# Validity of the Fingertip-to-floor test and Straight leg raising test in patients with acute and subacute low back pain: A comparison by sex and radicular pain.

K Harald Ekedahl PT, M.Sc. †§, Bo Jönsson MD, Ph.D *, Richard B Frobell PT, Ph.D *

† Department of Health Science, Div of Physiotherapy, Lund University, Lund, Sweden

§ Helsingborgs Fysio, Helsingborg. Sweden

* Department of Orthopedics, Clinical Sciences Lund, Lund University, Lund, Sweden

Corresponding author:

Harald Ekedahl, Helsingborgs Fysio, Bergaliden 11, 252 23 Helsingborg, Sweden. Phone: +46-42-210510. Fax: +46-42-210512

E-mail: harald.ekedahl@comhem.se

ABSTRACT

**Objective**

To use self-reported disability (Roland Morris Disability Questionnaire [RMDQ]) to assess the criterion validity of Straight leg raising test (SLR) and flexion ROM (Fingertip-to-floor test) before and after stratification by sex and presence/absence of radicular pain.

**Design**

Cross-sectional study.

**Setting**

Out-patient physical therapy clinic.

**Participants**

Subjects with acute/sub-acute low back pain with (n=40) and without (n=35) radicular pain.

**Main Outcome Measures**

We examined the relationship between RMDQ (reference variable) and SLR and Fingertip-to-floor test. The sample was stratified by presence/absence of radicular pain (categorized by the dichotomous Slump test).

**Results**

In the entire sample, fair correlations were found between both physical impairment tests (i.e. SLR and flexion ROM) and self-reported disability (0.27<r>0.44). After stratification by sex, the correlation between RMDQ and flexion ROM and between RMDQ and non-side specific SLR increased in women, but decreased in men. In those with radicular pain, good correlations were found between RMDQ and flexion ROM (r=0.68 for men and r=0.70 for women) and moderate correlation was found between RMDQ and SLR of the affected side in women (r=0.60) but only fair correlation was found between RMDQ and SLR of the affected side in men (r=0.28).

**Conclusions**

After stratification by sex and presence/absence of radicular pain, the present study supports a good validity of the Fingertip-to-floor test for both men and women with radicular pain. The SLR, however, was of less value as an indicator of self-reported disability also after stratification, especially for men.

# Validity of the Fingertip-to-floor test and Straight leg raising test in patients with acute and subacute low back pain: A comparison by gender and radicular pain.

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## INTRODUCTION

The physical examination of patients with low back pain (LBP), mainly relaying on physical impairment tests, is not only designed to distinguish painful structures but also to assess severity of the low back disorder and hence contribute to treatment decisions as well as measure improvement [1-5]. Enhancement of spinal and hip flexibility is often a treatment goal of manual therapy and exercise therapy in patients with LBP and thus the need for validated impairment tests is evident. Forward bending, along with Straight leg raising test (SLR), is the most frequently studied physical impairment test [5, 6] and can be measured in both standing and long-sitting, with or without an inclusion of hip flexion [7-9]. The Fingertip-to-floor test, measured in standing with inclusion of hip flexion, was previously shown reliable[10, 11] in patients with LBP and valid in relation to radiography[11]; similar reliability was reported for the SLR [12].

The criterion validity is used to show whether test scores are meaningfully related to other valuable measures. One such valuable measure is self-reported disability where the patient's own opinion of function and symptoms are assessed. Self-reported disability has been suggested as a good clinical assessment tool to assess severity of low back disorders and was recommended as outcome in clinical research [13, 14]. Amongst several different self-reported disability scores, the Roland and Morris disability questionnaire (RMDQ) [15] is one of the most frequently used back-specific scores[16] with high correlation to clinical findings and symptoms as well as responsiveness to change in physical function [17-20]. The RMDQ was shown reliable and valid[17-20] and was explicitly suggested to be used as reference variable in validity testing [21] and its relationship to impairment was previously investigate[17, 21, 22] in patients with non-specific LBP.

Thus, the criterion validity of the Fingertip-to-floor test, as well as for all other range of motion (ROM) tests, including SLR, was questioned due to only fair relationship to self-reported disability[17, 22]. One reason for the relatively low correlations might be that the Fingertip-to-floor test, SLR and RMDQ all were shown to have relation to gender, where the values for women were higher, [11, 22-27] but none of the previous studies stratified or adjusted their findings for men and women.

