

WORKWELL SYSTEMS FCE RESEARCH COMPENDIUM

Please note: The Isernhagen Work Systems FCE has been officially replaced with the name WorkWell FCE. Therefore, the following research articles cite the name IWS FCE.

1. **Test-Retest Reliability of the Isernhagen Work Systems Functional Capacity Evaluation in Patients With Chronic Low Back Pain**
(Journal of Occupational Rehabilitation, Vol 13, No 4, December 2003)
Brouwer, S, Reneman, MF, Dijkstra PU, J. W. Groothoff, J. M. H. Schellekens, and L. N. H. Göeken
2. **Comparing Self-Report, Clinical Examination and Functional Testing in the Assessment of Work-Related Limitations in Patients with Chronic Low Back Pain**
(Disab and Rehabilitation, 2005 Sep 2;27 (17): 999-1005)
Brouwer S, Dijkstra PU, Stewart RE, Göeken LNH, Groothoff JW, Geertzen JHB
3. **Reliability Of Safe Maximum Lifting Determinations of a Functional Capacity Evaluation**
(Physical Therapy, Vol 82, No 4, April 2002)
Gross DP, Battie MC
4. **Construct Validity of a Kinesiophysical Functional Capacity Evaluation Administered within a Worker's Compensation Environment**
(Journal of Occupational Rehabilitation, Vol 13, No 4, December 2003, pp. 287-295)
Gross DP, Battie MC
5. **The Prognostic Value of Functional Capacity Evaluation in Patients with Chronic Low Back Pain: Part 1: Timely Return to Work.**
(Spine, Vol 29, No 8, April 2004, pp. 914-919)
Gross DP, Battie MC
6. **The Prognostic Value of Functional Capacity Evaluation in Patients with Chronic Low Back Pain: Part 2 - Sustained Recovery**
(Spine, Vol 29, No 8, April 2004, pp. 920-924)
Gross DP, Battie MC
7. **Reliability of Independent Observer Judgments of Level of Lift Effort in a Kinesiophysical Functional Capacity Evaluation**
(Work 12, 1999, 145-150)
Isernhagen SJ, Hart DL, and Matheson LM
8. **Measuring Physical Performance via Self-Report in Healthy Young Adults**
(Journal of Occupational Rehabilitation, Vol 14, Number 1, March 2004, pp. 77-87)
Kiujer W, Gerrits EHJ, Reneman MF
9. **Relationships Among Lifting Ability, Grip Force, and Return to Work**
(Physical Therapy, Vol 82, No 3, March 2002)
Matheson LN (a), Isernhagen SJ (b), Hart DL (c)
10. **Test-Retest Reliability of the Isernhagen Work Systems Functional Capacity Evaluation in Healthy Adults**
(Journal of Occupational Rehabilitation, Vol 14, No 4, December 2004, pp. 295-305)
Reneman MF, Brouwer S, Meinema A, Dijkstra PU, Geertzen JHB, Groothoff JW
11. **Measuring Maximum Holding Times and Perception of Static Elevated Work and Forward Bending in Healthy Young Adults**
(Journal of Occupational Rehabilitation. Vol. 11, No. 2, June 2001)
Reneman MF (a), Bults MMEE (b), Engbers LH (b), Mulders KKG (b), and Goeken LNH (c)
12. **Test-Retest Reliability of Lifting and Carrying in a 2-day Functional Capacity Evaluation**
(Journal of Occupational Rehabilitation, Vol 12, No 4, December 2002, pp. 269-275)
Reneman MF, Dijkstra PU, Westmaas M, Göeken LNH
13. **Testing Lifting Capacity: Validity of Determining Effort Level by Means of Observation**
(Spine, Vol 30, No 2, Jan 2005)
Reneman MF, Fokkens AS, Dijkstra PU, Geertzen JHB, Groothoff JW

