NeuroRehabilitation 34 (2014) 253–258
DOI:10.3233/NRE-131033
IOS Press

Evaluation of intrarater and interrater reliability of the Wisconsin Gait Scale with using the video taped stroke patients in a Turkish sample

A. Yaliman, N. Kesiktas*, M. Ozkaya, N. Eskiyurt, O. Erkan and E. Yilmaz
Physical Medicine and Rehabilitation Department, Istanbul Medical Faculty, Istanbul University, Istanbul, Turkey

Abstract.
OBJECTIVE: To establish the intrarater and interrater reliability of Wisconsin Gait Scale (WGS) in hemiplegic patients.
DESIGN: Repeated-measures reliability study using video data of stroke patients.
SETTING: Rehabilitation department of the university hospital.
PARTICIPITANTS: Nineteen hemiplegic patients with 3–9 months stroke history and two physiatrists and two physical therapists.
INTERVENTIONS: Video recordings were assessed twice, at an interval of 2 days, by the two physiatrists and two physical therapists.
MAIN OUTCOME MEASURE: Wisconsin Gait Scale.
RESULTS: Internal consistency coefficients for the WGS were excellent; Cronbach scores were 0.91 and 0.94 for the first and third days. Coefficient of Repeatability (CR) for observers' WGS assessments were ranged between 4.23–5.76 and intraclass correlation coefficients for total WGS score were indicated very high interrater reliability at the begining and end, respectively 0.91 and 0.96. Intraclass correlation coefficients for fourteen items of WGS ranged from 0.81 to 1. "Hip hiking at mid-swing", "Circumduction at mid-swing" and "Hip extension of the affected leg" were the items with lowest correlation coefficients. Intrarater reliability for total WGS scores ranged from 0.75 to 0.90.
CONCLUSION: WGS was found excellent in reliability and may provide an objective means to document the findings from observational gait analysis, which is frequently used in clinical practice by rehabilitation teams.

Keywords: Gait, stroke, Wisconsin Gait Scale, reliability

1. Introduction

Stroke rehabilitation given by a coordinated specialist team reduces morbidity and mortality [1]. The initial success of rehabilitation team, to enhance motor outcome after stroke have required subjective scales of greater specificity and detail in order to measure accurately the observed motor changes [2]. A major problem in determining the efectiveness of stroke rehabilitation is a lack of standardized outcome measures for rehabilitation team [3]. Therefore, the search for appropriate assessment and outcome measures has been a focus of rehabilitation research for the last few decades [4–10]. The increasing need to show clinical effectiveness through the delivery of evidence-based practice, more specific outcome measures are being developed to investigate recovery from stroke and to establish the

*Address for correspondence: Nur Kesiktas, MD, PhD, Asc Prof, Mehmet Akif Ersoy GKDC Edu Hosp., Avrupa Konutlari 1 Atakent mahallesi, 8. Blok 27 No Halkali Kücükcekmece, Istanbul, Turkey. Tel.: +90 212 6931323; Mobile: +90 541 455 79 33; E-mail: nur.kesiktas@gmail.com.

effectiveness of intervention. Mobility measures currently available, with only a few exceptions, are in the English language. For a questionnaire to be valid and useful, it must be available in a population's mother language. Tools used for outcome must be reliable, valid, and discriminative [2, 5–7, 9, 10].

Many outcome measures exist for the routine assessment of stroke, including the Barthel Index [11] or the FIM [12] instrument. These outcome measures can be used to show gross changes over time in patients' overall performance. Impairment in the ability to walk is one of the main functional problems in caring for hemiparetic patients. The recovery of independent walking is among the most important goals for patients with hemiparetic stroke and for their rehabilitation specialists. Hemiplegic gait is characterized by impaired coordination, shorter step length, longer duration of stance, and shorter swing phase on the affected side, as compared with the opposite, unaffected side [13, 14]. Gait velocity of patients with stroke was mainly affected by weakness of the affected hip flexors and knee extensors. Gait asymmetry was influenced primarily by the degree of the spasticity of the affected ankle plantar flexors [15, 16]. Impairments in muscle strength, motor and sensory functions, visuospatial perception, spasticity, and balance have been suggested to be related to the inability of hemiplegic patients to walk in normal fashion [17, 18].

