Cognitive and physical functions related to the level of supervision and dependence in the toileting of stroke patients

Atsushi SATO1, Yutaka OKUDA1, Takaaki FUJITA2,3, Norihiko KIMURA1, Noriyuki HOSHINA4, Sayaka KATO5 and Shigenari TANAKA6

1) Department of Physical Therapy, Yachiyo Rehabilitation College
2) Department of Rehabilitation, Tohoku Fukushi University
3) Department of Rehabilitation Sciences, Gunma University Graduate School of Health Sciences
4) Department of Rehabilitation, Chiba minato Rehabilitation Hospital
5) Department of Rehabilitation, Yachiyo Rehabilitation Hospital
6) Department of Rehabilitation, Gotanda Rehabilitation Hospital

ABSTRACT. Purpose: This study aimed to clarify which cognitive and physical factors are associated with the need for toileting assistance in stroke patients and to calculate cut-off values for discriminating between independent supervision and dependent toileting ability. Method: This cross-sectional study included 163 first-stroke patients in nine convalescent rehabilitation wards. Based on their FIM® instrument score for toileting, the patients were divided into an independent-supervision group and a dependent group. Multiple logistic regression analysis and receiver operating characteristic analysis were performed to identify factors related to toileting performance. The Minimental State Examination (MMSE); the Stroke Impairment Assessment Set (SIAS) score for the affected lower limb, speech, and visuospatial functions; and the Functional Assessment for Control of Trunk (FACT) were analyzed as independent variables. Result: The multiple logistic regression analysis showed that the FIM® instrument score for toileting was associated with the SIAS score for the affected lower limb function, MMSE, and FACT. On receiver operating characteristic analysis, the SIAS score for the affected lower limb function cut-off value was 8/7 points, the MMSE cut-off value was 25/24 points, and the FACT cut-off value was 14/13 points. Conclusion: Affected lower limb function, cognitive function, and trunk function were related with the need for toileting assistance. These cut-off values may be useful for judging whether toileting assistance is needed in stroke patients.

Key words: toileting assistance, cognitive function, Physical function, FIM® instrument

Cognitive and physical dysfunctions in stroke patients cause reduction in the activities of daily living (ADLs)1-5 and quality of life (QOL)5-8. Loss of independence in ADLs of stroke patients leads to emotional distress5. Furthermore, family caregivers of elderly persons with stroke have inadequate respite and time to participate in personal activities and social interactions5, and they often suffer from somatic symptoms such as hypertension and lower back pain5. In particular, dependence in toileting leads to somatic and mental stress for both patients and caregivers8. In addition, toileting is an important ADL in stroke patients when they return home from hospital9. Therefore, it is important for rehabilitation therapists to address and improve toileting performance as soon as possible.

The clarification of factors that are related to and that influence independence in toileting is useful when planning effective rehabilitation programs. Previous studies have reported that balance function is associated with the level of independence in overall ADLs4,5. The Berg Balance Scale (BBS), which is a balance assessment, has been found to be associated with differences in toileting ability between an independent group and a supervision group8; however, BBS is not associated with strong differences in toileting...
ability between a supervision group and a dependent group. This suggests that factors other than balance function are related to differences in toileting ability between supervision and dependent groups. Other studies have reported that trunk function and aphasia are relevant to toileting ability.

Moreover, according to previous studies, there is a possibility that cognitive function, unilateral spatial neglect, and affected lower limb function are related to toileting ability. These cognitive and physical functions may be associated with differences between supervision and dependent groups in toileting ability; however, it is unclear which function is most strongly related to toileting ability.

In addition, it has been reported that a BBS score of 42 points is required for achieving independence without supervision by caregivers in toileting. However, to our knowledge, there are no reports revealing the cut-off points for discriminating the necessity for assistance (i.e., discriminating between an independent-supervision group and a dependent group). These cut-off values will become objective criteria in judging the amount of assistance and will be helpful in avoiding excessive care of caregivers and falling accidents. The aim of the present study was to clarify which cognitive and physical factors are associated with the need for toileting assistance in stroke patients and to calculate cut-off values for discriminating between independent supervision and dependence in toileting ability.

### Methods

This was a cross-sectional study. Patient data from nine rehabilitation hospitals were collected and analyzed. The ethical review board of Yachiyo Rehabilitation College (Y15009) approved this study.

### Subjects

The study included 163 stroke patients who had unilateral cerebral hemispheric lesions (Table 1). The exclusion criteria were as follows: obvious ataxia symptoms due to lesions in the cerebellum and brain stem, activity limited by treatment of the original disease, severe bone and joint dis-eases, and pain in the lower limb, visual impairment, two or more strokes, and abnormal or missing data in measurements. All patients received a conventional stroke rehabilitation program, prescribed by a doctor, with physical therapists, occupational therapists, and speech therapists. The therapy was performed 7 days a week for 2-3 h per day on weekdays, Saturdays, Sundays, and holidays.

