Cost analysis of an exercise program for older women with respect to social welfare and healthcare costs: a pilot study

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The aim of this study was to analyze social welfare and healthcare costs and fall-related healthcare costs after a group-based exercise program. The 10-week exercise program, which started after discharge from the hospital, was designed to improve physical fitness, mood, and functional abilities in frail elderly women. Sixty-eight acutely hospitalized and mobility-impaired women (mean age 83.0, SD 3.9 years) were randomized into either group-based (intervention) or home exercise (control) groups. Information on costs was collected during 1 year after hospital discharge. There were no differences between the intervention and control groups in the mean individual healthcare costs: 4381€ (SD 3829€) vs 3539€ (SD 3967€), P = 0.477, in the social welfare costs: 3336€ (SD 4418€) vs 4073€ (SD 5973€), P = 0.770, or in the fall-related healthcare costs: 996€ (SD 2612€) vs 306€ (SD 915), P = 0.314, respectively. This exercise intervention, which has earlier proved to be effective in improving physical fitness and mood, did not result in any financial savings in municipal costs. These results serve as a pilot study and further studies are needed to establish the cost-effectiveness of this exercise intervention for elderly people.

The aging population is an important factor contributing to the increase in social welfare and healthcare costs. It is a major challenge to municipal service providers and policy decision-makers as they attempt to match constant healthcare budgets with the steep growth of costs. The need for home help and healthcare services increases in individuals with poor functioning (Meinow et al., 2005; Carpenter et al., 2007), and falls are especially expensive to the public healthcare systems (Robertson et al., 2001a; Scufllham et al., 2003). Exercise interventions among older people can have positive effects on physical performance (Hauer et al., 2001; Brochu et al., 2002; Latham et al., 2004), functional abilities (Binder et al., 2002; Gill et al., 2002) and falling incidents (Campbell et al., 1997; Robertson et al., 2001a). However, there have been few economic evaluations of these interventions, and even then the results have been conflicting. The existing economic studies have focused on the prevention of falls after exercise-only interventions (Robertson et al., 2001a, 2001b, 2001c) or have included multifactorial interventions, such as combinations of exercise, behavioral instructions and home hazard assessment (Rizzo et al., 1996; Ruchlin et al., 2001; Campbell et al., 2005). Although exercise classes are increasingly popular among older people, there are no earlier reports of whether they have beneficial impacts to municipal social welfare and healthcare budgets.

This study was a part of an exercise trial designed to evaluate the effects of a group-based exercise program on physical fitness, mood and functional abilities in frail older women. The exercise program was successful in improving muscle strength, walking speed, balance and mood, but it failed to improve functional abilities (Timonen et al., 2002a, 2002b, 2006). This study undertakes a cost analysis of the exercise program with respect to municipal social welfare and healthcare resource use. Our hypothesis was that the financial input into this program could produce savings in municipal social welfare or healthcare costs through improved fitness of the participants. We hypothesized that an exercise program designed to improve muscle strength and balance would lead to savings by decreasing the number of injuries resulting from falls. The sample size calculations of this trial were based on the expected improvements in muscle strength and walking speed. An earlier study (Skelton et al., 1995) indicated that the expected improvement of knee...
extension strength would be 0.65 of a SD and we calculated that a sample size of 70 should be sufficient for our study based on two-sided significance of $\alpha = 5\%$ and statistical power $\beta = 80\%$. We believed that this sample size would be sufficient to detect at least a trend to lesser service use and costs.

Materials and methods

Participants

The participants were female patients who had been admitted to a primary-care health-center hospital for an acute illness. The inclusion criteria were age 75 years or older and difficulties in mobility and balance at admission. Exclusion criteria included severe heart or circulatory disease, severe dementia, malignant terminal disease or inability to walk. Before the consent was asked, all patients were offered the opportunity to familiarize themselves with the training equipment, because none of them had prior experience of fitness centers. After 20 months of recruiting, the number of eligible candidates was 79, of whom 11 refused to participate before randomization. Written informed consent was given by 68 women, who were thereafter randomized into a group-based intervention program ($N = 34$) and a home exercise control program ($N = 34$).

The study was approved by the Ethics committee of the Joensuu Municipal Health Center.

