Occupational Therapy for Stroke Patients: A Systematic Review
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Occupational Therapy for Stroke Patients
A Systematic Review

Esther M.J. Steultjens, MA; Joost Dekker, PhD; Lex M. Bouter, PhD; Jos C.M. van de Nes, MD; Edith H.C. Cup, MSc; Cornelia H.M. van den Ende, PhD

Background and Purpose—Occupational therapy (OT) is an important aspect of stroke rehabilitation. The objective of this study was to determine from the available literature whether OT interventions improve outcome for stroke patients.

Methods—An extensive search in MEDLINE, CINAHL, EMBASE, AMED, and SCISEARCH was performed. Studies with controlled and uncontrolled designs were included. Seven intervention categories were distinguished and separately analyzed. If a quantitative approach (meta-analysis) of data analysis was not appropriate, a qualitative approach (best-evidence synthesis), based on the type of design, methodological quality, and significant findings of outcome and/or process measures, was performed.

Results—Thirty-two studies were included in this review, of which 18 were randomized controlled trials. Ten randomized controlled trials had a high methodological quality. For the comprehensive OT intervention, the pooled standardized mean difference for primary activities of daily living (ADL) (0.46; CI, 0.04 to 0.88), extended ADL (0.32; CI, 0.00 to 0.64), and social participation (0.33; CI, 0.03 to 0.62) favored treatment. For the training of skills intervention, some evidence for improvement in primary ADL was found. Insufficient evidence was found to indicate that the provision of splints is effective in decreasing muscle tone.

Conclusions—This review identified small but significant effect sizes for the efficacy of comprehensive OT on primary ADL, extended ADL, and social participation. These results correspond to the outcome of a systematic review of intensified rehabilitation for stroke patients. The amount of evidence with respect to specific interventions, however, is limited. More research is needed to enable evidence-based OT for stroke patients. (Stroke. 2003;34:676-687.)

Key Words: meta-analysis ■ occupational therapy ■ stroke

One year after the onset of the first stroke, physical independence (for 66% of the stroke survivors) and occupation (for 75% of the stroke survivors) are the most affected domains of handicap.1 This necessitates the multidisciplinary rehabilitation of stroke patients, which is aimed at decreasing the consequences of the illness in daily functioning. Occupational therapy (OT) aims at facilitating task performance by improving relevant performing skills or developing and teaching compensatory strategies to overcome lost performance skills.2 Training of self-care activities, training of leisure activities, and advice and instruction regarding assistive devices are the 3 most frequently chosen interventions for stroke patients.3 In addition, the occupational therapist educates and shares information with the family and primary caregiver about the patient’s ability to perform and about how to provide proper assistance.4

The efficacy of occupational therapy has been addressed in several rehabilitation reviews.5–10 However, these reviews are narrative,7–9 or discuss specific topics such as the treatment of hemiplegia or the treatment of cognitive impairments like unilateral neglect.5,10 One letter to the editor11 presented some results of a meta-analysis in comprehensive OT on activities of daily living (ADL). The efficacy of various OT interventions has yet to have been systematically summarized. Therefore, the aim of our systematic review was to determine whether OT interventions improve outcome for stroke patients.

Materials and Methods

An extensive search was conducted through the following resources: MEDLINE (1966 through June 2002), CINAHL (1982 through June 2002), EMBASE (1988 through March 2001), SCISEARCH (1974 through March 2001), AMED (1985 through April 2001), Cochrane Controlled Trials Register (June 2002), the Rehabilitation and Related Therapies Field (Cochrane Collaboration), the specialized trial register of the Cochrane Collaborations Stroke Group, and 2
Dutch libraries of medical and rehabilitation literature (the Dutch National Institute Allied Health Professions and Netherlands Institute for Health Services Research).

The broad computerized search strategy was built on (1) search strategy for stroke (Stroke Group of the Cochrane Collaboration), (2) search strategy for OT interventions, (3) search strategy for controlled trials (Cochrane Collaboration), and (4) search strategy for designs other than controlled designs (ODs). The full search strategy is available on request from the corresponding author. Additionally, the reference lists of all identified studies were scanned, and corresponding authors of articles eligible for inclusion were contacted by mail to identify further studies. Inclusion of articles, which was based on the title and abstract, was performed by 2 independent reviewers (E.M.J.S., C.H.M.E.). In case of uncertainty, the full article was read. Disagreements were resolved by discussion.12 The applied inclusion criteria were the following: (1) efficacy studies with either a controlled design or an OD such as pre/post tests and time series; (2) studies evaluating OT interventions in clinically diagnosed adult stroke patients; (3) studies on primary outcome measures, including primary ADL, extended ADL, or social participation or secondary process measures, which are measures considered to be indicators of successful treatment (arm or hand function, muscle tone, or cognitive functions such as memory and attention); and (4) full-length articles.

