Effects of Exercise Programs to Prevent Decline in Health-Related Quality of Life in Highly Deconditioned Institutionalized Elderly Persons

A Randomized Controlled Trial

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Background: Our objective was to assess the effects of targeted exercise programs on health-related quality of life compared with usual care based on the ability to perform activities of daily living (ADL) and the Neuropsychiatric Inventory scores in geriatric institutionalized persons.

Methods: A randomized controlled trial of 2 exercise programs vs usual care was conducted in 160 institutionalized persons 65 years or older who were able to understand basic motor commands and to move from one position to another. Interventions were performed over 6 months and were either an adapted tai chi program (4 times 30 min/wk) or a cognition-action program (2 times 30-45 min/wk) that focused primarily on an adapted guidance of patient-centered communication skills. The control group received usual care. The study was conducted at 4 settings. The main outcomes were changes in health-related quality of life based on ADL and Neuropsychiatric Inventory scores after 12 months.

Results: The control group experienced a decline in ADL over the 12-month period compared with the adapted tai chi and cognition-action groups, but the differences were not significant (P = .24 and P = .15, respectively). Also, the components of ADL, eg, ability to walk, continence, and nutrition, were maintained better in the intervention groups than in the control group. The total Neuropsychiatric Inventory score also worsened significantly in the control group, while it was unchanged or improved in the intervention groups. The differences between the cognition-action group and the control group were significant (P > .001). Neuropsychiatric diagnosis subgroups (such as dementia and psychosis) did not show a specific response from any intervention.

Conclusion: Adapted exercise programs can slow down the decline in health-related quality of life among heterogeneous, institutionalized elderly persons.

Trial Registration: clinicaltrials.gov Identifier: NCT00623532

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Original Investigation

FUNCTIONAL DEPENDENCE IN geriatric institutions raises important issues related to decline in overall health-related quality of life (HRQoL) and professional caregivers’ distress. Physical inactivity and disability in elderly institutionalized patients may negatively affect their ability to perform activities of daily living (ADL) and worsen their HRQoL status.1-4 A meta-analysis has shown that exercise training can effectively improve HRQoL in persons with cognitive impairments.5 Nevertheless, randomized controlled trials of exercise program implementation in geriatric settings are scarce. Moreover, frequent and severe behavioral disturbances,6 severe deconditioning, lack of compliance, and assessment difficulties have compelled the majority of exercise intervention programs to exclude highly deconditioned and severely demented or psychotic institutionalized older adults.1,7,8

Nonpharmacological, randomized, controlled trial interventions incorporating exercise have investigated the management of physical deterioration, undernutrition, and behavioral disturbances in demented patients, but their benefits in ADL have yet to be confirmed.1,7,8 Although elderly persons with neuropsychiatric diagnoses and overall functioning impairments may be particularly good candidates for intervention to prevent decline, little is known regarding exercise program benefits on behavioral disturbances in this population.5

No recommendations have been made about the structure and intensity of exercise programs to prevent decline in overall HRQoL in highly deconditioned el-

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derly persons. We previously found that adapted tai chi (AT) exercises are feasible and effective in institutionalized elderly populations. 10 Another form of training program, named cognition-action (CA), which aims to increase adherence to exercise by adding a meaning to exercise in relation to everyday actions, could also be effective. Exercises in AT and CA are of light to moderate intensity and are designed to be harmless in a frail population. Instructors of AT need to have the mastery of tai chi; CA instructors could be physical activity teachers, occupational therapists, or physiotherapists who undergo training. Therefore, CA may be more accessible in institutions than AT. However, the efficacy of CA needs to be tested. The main objectives of this study were (1) to determine the clinical effectiveness of AT and CA interventions to improve HRQoL as assessed by changes in Katz and colleagues' 11 index of ADL and Neuropsychiatric Inventory (NPI) scores 12 for highly deconditioned, institutionalized elderly persons; (2) to compare both groups with a routine care group; and (3) to identify which neuropsychiatric diagnoses could modify the effectiveness of the interventions.