Intervention

A more detailed description of the intervention program has been published earlier (Timonen et al., 2002a). The subjects assigned to the intervention group started exercise classes within 1 week after discharge. Each participant was provided with an opportunity to attend training sessions twice a week, for a 10-week period (20 sessions, 90 min each). Two physiotherapists supervised each session. There were three to eight participants attending each exercise session. The training program included progressive resistance training on weight machines for the lower body and also functional exercises, such as rising from a chair, hip flexion and extension, and rising to a tiptoe position. Control subjects received one visit at their homes from a physiotherapist after hospitalization, and during the visit they were taught the home exercise program including the functional exercises described above.

The costs of implementing the intervention programs

The costs were assessed from the perspective of the use of municipal services, and monetary values were converted to 2004 euros. The costs included the working time of two physiotherapists, transportations by a private transportation company and meals (Table 1). The costs of the exercise classes and meals included overhead costs and were obtained from the annual report of the health center. The rent of the location, cleaning, electricity, equipment and the maintenance of the computer system accounted for the most of the overhead costs, which were about 11% of the total costs.

The costs of the social welfare and healthcare services

The costs of the social welfare services included home help services ($23.8€/h$) and nursing home stays ($89.3€/day$). The total hourly rate of home help visits after 1 year was obtained from the billing files of the home help agency. The number of days in the nursing homes was obtained from the medical records of the health center. The costs of the healthcare services included home nurse visits ($28.9€/h$), outpatient clinic consultations in the primary-care health-center ($34.2€/visit$) and in the North Karelia Central Hospital, the number of days in the geriatric day hospital ($60.6€/day$), and the number of inpatient days in the primary-care hospital ($88.2€/day$) and the North Karelia Central Hospital. All of this information was available from the medical records. The costs of the municipal services were obtained from the annual reports of the financial department of the health center. These prices included overhead costs (about 13% of the total costs) and excluded the persons' own average share of expenses. The costs of the central hospital in- and outpatient consultations were obtained from the monthly hospital charges and were dependent on the length of stay and the medical procedures performed and treatments provided. Medical records were analyzed for falling events, and direct healthcare costs for falls were recorded.

Table 1. Costs of implementing the group training (intervention) and home exercise (control) programs per session/visit and total costs for the groups

<table>
<thead>
<tr>
<th>Group training program</th>
<th>Costs per session</th>
<th>Total costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two physiotherapists' working time ($€$)</td>
<td>89.8</td>
<td>12 931</td>
</tr>
<tr>
<td>Transportation ($€$)</td>
<td>36.1</td>
<td>5197</td>
</tr>
<tr>
<td>Meals ($€$)</td>
<td>8.2</td>
<td>1181</td>
</tr>
<tr>
<td>Total ($€$)</td>
<td>134.1</td>
<td>19 310</td>
</tr>
<tr>
<td>Cost per participant ($€$)</td>
<td>37.3</td>
<td>568</td>
</tr>
<tr>
<td>Home exercise program</td>
<td>Cost per participant ($€$)</td>
<td>44.9</td>
</tr>
</tbody>
</table>

*Includes overhead costs.

Costs of a private transportation company.

There was an average of 3.6 participants per session, the average number of sessions (including drop-outs) was 15.23 per participant.

Statistical analyses

The data was analyzed using the SPSS and STATA (Stata-Corp, 2003) statistical packages. For cost analyses between the groups, we used negative binominal regression (Gardner et al., 1995) in STATA to make the comparisons as powerful as possible. For continuous data, we used the two-sided $t$-test or the Mann–Whitney test and for categorical data, the Fisher’s exact test.

Results

Baseline characteristics

Some of the baseline characteristics are summarized in Table 2. Most of the participants had walking difficulties even before the acute illness. For instance, 36 women (22 vs 14 in the intervention and control groups) needed a cane or walking device when walking indoors, and 34 (15 and 19 from the intervention and control groups, respectively) needed assistance or were unable to walk outdoors. Seventeen participants (11 vs 6 in the intervention and control groups) had
of 72 weeks (exercise classes twice per week) were transportation and meals) for the whole study period. There were altogether 518 sessions during the 72-week intervention period was $2.28 h$ per meal including over- head costs. The total costs of the intervention program were 19 310€. The number of training sessions during the 72-week intervention period was 144, and the price for one session was 134.1€. On the average there were 3.6 participants in every session (range 3–8), and for each participant the unit cost of one session was 37.3€. The average number of training sessions per participant (including dropouts) was 15.23 and the total costs of the intervention per participant were 568€.