OT interventions either were regarded as comprehensive OT (when all 6 specific intervention categories were part of the evaluated OT treatment) or were classified into 6 specific intervention categories: (1) training of sensory-motor functions; (2) training of cognitive functions; (3) training of skills such as dressing, cooking a meal, or performing domestic activities; (4) advice and instruction in the use of assistive devices; (5) provision of splints and slings; and (6) education of family and primary caregivers. This classification is based on the International Classification of Functioning, Disability and Health.13 A group of 4 occupational therapists (including E.M.J.S. and E.H.C.C.) and a reviewer (C.H.M.E.) reached consensus about this classification. They assessed whether the interventions evaluated in each study were regarded as OT and, if so, classified them into 1 of the intervention categories. The criteria applied were that the intervention would most likely be part of an OT treatment plan and that the treatment was aimed at enhancing occupational performance. Disagreements were resolved by discussion.

The methodological quality of all studies was independently assessed by 2 reviewers (E.M.J.S., E.H.C.C.). Disagreements were resolved by discussion. If no consensus was met, a third reviewer (C.H.M.E.) made the final decision. For randomized controlled trials (RCTs) and case-control trials (CCTs), a list of methodological criteria recommended by Van Tulder et al13 was used. This list, containing all criteria proposed by Jadad et al14 and Verhagen et al15 consists of 11 criteria for internal validity, 6 descriptive criteria, and 2 statistical criteria (Appendix 1). One modification was made regarding the specification of the eligibility criterion: The condition of interest (the impairment or disability that indicated referral to OT) was added as an eligibility criterion, as proposed by Wells et al.16 All criteria were scored as “yes,” “no,” or “unclear.” Studies were considered to be of high quality if at least 6 criteria for internal validity, 3 descriptive criteria, and 1 statistical criterion were scored positively.

To rate the methodological quality of the ODs, the list of Van Tulder et al12 was adapted with regard to some items (Appendix 1). The final list consisted of 7 criteria for internal validity, 4 descriptive criteria, and 2 statistical criteria. Studies were considered to be of sufficient quality if at least 4 internal validity criteria, 2 descriptive criteria, and 1 statistical criterion were met.

Analysis of the results was performed separately for each intervention category. For continuous variables, a standardized mean difference (Hedges’ g) was calculated. Means and SD were converted from medians and interquartile ranges, if necessary.17 For dichotomous variables, odds ratios with corresponding 95% confidence intervals were computed. In cases of missing data, the first authors of the specific studies were not contacted to obtain additional information. In crossover trials without a washout period between intervention phases, data after the first phase was not further analyzed. The primary analysis was focused on comparisons of an OT intervention with a no treatment control group. However, if studies compared the effect of more than 2 intervention groups, 2 reviewers (E.M.J.S., C.H.M.E.) decided by consensus how these comparisons would be classified. In particular, if 2 interventions were compared, the predominant contrast needed to be the OT treatment provided. For each intervention category, a decision was made as to whether to apply a quantitative (eg, meta-analysis) or qualitative (eg, best-evidence synthesis) approach for the analysis of data. The qualitative approach was considered appropriate if the included studies within 1 intervention category were clinically diverse and/or statistically heterogeneous. Clinical diversity among studies was assessed by 2 reviewers (E.M.J.S., C.H.M.E.), taking into account the classification of patients (severity of the disease), interventions (duration, frequency and setting), and outcome measures (dimensions of outcome measures). Disagreements were resolved by discussion. Statistical heterogeneity was determined by the sign test. If meta-analysis was appropriate, the pooled standardized mean difference (Hedge’s g effect size) was computed from a random effects model. In cases of too much diversity and/or heterogeneity, a best-evidence synthesis was applied. The best-evidence synthesis is based on that proposed by Van Tulder et al13 and adapted for the purpose of this review by attributing the appropriate level of evidence to the efficacy of OT, taking into account the design of the studies, methodological quality, type of outcome measures, and statistical significance of the findings (the Figure). To reanalyze the results, a sensitivity analysis was performed by excluding low-quality studies.

**Results**

The search strategy resulted in a list of 4183 citations. After a selection based on title and abstract, 210 full articles were obtained. Sixty-two publications concerned the efficacy of OT in stroke patients, of which 36 articles, presenting 32 studies, fulfilled all inclusion criteria. Data from 5 studies were presented in 1 article.19–28 One publication presented 2 studies.23 Twenty-six publications presenting 25 studies evaluating the efficacy of OT were excluded because a
single-subject design was used, healthy persons or patients with diseases other than stroke participated in the study, or the outcome measures were beyond the scope of our review (Appendix 2).