Patients with LBP is a heterogeneous group and in consequence the European Guidelines [28] suggest classification according to three categories: serious spinal pathology (i.e. tumour, infection, fracture); radicular pain and non-specific low back pain. In patients with MRI-verified nerve root involvement and radicular pain, the Fingertip-to-floor test and SLR showed significant relationships with self-reported disability, both before and after treatment with surgery or transforaminal epidural injection.[21, 29-33] Thus, both tests appear to produce valid measures of impairment in patients with a nerve root involvement but we are not familiar with any publication using a clinical test to categorize individuals according to the presence/absence of radicular pain (neural tissue mechanosensitivity) and then assess the criterion validity of the Fingertip-to-floor test and SLR in both categories. To clinically identify the presence of radicular pain, the validated dichotomous Slump test[4, 34] has become widely advocated[35].

In patients with acute/sub-acute LBP, we used the RMDQ to assess the criterion validity of the Fingertip-to-floor test and the SLR before and after stratification by gender and by the presence/absence of radicular pain as determined by the Slump test. We hypothesized that the

relationship between RMDQ, Fingertip-to-floor test, and SLR were different between men and women, and that it was stronger in those with radicular pain than in the entire sample.

## METHODS

### Subjects

In this cross-sectional study, we consecutively recruited all patients with acute or sub-acute LBP (i.e. less than 3 months' symptom duration) in an out-patient physical therapy (PT) clinic in southern Sweden. Recruitment started October 2006 and ended January 2007 when 100 patients, 54 men and 46 women, were recruited. Inclusion and exclusion criteria are presented in figure 1. Eligible patients received oral and written information about the study and signed informed consent prior to inclusion. This study included no treatment and ethical aspects (according to the Declaration of Helsinki) were considered prior to the initiation of the trial.

Twenty-five patients were excluded (Figure 1) leaving 75 patients (33 women and 42 men) with mean LBP symptom duration of 24 days ($25^{th}$/$75^{th}$ percentiles, 5/30) in the study. Of the included subjects, 16 men and 17 women suffered from self-reported leg pain, 6 men and 10 women reported pain below the knee. Ten subjects (4 men and 6 women) described weakness or numbness in the lower extremity.

### Outcome measures

Demographic and medical history was obtained when eligibility was confirmed. The clinical assessment, using similar structure and approach, was performed by one physical therapist (HE). Clinical tests were performed in the following order: 1) The Fingertip-to-floor test; 2) The Slump test; 3) SLR. Clinical tests were performed first followed by self-reported disability according to

RMDQ. Clinical assessment, including time to fill out the RMDQ questionnaire, took approximately 25 minutes.

*Fingertip-to-floor test (flexion ROM)* was performed according to the published instructions and the vertical distance between the tip of the index finger and the floor was measured in centimetres [11].

*Straight leg raising test (SLR),* was performed according to the published instructions and the angle between the tibial crest and the horizontal plane was measured using a goniometer in (non-rounded) degrees [22].

*The Slump test,* a validated dichotomous test [4, 34] to assess the presence/absence of radicular pain., was performed according to the published instructions [36]. The occurrence of neural tissue mechanosensitivity through a combination of sitting thoracolumbar flexion, cervical flexion, ankle dorsiflexion and knee extension was assessed. The test was considered positive for radicular pain when the patient's symptoms were reproduced, a sensitising manoeuvre changed the symptoms and a difference occurred between index and contralateral side [36]. The results from this test also determined which leg (left/right) was affected and this information was used in the analysis of SLR results.

*Roland and Morris disability questionnaire (RMDQ),* a reliable, responsive and valid test of self-reported disability among patients with LBP[15, 16, 19], is available in a validated Swedish version [37] and was self-reported by the patient. The RMDQ consists of 24 dichotomous (yes/no) statements about activities of daily living likely to have an impact on patients with LBP. A total score is compiled by summing the "yes" answers (1 point each), ranging from 0 (no disability) to 24 (extremely severe disability).

Statistical analysis

Statistical analysis were made using SPSS (15.0). All variables were normally distributed both before and after stratification. Statistical comparisons between sexes were made using the T-test except for the dichotomous result (yes/no) of the Slump test where the Chi-square test was used. Correlations between RMDQ, ROM, and SLR were made using the Pearson coefficient of correlation (r). In those with radicular pain (i.e. a positive Slump test), an additional correlation of SLR was performed for the affected side as determined by the Slump test. Correlations ranging from 0.00 to 0.25 indicate little or no relationship; 0.25 to 0.50 suggest a fair degree of relationship; values of 0.50 to 0.75 are moderate to good and above 0.75 are good to excellent[38].