Valid, reliable and communicaible measures are needed to determine abnormality in a patient's gait, how the abnormalities can be treated and the evidence of effectiveness of physical therapy. Conventional gait analysis includes computer based optical motion captur systems for data interpretation [19]. However, the data is often too complicated for clinicians to interpret and to correlate with neurologic deficits in stroke patients. The sophisticated quantitative gait assessment systems are very expensive in terms of time, technical expertise or equipment requirements. And furthermore, these systems often provide more information than is usually needed to assess treatment outcomes in most clinical settings.

There are some visual assessment tools used for the gait analysis of patients with hemiplegia; the Stroke Rehabilitation Assessment of Movement [5], the Rivermead Visual Gait Assessment scale [8] and others. A simple, reliable, valid outcome measure that is sensitive to physical recovery profiles in stroke rehabilitation may therefore provide an approppriate tool in the therapeutic setting for evaluating and optimizing physical outcome after stroke. WGS, designed by Rodriquez et al. [7] is a visual gait assessment tool, evaluates fourteen observable temporal gait parameters and some body movement patterns like use of hand held gait aid, stance time and width, weight shift, toe off, hip, knee and pelvic motions and heel strike of the affected leg. The purpose of the present study was to determine the interrater and intrarater reliability of the Wisconsin Gait Scale (WGS) [7] and used for hemiplegics by all team members in daily practice in Turkey.

2. Methods

2.1. Patients

Nineteen hemiparetic patients (14 men, 5 women) with a cerebrovascular accident (CVA) history were recruited from inpatient of Physical Medicine and Rehabilitation Department, in the study by performing WGS, which was video taped. The mean age of the people was 59.4 ± 9.12 years (range, 19–67 years). The time from onset of CVA to admission ranged from 3 to 9 months. 7 patients had right hemisphere lesions. 6 patients had hemorrhagic strokes and 13 patients had infarcts. Inclusion criteria is the ability to walk independently (with/without device). Patients were excluded if they suffered another major incident at onset of stroke, unstabile medical conditions, and contractures in extremities or had orthopaedic lower extremity problem. Both subjects with CVA and assessors signed consent forms before participating in this study. The project was approved by the local Ethics Comittee.

2.2. Standarts of video recording

Patients walked on a level surface 10 meters long for the gait assessments recording; the video camera was one meter away from the patient; and patients were instructed to turn on three times for viewing them on frontal, lateral and backward plans.

2.3. Scale

WGS is used to measure the individuals' gait. WGS has a total of fourteen items presented on the same sheet. The first five submeasures are about stance phase of affected leg: 1-Use of hand-held gait aid, 2-Stance time on impaired side, 3-Step length of unaffected side, 4-Weight shift to the affected side 5-Stance width. Toe-off the affected leg is the second part of the scale and contains two submeasures; guardedness (pause prior to advancing affected leg) and hip extension of affected

side (observe gluteal creases from behind the subject). Swing phase of the affected leg is the third part and includes six submeasures. These are external rotation during intial swing, circumduction at mid swing (observe path of affected heel), hip hiking at mid swing, knee flexion from toe off to mid swing, toe clearance, pelvis rotation. Last part of scale is heel strike of the affected leg and only one submeasure (initial foot contact). The minimum and maximum scores a patient can attain on the WGS are 13.35–42 respectively. The higher the score the more seriously affected the gait. Patients WGS scores were measured by a computer programme for WGS.

2.4. Scale translation and adaptation

The WGS was translated with the forward and backward translation procedure. Two bilingual translators separately translated the original scale once. As recommended, they were encouraged to strive for idiomatic rather than word-for-word translation. Then the investigators reviewed the translations to make cultural and vocabulary adaptations. Each of the investigators proposed changes, and a consensus meeting was scheduled. A backward translation of the reviewed version was translated into English, to verify that the meaning of each item of the scale was preserved.