STUDY METHODS

This study was a 12-month multicenter, randomized, controlled trial of highly deconditioned, institutionalized elderly persons living in 4 settings close to Bordeaux, France. Enrollment began in May 2006 and follow-up ended in February 2008. Informed written consent was retrieved from the patient, guardian, or legal representative. When inclusion criteria were met and written informed consent was obtained, patient assignment was randomly determined by computer-generated random allocation number by a blind assiner, without any possibility of identification of the assignment allocation. All exercise sessions were conducted in groups and given at the patients’ facilities. The institutional review board of the University Hospital Centre, Bordeaux, France, approved the study protocol.

PARTICIPANTS

Two hundred seventy persons from 3 nursing homes and 1 long-term care home were screened during individual interviews (Figure). The inclusion criteria were broad: the participants had to be 65 years or older, had to be living in an institution for more than 6 months, had to have the ability to get up alone or with technical or human help if necessary, and had to have the ability to understand basic motor commands. Terminally ill and bedridden patients were excluded.

A total of 160 patients were recruited from the nursing homes (n = 121) and the long-term care home (n = 39). The intervention groups consisted of either 6-month exercise programs of AT (n = 51) or CA (n = 49), and the control group consisted of routine care (n = 60). The participants’ neuropsychiatric diagnoses were retrieved from their medical records. In case of doubt, an opinion was obtained from the research team using standard and comprehensive diagnostic measures for dementia types and psychiatric disorders. 13, 14 Mini-Mental State Examination 15 scores were assessed for descriptive and statistical adjustment. Mini-Nutritional Assessment (MNA) scores below 17 were used to diagnose undernutrition. 16 Over a 1-week period, all assessments were completed by physicians who were not informed of treatment allocation.

INTerventions

The planned class size was 8 patients per group. During interventions, the patients’ safety was ensured using adequate materials, and the intensity of the exercise was tailored according to the patients’ state. Both interventions were applied in addition to usual care. The AT classes were taught by an experienced instructor who followed an adapted variation of the Yang style for elderly persons, 17 which emphasizes body sensation, awareness of multidirectional weight shifting, body alignment, and multisegmental movement coordination. Deep breathing and muscular reinforcement exercises were integrated into the AT routine. Therefore, after the population characteristics were taken into consideration, AT was defined as 4 sessions of 30 minutes a week over the course of 6 months.

The CA program was monitored by a trained physical activity teacher. Based on the reported frequency and duration of exercise from a pilot study, the CA group met for 30 minutes and progressed to 40 minutes twice a week for 6 months. 10 The CA intervention relied more on instructor guidance than on the type of exercise. The interrelationship with the patient was established with respect to the patient’s perception. The instructor gave meaning to events and actions that helped the patient to find his or her own situational awareness and comfort in ADL. 10, 14 Each session consisted of a 10-minute warm-up while participants were seated in a circle so that they could see each other. Lower limb movements (eg, cycling and knee elevations) alternated with upper body exercises (eg, arm rising and circle drawing) and were followed by stretching and resistance exercises against the hand of the instructor. The backs of chairs were used to secure balance exercises with the patients shifting their bodies and legs (front, back, and both sides) in a standing position. The participants, all seated, also passed a light and medium-size ball to the participants next to them, with their feet and arms at different heights. The sessions ended with deep-breathing exercises and relaxation. The exercises were
shown and explained using simple and short sentences. The CA instructor helped to contain the participants’ frustration during practice and solicited the remaining self-regulative resources.4,10

Overall, in both groups (AT and CA), the exercises were light to moderate in intensity. The 2 intervention groups had 3 distinct characteristics: (1) AT was a movement-based approach, while CA was a guidance-centered approach; (2) speed of motion was predominantly slower in the AT group; and (3) the patients could rely more on procedural memory in CA, while the patients’ relied more on their learning capacity in AT.

CONTROL GROUP

The participants assigned to the control group received usual care with no additional attention or exercise or cognitive-behavioral training. This group had no restriction in nursing, medical care, counseling, physical activity, psychotherapy, or any health care support.

