (425) 0 (0 to 0)	213 (393) 0 (0 to 277)	0.77	0.40
Gym cost – patient	555 (338) 540 (260 to 780)	–		
Gym cost – health service	545 (332) 530 (255 to 767)	–		
Home cost	–	117 (25) 123 (123 to 123)		

Table 2 (*Continued*)

Cost domain	Gym (n = 51)	Home (n = 49)	t-test	Rank sum
	mean (SD) median (IQR)	mean (SD) median (IQR)	*p*	*p* [a]
Total costs [b]	10,655 (15,450) 7,675 (796 to 21,314)	6,526 (15,715) 5,258 (–3,053 to 14,250)	0.19	0.13

Gym = gym-based exercise, Home = home-based exercise with telephone support.
[a] Non-parametric rank sum test has been presented where data are not normally distributed.
[b] Total costs includes the sum of all costs. Pharmaceutical Benefits Scheme pathology, radiology, general practitioner, allied health, nurse, specialised physician, dentist, therapeutic procedure, diagnostic, paid occupation, unpaid occupation, hospital day, hospital overnight, complementary, nursing, meals of wheels, home help, gym costs patient, gym cost health service and telephone costs.

the home-based approach was both less costly and more effective than the gym-based approach (Figure 1).

The sensitivity analysis conducted from a health service perspective identified that the gym-based intervention would cost the health service an additional AUD284,858 at 2011 values to gain 1 additional QALY compared with the home-based approach. There was similar uncertainty in this approach as compared with the primary analysis, as there was a 40% probability that the home-based approach was both less costly and more effective than the gym-based approach (Figure 2).

The sensitivity analysis conducted from a patient perspective identified that the gym-based intervention would cost patients an additional AUD206,714 at 2011 values to gain 1 additional QALY compared with the home-based approach. There was similar uncertainty in this finding to that identified in the previous analyses, as there was a 29% probability that the home-based approach was both less costly and more effective than the gym-based approach (Figure 3).

Discussion

Stakeholders would need to be willing to pay AUD491,572 for 1 QALY in order to justify providing the gym-based follow-up in preference to the home-based follow-up. This value is well in excess of the National Institute for Health and Clinical Exercise[15] cost-effectiveness threshold range of AUD34,200 to 51,000. However, this finding should be seen in its appropriate context. The uncertainty of these finding suggests that if either intervention is already established in a community setting, then the other intervention is unlikely to replace it in an efficient manner. To date, no economic evaluation has been published examining the comparative efficiency of the two leading approaches for encouraging ongoing exercise adherence in people with chronic health conditions who have completed a supervised exercise program. One trial was identified that conducted an economic evaluation of a community gym program for people with chronic disease; however, this was compared to a 'no intervention' control.[16] Thus, there were few insights that could be gained in terms of likely efficiency compared to other intervention approaches that could be employed.

A limitation of the current study was that the estimates of the comparative, incremental cost-utility of the interventions were highly uncertain. Factors contributing to this were the overall sample size from the randomised trial, and the highly skewed nature of some cost variables. Conducting economic evaluations alongside randomised trials can often lead to uncertain outcomes, as the sample size required to address the trial primary end-point may be different to that required for the economic evaluation.[17] Healthcare costs can often be very skewed, as was observed for the 'overnight hospital cost' variable in the present study. This skew in distribution also added to the uncertainty when examining mean cost values. Another limitation was the cost difference in service delivery between the two interventions. When conducting a randomised trial, it is impossible to predict the number of patients that will be present in each group at any point in time. This was not a problem for the home-based exercise program with telephone follow-up group where resources were consumed only on an as-required basis. However, for the gym-based follow-up, the health service needed to send the exercise physiologist to the gym regardless of how many study participants were there. Hence, the same total cost was accrued regardless of whether there was one participant there or 10.

Our finding of considerable economic uncertainty along with the lack of empirical evidence of exercise adherence interventions for this patient population raises questions about the value of these programs. The primary randomised, controlled trial found no

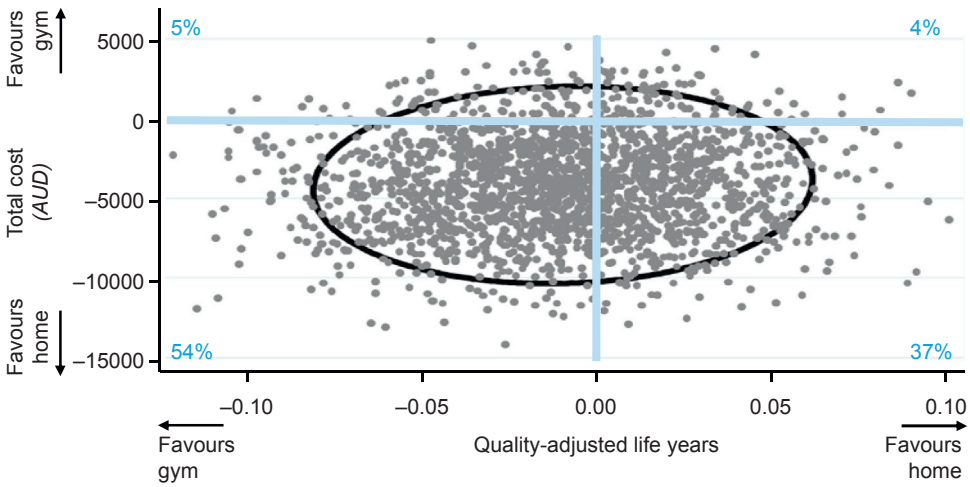

Figure 1. Cost-effectiveness of a gym-based maintenance exercise program versus a home-based maintenance exercise program with telephone follow-up, with 95% confidence ellipse for total costs versus quality-adjusted life years.