14. **The Reliability of Determining Effort Level of Lifting and Carrying in a Functional Capacity Evaluation**
(WORK, Winter 2002)
Reneman MF (a), Jaegers SMHJ (b), Westmaas M (c), Goeken LNH (d)
15. **Functional Capacity Evaluation: Ecological Validity of Three Static Endurance Tests**
(Work 16, 2001, 227-234)
Reneman MF (a), Joling CI (b), Soer EL (b) and Goeken LNH (c)
16. **The Relationship between Kinesiophobia and Performance in a Functional Capacity Evaluation**
(Journal of Occupational Rehabilitation, Vol 13, No 4, 2003, pp. 277-285)
Reneman MF, Jorritsma W, Dijkstra SJ, Dijkstra PU
17. **Concurrent Validity of Questionnaire and Performance Based Disability Measurements in Patients with Chronic Non-Specific Low Back Pain**
(Journal of Occupational Rehabilitation, Vol 12, 2002, pp. 119-129)
Reneman MF, Jorritsma W, Schellekens JMH, and Goeken LNH
18. **Basis for an FCE Methodology for Patients with Work-Related Upper Limb Disorders**
(Journal of Occupational Rehabilitation, Vol. 15, No. 3, September 2005)
Reneman MF, Soer R, and Gerrits EHJ
19. **Therapists' Ability to Identify Safe Maximum Lifting in Low Back Pain Patients During Functional Capacity Evaluation**
(JOSPT, Vol 19, No 5, May 1994)
Smith RL, MS, PT
20. **Test-Retest Reliability of the Static Push/Pull Tests for Functional Capacity Evaluations**
(Physical Therapy, 1988, 68, 824)
Hart DL
21. **Work Status and Chronic Low Back Pain. Exploring the International Classification of Functioning, Disability and Health.**
(Disabil Rehab, accepted)
Kuijjer W, Brouwer S, Schiphorst Preuper HR, Groothoff JW, Geertzen JHB, Dijkstra PU
22. **Test-Retest Reliability of an RSI Functional Capacity Evaluation in Healthy Adults**
(WORK, accepted)
Reneman MF, Soer R, Gerrits EHJ
23. **Functional Capacity Evaluation in Patients with Chronic Low Back Pain: Reliability and Validity**
(Doctoral Thesis, June 2004)
Reneman, MF
24. **Factors Influencing Results of Functional Capacity Evaluations in Workers' Compensation Claimants with Low Back Pain**
(Physical Therapy, Vol 85, No 4, april 2005, pp. 315-22)
Gross DP, Battie MC
25. **The Prognostic Value of Functional Capacity Evaluation in Patients with Chronic Low Back Pain: part 1: timely return to work. And part 2: sustained recovery; Letters to the Editor**
(Spine Vol 30, No 10, May 2005, pp. 1233-1234)
Gross D; Battie, M; Cassidy D
(Spine Vol 30, No 10, May 2005, pp. 1232-1233)
Oliveri, M; Jansen T; Oesch P; Kool J
26. **Reliability and Validity of Grip and Pinch Strength Evaluations**
(J Hand Surg [Am]. Vol 9, No 2, March 1984, pp. 222-226)
Mathiowetz V, Weber K, Volland G, Kashman N.
27. **Grip and Pinch Strength: Normative Data for Adults**
(Arch Phys Med Rehabil, Vol 66, February 1995, pp. 69-72)
Mathiowetz V, MS, OTR, Kashman N, OTR, Volland G, OTR, Weber K, OTR, Dowe M, OTS, Rogers S, OTS

WORKWELL SYSTEMS FCE RESEARCH COMPENDIUM

1. **Test-Retest Reliability of the Isernhagen Work Systems Functional Capacity Evaluation in Patients With Chronic Low Back Pain**

(Journal of Occupational Rehabilitation, Vol 13, No 4, December 2003)