ASSESSMENTS

The primary patient outcome measures consisted of ADL scores and neuropsychiatric symptoms. The ADL, Mini-Mental State Examination, mood (Geriatric Depression Scale [GDS]), and NPI scores were assessed at baseline and at 6 and 12 months. Physical functioning measurements were evaluated at baseline and at 3, 6, and 12 months. Based on previous studies, a reduction in ADL impairment was unlikely.8 We therefore judged primary outcomes as clinically successful if the patient showed a mean slowdown of 1 point in the total ADL impairment score compared with the control group and a reduction of 20 points in the NPI total score.20

Main Outcome Assessments

Katz and colleagues11 index of ADL assesses the ability of participants to perform 6 ADL. Each item (bathing, dressing, using the toilet, walking, continence, and eating) was scored on a scale from 0 to 2 (0, able to perform the activity without any help; 1, able to perform the activity with little help; and 2, unable to perform the activity without complete help). Nursing staff members were interviewed for scoring. The total score ranged from 0 to 12.

Behavioral disturbances were evaluated using the nursing home version of the NPI,12 which consists of a 15- to 20-minute interview by a physician or a psychologist involving at least 2 staff members who usually care for the patient (range, 2-7 staff members, including a certified nurse). The nursing home version of the NPI includes 12 neuropsychiatric symptoms, including delusions, hallucinations, agitation/aggression, depression/dysphoria, anxiety, euphoria/elation, apathy/indifference, disinhibition, irritability/lability, aberrant motor behavior, nighttime behavior, and eating disorders. The NPI scores range from 0 to 144; higher scores indicate greater behavioral disturbances. The impact of each neuropsychiatric symptom on caregiver occupational distress was rated from 0 (not at all) to 5 (very severely or extremely), and the total score ranged from 0 to 60.

Physical Functioning and Mood Assessments

Physical functioning was assessed using the Timed Up and Go test11 (ie, time taken to rise from a chair, walk 3 minutes, return, and walk back to sit down); the chair rise test (time taken to rise 5 times from a chair), walking speed, and the 1-leg stance (time taken to stay in equilibrium while standing on 1 leg). Mood was assessed during a face-to-face interview using the 15-item GDS; the score ranges from 0 to 15, with higher scores indicating more depressive symptoms.22

STATISTICAL ANALYSIS

This study was designed to have 90% power (0.05) to detect a mean (SD) difference of 0.5 (0.8) point in the total ADL score. Because of patients’ poor physical status, the Timed Up and Go test and the chair rise tests were categorized in 20 classes according to the baseline distribution for each variable. The inability to perform a test was modeled using an extra 21st category. The scores ranged from 1 to 21, with higher scores indicating performance impairment.

To reinforce our results, 2 different types of statistical analysis were performed. First, we assessed changes in the outcome measures over time and between groups by using repeated-measures analysis of variance (at baseline and at 3, 6, and 12 months), with up to 4 observations per individual. Age, sex, Mini-Mental State Examination score, number of comorbidities, neuropsychiatric category, and baseline value of the dependent variable were used as covariates. Size effects were estimated (using the Cohen f effect size). To investigate the influence of neuropsychiatric categories, we conducted separate analyses within each neuropsychiatric diagnosis category using the same repeated-measures design described for primary analysis.

Adherence was determined by presence at sessions. Residents who stopped participating or who missed a session for any reason (death, change of facility, or medical event) were considered absent. All analyses were conducted on an intention-to-treat basis, using all available data from all randomized patients and carrying forward the last observation for dropouts. P values were adjusted with Bonferroni correction. P values less than .05 were considered statistically significant.

The second type of analysis was a linear mixed-effects model, adjusted according to age and sex. This model allows exploration of the slope of changes in major end points (ADL and NPI scores) over 1 year.

RESULTS

BASELINE CHARACTERISTICS

The mean (SD) age of the participants was 82.3 (9.1) years (age range, 65-102 years). The participants were predominantly female (71.7%). At baseline, there was a trend for better health status for participants in the AT group compared with controls, and the ADL score was lower (better) for the AT participants than for the controls (F=7.002; P=.009) (Table 1 and Table 2).