2.5. Procedure

Two medical doctors and two licenced therapists received a training session about gait disorders in hemiplegic patients and a copy of the WGS scoring criteria by principal investigator before they viewed the videotapes. To examine interrater and intrarater reliability, medical doctors and two physical therapists scored the 19 subjects' performance of the WGS at 2 video taped viewing sessions, 2 days apart. Video taped subjects' performance of a task is frequently used in research that examines the interreliability of an instrument. The assessors were not permitted to ask questions during the viewing of the video tapes and were given only 1 opportunity to view each patient during scoring. Session 1 video taped views repeated in session 2 with the same guidelines used in session 1 followed in session 2.

2.6. Statistical analysis

The raters were asked to return two days later to score the same video tape to assess reliability studies. Interrater reliabilities were assessed with interclass correlation (ICC) method and the Bland and Altman test [20]. An ICC coefficient of >0.80 was accepted as evidence of almost perfect agreement [21]. Intrarater reliability was evaluated by using Pearson bivariate analysis. Individual item scores on the WGS and total WGS scores were calculated for interrater reliability. The internal consistency of scale was expressed using Cronbach's α coefficients. An α coefficient of >0.70 is considered adequate for group comparison [22]. The data was analysed on computer using versions 10.0 of SPSS for Windows software.

3. Results

3.1. Internal consistency

Internal consistency coefficient (Cronbach α) for WGS were 0.91 and 0.94 for the first and third days ($p < 0.0001$). The reliabilities of WGS, as assessed by internal consistency were excellent for both evaluations. Total mean scores of WGS were 23.21 ± 5.59 and 23.06 ± 5.20 for the first and second assessments.

3.2. Test-retest reliability and repeatability

Translated WGS in Turkish was found reliable. The test-retest reliability was calculated using the data from nineteen video clips scored on two ocassions, two days apart. All raters' assesments were evaluated with Bland Altman plot graphical method. CR for WGS assessments of observers ranged between 4.23–5.76. The same results were found with ICC as well.

3.3. Total score reliability

The intraclass correlation coefficient (ICC) for the total WGS scores were 0.91 at the first assessment, and 0.96 at the second assessment, indicating very high interrater reliability.

3.4. Interrater reliability of individual items

In the interrater reliability part of the study, the gait of nineteen hemiplegic patients was measured twice by each of the four raters. Reliability was measured by calculating the ICC for each 14 items. Agreement strengths for ICC values have been classified as follows: 0: poor; 0–0.20: slight, 0.21–0.40: fair; 0.41–0.60: moderate; 0.61–0.80: substantial and 0.81–1.00: almost perfect [21].

Table 1
WGS-item reliability

WGS tasks	ICC	95% CI
1. Use of hand-held gait aid	1*	(0.98–1)
2. Stance time on impaired side	0.946*	(0.92–0.96)
3. Step length of unaffected side	0.961*	(0.94–0.98)
4. Weight shift to the affected side with or without gait aid	0.976*	(0.95–0.99)
5. Stance width	0.959*	(0.93–0.97)
6. Guardedness	1*	(0.98–1)
7. Hip extension of the affected leg	0.911*	(0.89–0.93)
8. External rotation during initial swing	0.923*	(0.90–0.94)
9. Circumduction at mid-swing	0.910*	(0.89–0.93)
10. Hip hiking at mid-swing	0.816*	(0.79–0.83)
11. Knee flexion from toe off to mid-swing	0.983 *	(0.96–1)
12. Toe clearance	0.955*	(0.92–0.97)
13. Pelvic rotation at terminal swing	0.916*	(0.89–0.94)
14. Initial foot contact	0.980*	(0.96–1)

*Significant at the 0.001 level.