### Measurements

The FIM instrument for the toileting item was used to assess the independence level of toileting. The Mini-Mental State Examination (MMSE) was used to assess cognitive function and the Stroke Impairment Assessment Set (SIAS) items were used to assess the motor function of the affected lower limb, speech, and visuospatial function. The Functional Assessment for Control of Trunk (FACT) was used to assess trunk function. Nurses scored the FIM instrument and the rehabilitation therapist in charge measured MMSE, SIAS, and FACT. All subjects were evaluated once from mid-August to mid-September 2015, and four assessments mentioned above were conducted within 1 week for each subject.

The FIM instrument items are scored using a 7-point scale, where 1 indicates complete dependence, 5 indicates supervision, and 7 indicates complete independence. The reliability and validity of the FIM instrument have been confirmed in stroke patients. MMSE is a screening method to quantitatively evaluate cognitive mental status. It comprises questions on 11 items. Higher scores indicate greater function (score range: 0-30). SIAS is a tool for measuring various aspects of stroke impairment and includes the following items: motor function, muscle tone, sensory function, range of motion, pain, trunk function, visuospatial function, speech, and function of the unaffected side. The motor function of the affected lower limb is tested by the hip-flexion, knee-extension, and foot-pat tests. Each item assesses the patient’s performance on a scale of 0-5. Speech and visuospatial perception items are assessed using a 3-point scale. Scores of 5 or 3 indicate normality in SIAS. The reliability and validity of SIAS have been confirmed in stroke patients. FACT is a tool for measuring trunk function and comprises 10 items on a 20-point scale with higher scores indicating greater trunk function. FACT assessment is performed in the sitting position with both soles of the feet on the ground and measures the selective movement of static sitting and upper and lower limbs. To measure the maximum capacity, a representative value is taken as the maximum performance over 3 trials.

### Statistical analysis

According to their FIM instrument score for toileting, the 163 stroke patients were divided into 2 groups: an independent-supervision group, including patients with a score of 5-7, and a dependent group, including patients with
Toileting assistance in stroke patients

Table 2. Differences between the independent-supervision and dependent in the toileting of stroke patients

<table>
<thead>
<tr>
<th></th>
<th>Independent supervision (N = 114)</th>
<th>Dependent (N = 49)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>66.7 ± 15.0</td>
<td>70.3 ± 12.3</td>
<td>0.223</td>
</tr>
<tr>
<td>Time post-stroke, days</td>
<td>94.0 ± 39.4</td>
<td>97.1 ± 47.5</td>
<td>0.924</td>
</tr>
<tr>
<td>MMSE, points</td>
<td>25.3 ± 5.4</td>
<td>21.8 ± 6.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Affected L/L function, points</td>
<td>11.4 ± 3.6</td>
<td>6.6 ± 4.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SIAS Speech, points</td>
<td>2.7 ± 0.7</td>
<td>2.3 ± 1.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SIAS Visuospatial, points</td>
<td>2.5 ± 0.6</td>
<td>2.6 ± 0.6</td>
<td>0.986</td>
</tr>
<tr>
<td>Total score of FACT, points</td>
<td>14.4 ± 4.5</td>
<td>9.8 ± 5.3</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Mann-Whitney U-test: p<0.05
MMSE: Mini-mental State Examination, L/L: Lower Limb, SIAS: Stroke Impairment Assessment Set, FACT: Functional Assessment for Control of Trunk

Table 3. Simple correlation analyses between independent variables in the stroke patients

<table>
<thead>
<tr>
<th></th>
<th>Affected L/L function</th>
<th>SIAS Speech</th>
<th>Total score of FACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMSE</td>
<td>0.006</td>
<td>0.313*</td>
<td>0.257*</td>
</tr>
<tr>
<td>Affected L/L function</td>
<td>0.331*</td>
<td>0.407*</td>
<td></td>
</tr>
<tr>
<td>SIAS Speech</td>
<td></td>
<td>0.237*</td>
<td></td>
</tr>
</tbody>
</table>

Values are Spearman’s rank coefficients, *p<0.01
MMSE: Mini-mental State Examination, L/L: Lower Limb, SIAS: Stroke Impairment Assessment Set, FACT: Functional Assessment for Control of Trunk

Results

The scores of the FIM instrument toileting item were 7 points in 50 subjects (30.7%), 6 points in 40 subjects (24.5%), 5 points in 24 subjects (14.7%), 4 points in 13 subjects (8.0%), 3 points in 9 subjects (5.5%), 2 points in 17 subjects (10.4%), and 1 point in 10 subjects (6.1%).

