Economic evaluation of aquatic exercise for persons with osteoarthritis
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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The use of aquatic exercise was compared with usual care for patients with osteoarthritis.

Type of intervention
Secondary prevention.

Economic study type
Cost-utility analysis.

Study population
The study population comprised patients with osteoarthritis. The site of the osteoarthritis, in terms of the affected joint, was not defined.

The participants were eligible for inclusion if they met the following criteria:
there was a clinically confirmed diagnosis of osteoarthritis from a physician;
they were aged 55 to 75 years;
they were not currently exercising, defined as engaging in an average of less than 60 minutes exercise per week during the last month;
they had permission from their primary physician to participate in the aquatic class;
they were not currently enrolled in another medical study;
they were not scheduled for joint replacement during the study;
they were living in an area where the Arthritis Foundation's aquatic programmes were offered; and
they were willing to be randomised and to commit to the 5-month study period.

Setting
The setting was community. The economic study was carried out in the USA.

Dates to which data relate
The effectiveness evidence and resources used were collected between March 1997 and December 1997. The price year was 1997.
**Source of effectiveness data**
The effectiveness data were derived from a single study.

**Link between effectiveness and cost data**
The costing was carried out prospectively on the same sample as that used to collect the effectiveness evidence.

**Study sample**
Power calculations were used to determine the study sample size. These used a 90% power to detect a 0.038 (alpha=0.05) difference in the quality of well-being scores between the intervention and control groups. In addition, the sample size necessary to reject the null hypothesis, that the non-discounted incremental cost-effectiveness of the arthritis exercise programme was more than $50,000 per quality-adjusted life-year (QALY), at 80% power was determined. This was calculated using power calculations, together with a method for determining the sample size for cost-effectiveness studies.

The participants were recruited throughout the state of Washington by sending letters of direct invitation to members of the Arthritis Foundation. The adults who were interested called a toll-free number, and were screened for eligibility before being randomised to the intervention or control group. There was no evidence that the initial study sample was appropriate for the clinical study question. A total of 249 participants were enrolled into the study. Of these, 125 were randomised to the intervention group and 124 to the control group.

**Study design**
The study was a multi-centre, prospective, randomised controlled trial. The number of centres (exercise pools) was not reported. The randomisation process was stratified according to gender. The participants were followed-up for 20-weeks. Twenty-one participants (16.8%) in the intervention group and 3 (3%) in the control group did not complete the study and were lost to follow-up. No significant differences in the baseline characteristics of the drop-outs and completers were reported. There was no blinding method for the assessment of outcomes.

**Analysis of effectiveness**
The analysis of the clinical study was performed on an intention to treat basis. The primary health outcomes used in the analysis were nonpreference-weighted outcomes. These included an assessment of arthritis-specific function using the Health Assessment Questionnaire (HAQ) for pain and disability; the perceived quality of life using the Perceived Quality of Life Scale (PQOL); and depressive symptoms, measured using the Centre for Epidemiological Studies-Depression Scale (CES-D). Adherence to the exercise protocol was also recorded.

The intervention and control groups were comparable in terms of gender, age, health status, or utilisation measures, with the exception of the number of medications used per week. The difference between the two groups in terms of the number of medications used weekly was no longer significant when one participant's medication count, which was more than two standard deviations (SDs) above the mean number, was removed from the analysis.

The outcome measures were compared used an analysis of covariance, which controlled for health outcome measures at baseline.

**Effectiveness results**
The HAQ disability score at baseline was 1.035 (SD=0.535, n=125) for the intervention group and 1.047 for the control group (SD=0.608, n=124). The postclass (20 weeks) HAQ disability score was 0.933 (SD=0.550, n=101) for the intervention group and 1.127 for the control group (SD=0.671, n=121). This difference was statistically significant, (p<0.015).

The HAQ pain score at baseline was 1.533 (SD=0.602, n=121) for the intervention group and 1.440 for the control group (SD=0.610, n=123). The postclass (20 weeks) HAQ pain score was 1.382 (SD=0.737, n=98) for the intervention
group and 1.462 for the control group (SD=0.619, n=117). This difference was not statistically significant, (p<0.660).

The PQOL physical score at baseline was 5.741 (SD=1.622, n=122) for the intervention group and 5.919 for the control group (SD=1.729, n=124). The postclass (20 weeks) PQOL physical score was 6.396 (SD=1.697, n=101) for the intervention group and 5.790 for the control group (SD=1.752, n=121). This difference was statistically significant, (p<0.007).