S. Brouwer, M. F. Reneman, P. U. Dijkstra, J. W. Groothoff, J. M. H. Schellekens, and L. N. H. Göeken

INTRODUCTION

To determine whether the IWS FCE can be used as an instrument to assess work-related rehabilitation outcome in patients suffering from CLBP, the reliability of the instrument, amongst other psychometric properties, has to be known. Parts of the IWS FCE already have been tested for their reliability. In a test-retest design, “lifting” and “carrying” have been found to possess a good reliability (3,4). The intraclass correlations ranged from 0.77 to 0.94. Pushing static and pulling static also appeared to possess good test-retest reliability (5), as does the measurement of maximum holding times (6). However, no studies are available that investigated all of the tests of the IWS FCE. The aim of this study was to investigate test-retest reliability of all tests of the IWS FCE in a sample of patients suffering from CLBP.

PURPOSE

The aim of this study was to investigate test-retest reliability of the Isernhagen Work Systems Functional Capacity Evaluation (IWS FCE) in a sample of patients (n = 30) suffering from Chronic Low Back Pain (CLBP) and selected for rehabilitation treatment.

METHODS

Two FCE sessions were held with a 2-week interval in between.

SUBJECTS

Patients were included in the study if they were still at work or were less than 1 year out of work because of CLBP. Participants' mean age was 40 years, the duration of low back pain ranged between 5 and 10 years. Fifteen patients (50%) were out of work for a mean of 17 weeks, and they all received financial compensation.

DISCUSSION

Tests of the IWS FCE were divided into tests with and tests without an acceptable test-retest reliability on the basis of the kappa values, the percentage of absolute agreement and the ICC values. Fifteen tests (79%) showed an acceptable test-retest reliability based on Kappa values and percentage of absolute agreement. Eleven tests (61%) showed an acceptable test-retest reliability based on ICC values.

2. **Comparing Self-Report, Clinical Examination and Functional Testing in the Assessment of Work-Related Limitations in Patients with Chronic Low Back Pain**

(Disab and Rehabilitation, 2005 Sep 2;27 (17): 999-1005)

Brouwer S, Dijkstra PU, Stewart RE, Göeken LNH, Groothoff JW, Geertzen JHB

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PURPOSE

To compare the work-related limitations assessed using self-report, clinical examination and functional testing in patients with chronic low back pain (CLBP).

METHODS

Work-related limitations of 92 patients were assessed using self-report, clinical examination and functional testing. To obtain the assessed limitations the patient (self-report), the physician (clinical examination) and a trained evaluator (functional testing) completed a scorings form about the work-related limitations of the patient. The Isernhagen Work Systems Functional Capacity Evaluation (IWS FCE) was used to obtain the functional testing results. A kappa value of more than 0.60, absolute agreement of more than 80% and ICC of more than 0.75 were considered as acceptable.

RESULTS

Little agreement and correlation among self-report, clinical examination and functional testing were found for the assessment of work-related limitations. Self-reported limitations were considerably higher than from those derived from clinical examination or functional testing. Additionally, the limitations derived from the clinical examination were higher than those derived from the IWS FCE.

CONCLUSION

Comparing self-report, clinical examination and functional testing for assessing work-related limitations in CLBP patients showed large considerable differences in limitations. Professional health care workers should be aware of those differences when using them in daily practice.

3. **Reliability Of Safe Maximum Lifting Determinations of a Functional Capacity Evaluation** (Physical Therapy, Vol 82, No 4, April 2002)

DP Gross, MC Battie

Department of Physical Therapy, University of Alberta

Funding provided by Alberta Physiotherapy Association and the Department of Physical Therapy, University of Alberta, Clinical Research Partnership Fund

INTRODUCTION

- Functional Capacity Evaluations (FCE) are used to determine tolerable levels of function and readiness to return to work
- Reliability must be shown

PURPOSE

- To determine the reliability of maximal lifting and carrying determinations of kinesiophysical FCE in a low back pain (LBP) population receiving compensation

METHODS

- Location: WCB-Alberta Rehab. Centre

SUBJECTS

- n=28, 70% Male, Mean age 41, Off work for stable LBP

THERAPISTS

- 5 OTs: >5 years using FCE and trained by Isernhagen Work Systems (Duluth, MN)

DISCUSSION

- Interrater reliability of kinesiophysical lifting and carrying determinations performed on a sample of low back-injured WCB claimants was excellent
- Test-retest reliability was slightly lower but acceptable when subjects willing to participate in both sessions were analyzed.