Table 2
Pearson's bivariate correlations between raters' assessments at time 1 and 2

	N	*r*	Significance (*p*)
MD1& PT1(T1)	19	0.754	0.000
MD1& PT2(T1)	19	0.792	0.000
MD2& PT1(T1)	19	0.796	0.000
MD2T& PT2(T1)	19	0.753	0.000
MD2& PT1(T2)	19	0.834	0.000
MD2& PT2(T2)	19	0.813	0.000
MD1& PT2(T2)	19	0.898	0.000
MD1& PT1(T2)	19	0.796	0.000

Abbreviations: MD, medical doctor; PT, physical therapist; T1, Time 1; T2, Time 2.

As shown in Table 1, there were good agreements between the four raters for all gait assessment parameters.

Agreements for four items were found high, respectively: 'Use of hand-held gait aid', 'Guardedness', 'Knee flexion from toe off to mid-swing', 'Initial foot contact'. Interestingly, low agreements between the raters were most marked for kinematic data, especially for the hip movement. However, three items in particular showed lower agreement levels than others; these are 'Hip hiking at mid-swing' (item 10), 'Circumduction at mid-swing' (item 9) and 'Hip extension of the affected leg' (item 7) (ICC s were 0.81; 0.91; 0.91 respectively).

3.5. Intrarater reliability

Intrarater reliability for total WGS scores ranged from 0.75 to 0.90 (Pearson bivariate analysis, $P < 0.001$) for all raters (Table 2). All raters' total test-retest assessments are shown in Fig. 1.

4. Discussion

The degree to which walking is impaired following a stroke can vary widely and relates to the severity of the patient's lower extremity motor impairment and decreased muscle activation resulting in limitations to both stance and swing phase movement patterns [23]. The WGS has been used in many studies examining hemiplegic gait [7, 24, 25]. Authors were reported that, it was sensitive enough to reveal the progress made by the patients, as indicated by the statistical comparison of scores from before and after the rehabilitation program [7, 24, 25]. Rehabilitation of stroke is a team study. This scale is intended to be easy to use of gait analysis in stroke patients.

Internal consistency of this scale was very high for all raters' first and second assessment. Rodriquez et al found total WGS score rating were highly consistent too [7]. Intrarater reliability of WGS scores between all raters and between doctors and physiotherapists were very high. Interrater reliability was also good for all raters. It might be related to assessors' high experience in stroke rehabilitation and the second reason might be because, all raters had previous training for gait deviations in stroke and WGS scoring.

Intra and interrater reliability scores were the best for task first (use of hand-held gait aid) and sixth (guardedness). These tasks were the best-defined, clear and visible short answered questions. The lowest ICC score were found in tasks; hip hiking at mid-swing, circumduction at mid-swing, hip extension of the affected leg, pelvic rotation at terminal swing. All of them were related to hip and pelvis movement. These tasks were seen more difficult to assess, that might be related