The CES-D score at baseline was 7.261 (SD=5.308, n=123) for the intervention group and 7.715 for the control group (SD=4.995, n=120). The postclass (20 weeks) CES-D score was 6.956 (SD=4.729, n=101) for the intervention group and 8.092 for the control group (SD=6.005, n=113). This difference was not statistically significant, (p<0.096).

A total of 36 participants attended the aquatic exercise class at least twice per week for at least 16 weeks.

**Clinical conclusions**

The authors concluded that the aquatic exercises had better outcomes, as measured using HAQ and PQOL, than the controls. There was no difference in CES-D scores. The participants undergoing aquatic exercise did not report any improvements in pain scores.

**Modelling**

A multivariate general linear model was used to assess whether there were significant differences in the means of certain outcome variables. The covariates used in this model were the postclass difference scores for age, gender and a number of medical conditions.

**Measure of benefits used in the economic analysis**

Two preference-weighted health status measures were used in the economic analysis, the Quality of Well Being (QWB) scale and the single-item Current Health Desirability Weighting (CHDR). The QWB scale is a generic measure of health status with community-derived preference weights for use in cost-effectiveness analysis. The CHDR asks participants to rate the desirability of their current health status on a scale from 0 to 100, ranging from least desirable to most desirable. This outcome measure is specific to patients with osteoarthritis.

The participants were asked to complete the two health status measures, in the form of self-completion questionnaires, at baseline and 20 weeks later. A generalised linear model was used to compare QWB and CHDR for adherers, nonadherers and controls. The QALYs were calculated by multiplying the mean post-aquatic class QWB score and CHDR by the expected years of life remaining. The expected years of life remaining were derived from the ages of the participants and life tables. This was found to be 18.44 years. The QALYs were discounted at a rate of 3%.

**Direct costs**

The quantities and costs were not analysed separately. The quantities were estimated from a weekly diary in which the participants recorded the use of the following:

- health care providers such as primary care physicians, arthritis specialists, podiatrists, chiropractors, surgeons, physical and occupational therapists, and home health care nurses;
- non-traditional therapy such as acupuncture and massage;
- ‘other’ arthritis-related care, such as wax therapy, hot gloves, or a transcutaneous electrical nerve stimulator unit; and
- arthritis-related household or chore-worker help.

The participants also recorded the use of arthritis-specific drugs, aids and devices, using questionnaires given at the beginning and end of the study period. The medicines itemised included over-the-counter pain-controlling drugs such as non-steroidal anti-inflammatory drugs, antirheumatic medications, muscle relaxants, antidepressants or sleep aids, and...
other prescription drugs.

The recruitment costs included the production of direct mail flyers, letters and advertisements. The participants’ costs included the fees for the aquatic class, transport, and the time associated with travelling to and attending the class. The cost of the time associated with travel and participating in the class was derived from the median personal income in 1997 for the modal participant. The modal participant was defined as female, white and aged between 55 and 68 years. The distance travelled was obtained from a website that computes travel distances between destinations.

The unit medical costs were obtained from the charges for the Medicare reimbursement rates for the state of Washington. The unit costs of health care provider visits were obtained from Current Procedural Terminology codes and Medicare reimbursement rates. Non-traditional health treatments, such as massage and acupuncture, were assigned average costs derived from a survey of 10 Seattle area providers. The medication prices were based on the average wholesale price from the Drug Topics Red Book. The unit cost of aids and devices, such as canes, wheelchairs, special utensils, removable splints, bathroom aids, and appliances for grip and reach were taken from an average of 10 Seattle area special equipment shops. The unit cost of a chore worker visit was obtained from the average from 10 Seattle area housekeeping agencies. The unit costs for recruitment were not reported. The fees for 20-weeks' aquatic classes ranged from $0 to $262 per person. The transport costs were calculated from the distance between the participants' homes and the aquatic class, multiplied by $0.31 per mile.

The total costs were estimated from annualised projections of the 20-week observation period (March 1997 to December 1997). The costs were discounted at a rate of 3%.

Statistical analysis of costs
Nonparametric bootstrapping was used to estimate the 95% confidence intervals for the incremental cost-utility ratio (ICUR) using QALY results derived from the QWB and CHDR.

Indirect Costs
The monetary value of productivity losses was not included. The indirect costs arising from intangible outcomes associated with poor health status, due to arthritis or adverse consequences of the intervention and control group, were also excluded.

Currency
US dollars ($). No conversion rate was reported.

Sensitivity analysis
The authors did not report a sensitivity analysis on the individual cost or outcome parameters. They did report a statistical analysis (nonparametric bootstrap) of uncertainty around the ICURs.