The methodological quality was assessed in 18 RCTs, 6 CCTs, and 8 ODs (Appendix 1). Ten RCTs had a high methodological quality. All CCTs scored low in methodological quality. One of the ODs had sufficient methodological quality. The raters disagreed on 17% of the items. Specifically, the items “allocation concealment” and “intention-to-treat analysis” were scored differently. All disagreements were resolved after discussion.

For each intervention category, results of studies that contribute to the outcome of the meta-analysis or the best-evidence synthesis are presented.

**Comprehensive OT**
Seven studies—6 RCTs19,21,25,29–31 (Table 1) and 1 CCT32—were identified. Five RCTs19,21,25,29,30 had a high methodological quality. Two studies19,31 compared 2 treatment groups (1 for ADL problems, 1 for leisure problems) with a nontreated control group.

**Outcome Measures**
Primary ADL was measured in 5 RCTs with the Barthel Index.21,25,29–31 One high-quality RCT30 presented NO SD and was excluded from the meta-analysis (Table 2). The pooled standardized mean difference (Hedge’s g effect size) for the remaining RCTs was 0.31 (CI, 0.03 to 0.60). For extended ADL, measured with the Nottingham Extended ADL Scale, the pooled effect size of 0.20 (CI, −0.02 to 0.42) was calculated. The sensitivity analysis excluding low-quality RCTs showed changes of the pooled effect sizes of 0.46 (CI, 0.04 to 0.88) and 0.32 (CI, 0.00 to 0.64), respectively. Social participation was measured in all RCTs. Two studies29,30 presented inappropriate data and were excluded from pooling. The effect size for the remaining RCTs was 0.18 (CI, −0.03 to 0.40). When only the high-quality studies were pooled, the effect size changed to 0.33 (CI, 0.03 to 0.62). No process measures were assessed.

Thus, the pooled high-quality studies show small33 but significant effect sizes on primary ADL, extended ADL, and social participation. A trend favoring comprehensive OT remains when the low-quality studies are incorporated into the meta-analysis.

**Training of Sensory-Motor Functions**
Three diverse high-methodological-quality RCTs27,34,35 (Table 1), 1 CCT36, and 1 OD37 focused on the training of sensory-motor functions intervention. The outcome measures primary ADL, extended ADL, and social participation showed nonsignificant results (Table 2). Two RCTs27,34 reported nonsignificant results for the arm and hand function process measure (Table 3).

Thus, no evidence has been found for the efficacy of training of sensory-motor function on primary ADL, extended ADL, social participation, and arm and hand function.

**Training of Cognitive Functions**
Four low-methodological-quality studies (1 RCT [Table 1], 2 CCTs, 1 OD) evaluated the efficacy of training of visual scanning and visual-spatial ability. The RCT24 measured the primary ADL outcome measure and showed nonsignificant results; however, the study presented positive results on the visual scanning and visual-spatial ability process measures.

Thus, no evidence is found for the efficacy of visual perception training on primary ADL. There are indicative findings that visual scanning and visual-spatial ability improve after treatment.

**Training of Skills**
Eight studies40–47 (3 RCTs [Table 1], 1 CCT, 4 ODs) evaluating training of skills and activities focused on strategy training (eg, learn to compensate for impairments) to overcome limitations in the performance of activities resulting from cognitive dysfunctions. Additionally, 1 RCT48 (Table 1), excluded from further analysis because of missing data, evaluated a particular dressing practice. One RCT49 had a high methodological quality.

**Outcome Measures**
The high-quality RCT40 presented significant results on primary ADL, whereas the low-quality RCT47 showed significant results on extended ADL (Table 2).

**Process Measures**
Two studies40,46 evaluated arm-hand function. The high-quality RCT40 reported nonsignificant results. Cognitive functions were evaluated in all studies. The low-quality RCT43 showed an increase in cognitive functions such as memory, verbal function, and visual-spatial ability (Table 3).

Thus, limited evidence is found for the efficacy of strategy training on primary ADL. No evidence is found for extended ADL, cognitive functions, and arm-hand function.

One low-quality RCT49 compared training of cognitive functions with strategy training and presented no significant difference between treatments on Barthel Index, extended ADL, cognitive functions, and arm-hand function.

**Advice and Instruction Regarding Assistive Devices**
One high-quality RCT50 (Table 1) evaluated whether encouragement of wheelchair propulsion would lead to better functional ability and well-being. No significant results were found. Thus, there is no evidence that training of wheelchair propulsion in acute stroke increases functional ability and well-being.