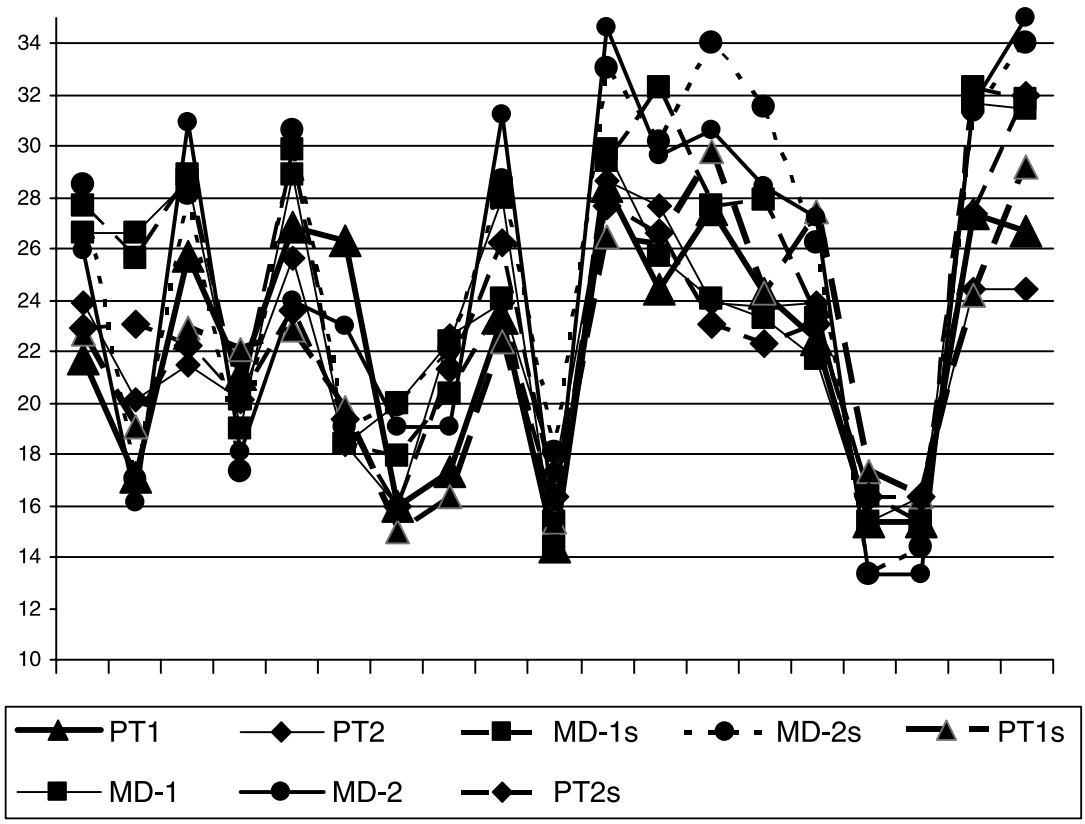

Fig. 1. WGS scores' distribution of MDs and PTs.

wearing large dressess. We had unique amateur video camera for recording, but anterior, posterior, lateral video views were recorded. There is no doubt that computerized gait monitoring systems provide reliable numerical data on temporal gait parameters, and probably give more evidence related to the asymmetric pattern of the hemiplegic gait. However, these systems are not available for many rehabilitation clinics, and unless they involve goniometric and electromyographic recordings, most such systems do not provide details about the patient's walk and how the various body parts move during different phases of the gait cycle.

5. Conclusions

This study demonstrates that the inter and intrarater reliabilities of the WGS in Turkey are high when administered by doctors and physical therapists. This tool is available for clinical use and is a promising outcome measure for rehabilitation team members' usage when analyzing the gait of individuals' post-stroke. The WGS provides an objective means to document the findings from observational gait analysis, which is an approach frequently, used in clinical settings to examine gait.

Declaration of interest

There is no conflict of interest.

References

[1] Stroke Unit Trialists' Collaboration (1997). Collaborative systematic review of the randomised trial of organised inpatient (stroke unit) care after stroke. *BMJ*, *314*, 1151-1159.

[2] Ferraro, M., Demaio, J. H., Krol, J., et al. (2002). Assessing the motor status score: A scale for the evaluation of upper limb motor outcomes in patients after stroke. *Neurorehabil Neural Repair*, *16*, 283-289.

[3] Torenbeek, M., Caulfild, B., Garrett, M., & Van Harten W. (2001). Current use of outcome measures for stroke and low back pain rehabilitation in European countries: Results of the ACROSS project. *International Journal of Rehabilitation Research*, *24*, 95-101.

[4] Fugl-Meyer, A. R., Jaasko, L., Leyman, I., Olsson, S., & Steglind, S. (1975). The post-stroke hemiplegic patient. 1. A method for evaluation of physical performance. *Scand J Rehabil Med*, *7*, 13-31.

[5] Daley, K., Mayo, N., & Wood-Dauphinee, S. (1999). Reliability of scores on the stroke rehabilitation assessment of movement (STREAM) measure. *Phys Ther*, *79*, 8-19; quiz 20-3.