INTERVENTION COMPLIANCE, ATTRITION, AND ADVERSE EVENTS

Class sizes in both intervention groups ranged from 5 to 11 participants (mean, 8 participants). Of the 160 patients who began the study, 146 completed the 6-month assessments and 135 completed the 12-month assessments (Figure). Participants who did not complete the study (n=25) did not differ from the other participants (n=135) in any of the baseline variables except for the patients who were older and who died during follow-up.
While the control group experienced a significant difference (AT group vs control group) between the CA group and the control group (AMD, 0.71; 95% CI, −0.36 to 1.07 in the AT group, compared with the intervention group (AMD, 0.36; 95% CI, 0.43 to 1.15 in the AT group, compared with the control group (AMD, −0.09; 95% CI, −0.90 to 0.72 in the CA group). Over the 12-month period, the control group had a larger decline in the ADL score (AMD, 1.57; 95% CI, 0.83 to 2.31) compared with the intervention groups (AMD, 0.70; 95% CI, −0.26 to 0.96 in the AT group, and AMD, 0.71; 95% CI, −0.36 to 1.07 in the CA group), P = .007.

Using the mixed-effects model, the change in the total ADL score over 12 months was not significantly different between the CA group and the control group (β = −0.07/mo; P = .16) or between the AT group and the control group (β = −0.06/mo; P = .24). However, walking abilities were better preserved in the control group than in the control group (β = −0.02/mo; P = .03); continence was better preserved in the AT group than in the control group (β = −0.02/mo; P = .04), and eating was better preserved in both groups than in the control group (β = −0.03/mo; P = .02 in the AT group, and β = −0.03/mo; P = .02 in the CA group).

Patients in the control group significantly increased their total NPI score at 6 months (AMD, 9.9; 95% CI, 2.0 to 17.6; P < .001) and over the 12-month observation period (AMD, 14.2; 95% CI, 5.4 to 23.0; P < .001) (Table 4). In the CA group, the total NPI score was reduced in a clinically significant way from baseline to 6 months (P < .001) and to 12 months (P < .001). The caregivers’ distress increased over the 1-year period in the control group (P = .006), while it remained somewhat constant in the CA group and was reduced significantly in the AT group (P = .02).

Using the mixed-effects model, the evolution of NPI scores over the 1-year period was significantly better in the CA group compared with the control group (β = −1.14/mo; P = .03) but did not differ between the AT group and the control group (β = −0.80/mo; P = .12). We found that the increase in the total NPI score over the 12-month period increased the risk of the ADL worsening in the whole population (OR, 1.14; 95% CI, 1.04 to 1.25; P = .005). Overall, when the CA and AT interventions were compared with each other according to both models, no difference was shown for main outcomes.

### Functional Testing and Mood

After 6 months, the performance of the participants in the control group significantly worsened during the intervention period (CA group vs control group, P = .007). We found that the improvement in the total NPI score over the 12-month period increased the risk of the ADL worsening in the whole population (OR, 1.14; 95% CI, 1.04 to 1.25; P = .005). Overall, when the CA and AT interventions were compared with each other according to both models, no difference was shown for main outcomes.
### Table 3. Adjusted Mean Difference per Patient in MMSE Score, ADL Score, and Mood Over the 12-Month Study Period\(^a\)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline to 6 Months (Intervention), Adjusted Mean Difference (95% CI)</th>
<th>Baseline to 12 Months (Intervention and Follow-up), Adjusted Mean Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AT Group (n=45)</td>
<td>CA Group (n=47)</td>
</tr>
<tr>
<td>MMSE</td>
<td>(−0.13 to 0.2)</td>
<td>(−0.9 to 1.7)</td>
</tr>
<tr>
<td>ADL</td>
<td>0.36</td>
<td>−0.09</td>
</tr>
<tr>
<td>Bathing</td>
<td>0.09</td>
<td>−0.17</td>
</tr>
<tr>
<td>Dressing</td>
<td>0.01</td>
<td>−0.04</td>
</tr>
<tr>
<td>Using the toilet</td>
<td>0.09</td>
<td>−0.17</td>
</tr>
<tr>
<td>Walking</td>
<td>−0.02</td>
<td>−0.04</td>
</tr>
<tr>
<td>Conti. of toileting</td>
<td>0.18</td>
<td>0.39</td>
</tr>
<tr>
<td>Feeding</td>
<td>−0.15</td>
<td>0.03</td>
</tr>
<tr>
<td>GDS</td>
<td>−1.7</td>
<td>−2.8</td>
</tr>
</tbody>
</table>

Abbreviations: ADL, activities of daily living; AT, adapted tai chi; CA, cognition-action; CI, confidence interval; GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination.