**Provision of Splints**
Five studies (2 RCTs51,52 [Table 1], 2 CCTs, 1 OD) evaluated splinting on the muscle tone51–55 process measures. All studies were of low methodological quality. None of the studies presented significant results of these measures (Table 3). Thus, there is insufficient evidence that splinting is effective for decreasing muscle tone.

**Education of Family or Primary Caregiver**
No OT studies focusing on this intervention were identified.
<table>
<thead>
<tr>
<th>First Author (ref)</th>
<th>No. of Participants</th>
<th>Methods</th>
<th>Inclusion Criteria</th>
<th>Intervention</th>
<th>Outcome Measures</th>
<th>Duration of Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehensive OT</td>
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</tr>
<tr>
<td>Corn 29</td>
<td>110</td>
<td>RCT</td>
<td>Discharged alive from stroke unit following acute stroke</td>
<td>I: individual OT treatment* R: no treatment</td>
<td>Barthel Index</td>
<td>No information available</td>
</tr>
<tr>
<td>Drummond 19</td>
<td>65</td>
<td>RCT</td>
<td>Independent living, discharged alive from stroke unit following acute stroke</td>
<td>I1: OT for leisure activities I2: conventional OT, ADL R: no additional input</td>
<td>Barthel Index, NEADL, Pearlman’s quality of life scale</td>
<td>I: 30 min 1 × wk for 3 mo then: 30 min 1 × 2 wks for 3 mo</td>
</tr>
<tr>
<td>Gilbertson 21</td>
<td>138</td>
<td>RCT</td>
<td>CVA, referral to OT, severe cognitive and communication problems excluded</td>
<td>I: individual client centered OT treatment* at home R: inpatient multidisciplinary rehabilitation + follow-up</td>
<td>Barthel Index, NEADL, London Handicap Scale</td>
<td>I: 10 × 30–45 min, 6 wks R: 1 home visit pre discharge</td>
</tr>
<tr>
<td>Logan 23</td>
<td>111</td>
<td>RCT</td>
<td>First stroke, referral to social service OT</td>
<td>I: enhanced OT service* R: routine OT</td>
<td>Barthel Index, NEADL, General Health Questionnaire</td>
<td>I: 6 visits R: 2.5 visit</td>
</tr>
<tr>
<td>Parker 21</td>
<td>466</td>
<td>RCT</td>
<td>Independent living stroke patients, no dementia, stroke ≥6 mo first visit clinic</td>
<td>I1: OT for leisure activities I2: OT for ADL R: no treatment</td>
<td>Barthel Index, NEADL, Nottingham Leisure Questions, London Handicap Scale</td>
<td>I: 10 × 30 min</td>
</tr>
<tr>
<td>Walker 25</td>
<td>185</td>
<td>RCT</td>
<td>&lt;1 mo clinically diagnosed stroke, no hospital admission</td>
<td>I: individual OT treatment* at home R: no OT treatment, normal home service available</td>
<td>Barthel Index, NEADL, London Handicap Scale</td>
<td>I: on average 5.8 × 52 min</td>
</tr>
<tr>
<td>Training of sensory-motor function</td>
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<tr>
<td>Feys 34</td>
<td>100</td>
<td>RCT</td>
<td>First stroke, admission to hospital, motor deficit, sit independently</td>
<td>I: sitting in rocking chair, actively rocking with hemiplegic site R: sitting in rocking chair, hemiplegic site in rest Inpatients</td>
<td>Barthel Index, Action Research Arm Test</td>
<td>30 min, 5 d for 6 wks</td>
</tr>
<tr>
<td>Jongbloed 25</td>
<td>90</td>
<td>RCT</td>
<td>First CVA, admitted to hospital &lt;12 weeks after onset, hemiplegia</td>
<td>I: OT treatment functional approach R: OT treatment sensory-motor Inpatients</td>
<td>Barthel Index, Meal preparation test</td>
<td>40 min 5 d/wk, 8 wks</td>
</tr>
<tr>
<td>Kwakkel 27</td>
<td>101</td>
<td>RCT</td>
<td>Primary first stroke in middle cerebral artery</td>
<td>I: OT arm-rehabilitation group R: immobilization of hemiplegic site Inpatients</td>
<td>Barthel Index, Sickness impact profile, Action Research Arm test</td>
<td>30 min 5 d/wk, 20 wks</td>
</tr>
<tr>
<td>Training of cognitive functions</td>
<td></td>
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<tr>
<td>Carter 29</td>
<td>33</td>
<td>RCT</td>
<td>Admission to hospital with acute stroke</td>
<td>I: cognitive skill remediation training R: no treatment</td>
<td>Barthel Index, Cognitive skills (visual scanning + spatial time)</td>
<td>30–40 min 3 d/wk, 3–4 wks</td>
</tr>
<tr>
<td>Training of skills</td>
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<tr>
<td>Donkervoort 40</td>
<td>113</td>
<td>RCT</td>
<td>Left hemisphere stroke &gt;4 wks &lt;2 y, apraxia, age &gt;24 &lt;95, no brain damage</td>
<td>I: apraxia strategy training R: conventional OT Inpatients</td>
<td>Barthel Index, ADL observation, Functional motor test, Apraxia test</td>
<td>I: 15 h in 25 session R: 19 h in 27 sessions</td>
</tr>
</tbody>
</table>