4. **Construct Validity of a Kinesiophysical Functional Capacity Evaluation Administered within a Worker's Compensation Environment**

(Journal of Occupational Rehabilitation, Vol 13, No 4, December 2003, pp. 287-295)

Douglas P. Gross, Michele C. Battie

INTRODUCTION

Functional capacity evaluations (FCE) are standardized batteries of physical performance and functional measures that are commonly used to determine a subject's ability to perform work-related activities (1). During FCE, an injured worker's performance on job-related tasks is measured and compared to his or her physical job demand levels. Recommendations are made on the basis of FCE results regarding employability, including whether the worker can safely return to preinjury or modified work. Many formal FCE protocols have been developed and are currently marketed (2). Yet, recent reviews of the scientific literature have revealed a lack of peer-reviewed studies exploring the psychometric properties of work-related functional assessment (3,4).

PURPOSE

The construct validity of a kinesiophysical Functional Capacity Evaluation (FCE) administered within a worker's compensation context was examined.

METHOD

A cross-sectional study design was employed. Clinical and demographic information on workers' compensation claimants was extracted from a rehabilitation facility's database. Measures of interest were the Isernhagen Work Systems' (Duluth, MN) FCE, the Pain Disability Index (PDI), and a pain visual analogue scale (VAS). A multitrait Pearson correlation matrix was created to observe the pattern of relationships between variables.

SUBJECTS

The sample consisted of 321 subjects with work-related, medically stable low back pain of median duration of 307 days.

DISCUSSION

FCE performance was moderately correlated with the PDI ($r = -0.44$ – -0.52) and with the pain VAS ($r = 0.34$ – 0.45). Pain intensity was correlated highly with the PDI ($r = 0.79$). The moderate relationship between FCE and the PDI supports the construct validity of FCE as a functional measure.

5. **The Prognostic Value of Functional Capacity Evaluation in Patients with Chronic Low Back Pain: Part 1: Timely Return to Work.**

Douglas P. Gross, PhD(Cand),* and Michele C. Battie, PhD†

6. **The Prognostic Value of Functional Capacity Evaluation in Patients with Chronic Low Back Pain: Part 2 - Sustained Recovery**

Douglas P. Gross, PhD(Cand),* and Michele C. Battie, PhD†

STUDY DESIGN

Historical cohort study.

OBJECTIVES

We investigated the ability of the Isernhagen Work Systems' Functional Capacity Evaluation to predict sustained recovery.

SUMMARY OF BACKGROUND DATA

Functional Capacity Evaluation is commonly used to determine readiness or ability for safe return to work following musculoskeletal injury, implying a low risk of future recurrence or "reinjury." However, this theoretical construct has not yet been tested.

METHODS

Workers' compensation claimants who underwent Functional Capacity Evaluation following low back injury and subsequently demonstrated recovery in the form of suspension of total temporary disability benefits or claim closure were studied. The number of failed tasks and performance on the floor-to-waist lift task in the protocol were used as indicators of Functional Capacity Evaluation performance.

Indicators of sustained recovery included whether or not total temporary disability benefits restarted, the claim was reopened, or a new back claim was filed. Logistic regression was used to determine the prognostic effect of Functional Capacity Evaluation alone and after controlling for suspected confounding variables.

RESULTS

Overall, 46 of 226 patients (20%) experienced a recurrent back-related event within the year following Functional Capacity Evaluation. Opposite to the initial hypothesis, a lower number of failed Functional Capacity Evaluation tasks was consistently associated with higher risk of recurrence after controlling for potential confounding variables. Performance on the floor-to-waist lift task was not related to future recurrence.