Estimated benefits used in the economic analysis
When using the QWB scale, the total non-discounted QALY was 11.16 for the aquatic class group and 11.04 for the usual care group. The total discounted QALY was 6.47 for the aquatic class group and 6.40 for the usual care group.

When using the CHDR, the total non-discounted QALY was 12.13 for the aquatic class group and 11.37 for the usual care group. The total discounted QALY was 7.03 for the aquatic class group and 6.59 for the usual care group.

After controlling for differences in age, gender, the number of medical conditions and the measure at baseline, the mean QWB score for adherers in the aquatic group was 0.613. This was significantly higher than for the control group (0.599) or the nonadherers (0.602), (p<0.01). There was insufficient power for the CHDR to detect a significant difference between the mean values for the three groups.
Cost results
The total annualised cost was $3,634 for the aquatic class group and $3,182 for the control group.

The total lifetime cost was $67,017 for the aquatic class group and $59,689 for the control group.

Synthesis of costs and benefits
When using the QWB scale, the incremental cost per QALY gained was $205,186 for the lifetime costs of arthritis care of aquatic exercise class, compared with usual care.

When using the CHDR, the incremental cost per QALY gained was $32,643 for the lifetime costs of arthritis care of aquatic exercise class, compared with usual care.

The 95% confidence intervals around the base-case ICURs were estimated using a bootstrapping procedure. When using the results from the QWB, the confidence intervals ranged from the aquatic exercise class being dominant (less expensive and more effective) to being dominated (more expensive and less effective) by usual care. Overall, 24% of the bootstrap replicates for ICURs showed the aquatic class being dominated by usual care. Eight per cent showed the aquatic class being cost-saving with higher QALYs.

Similarly, when using the results from the CHDR, the confidence intervals ranged from the aquatic exercise class being dominated to $498,700/QALY gained. Overall, the bootstrap replicates for ICURs showed the aquatic class being dominated by usual care. Seven per cent showed the aquatic class being cost-saving with higher QALYs.

Authors' conclusions
The study did not demonstrate that the aquatic class was associated with reduced costs and improved health outcomes in comparison with usual care.

CRD COMMENTARY - Selection of comparators
The selection and description of the aquatic exercise class was supported by published evidence. However, the reason for the choice of the comparator and its relevance to usual practice were not described adequately. Therefore, it was not possible to generalise the results of this study to other health care settings. You should consider whether the two alternatives compared in this study are relevant to practice in your own setting.

Validity of estimate of measure of effectiveness
The study design and power calculations were described explicitly. However, there was no blinding of the assessment or analysis of outcome, and this may have biased the results in favour of the intervention group. The authors did not describe clearly those patients with osteoarthritis who were likely to benefit from aquatic exercise classes. This limited the generalisability of the findings of the study sample, in relation to the population of people with osteoarthritis.

Validity of estimate of measure of benefit
The authors used QALYs as the measure of benefit for the study. The QALYs were based on two health status measures, QWB and CHDR, which were described as preference-weighted measures.

Validity of estimate of costs
All the direct costs were identified and valued explicitly. The study used charges rather than unit prices for the majority of the cost estimates. The exception to this was the unit cost of drugs and appliance aids. The study presented cost data that were a mixture of charges and prices. This made it difficult to generalise the results to settings outside of the state of Washington.

The indirect costs of productivity losses and intangibles due to ill health resulting from osteoarthritis were not included.
However, the authors did include mortality and morbidity effects in the denominator of the ICUR (QALYs). It would not have been appropriate to include the monetary values of lost productivity and intangible outcomes in the cost-utility ratio if the QALY measure included the value of some or all of these mortality and morbidity consequences.

Other issues
A 3% discount rate was used for the costs and outcomes. This rate was lower than that usually recommended for costs in the UK setting (6%), and higher than that recommended for outcomes (1.5%). Applying a 6% discount rate on future costs would have decreased the expected lifetime costs for the intervention and control group.

Implications of the study
When using results from the QWB scale, the ICUR of the aquatic class compared with usual care was not favourable in comparison with other common health care interventions, when using $50,000/QALY gained as the ceiling for cost-effectiveness. The baseline change in utility was small for the aquatic class group, and the 95% confidence intervals derived around the mean ICUR were extremely large.

Further, the authors reported that adherence with the aquatic class was low and less than one-third met the criteria for adherence. The aquatic class had a positive effect on outcomes for those participants who regularly attended classes. Motivational incentives are required to encourage people to attend the aquatic class.

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