TABLE 1. Characteristics of Included RCTs
This systematic review explored the efficacy of several OT interventions for stroke. Seven intervention categories were separately analyzed for the primary outcome measures of primary ADL, extended ADL, and social participation and the secondary process measures of arm and hand function, muscle tone, and cognitive functions. This review established for comprehensive OT small but significant effect sizes on primary ADL, extended ADL, and social participation. The magnitudes of these effect sizes correspond to the results of a systematic review of intensified rehabilitation for stroke patients. Kwakkel et al.56 presented a small significant effect size on ADL. Within the specific intervention categories, quantitative pooling of data was not appropriate for analyzing results. Instead, we applied a qualitative best-evidence synthesis. For the training of skills category, limited evidence for improving primary ADL was found. The training of cognitive functions category revealed indicative findings for efficacy in visual perception skills. Insufficient evidence was found to indicate that the provision of splints is effective in decreasing muscle tone.

The results of comprehensive OT on ADL support the conclusions presented by Langhorne et al.11 In their letter to the editor regarding the results of a meta-analysis of comprehensive OT, data on extended and primary ADL scores were pooled and showed a positive significant effect size favoring OT. However, in our view, primary ADL (eg, self-care and basic mobility skills) and extended ADL (eg, domestic and leisure skills) are 2 distinct dimensions of functional ability. Therefore, they were
Comprehensive OT

Training of cognitive functions vs training of skills

Advice/instruction regarding assistive devices

<table>
<thead>
<tr>
<th>Reference (n)</th>
<th>Method Quality</th>
<th>Barthel Index</th>
<th>EADL</th>
<th>Participation</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD) Baseline</td>
<td>SMD* [CI]</td>
<td>Mean (SD) Baseline</td>
<td>SMD* [CI]</td>
</tr>
<tr>
<td></td>
<td>I: 15 (13.3)</td>
<td>0.19 † [−0.23;0.60]</td>
<td>NR</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>R: 14 (7.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drummond19 (44), ADL group</td>
<td>High</td>
<td>...</td>
<td>...</td>
<td>NR</td>
</tr>
<tr>
<td>Drummond19 (44), Leisure group</td>
<td>High</td>
<td>...</td>
<td>...</td>
<td>NR</td>
</tr>
<tr>
<td>Gilbertson21 (138)</td>
<td>High</td>
<td>I: 17 (2.2)</td>
<td>0.30 † [0.04;0.64]</td>
<td>NR</td>
</tr>
<tr>
<td>Logan25 (111)</td>
<td>High</td>
<td>NR</td>
<td>NS</td>
<td>NR</td>
</tr>
<tr>
<td>Parker25 (310), Leisure group</td>
<td>Low</td>
<td>I: 18 (3.0)</td>
<td>0.00 † [−0.22;0.22]</td>
<td>NR</td>
</tr>
<tr>
<td>Parker25 (313), ADL group</td>
<td>Low</td>
<td>I: 18 (3.0)</td>
<td>0.27 † [0.05;0.49]</td>
<td>NR</td>
</tr>
<tr>
<td>Walker25 (185)</td>
<td>High</td>
<td>I: 18 (3.7)</td>
<td>0.86 † [0.54;1.18]</td>
<td>I: 10 (6.7)</td>
</tr>
<tr>
<td>Pooled effect size high quality studies</td>
<td></td>
<td>0.46 [0.04;0.88]</td>
<td>0.32</td>
<td>0.33</td>
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Training of sensory-motor function