\(^a\) Repeated measures were adjusted for baseline measure, age, sex, MMSE score, neuropsychiatric diagnoses, and number of comorbidities; data are based on comparison of repeated adjusted time times treatment groups; and f is the Cohen \(f\) effect size.

\(^b\) Adjusted repeated designs with baseline and 6- and 12-month values; results are in intention to treat, with the last observation carried forward for missing data.

\(^c\) Indicates the within-group adjusted mean difference (\(P<.05\)).

### Table 4. Adjusted Mean Difference per Patient in Behavioral Disturbances Over the 12-Month Study Period\(^a\)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline to 6 Months (Intervention), Adjusted Mean Difference (95% CI)</th>
<th>Baseline to 12 Months (Intervention and Follow-up), Adjusted Mean Difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AT Group (n=45)</td>
<td>CA Group (n=47)</td>
</tr>
<tr>
<td>Delusions</td>
<td>−0.9</td>
<td>−0.5</td>
</tr>
<tr>
<td>Hallucinations</td>
<td>−0.2</td>
<td>−0.2</td>
</tr>
<tr>
<td>Agitation</td>
<td>−0.9</td>
<td>0.1</td>
</tr>
<tr>
<td>Depression</td>
<td>−1.3</td>
<td>−1.6</td>
</tr>
<tr>
<td>Anxiety</td>
<td>−1.6</td>
<td>−1.2</td>
</tr>
<tr>
<td>Euphoria</td>
<td>−0.2</td>
<td>−0.3</td>
</tr>
<tr>
<td>Apathy</td>
<td>−1.3</td>
<td>−1.7</td>
</tr>
<tr>
<td>Disinhibition</td>
<td>−1.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Irritability</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Abl. motor behavior</td>
<td>−1.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Nighttime behavior</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Eating change</td>
<td>0.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Total NPI score</td>
<td>−1.4</td>
<td>9.9</td>
</tr>
<tr>
<td>Total distress score</td>
<td>−0.8</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Abbreviations: AT, adapted tai chi; CA, cognition-action; CI, confidence interval; NPI, Neuropsychiatric Inventory.

\(^a\) Repeated measures were adjusted for baseline measure, age, sex, Mini-Mental State Examination score, neuropsychiatric diagnoses, and number of comorbidities; data are based on comparison of repeated adjusted time times treatment groups; and f is the Cohen \(f\) effect size.

\(^b\) Adjusted repeated designs with baseline and 6- and 12-month values; results are in intention to treat, with the last observation carried forward for missing data.

\(^c\) Indicates the within-group adjusted mean difference (\(P<.05\)).
Timed Up and Go test (P = .003) and the chair rise test (P < .001), and their walking speed declined (P < .001), while the intervention groups showed no improvement or worsening (Table 5). At 12 months, the walking speed significantly declined in all groups (AT group, P = .03; CA group, P = .02; and control group, P < .001).

Depressive symptoms were reduced on the GDS at 6 months in all 3 groups (AT group, P = .002 and f = 0.75; CA group, P < .001 and f = 0.94; and control group, P < .001 and f = 0.64) and were maintained at 12 months in both intervention groups (AT group, P = .004 and f = 0.96; CA group, P < .001 and f = 1.27) (Table 3).

Specific analysis demonstrated that, when compared with their randomized peers, psychotic participants, demented patients of any stage, and undiagnosed participants had a similar response to the interventions (data not shown).

This study demonstrated that targeted exercise intervention programs can slow the decline in HRQoL in deconditioned, institutionalized elderly persons, even in those with severe neuropsychiatric disability. Our results showed that, while 5 out of the 6 basic ADL scores significantly worsened in the control group, the participants who benefited from the interventions showed a reduction in the functional degradation process according to the adjusted multivariate analysis of variance model. However, clinical significance was not achieved because the ADL difference was below the threshold of 1 point (range, 0-12 points), and the results of the mixed-effects model did not confirm this effect. Despite randomization, the participants in the AT group were less disabled than those in the control group. This outcome could have modified their 1-year response to exercise. However, interventions have modified the course of some of the ADL items according to both models. The observed maintenance of the ADL continence score in the AT group may have been triggered by the exercise training and environmental factors, as were the walking capacities in the CA group. While no data are available regarding the effect of tai chi on continence in institutionalized elderly persons, it has been shown that continence outcomes were better in nursing home patients who were in an exercise intervention group compared with usual care.23 Both inter-