## RESULTS

Women had larger flexion ROM and SLR angles compared to men but no other differences were found between the sexes (Table 1). In the entire sample, fair correlations were found between both physical impairment tests (i.e. flexion ROM and non-side specific SLR) and RMDQ (0.27<r>0.44, Table 2). After stratification by gender, the correlation between RMDQ and flexion ROM and between RMDQ and non-side specific SLR increased in women, but decreased in men (Table 2). In total, 53% of the sample (19/42 men and 21/33 women) had radicular pain as determined by the Slump test and there were no differences in age, symptom duration or self-reported disability between men and women in this group (Table 1). In those with radicular pain, good correlations were found between RMDQ and flexion ROM (r=0.68 for men and r=0.70 for women) and moderate correlation was found between RMDQ and SLR of the affected side in

women (r=0.60) but only fair correlation was found between RMDQ and SLR of the affected side in men (r=0.28, Table 2).

## DISCUSSION

To our knowledge this is the first study assessing the criterion validity of SLR and Fingertip-to-floor test in patients with acute/sub-acute LBP before and after stratification by gender and the presence/absence of radicular pain. Prior to stratification, our results were in agreement with the fair criterion validity found in earlier studies[17, 22] but after stratification the validity essentially improved. We confirmed our hypothesis in that the results for the Fingertip-to-floor test and the SLR were different between men and women. Further, both men and women with radicular pain were found to have stronger correlations for the Fingertip-to-floor test than did the un-stratified sample but we failed to confirm a similar relation for SLR.

The patients' perspective of disability is the most reliable and valid tool of measurement along with self-reported pain scores in patients with LBP [16] and thus we used the RMDQ as a reference variable in this study. As for such a criterion validity analysis the differences in the valid indicator and the target variables must be taken in consideration. Gender differences in self-reported disability were previously reported in patients with LBP[23, 24, 26, 39] however, we failed to confirm such differences in the present study. Gender differences have also been reported for impairment tests where hip flexion is included in the measurements[9, 11, 22, 40] but no respective differences has been established when lumbar flexion ROM was measured without hip flexion[41]. The increased ROM in SLR and Fingertip-to-floor test found among women in this study is in agreement with these previous findings [11, 22]. These gender differences are suggested to originate

from the hamstring musculature[9, 40], however, others consider forward bending with straight legs a loading of the neural tissue[4, 34]. Our results suggest that these differences remain also after stratification for a presence/absence of radicular pain. The driving mechanisms for these differences need to be further investigated. We confirmed our hypotheses that stratification by gender was of importance for the relationship among SLR, Fingertip-to-floor test and self-reported disability in this study. The correlations between SLR and RMDQ decreased in men after stratification by gender but in contrast, the respective correlations improved substantially in women. This might suggest that range of motion tests were more valid for women than for men, however, we are not aware of any report of similar findings and it should be noted that such correlations between variables do not necessarily prove the existence of causal relationship. Still, based on the results of this and previous studies [41, 42] we suggest that gender differences are of importance for measurements of flexion ROM and SLR in clinical practice but also when correlating impairment measures and self-reported disability.

Neural tissue involvement and/or disc herniations were shown to have a large influence on self-reported disability in previous reports as well as in the present study [21, 29, 39]. We confirmed our hypothesis by showing that flexion ROM had a good correlation to self-reported disability in those with a positive Slump test whereas the respective correlation was only fair in the entire sample. Although, earlier studies support the validity of the use of sensitising manoeuvres during slump testing[4, 34], the Slump test has a good sensitivity but a low specificity in detecting disc herniations as visualised on MRI [42, 43]. However, MRI verified disc herniations are only moderately associated with LBP and radiating symptoms [44]. Radicular pain could be produced not only from mechanical components (visualized on MRI) but also originate from dynamic and

chemical components. Hence, neural tissue involvement, other than mechanical compression at rest, is likely to be symptomatic and a positive Slump test could possibly indicate dynamic compression as well as chemical stimuli of the neural tissue. Our findings of good correlations between flexion ROM and self-reported disability in those with radicular pain agree well with findings reported in subjects with radiculopathy after transforaminal epidural corticosteroid injection [29, 30, 32] and after disc herniation surgery [21, 31]. Therefore, it appears that Fingertip-to-floor test measures the severity of mechanosensitivity in the neural tissue, not only in patients with verified disc herniations, but also in patients with radicular pain as determined by a positive Slump test. This emphasizes that classification of presence/absence of radicular pain according to the Slump test could be favourably used in the clinical setting and we recommend further use of the Slump test in scientific work on LBP.