There were significant differences between the independent-supervision and dependent groups in MMSE, the motor function of the affected lower limb and speech items of SIAS, and FACT (Table 2). On Spearman’s rank correlation analysis, there were no strong correlations between items that showed significant differences between the two groups (Table 3). Multiple logistic regression analysis was performed on MMSE, the motor function of the affected lower limb and speech items of SIAS, and FACT. The motor function of the affected lower limb (odds ratio: 1.300, 95% confidence interval (CI): 1.160-1.458, p<0.001), MMSE (odds ratio: 1.141, 95% CI: 1.059-1.230, p= 0.001), and FACT (odds ratio: 1.126, 95% CI: 1.027-1.235, p= 0.012) were selected as significant variables. The Hosmer-Lemeshow test was p= 0.564 (Table 4), and there were no problems with the fitness of the model.

For the ROC curves in the selected items by multiple logistic regression analysis, AUC was 0.780 for the motor function of the affected lower limb, 0.738 for FACT, and 0.694 for MMSE. The cut-off values that were determined
Discussion

This multicenter study examined which cognitive and physical factors are associated with the need for toileting assistance in stroke patients and the cut-off values for discriminating between independence-supervision and dependence in toileting ability. Considering their impact on the need for toileting assistance, our results indicated that the motor function of the affected lower limb had the strongest relationship, followed by cognitive function and trunk function.

Koike et al.\textsuperscript{18} reported that the Brunnstrom stage, as an indicator of the motor function of the affected lower limb,

Table 4. Multiple logistic regression analysis of factors related to toileting in stroke patients

<table>
<thead>
<tr>
<th></th>
<th>p-value</th>
<th>OR</th>
<th>OR 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affected L/L function</td>
<td>&lt;0.001</td>
<td>1.300</td>
<td>1.160</td>
</tr>
<tr>
<td>MMSE</td>
<td>0.001</td>
<td>1.141</td>
<td>1.059</td>
</tr>
<tr>
<td>Total score of FACT</td>
<td>0.012</td>
<td>1.126</td>
<td>1.027</td>
</tr>
<tr>
<td>SIAS Speech</td>
<td>0.759</td>
<td>1.080</td>
<td>0.660</td>
</tr>
<tr>
<td>Intercept</td>
<td>&lt;0.001</td>
<td>0.002</td>
<td></td>
</tr>
</tbody>
</table>

Model \( \chi^2 \)-test: \( p<0.001 \)
Hosmer-Lemeshow test: \( p = 0.564 \)
Predictive accuracy: 81.0%

Filter: Dependence = 0, Independent supervision = 1
L/L: Lower Limb, MMSE: Mini-mental State Examination, FACT: Functional Assessment for Control of Trunk, SIAS: Stroke Impairment Assessment Set

Table 5. Cut-off values for the judgment of independence in toileting

<table>
<thead>
<tr>
<th></th>
<th>AUC (95% CI)</th>
<th>Cut-off point (points)</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affected L/L function</td>
<td>0.780 (0.695-0.866)\textsuperscript{1}</td>
<td>8</td>
<td>81.6</td>
<td>67.3</td>
</tr>
<tr>
<td>Total score of FACT</td>
<td>0.738 (0.653-0.823)\textsuperscript{1}</td>
<td>14</td>
<td>64.0</td>
<td>75.5</td>
</tr>
<tr>
<td>MMSE</td>
<td>0.694 (0.608-0.780)\textsuperscript{1}</td>
<td>25</td>
<td>67.5</td>
<td>67.3</td>
</tr>
</tbody>
</table>

Receiver operating characteristic curves, \( ^1 p<0.001 \)
L/L: Lower Limb, FACT: Functional Assessment for Control of Trunk, MMSE: Mini-mental State Examination

Figure 1. Receiver operating characteristic curves
L/L: Lower Limb, FACT: Functional Assessment for Control of Trunk, MMSE: Mini-mental State Examination
Toileting assistance in stroke patients

had no significant differences between an independent toileting group and a non-independent toileting group of stroke patients. On the other hand, Fujita et al. reported that there was a strong relationship between the motor function of the affected lower limb and ADL independence, even when the effects of confounding factors, such as age and the motor function of the trunk and the limbs of the unaffected side, were excluded using partial correlation analysis. Our results revealed that the motor function of the affected lower limb was relevant to toileting performance when the stroke patients were divided into groups of independent-supervision or dependent toileting ability. The most commonly expressed reason for this is that the impairment of the affected lower limb becomes a risk factor of falls. In particular, toileting is a situation in which falling accidents easily occur in stroke patients. Therefore, the decline in the motor function of the affected lower limb seems to have been associated with the needs of assistance in toileting. The cut-off value of the SIAS score calculated by this study may be utilized as the criteria for judging the level of independence, which prevent fall accident and excessive assistance in toileting.