The cost of the home exercise program including one visit of a physiotherapist was 44.9€ and the costs for the whole control group were 1527€.

### Effect of intervention on falls

Falls were monitored using the participants’ self-reports and questionnaires completed by home helpers and home nurses. Falls resulting in medical contacts were obtained from the medical records. Forty-five (23 vs 22 in the intervention and control groups) subjects fell at least once (Table 3). There were four major traumas: three hip fractures (all in the intervention group) and one pelvis fracture (in the control group). Two of the intervention group patients who suffered hip fractures had withdrawn from the intervention about 6 weeks before the fall. The third patient suffering a hip fracture fell 8 months after the end of the training period. We found that those subjects who had medical consultations for traumas (23 subjects) had had slower walking speeds (0.66, SD 0.36 vs 0.89 m/s, SD 0.37 m/s, $P = 0.020$) and poorer knee extension strength (17.9, SD 5.0 vs 21.5 kg, SD 6.4 kg, $P = 0.013$) at the baseline compared with those who had no consultations for traumas (45 subjects). The improvements after the group-based or the home-based interventions did not, however, predict lower incidence of traumas. Furthermore, those with poor compliance (17 subjects) with the group-based or the home exercise programs required more medical consultation for traumas (10 consultations) than

### Table 2. Baseline characteristics in the intervention and control groups ($N = 34/34$)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention group</th>
<th>Control group</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (SD)</td>
<td>83.5 (4.1)</td>
<td>82.6 (3.7)</td>
<td></td>
</tr>
<tr>
<td>Number of medications</td>
<td>6.2 (3.1)</td>
<td>6.1 (3.0)</td>
<td></td>
</tr>
<tr>
<td>Hand grip (kg)</td>
<td>16.1 (5.4)</td>
<td>16.6 (5.5)</td>
<td></td>
</tr>
<tr>
<td>Knee extension (kg)</td>
<td>19.7 (5.7)</td>
<td>20.7 (6.6)</td>
<td></td>
</tr>
<tr>
<td>Gait speed (m/s)</td>
<td>0.77 (0.32)</td>
<td>0.85 (0.43)</td>
<td></td>
</tr>
<tr>
<td>Balance Scale$^*$ score</td>
<td>38.0 (13.3)</td>
<td>40.3 (15.4)</td>
<td></td>
</tr>
<tr>
<td>ZSRS$^*$ score</td>
<td>47.3 (7.8)</td>
<td>48.2 (10.2)</td>
<td></td>
</tr>
<tr>
<td>MMSE$^*$ score</td>
<td>23.8 (3.7)</td>
<td>25.2 (3.0)</td>
<td></td>
</tr>
<tr>
<td>Length of hospital stay (d)</td>
<td>13.5 (7.3)</td>
<td>13.2 (10.0)</td>
<td></td>
</tr>
<tr>
<td>Home nursing (h/month)</td>
<td>0.35 (0.58)</td>
<td>0.23 (0.52)</td>
<td></td>
</tr>
<tr>
<td>Home help (h/month)</td>
<td>8.8 (13.3)</td>
<td>11.9 (18.5)</td>
<td></td>
</tr>
<tr>
<td>Informal help (times/month)</td>
<td>9.7 (11.4)</td>
<td>7.7 (11.8)</td>
<td></td>
</tr>
<tr>
<td>Physical activity (min/week)</td>
<td>270 (282)</td>
<td>225 (320)</td>
<td></td>
</tr>
</tbody>
</table>

Isometric muscle strengths were measured using a dynamometer chair (Viitasalo et al., 1985).

$^*$Berg Balance Scale (Berg et al., 1992);

$^*$Zung Self-Rating Depression Scale (Zung, 1965).

$^*$Mini-Mental State Examination (Folstein et al., 1975).