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<thead>
<tr>
<th>Reference (n)</th>
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<tr>
<td></td>
<td>Mean (SD) Baseline</td>
<td>SMD* [CI]</td>
<td>Mean (SD) Baseline</td>
<td>SMD* [CI]</td>
</tr>
<tr>
<td>Jongbloed26 (90)</td>
<td>High</td>
<td>I: 5.0 (2.0)</td>
<td>0.18 † [−0.29;0.65]</td>
<td>I: 26.5 (6.1)</td>
</tr>
<tr>
<td>Kwakkel27 (70)</td>
<td>High</td>
<td>R: 5.5 (2.0)</td>
<td></td>
<td>R: 26.8 (6.8)</td>
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<tr>
<td>Pooled effect size high quality studies</td>
<td></td>
<td>0.60</td>
<td>0.32</td>
<td>0.33</td>
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Training of cognitive functions

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<thead>
<tr>
<th>Reference (n)</th>
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<th>EADL</th>
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<td>SMD* [CI]</td>
<td>Mean (SD) Baseline</td>
<td>SMD* [CI]</td>
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<tr>
<td>Carter28 (33)</td>
<td>Low</td>
<td>NR</td>
<td>0.60</td>
<td>NR</td>
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<tr>
<td>R: 11.2 (5.0)</td>
<td>[0.05;0.87]</td>
<td></td>
<td>R: 2.2 (0.5)</td>
<td>0.34</td>
</tr>
<tr>
<td>Weinberg29 (57)</td>
<td>Low</td>
<td>...</td>
<td>...</td>
<td>I: 39.3 (18.1)</td>
</tr>
<tr>
<td>R: 31.6 (10.9)</td>
<td>[1.26;3.32]</td>
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Training of cognitive functions vs training of skills

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<tr>
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<td>Mean (SD) Baseline</td>
<td>SMD* [CI]</td>
</tr>
<tr>
<td>Edmans40 (80)</td>
<td>Low</td>
<td>I: 9.0 (2.1)</td>
<td>0.32 † [−0.12;0.76]</td>
<td>I: 26.8 (9.1)</td>
</tr>
<tr>
<td>R: 9.0 (2.1)</td>
<td></td>
<td></td>
<td>R: 29.0 (8.4)</td>
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</table>
| Advice/instruction regarding assistive devices

<table>
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<td>Mean (SD) Baseline</td>
<td>SMD* [CI]</td>
<td>Mean (SD) Baseline</td>
<td>SMD* [CI]</td>
</tr>
<tr>
<td>Barrett40 (40)</td>
<td>High</td>
<td>I: 7.4 (1.9)</td>
<td>0.35</td>
<td>NR</td>
</tr>
<tr>
<td>R: 7.0 (2.5)</td>
<td>[−0.27;0.98]</td>
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</tbody>
</table>

ADL indicates activities of daily living; ADL group, activities of daily living training given; leisure group, leisure training given; SMD, standardized mean difference; *measurement after ending therapy; [CI], 95% confidence interval; I, intervention group; R, reference group; RCT, randomized clinical trial; CCT, controlled clinical trial; NR, not reported; NE, not estimable; NS, not significant; †effect size calculated with median and converted SD from interquartile range; ‡odds ratio; ‡‡, not assessed.

analyzed separately in this systematic review. The effect sizes for both primary and extended ADL show a small significant effect size for OT treatment, which is encouraging.

One third of the identified studies had a high methodological quality. The 10 high-quality RCTs covered mainly 2 intervention categories, namely comprehensive OT and training of sensory-motor functions. Consequently, evidence for the efficacy of some categories of OT interventions such as training of cognitive functions (0 high-quality trials), training of skills (1 high-quality RCT), advice and instruction regarding assistive devices (1 high-quality RCT), and provision of splints (0 high-quality trials) is lacking. Furthermore, no OT studies were identified for the widely applied intervention category of instruction of family or primary caregiver. Thus, there is an urgent need for more high-methodological-quality efficacy trials evaluating these categories of OT interventions.

Surprisingly, 8 of 9 studies in the training of skills intervention category evaluated strategy training to reduce the conse-
The qualitative levels-of-evidence approach was used to analyze the results of diverse and heterogeneous studies if a quantitative meta-analysis was not appropriate. This approach has been criticized because conclusions of reviews using this approach are essentially based on arbitrary criteria. However, in the present review, both qualitative and quantitative approaches of analysis can be compared. If we apply the best-evidence synthesis to the pooled outcomes in our review, the result would be no evidence for the efficacy of comprehensive OT on primary and extended ADL because <50% of the included studies presented statistically significant effect sizes. Results of the best-evidence synthesis regarding social participation would confirm the results of the meta-analysis. So, this comparison of qualitative and quantitative approaches shows that our best-evidence synthesis seems to be a strict one. Furthermore, meta-analysis may be flawed by the need to convert data recorded as median scores and interquartile ranges into means and SD. Additionally, in our review, several studies did not report the data necessary for computing the standardized mean differences and were excluded from pooling procedures. Therefore, both approaches of analysis have limitations, but the use of a levels-of-evidence approach seems justified when pooling is not appropriate or severely hampered.