Several previous studies have examined the relationship between the toileting performance of stroke patients and trunk function using the Trunk Control Test (TCT). Franchignoni et al. reported that there was a significant correlation between the level of independence in toileting and TCT in 49 stroke patients. Furthermore, Koike et al. reported that the score of TCT in an independent toileting group was significantly higher than that in a non-independent toileting group in 11 stroke patients. The present study also indicated that trunk function was associated with toileting performance using FACT, which was developed as a therapeutic-oriented evaluation index of trunk function. The FIM instrument toileting item, which was used to assess toileting performance in the present study, comprised “get out of the pants,” “perineal debridement,” and “raise the pants.” These motion patterns become specific in stroke patients due to motor paralysis and sensory impairment. For example, when stroke patients operate their pants, the movement of the center of gravity (COG) to both sides and forward flexion, lateral flexion, and rotation of the trunk are required. In addition, COG of stroke patients always shifts to the unaffected side and hardly moves compared to that of normal subjects when wiping their bottoms. FACT is an evaluation method that reflects the static sitting retention capacity and dynamic sitting retention capability such as the rotation of the trunk and movement of COG. Therefore, FACT reflects functions that are required for toileting. The results of the present study supported those of previous studies that reported on the relationships between trunk function and toileting performance. In addition, FACT is most likely the evaluation method that is most appropriate as objective criteria for judging the level of independence in toileting. According to the results of the ROC curves, AUC of FACT, which indicated the discriminating ability of the index, did not have a sufficiently high value; this means that it is difficult to determine toileting independence only using the FACT score. However, a score of 14 points on FACT, which was calculated as the cut-off value in the present study, indicates the amount of trunk function that is necessary for toileting without physical assistance from caregivers.

According to a systematic review, cognitive function is strongly associated with urinary incontinence (UI), including functional UI. The results of the present study support this. According to the study by Chen et al., cognitive impairment is a risk factor for falling. This previous report suggested that falling risk is associated with reduction in toileting performance because it induces a fear of falls in caregivers. Therefore, a score of 25 points on MMSE, which was calculated in the present study, may represent the cut-off point at which stroke patients do not require physical assistance in toileting due to cognitive problems.

One of the limitations of this study is that the patients had comparatively good cognitive function including speech and visuospatial function. In addition, no information on medications was addressed. When evaluating toileting by the FIM instrument, the lower score is used if the daytime and nighttime scores are different. The use of medications leads to the risk of falls in the elderly, and medications, such as sleeping pills, might influence the level of toileting independence at night. Moreover, the cut-off values, which were calculated in this study, are not sufficiently accurate. Therefore, these cut-off values should be used carefully or in combination with other assessments. It is necessary to further examine the criteria that can be determined with higher accuracy.

Conclusion

The present study revealed that the need for toileting assistance in stroke patients is associated with the motor function of the affected lower limb, trunk function, and cognitive function. The cut-off values for judging whether toileting assistance is needed in stroke patients were 8 points for the motor function of the affected lower limb on SIAS, 14 points on FACT, and 25 points on MMSE. It is possible that these cut-off values will become objective criteria; however, these values should be carefully used because of insufficient accuracy.

Acknowledgments: We thank the staff of Yachiyo Rehabilitation Hospital, Chiba Minato Rehabilitation Hospital, Matsudo Rehabilitation Hospital, Kamata Rehabilitation Hospital, Koganei Rehabilitation Hospital, Akabane Rehabilitation Hospital, Midorino Rehabilitation Hospital, Meisei Rehabilitation Hospital, Utsunomiya Rehabilitation
Hospital, and Shin-kaminokawa Hospital for data collection.

Disclaimer: The use of the FIM® instrument to collect data for this research study was authorized and conducted in accordance with the term of a special purpose license granted to the licensee by the Uniform Data System for Medical Rehabilitation (UDSMR). Licensee has not been trained by UDSMR in the use of the FIM® instrument, and the patient data collected during the course of this research study has not been submitted to or processed by UDSMR. No implication is intended that such data has been or will be subjected to UDSMR’s standard data processing procedures or that it is otherwise comparable to data processed by UDSMR.

Conflict of Interest: There are no conflict of interest

References

26) The Date Management Service of the Uniform Data System for Medical Rehabilitation and the Center for functional Assessment Research: Guide for the Uniform Data Set for Medical Rehabilitation, Version 3.0, Buffalo, NY, State University of New York, 1990.
Toileting assistance in stroke patients