### Table 3. Number and healthcare costs of falls during the one-year follow up in the intervention and home control groups ($N = 34/34$)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention group</th>
<th>Control group</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>No falls</td>
<td>10</td>
<td>13</td>
<td>0.609</td>
</tr>
<tr>
<td>One fall</td>
<td>11</td>
<td>9</td>
<td>0.791</td>
</tr>
<tr>
<td>Two or more falls</td>
<td>13</td>
<td>12</td>
<td>&gt;0.999</td>
</tr>
<tr>
<td>Medical contacts for falls/</td>
<td>20.3/58.0</td>
<td>12.3/46.2</td>
<td>0.398</td>
</tr>
<tr>
<td>Total number of falls per person year$^*$</td>
<td>996 (SD 2612)</td>
<td>306 (SD 915)</td>
<td>0.314$^*$</td>
</tr>
<tr>
<td>Healthcare</td>
<td>996 (SD 2612)</td>
<td>306 (SD 915)</td>
<td></td>
</tr>
</tbody>
</table>

$^*$The average follow up times were 11.8 months in the intervention group and 11.7 months in the control group.

$^*$Differences between the groups were calculated using the Fisher’s exact test and negative binominal regression.

### Adherence to intervention

Eight subjects dropped out from the intervention group during the exercise program, mostly because of lack of motivation. The dropouts did not differ in the baseline characteristics from those 26 women who continued with the program. Those who continued with the training program attended an average of 18 sessions (median 19, IQR 3.25, range 11–20). In the control group, there were three withdrawals during the home exercise intervention, and 22 out of 32 subjects who participated in the first follow-up assessment reported having done regular home gymnastics exercises at least once a week (average 68 min, median 61 min, IQR 35).

### Costs of the intervention programs

The expenses of the training sessions (excluded transportation and meals) for the whole study period of 72 weeks (exercise classes twice per week) were 12 931€(Table 1). The transportation between the health center and participants’ homes was arranged by a private company and costs amounted to 5197€ for the whole study period. There were altogether 518 visits in the exercise classes and the total expenses for the meals were 1181€(2.28€ per meal including overhead costs). The total costs of the intervention program were 19 310€. The number of training sessions during the 72-week intervention period was 144, and the price for one session was 134.1€. On the
those who were compliant (48 subjects, 13 consultations) with the programs (Fisher’s exact test \( P = 0.037 \)).

The effect of exercise intervention on social welfare and healthcare costs

Table 4 shows the total social welfare and healthcare costs and the percentage shares of the different domains of services. The distribution of the total costs was highly skewed, seven subjects accounted for 32% of the total costs. After adding the costs of the exercise classes and home visits, the total individual average costs were 8282€ (SD 6632€) in the intervention group and 7656€ (SD 7903€) in the control group (\( P = 0.731 \)).

The direct healthcare costs for falls including in- and outpatient treatments were 16.4% of the total healthcare costs. There were five patients whose costs exceeded 3000€ (four in the intervention and one in the control group) and their costs accounted for 77.5% of the total costs attributable to falls. The difference was, however, statistically non-significant between the groups (Table 3). Those who had no falls needed an average of 8.4 h (SD 13.7 h) of home help services per month at the baseline, and 8.6 h (SD 13.6 h)/month during the last 6 months of the follow-up, i.e. the increase in home help use was only 2%. Those with at least one fall had an average of 11.3 h (SD 17.2 h) of home help per month at the baseline and 16.8 h (SD 23.8 h)/month during the last part of the follow-up, which represented a 49% increase in the use of home help services. It was not possible to estimate whether the expansion was directly due to the falls or simply a reflection of an accelerated decline in functional abilities.

Discussion

This group-based exercise program after acute hospitalization did not reduce social welfare or healthcare costs in older women with balance and mobility problems. Although the program was targeted to older women at increased risks of falling, the program did not succeed in reducing the number of falls. The study sample calculations were based on the expected improvements in physical performance and strength, and we anticipated that perhaps at least a trend toward lesser falls and public service use would be detected. However, the number of research subjects was so small that a few isolated cases that needed costly hospital interventions increased the total healthcare costs in the intervention group. The subjects in the interventions group were somewhat older, had slower walking speeds, and poorer muscle strength, memory and balance than the control subjects at the baseline. Although the differences were not statistically significant, it is possible that the combination of disabilities made them frailer and more vulnerable to falls and other health problems. The training period of 10 weeks was long enough to improve physical performance (Timonen et al., 2002a), but too short to influence functional abilities and need for home services (Timonen et al., 2006). Several exercise interventions with longer durations (Campbell et al., 1997; Barnett et al., 2003) and healthier subjects (Buchner et al., 1997; Day et al., 2002) have proved to be effective at preventing of falls as well as total and fall-related healthcare costs (Buchner et al., 1997; Robertson et al., 2001a).