CONCLUSIONS

Contrary to Functional Capacity Evaluation theory, better Functional Capacity Evaluation performance as indicated by a lower number of failed tasks was associated with higher risk of recurrence. The validity of Functional Capacity Evaluation's purported ability to identify claimants who are "safe" to return to work is suspect. [Key words: Functional Capacity Evaluation, predictive validity, low back pain, prognosis, return to work, recurrence] **Spine 2004;29:920-924**

7. Reliability of Independent Observer Judgments of Level of Lift Effort in a Kinesiophysical Functional Capacity Evaluation

(Work 12, 1999, 145-150)

SJ Isernhagen, DL Hart and LM Matheson

BACKGROUND AND PURPOSE

Functional Capacity Evaluation (FCE) is designed to quantify the safe functional abilities of a person with an impairment. Return to work decisions are often made or influenced by both the heaviest amount of weight that can be lifted and that can be handled repetitiously. The accurate measurement of lifting abilities is paramount in the determination of work-related functional performance.

SUBJECTS AND METHODS

Three male adults who were receiving workers' compensation and participating in a work conditioning program were videotaped performing five sets of three different lifts. Twelve professionals rated their effort levels by viewing randomized sets of different lifts. Kinesiophysical observational criteria were developed and utilized in the rating.

RESULTS

Both interrater and intrarater reliability were high when three levels of lift were used (.68 and .81). When light and heavy categories were isolated, there were no errors in the judges' ratings (1.0).

DISCUSSION AND CONCLUSION

The data confirms that examiners from different disciplines can be trained to reliably use the kinesiophysical definitions of three lifts. When the requirements of professional clinician training and strict use of operational definitions are met, this method allows reliable assessment of a person's lifting ability.

8. **Measuring Physical Performance via Self-Report in Healthy Young Adults**
(Journal of Occupational Rehabilitation, Volume 14, Number 1, March 2004, pp. 77-87(11))
Kiujer W, Gerrits EHJ, Reneman MF

INTRODUCTION/PURPOSE

Discrepancies exist in literature as to what extent self-reporting can replace performance-based testing. To answer this question, self-reports and performance tests should measure identical constructs. Previous studies did not measure identical constructs. The objective of our study was to investigate to what extent self-reporting can replace performance-based testing.

SUBJECTS/METHODS

Seventy-two healthy subjects were tested. The constructs of the self-reports and the performance tests covered the same components to enable a comparison of self-reports and performance test results. Three different self-reports and a performance test were used to measure physical performance. Additionally, rating of perceived exertion was measured after the subjects lifted a reference weight to predict maximal lifting performance. The controls were age, gender, educational level, subject's participation in fitness, availability of reference data, motivation, attitude, general self-efficacy, and mood.

RESULTS

Results showed that all lifting tasks could be predicted, through not solely via self-reporting. A prediction of the performance test results with a margin of ± 5 kg of error could be made for at least 79% of the subjects, via gender, self-reporting, and subject's participation in fitness.

CONCLUSION

Self-reporting may not replace performance testing, although performance testing can be predicted with a margin of error of ± 5 kg for at least 79% of the health subjects.

9. **Relationships Among Lifting Ability, Grip Force, and Return to Work**
(Physical Therapy, Vol 82, No 3, March 2002)
Leonard N. Matheson (a), Susan J. Isernhagen (b), Dennis L. Hart (c)
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(c) Director of Consulting and Research, Focus On Therapeutic Outcomes Inc., Knoxville, TN

BACKGROUND AND PURPOSE

The relationship between functional capacity evaluation (FCE) data and work disability has not been studied. The validity of FCE testing results in terms of subsequent return to work (RTW) was the focus of this exploratory study.

SUBJECTS AND METHODS

Six hundred fifty adults of working age were evaluated as part of a standardized FCE. Clients were contacted by telephone 6 months after the FCE to determine their work status. Predictor variables were gender, age, time off work, maximum safe loads during 3 dynamic lifts, and isometric grip force. Other variables measured were whether or not the client returned to work (RTW-Y/N) and level of return to work (RTW level).