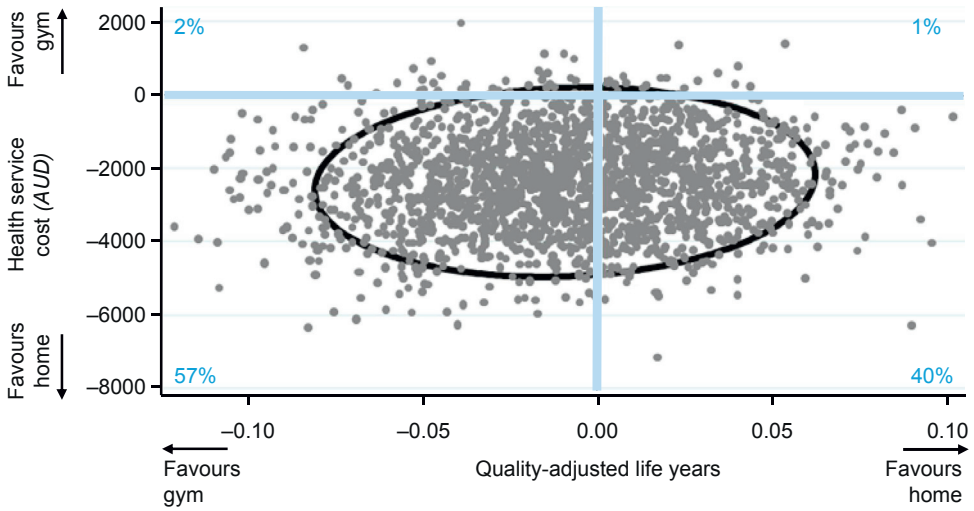

Figure 2. Cost-effectiveness of a gym-based maintenance exercise program versus a home-based maintenance exercise program with telephone follow-up, with 95% confidence ellipse for health service costs versus quality-adjusted life years.

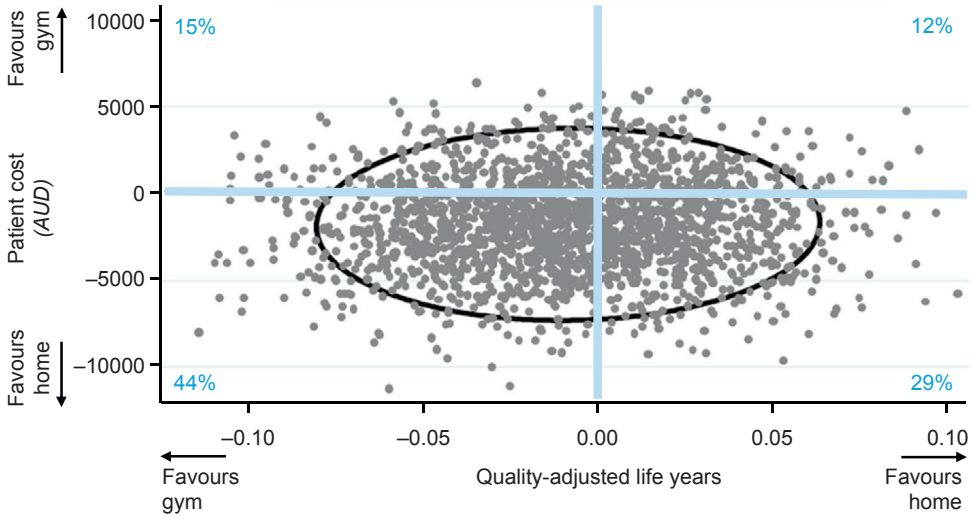

Figure 3. Cost-effectiveness of a gym-based maintenance exercise program versus a home-based maintenance exercise program with telephone follow-up, with 95% confidence ellipse for patient costs versus quality-adjusted life years.

difference in primary and secondary outcomes between intervention groups, except for fewer depressive symptoms in the gym-based group.[7] Future research needs to compare the efficiency and effectiveness with a 'no follow-up' control to inform clinical decision-makers about which intervention is most worthwhile prescribing. Although we observe that people with chronic disease lose the gains made from participating in physical activity programs if they cease exercising, it is unclear whether strategies aimed at enhancing participation in exercise after completion of the initial program are worth pursuing. It may also be worthwhile testing these questions across different locations with varying socioeconomic backgrounds because how participants respond to these different follow-up strategies may vary on this basis.

The gym-based follow-up approach was more costly than the home-based approach; this observed difference was not driven by differential costs of intervention delivery. These additional costs are unlikely to be justified by the difference in health outcomes attained by those allocated to these approaches. Further research conducted across multiple socioeconomic groups and with an additional no-intervention comparison group is warranted to further inform clinical decision-making in this area.

What is already known on this topic: Adults with a chronic disease who had completed a supervised exercise program and randomised to either a gym-based maintenance exercise program or a home-based maintenance exercise program with telephone support achieved similar outcomes 1 year later. To date, there is no comparative economic evaluation of the two maintenance strategies.
What this study adds: The gym-based approach was more costly than the home-based maintenance intervention with telephone support. The uncertainty of these finding suggests that if either intervention is already established in a community setting, then the other intervention is an unlikely option to replace it in an efficient manner.

Footnotes: [a] Stata v13, Stata Corp, College Station, USA.
eAddenda: Nil.
Ethics approval: The Southern Health Medical Research Ethics Committee; Number: 10187L approved this study. All participants gave written informed consent before data collection began.
Competing interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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