We have shown a good criterion validity for the Fingertip-to-floor test in both men and women with radicular pain but partly failed to show a respective good criterion validity for the SLR. Earlier reports advocate the use of SLR before and after surgery[31] and epidural injections[45] for patients with radiculopathy. Still, in a review study the accuracy and the validity of SLR have been questioned[12]. The results of the present study support a good validity for SLR for women with radicular pain but not for men due to only fair correlation with self-reported disability. In similar light, Walsh et al suggested reliability and a good correlation for SLR and the results of Measured Slump test (in degrees) in individuals with radicular pain, but not in those without [35]. The interesting relationship among Fingertip-to-floor test, SLR and Measured Slump test needs to be tested further.

Thus, we recommend clinicians to classify patients with acute/sub-acute low back pain according to the presence/absence of radicular pain, preferably using the Slump test, before interpreting results derived from impairment tests such as the Fingertip-to-floor-test and the SLR. A variation in results from these tests should also be considered to occur between sexes. However, in order to establish the usefulness of the impairment measures, future studies need to confirm the good responsiveness for Fingertip-to-floor test[11] and to demonstrate responsiveness for SLR in patients with LBP.

Our study had limitations. Firstly, the cross-sectional design and relatively small sample size (especially after separation into subgroups) limits our ability to generalise our results. We found relatively strong correlations despite the small sample size which might suggest that even stronger relations exists in larger sample trials, however, the sensitivity to change (responsiveness) for the investigated measures needs to be studied longitudinally. Secondly, psychological factors, previously shown to be associated with LBP [46] and fear-avoidance beliefs, previously linked to a reduced ability to flex forward[47], were not assessed as we focused on the most commonly used clinical tests.

## CONCLUSION

In a cross section of subjects with acute and sub-acute LBP, both the Fingertip-to-floor test and the SLR demonstrated only fair criterion validity compared to self-reported disability. After stratification by gender and presence/absence of radicular pain (classified by the Slump test), the present study supports a good validity of the Fingertip-to-floor test for both men and women

with radicular pain. The SLR, however, was of less value as an indicator of self-reported disability in these patients, especially for men.

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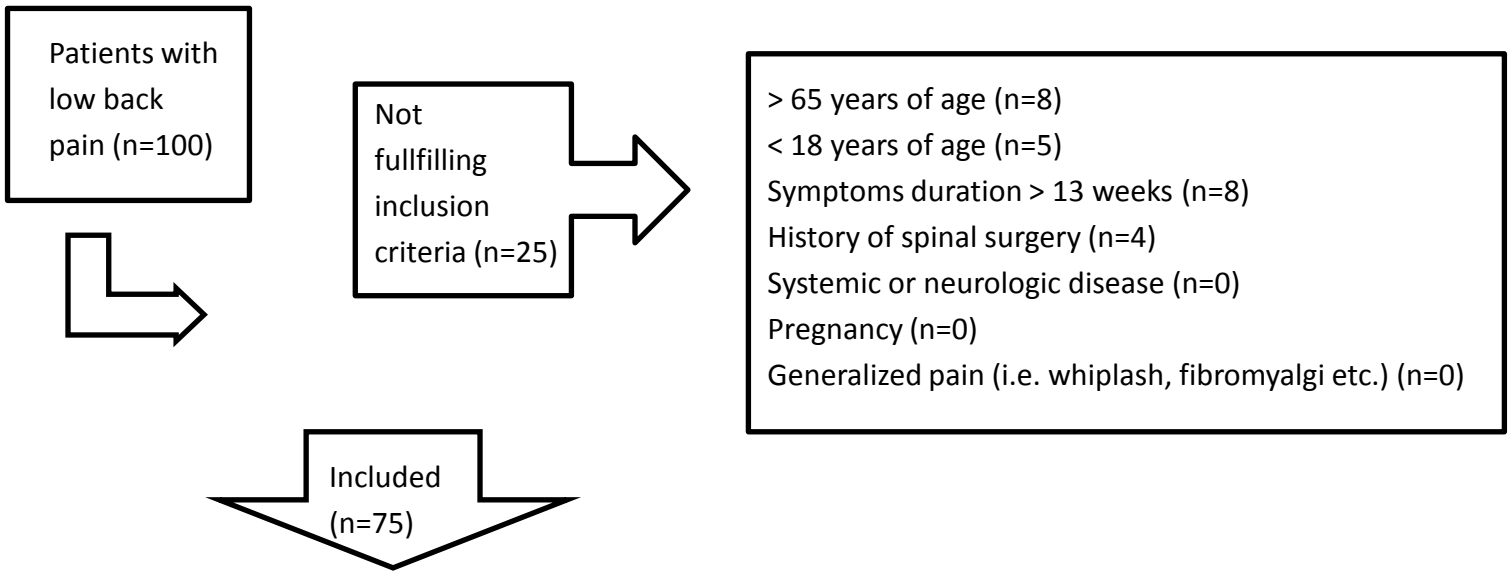
Patients with low back pain (n=100)
Not fullfilling inclusion criteria (n=25)
> 65 years of age (n=8)
< 18 years of age (n=5)
Symptoms duration > 13 weeks (n=8)
History of spinal surgery (n=4)
Systemic or neurologic disease (n=0)
Pregnancy (n=0)
Generalized pain (i.e. whiplash, fibromyalgi etc.) (n=0)
Included (n=75)
LBP without radiating pain below buttocks (n=42)
LBP with radiating pain above knee (n=17)
LBP with radiating pain below knee but without numbness (n=6)
LBP with radiating pain, numbness and weakness (n=10)