Table 5. Adjusted Mean Difference per Patient in Functional Testing Over the 12-Month Study Perioda

<table>
<thead>
<tr>
<th>Test</th>
<th>Baseline to 3 Months, Adjusted Mean Difference (95% CI)</th>
<th>Baseline to 6 Months (Intervention), OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT Group (n=49)</td>
<td>CA Group (n=49)</td>
<td>Control Group (n=56)</td>
</tr>
<tr>
<td>TUG test</td>
<td>0.1 (−1.2 to 1.4)</td>
<td>0.9 (−1.7 to 2.8)</td>
</tr>
<tr>
<td>Chair rise test</td>
<td>−0.6 (−1.2 to 1.7)</td>
<td>−0.2 (−1.1 to 2.9)</td>
</tr>
<tr>
<td>10-m Walking speed, m/s</td>
<td>0.03 (−2.8 to 0.5)</td>
<td>0.01 (−3.0 to 2.7)</td>
</tr>
<tr>
<td>OLS, s</td>
<td>0.9 (−0.4 to 1.0)</td>
<td>0.9 (0.7 to 5.1)</td>
</tr>
<tr>
<td>HGS, kg</td>
<td>−1.7 (−3.5 to 0.1)</td>
<td>−0.11 (−4.9 to −2.7)</td>
</tr>
</tbody>
</table>

Adjusted Mean Difference (95% CI) (n=49)

<table>
<thead>
<tr>
<th>Test</th>
<th>Baseline to 12 Months (Intervention and Follow-up), Adjusted Mean Difference (95% CI)</th>
<th>P Value (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT Group (n=41)</td>
<td>CA Group (n=43)</td>
<td>Control Group (n=51)</td>
</tr>
<tr>
<td>TUG test</td>
<td>1.6 (−1.1 to 4.4)</td>
<td>.61 (0.14)</td>
</tr>
<tr>
<td>Chair rise test</td>
<td>0.4 (−1.3 to 1.3)</td>
<td>.001 (0.29)</td>
</tr>
<tr>
<td>10-m Walking speed, m/s</td>
<td>−0.11 (−3.5 to 2.7)</td>
<td>.04 (0.23)</td>
</tr>
<tr>
<td>OLS, s</td>
<td>0.7 (1.4)</td>
<td>.002 (0.82)</td>
</tr>
<tr>
<td>HGS, kg</td>
<td>5.3 (−3.7 to −2.9)</td>
<td>.001 (0.44)</td>
</tr>
</tbody>
</table>

Abbreviations: AT, adapted tai chi; CA, cognition-action; CI, confidence interval; HGS, hand grip strength in kilograms on the best hand; NPI, Neuropsychiatric Inventory; OLS, 1-leg stance in seconds on the best leg; OR, odds ratio; TUG, Timed Up and Go.

aRepeated measures were adjusted for baseline measure, age, sex, Mini-Mental State Examination score, neuropsychiatric diagnoses, and number of comorbidities; data are based on comparison of repeated adjusted time times treatment groups; and f is the Cohen f effect size.

bAdjusted repeated design with baseline and 3- and 6-month values.

cAdjusted repeated design with baseline and 3-, 6-, and 12-month values; results are in intention to treat, with the last observation carried forward for missing data.

dIndicates the within-group adjusted mean difference (P < .05).
ventions were associated with better preservation of the self-feeding capacity, which is the last ability to deteriorate during the disabling process.

We found similar ADL worsening in neuropsychiatric diagnosis subgroups or across dementia stages, thus confirming the small differences in the decline profiles across demented and non-Alzheimer dementia populations. Possibly, the advanced deconditioning of the institutionalized population may have blurred the distinction between specific worsening patterns. It is noteworthy that living conditions were similar for all residents within each institution. Overall, these results indicated that severely deconditioned elderly patients with various neuropsychiatric diagnoses and health conditions could all benefit from adapted exercise interventions with a trained instructor’s guidance. Conversely, the increase in behavioral disturbances observed in the control group may presumably have played a role in the worsening of the ADL scores. However, no data are available from institutions to support this statement to date. The residents in the CA group were less agitated and showed less depressive symptoms, suggesting some interrelationships with the quality-of-life improvement process.