RESULTS

A multivariate logistic regression analysis demonstrated that the more time a worker was away from work, the less likely was RTW. Male subjects were less likely to return to work than female subjects. The more weight lifted from floor to waist, the more likely was RTW. The logistic regression equation correctly classified 80.3% of the subjects who returned to work and 56.6% of the subjects who did not return to work. Each of the 3 lift tests was related to RTW level, whereas the grip force tests were not related to either RTW-Y/N or RTW level.

DISCUSSION AND CONCLUSION

Time off work and gender were the strongest predictors of RTW, but certain FCE subtests of lifting were related to RTW and RTW level for people with work-related chronic symptoms. Grip force was not related to RTW.

10. **Test-Retest Reliability of the Isernhagen Work Systems Functional Capacity Evaluation in Healthy Adults**

(Journal of Occupational Rehabilitation, Volume 14, Number 4, December 2004, pp. 295-305)

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INTRODUCTION/PURPOSE

Aim of this study was to investigate test-retest reliability of the Isernhagen Work Systems Functional Capacity Evaluation (IWS FCE) in healthy subjects. The IWS FCE consists of 28 tests that reflect work-related activities such as lifting, carrying, bending, etc.

METHODS/SUBJECTS

A convenience sample of 26 healthy subjects participated in the study. The subjects' mean age was 34.9 years. Two FCE sessions were held within a 2-3 week interval. Descriptives per session, Intra Class Correlations (ICC), limits of agreement, Cohen's Kappa, and percentage of agreement were calculated where appropriate.

RESULTS

An ICC of ≥ 0.75 , a Kappa value ≥ 0.60 , and a percentage of absolute agreement of $\geq 0.80\%$ were considered acceptable reliability. Acceptable reliability was demonstrated for seven out of nine tests (78%) of the material handling group and the shuttle walk test based on ICC analyses only. Sixteen out of 17 criterion and ceiling tests (94%) showed acceptable reliability based on Kappa values and percentage of agreement. Of these 17 tests, 8 were eligible for further analysis, and of those 8 tests the reliability of one test was acceptable based on ICC analyses (13%).

CONCLUSION

In conclusion, the test-retest reliability of the material-handling group is acceptable. Crude analyses of the ceiling and criterion tests reveal acceptable test-retest reliability of most, but not all, tests.

11. **Measuring Maximum Holding Times and Perception of Static Elevated Work and Forward Bending in Healthy Young Adults**

(Journal of Occupational Rehabilitation. Vol. 11, No. 2, June 2001)

M.F. Reneman (a), M.M.E.E. Bults (b), L.H. Engbers (b), K.K.G. Mulders (b), and L.N.H. Goeken (c)

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BACKGROUND AND PURPOSE

The objectives of this study were to investigate the maximum holding times (MHT) of two highly stressful postures: standing in a forward bend position and performing elevated work in a standing position. The relationship between perceived exertion and MHT was also studied.

SUBJECTS AND METHODS

Subjects were 44 young adults, age 20-29 years (25 female, 19 male). A test-retest design was used to establish reliability.

RESULTS

Mean maximum holding times for forward bending and elevated work were respectively 14.51 and 16.18 min with large inter-individual variations. A logarithmic rather than a linear relation between perceived exertion and performance is found. It is not possible to reliably predict MHTs from subjective data. Test-retest correlation is high ($n=19$, $r=0.716$ and 0.813 , $p < 0.001$), and the scores did not differ significantly ($p < 0.005$), indicating a reliable procedure.

DISCUSSION AND CONCLUSION

The average holding times of the population studied are higher than expected from literature. Neither generic formulas, curve estimations, nor predictions can reliably predict an individual's MHT. An individual's MHTs are best tested through performance-based testing.