[6] Halsaa, K. E., Sodring, K. M., Bjelland, E., Finsrud, K., & Bautz-Holter, E. (1999). Inter-rater reliability of the Sodring motor evaluation of stroke patients (SMES). *Scand J Rehabil Med*, *31*, 240-243.

[7] Rodriquez, A. A., Black, P. O., Kile, K. A., et al. (1996). Gait training efficacy using a home-based practice model in chronic hemiplegia. *Arch Phys Med Rehabil*, *77* 801-805.

[8] Lord, S. E., Halligan, P. W., & Wade, D. T. (1998). Visual gait analysis: Development of a clinical assessment and scale. *Clin Rehabil*, *12*, 107-119.

[9] Ahmed, S., Mayo, N., Higgins J., et al. (2003). The stroke rehabilitation assessment of movement (STREAM): A comparison with other measures used to evaluate effects of stroke and rehabilitation. *Phys Ther*, *83*, 617-630.

[10] Horgan, N. F., Finn, A. M., O'Regan, M., & Cunningham, C. J. (2003). A new stroke activity scale-results of a reliability study. *Disabil Rehabil*, *25*, 277-285.

[11] Mahoney, F. I., & Barthel, D. W. (1965). Functional evaluation: The barthel index. *Md State Med J*, *14*, 61-65.

[12] Keith, R. A., Granger, C., Hamilton, B. B., & Sherwin, F. S. (1987). The functional independence measure: A new tool for rehabilitation. *Adv Clin Rehabil*, *1*, 6-18.

[13] Wade, D. T., & Hewer, R. L. (1987). Functional abilities after stroke: Measurement, natural history, and prognosis. *J Neurol Neurosurg Psychiatry*, *50*, 177-182.

[14] Kwakkel, G., Wagenaar, R. C., Twisk, J. W. R., Lankhorst, G. J., & Koetsier, J. C. (1999). Intensity of leg and arm training after primary middle cerebral artery stroke: A randomized trial. *Lancet*, *354*, 191-196.

[15] De Quervain, I. A., Simon, S. R., Luergans, S., Pease, W. S., & McAllister, D. (1996). Gait pattern in the early recovery period after stroke. *J Bone Joint Surg Am*, *78*, 1506-1514.

[16] Wade, D. T., Wood, V. A., Heller, A., Maggs, J., & Langton Hewer, R. (1987). Walking after stroke. Measurement and recovery over the first 3 months. *Scand J Rehabil Med*, *19*, 25-30.

[17] Hsu, A. L., Tang, P. F., & Jan, M. H. (2003). Analysis of impairments influencing gait velocity and asymmetry of hemiplegic patients after mild to moderate stroke. *Arch Phys Med Rehabil*, *84*, 1185-1193.

[18] Lindmark, B., & Hamrin, E. (1995). Relation between gait speed, knee muscle torque and motor scoresin post-stroke patients. *Scand J Caring Sci*, *9*, 195-202.

[19] Hill, K. D., Goldie, P. A., Baker, P. A., & Greenwood, K. M. (1994). Retest reliability of the temporal and distance characteristics of hemiplegic gait using a footswitch system. *Arch Phys Med Rehabil*, *75*, 577-583.

[20] Bland, J. M., & Altman, D. G. (1986). Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet*, *8*, 307-310.

[21] Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychol Bull*, *86*, 420-428.

[22] Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*, 297-334.

[23] Mulroy, S., Gronley, J., Weiss, W., Newsam, C., & Perry, J. (2003). Use of cluster analysis for gait pattern classification of patients in the early and late recovery phases following stroke. *Gait Posture*, *18*, 114-125.

[24] Turani, N., Kemiksizoglu, A., Karataş, M., & Ozker, R. (2004). Assessment of hemiplegic gait using the Wisconsin Gait Scale. *Scand J Caring Sci*, *18*, 103-108.

[25] Pizzi, A., Carlucci, G., Falsini, C., et al. (2007). Gait in hemiplegia: Evaluation of clinical features with the Wisconsin Gait Scale. *J Rehabil Med*, *39*(2), 170-174.