Table 1. Characteristics and outcomes for all subjects in the study (N=75)

| Variable | All (n=75) | Men (n=42) | Women (n=33) | P* |
|---|---|---|---|---|
| Age, yrs, mean (SD) | 45 (10) | 45 (11) | 46 (10) | 0.50 |
| Duration of symtoms, days, mean (SD) | 24 (24) | 23 (26) | 26 (20) | 0.67 |
| RMDQ, mean (SD) | 11.4 (5.7) | 10.8 (4.9) | 12.0 (6.6) | 0.36 |
| Flexion ROM, cm, mean (SD) | 22 (18) | 26 (18) | 17 (17) | 0.019† |
| SLR left, degrees, mean (SD) | 67 (15) | 63 (13) | 72 (16) | 0.016† |
| SLR right, degrees, mean (SD) | 65 (15) | 61 (14) | 71 (16) | 0.007† |
| | | | | |
| Slump test pos, n | 40 | 19 | 21 | 0.53 |
| Age, yrs, mean (SD) | 47 (10) | 47.2 (9) | 45.9 (11) | 0.68 |
| Duration of symtoms, days, mean (SD) | 24 (23) | 27.8 (29) | 21.1 (17) | 0.37 |
| RMDQ, mean (SD) | 12.0 (5.5) | 11.8 (4.1) | 12.2 (6.7) | 0.87 |
| Flexion ROM, cm, mean (SD) | 27 (17) | 34 (15) | 21 (17) | 0.010† |
| SLR affected side, degrees, mean (SD) ‡ | 57 (14) | 52 (11) | 63 (15) | 0.011† |
| SLR unaffected side, degrees, mean (SD) § | 65 (14) | 58 (10) | 71 (14) | 0.002† |

* T-test was used for the comparison, except for Slump where Chi-square test was used.
† Significant difference, P< 0.05
‡ SLR in affected leg according to Slump testing.
§ SLR in unaffected leg according to Slump testing in patients with positive Slump.

Table 2 Correlations between self-reported disability (RMDQ) and impairment level outcomes (i.e. SLR, and flexion ROM, N=75).

| | | SLR | | | Flexion ROM |
|---|---|---|---|---|---|
| | N | Left side | Right side | Affected side | |
| All | 75 | -0.27 ***** | -0.30 † | | 0.44 † |
| Men | 42 | -0.09 | -0.21 | | 0.33 ***** |
| Women | 33 | -0.48 † | -0.47 † | | 0.67 † |
| Slump pos | 40 | | | -0.45 † | 0.61 † |
| Slump pos men | 19 | | | -0.28 | 0.68 † |
| Slump pos women | 21 | | | -0.60 † | 0.70 † |

Pos, positive sign in a neurodynamic test.
* $p < 0.05$
† $p < 0.01$

Fig. 1. Flow–chart of the recruitment of subjects, demographics, and inclusion/exclusion criteria (N=100).