In contrast with physical activity recommendations and the dose-response paradigm, the current results did not show additional benefits from the increased number of sessions in the improvement of the outcome measures. Possibly, the apparent lack of dose effect may be attributable to differences in exercise intensity or to a reduction of the exercise response capacity because of physical inactivity and disability. Further research should include metabolic noninvasive assessment such as phosphorus 31 nuclear magnetic resonance spectroscopy to examine muscle properties and exercise adaptability.

To our knowledge, this is the first intervention study to report the detailed changes of the NPI symptom scores over a 1-year period. Our population had the particularity of having high behavioral disturbances scores on the NPI compared with those previously described, probably because we chose not to exclude residents with behavioral problems. The CA intervention method reduced agitation, irritability, overall total NPI score, and depression on the GDS, findings that are in agreement with those of a previous study. Compared with the control group, the CA group showed a reduction in the total NPI score, however, below what we have stated as clinically significant: 20 points in the total score. Although we did not find significant differences between the intervention groups, the observed effect magnitudes and clinically significant outcomes were greater in the CA group, especially in the management of behavioral disturbances. The CA benefits may have been emotionally triggered by the enhanced self-confidence resulting from the adapted guidance model, social stimulation, and exercise repetitions during the sessions. The time spent with the residents independently from exercise may have played a role in the effect of intervention, and a control group with an intervention that is not based on a physical activity may have different outcomes compared with our control group. However, the AT intervention included a longer contact time with the instructor compared with the CA intervention, and the outcomes were not better. Further investigations and targeted individualized interventions are needed to determine to what extent management of behavioral disturbances could benefit from such a program combining physical intervention and personal attention. The reduction of the caregivers’ distress showed that professionals may have benefited from the interventions. We have not explored this fact from a nursing home management point of view, and the underlying processes of this improvement need to be investigated.

The effect sizes were promising with respect to implementation and replication in other geriatric institutions. The intrinsic nature of the interventions did not allow a double-blind study. To limit the possible bias, assessors were independent and the nursing staff members were not informed about intervention allocation (AT or CA); however, they could not be unaware that the residents were attending an exercise group. Each ADL or NPI assessment involving staff interviews were separated by a long time (6 months), and it is likely that the staff did not keep the precedent scores in mind. Because we analyzed changes of scores rather than the scores themselves, we believe that our results are not greatly affected by observer bias, nor can contamination between groups be observed. In this study, we excluded the residents who were unable or unwilling to participate. However, the attendance reflects daily life in nursing homes, where the bedridden residents or the residents who are opposed to occupational activities are not compelled to participate. The target population of these interventions could be simply defined according to the inclusion criteria of the study: residents who were able to stand and to understand basic motor commands and who were not opposed to attending a physical activity group.

We did not perform any cost-effectiveness analysis in this study. The costs related to impaired quality of life could include various items. Predefined conditions related to incontinence or low physical activity have been previously used for this purpose. However, in this last study, despite positive effects on outcomes, no cost-effectiveness of an exercise program was shown. Severe acute events (eg, hospitalization or death) occurred at a similar rate in the 3 groups, and medication changes did not differ between the groups (data not shown); therefore, in this institutionalized population with fixed costs for nursing, it is unlikely that these interventions were cost-effective. However, it is obvious that an intervention with 2 sessions per week would be less expensive than one with 4 sessions per week, and the total expense per person in the CA group was less than €200/y. Considering the effects of the interventions on dependency and behavior, and the possible decrease of caregiver distress, this expense seemed reasonable.

In conclusion, exercise programs offer promising benefits for the prevention of HRQoL decline in institutionalized elderly persons. The CA intervention, which included an adapted guidance for physical activity, tended to provide better and more sustained results than the AT intervention. The intervention programs showed high adaptability across different populations, which makes these materials adaptable to other set-
tments. Further evaluations are needed to determine the cost-effectiveness of these promising interventions within institutions and their effects on caregivers’ welfare.

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