In conclusion, the positive results for comprehensive OT on primary ADL, extended ADL, and social participation endorse the importance of OT as part of the multidisciplinary rehabilitation of stroke patients. The amount of evidence with respect to specific interventions, however, is lacking. More research is needed to enable evidence-based OT for stroke patients.
### Appendix 1: Fulfilled Items of Methodological Quality Plus Quality Criteria for Randomized Controlled Trials, Case-Control Trials, and Controlled Designs

<table>
<thead>
<tr>
<th>First Author</th>
<th>Design</th>
<th>Internal Validity</th>
<th>Descriptive</th>
<th>Statistic</th>
<th>MQ</th>
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<td>Training of cognitive function versus training of skills</td>
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</table>

MQ indicates methodological quality; +, high methodological quality; −, low methodological quality.

a indicates eligibility criteria; b₁, method of randomization; b₂, treatment allocation concealed; c, groups similar at baseline; d, index and control interventions described; e, care provider blinded; f, co-interventions avoided/comparable?; g, compliance acceptable; h, patient blinded; l, outcome assessor blinded; j, outcome measures relevant; k, adverse effects described; l, withdrawal dropout rate described and acceptable; m₁, short-term follow-up measurement; m₂, long-term follow-up measurement; n, timing outcome assessment comparable; o, sample size for each group; p, intention-to-treat analysis; q, point estimates and measures of variability presented. Criteria b₁, b₂, c, e, and h were not scored for ODs.
Appendix 2: Excluded Studies With the Reason for Exclusion

<table>
<thead>
<tr>
<th>Reference</th>
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<tr>
<td>Borst and Pete</td>
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<tr>
<td>Cermak et al</td>
<td>Single subject design</td>
</tr>
<tr>
<td>Dirette and Hinojosa</td>
<td>Single subject design, outcome measures not included in review</td>
</tr>
<tr>
<td>Edmans and Lincoln</td>
<td>Single subject design</td>
</tr>
<tr>
<td>Johnson and Schkade</td>
<td>Single subject design</td>
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<td>Paul</td>
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<td>Paul</td>
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<td>Charait</td>
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<td>Giudice</td>
<td>Participants with CVA and other diseases, outcome measures not included in review</td>
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<tr>
<td>Hass et al</td>
<td>Outcome measures not included in review</td>
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<tr>
<td>Jongbloed, Jongbloed and Morgan</td>
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<td>Kaplan</td>
<td>Participants with CVA and other diseases, outcome measure not included in review</td>
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<tr>
<td>Lavelle and Tomlin</td>
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<td>Mathiowetz et al</td>
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<td>McPherson et al</td>
<td>Participants with CVA and other diseases</td>
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<td>Platz et al</td>
<td>Participants with CVA and other diseases</td>
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<tr>
<td>Poole</td>
<td>Participants with CVA and apraxia, CVA without apraxia and well healthy persons</td>
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<tr>
<td>Schemm and Gitlin</td>
<td>Outcome measures not included in review</td>
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<tr>
<td>Trombly and Quintana</td>
<td>Outcome measures not included in review</td>
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</table>


Acknowledgments

This study was funded by grant 00-04 from the Dutch Health Care Council (College Voor Zorgverzekeringen). We would like to thank A. Stoopendaal and F. Stehmann-Sarris for discussing occupational therapy issues and E. Weijzen for making the search strategy applicable to the several databases.

References


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**Editorial Comment**

**Occupational Therapy for Stroke Patients: When, Where, and How?**

Technological advances in medicine and increasing longevity in the general population have contributed to the growing number of physically disabled persons in Western countries. Functional impairment following acute illness (eg, stroke) frequently has devastating consequences, and the past several decades have witnessed increasing needs for multidisciplinary rehabilitation interventions. Occupational therapy, an essential part of rehabilitation, offers a wide range of interventions to facilitate independence among disabled patients. In recognition of occupational therapy as a key component in the multidisciplinary rehabilitation of stroke patients, this issue of *Stroke* includes a report from Steultjens and colleagues, who have documented the positive results of comprehensive occupational therapy programs on primary activities of daily living (ADLs), extended ADLs, and social participation of stroke survivors. This systematic review, in conjunction with other scientific evidence, contributes significantly to our pool of knowledge about occupational therapy research, an area that remains poorly studied. Nonetheless, a number of issues related to interventions for patients with impaired physical function following acute illness need to be addressed.