Our exercise program included no attempts to reduce the risk of falls by home hazard assessment, which has been found to be cost-effective in fall prevention in older community-dwelled adults with
histories of falls (Salkeld et al., 2000) and with severe visual impairments (Campbell et al., 2005). Fall reduction (Tinetti et al., 1994; Day et al., 2002; Gillespie et al., 2003; Clemson et al., 2004; Chang et al., 2004) and economic benefits (Rizzo et al., 1996; Ruchlin et al., 2001) also have been found in multifactorial intervention trials including combinations of exercise, behavioral instruction and medication adjustments.

It is also worth noting that the control subjects were provided with an exercise program, which the majority (69%) of them followed at least once a week. Performance of the home exercises may have reduced fallings in this group. The lack of a non-exercise control group limits our ability to determine the effectiveness of the exercise program compared with the usual care after hospitalization. In earlier studies, home exercise programs with combinations of balance and strengthening exercises and longer durations, have proved to be effective in fall reduction (Campbell et al., 1997; Campbell et al., 1999; Robertson et al., 2001a, 2001c) and in improving functional abilities (Gill et al., 2002; Binder et al., 2004; Nelson et al., 2004). There were more subjects in control group compared with the intervention group who reported that they had increased the time they had spent on the physical activities in the previous week before the first (18/31 in the control group vs 8/26 in the intervention group, $P = 0.039$) and second (21/30 in the control group vs 11/25 in the intervention group, $P = 0.052$) follow-up assessments. Increased physical activity might have had a protective effect on falls although it did not improve strength or physical performance. In several studies, increased physical activity has been found to be associated with fewer falls (Campbell et al., 1999; Rubenstein et al., 2000).

The trend in the cost distribution was slightly different between the groups. The subjects in the intervention group needed more healthcare services than the controls. Visits to the exercise classes which were situated in the health center, might have increased the use of healthcare services through more careful medical controls and awareness of functional disabilities. Improved physical performance by itself may not be sufficient to increase functional independence (Latham et al., 2004; Rydwik et al., 2004). In many cases, an older woman may not wish to lose home help services, especially if the services are publicly subsidized, even though her improved physical condition would permit a more independent performance of daily activities. The costs for a 10-week exercise period including the training, lunch and transportation were 568€ per participant. The recruitment strategy and randomization meant that there were an average of two new trainees in the intervention group every month. The average number of trainees was 3.6 (3–8) in a session. The capacity of the transportation and exercise program was designed for a group of eight participants, so the resources were under-used.

Although the program did not produce savings in costs in the short term, it did produce well being via improvements in physical fitness (Timonen et al., 2002a) and mood (Timonen et al., 2002b). The training sessions were acceptable to old frail women, i.e. there was a low dropout rate (24%). We believe that group-based exercise classes supplemented with transportation to and from the session are a good alternative especially, when out-of-doors activities are limited because of poor mobility. This small intervention study was rather a pilot study in this field and it was clearly underpowered to answer the research question comprehensively. The results of the current study, however, suggest that cost reduction to society may require more than just improving physical fitness, but this topic, clearly, requires further studies.

**Perspectives**

The growth of the elderly population is a major challenge to municipal service providers. We need new strategies to promote independent living at home and to reduce the number of falls suffered by our older citizens. There is already an abundance of evidence emphasizing the benefits of exercise interventions on physical fitness and mood in older adults (Arent et al., 2000; Latham et al., 2004). However, improved physical performance by itself may not be sufficient to increase functional independence (Latham et al., 2004), to decrease healthcare costs (Robertson et al., 2001b) or reduce the incidence of falls (Province et al., 1995). Factors other than fitness, such as cognitive capacity, personal strategies, attitudes as well as housing circumstances seem to be equally important. Although this group-based exercise program did not produce any financial savings to society, the exercise classes were relatively inexpensive compared with traditional individual physiotherapy in health centers or hospital wards. Two physiotherapists can run a group of eight participants compared with individual physiotherapy where only one patient per physiotherapist can be treated at the same time. Furthermore, participation in an exercise group offered social contacts and improved physical fitness and psychological well being (Timonen et al., 2002a, 2002b).

**Key words:** aged, 80 and over, female, frail elderly, physical fitness.

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Skelton DA, Young A, Greig CA, Malbut KE. Effects of resistance training on strength, power, and selected