**When Is Occupational Therapy Appropriate for Stroke Patients?**

The goal of occupational therapy is to restore functional independence, when possible, and to facilitate psychosocial adjustment to residual disability. Unfortunately, criteria for selection of patients who would most benefit from participation in occupational therapy programs have yet to be precisely defined. The heterogeneity of functional and health problems experienced by stroke patients makes it difficult to evaluate multiple outcomes of rehabilitation. Valid negative predictors of functional recovery after acute events likely include age, urinary incontinence, cognitive impairment, delirium, functional deficits present at admission, and level of social support.1,2 Other factors, however, make it difficult to draw definitive conclusions about the efficacy and cost-effectiveness of occupational therapy programs. These include the characteristics of the studied population and of the rehabilitation setting, the types of assessments and/or interventions, and the use of varying outcome measures.

Given the potential conflict between the increasing demand for occupational therapy programs and the development of health care services that limit the availability of rehabilitation beds, identification of stroke patients who could potentially gain improved function from such services is imperative. Although Steultjens and colleagues report a significant effect of occupational therapy on primary and extended ADLs and on social participation, the trials included in their study were very heterogeneous. The characteristics of stroke patients varied significantly, given the types of stroke and acute treatments (ie, in one trial, patients were not admitted to the hospital while in another, they were admitted to the acute stroke unit). The treatments themselves (ie, rehabilitation programs) were not similar to each other: a leisure activity intervention is not the same as an occupational therapy program. The duration of treatment significantly differed (from 30 minutes per week to 1 hour per 5 days a week), and the length of follow-up ranged from 4 weeks to 20 weeks. Furthermore, the current report provides no information concerning the effectiveness of occupational therapy programs in reducing health services use and relative costs for stroke patients. Comprehensive cost-effectiveness analyses and cost-benefit analyses are, therefore, needed to strengthen...
the evidence supporting endorsement of occupational therapy interventions.3

Where Is the Appropriate Place to Implement an Occupational Therapy Program?

Despite the growing body of evidence suggesting that improved functional performance after rehabilitation programs may relate to early initiation of treatment,4 findings are inconclusive concerning where occupational therapy should take place. Postacute hospital settings, day care programs, home care programs, and skilled nursing facilities are the most frequent settings for current rehabilitation programs that target stroke patients. A changing health care system necessitates that occupational therapy programs focus more on the long-term health needs of disabled persons, helping them to improve functional performance while reducing the health care costs associated with disabilities. It is noteworthy that most trials included in the systematic review of Steultjens and colleagues were conducted as a part of home care programs.

Occupational therapy programs need to be client and family oriented, offering services that range from an institutional setting (ie, postacute hospital) to the community (ie, home care). The occupational therapist may represent the health caregiver who can best provide continuity of care for patients who are being evaluated to join rehabilitation programs, who enter the postacute care hospital, then move back to their homes or to an institutional setting. Therefore, the challenge is to develop occupational therapy programs that improve and/or maintain daily functions of stroke survivors in the community across a continuum of primary and secondary care. A multidisciplinary approach, along with integration of medical, rehabilitative (occupational and physical therapy), and social services into a patient’s follow-up care, has already proven to decrease mortality and length of hospital stay, while improving the quality of life in a significant proportion of stroke-dependent patients, including those previously considered to be ineligible for a rehabilitation program.1,4,5

What Is the Best Way to Implement an Occupational Therapy Program?

Steultjens and colleagues note that a major challenge in summarizing the usefulness of occupational therapy relates to the great variability in interventions, which are implemented in very different occupational therapy settings and in numerous countries.6 Finally, one should be able to tease out those components of an intervention that may yield the most positive effects of occupational therapy. The meta-analysis of Steultjens et al does provide detailed information about the occupational therapy programs utilized in the analyzed trials. Nonetheless, we believe that a more precise understanding of the prognostic value of physical therapy (ie, specific exercise programs), as opposed to occupational therapy interventions or integrated multidisciplinary approaches, warrants future research.

Poststroke occupational therapy programs will have even greater relevance in the future, given the increasing morbidity and longevity in the population. Increased independence in self care and mobility can enhance quality of life and diminish the health care system burden. However, the emerging lack of resources for health care services in industrialized nations and, in particular, the increasingly limited availability of rehabilitation services point to a critical need for evidence-based criteria that would determine which patients stand to benefit the most (in terms of potential for recovery) from specific occupational therapy programs. Further investigations are needed to define which parameters can predict the rehabilitative potential of various types of therapy that focus on physical, psychological, and social approaches, and whether the potential recovery of stroke subjects is influenced by different techniques and/or occupational therapy programs.

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References