12. **Test-Retest Reliability of Lifting and Carrying in a 2-day Functional Capacity Evaluation**
(Journal of Occupational Rehabilitation, Vol 12, No 4, December 2002, pp. 269-275)
M.F. Reneman, P.U. Dijkstra, M. Westmaas, L.N.H. Göeken

INTRODUCTION/PURPOSE

The objectives of this study were to establish test-retest reliability of lifting and carrying of a functional capacity evaluation (FCE) on two consecutive days and to verify the need for a two-day protocol.

METHODS/SUBJECTS

A cohort of 50 patients (39 men, 11 women) with nonspecific low back pain were evaluated using a two-day FCE protocol. Intra-class Correlations (ICC) were calculated for weight lifted and carried. Predictive relationships between test and retest were explored by means of a regression analysis. The results were lifting low ICC=0.87, lifting overhead ICC=0.87, carrying ICC=0.77. Performances on day 2 were on average 6-9% higher. Other than the amount of weight handled on day 1, no variable was found to predict performance on day 2. It was concluded that test-retest reliability of lifting and carrying is good, and the need for a two-day protocol could not be confirmed.

13. **Testing Lifting Capacity: Validity of Determining Effort Level by Means of Observation**
(Spine, Vol 30, No 2, Jan 2005)
Michiel F. Reneman, Andrea S. Fokkens, Pieter U. Dijkstra, Jan H. B. Geertzen, Johan W. Groothoff

INTRODUCTION

To establish a person's functional capacity, the evaluatee must perform to his or her maximum level of physical ability. The maximum performance that can be measured is the portion of capacity the evaluatee is willing to produce. It is, therefore, important to assess the extent to which a person is willing to perform to his or her physical maximum. This type of assessment requires a validated means to identify level of effort. The primary aim of this study was to investigate the validity of determining effort levels during a lifting test by means of visual observations in a sample of healthy subjects and patients with CLBP. Secondary aims were to study the interrater reliability of observer ratings and to study whether one rating method was superior to another.

PURPOSE

To establish the validity of determining effort level by visual observation of a lifting test. Determining effort level during a lifting test is critical for interpretation of test performance, yet the validity of these determinations has not been established in patients with chronic nonspecific low back pain.

METHOD

The lifts were videotaped and independently observed by 9 trained observers, who rated effort levels using an Isernhagen Work Systems categorical scale and a Borg Category Ratio scale. External effort indexes were established to control for effort at group level. Validity of the observer ratings was analyzed by means of a sensitivity and specificity analysis and correlations between performances and observer ratings. Interrater reliability was analyzed by means of intraclass correlation coefficients and Cohen kappa.

SUBJECTS Fifteen healthy subjects and 16 patients with chronic nonspecific low back pain performed a standardized lifting test as outlined in the Isernhagen Work Systems Functional Capacity Evaluation.

DISCUSSION

External indexes differ significantly between patients with chronic low back pain and healthy subjects, indicating that at group level, patients did not perform maximally. Submaximal performances were correctly rated in 85% to 90% (healthy subjects) and in 100% (patients with chronic nonspecific low back pain) of the cases. “Maximal” performances were correctly rated in 46% to 53% (healthy subjects) and in 5% to 7% (patients with chronic nonspecific low back pain) of the cases. Correlations between performances and observer ratings were $r = 0.90$ to $r = 0.92$ (healthy subjects) and $r = 0.82$ (patients with chronic nonspecific low back pain). Reliability: intraclass correlation coefficient, $r = 0.76$ (patients with chronic nonspecific low back pain) to $r = 0.87$ (healthy), Kappa $K = 0.50$ (patients with chronic nonspecific low back pain) to $r = 0.58$ (health subjects).

CONCLUSION

Effort level can be determined validly by means of visual observation

14. **The Reliability of Determining Effort Level of Lifting and Carrying in a Functional Capacity Evaluation**

(WORK, Winter 2002)

M.F. Reneman (a), S.M.H.J. Jaegers (b), M. Westmaas (c), L.N.H. Goeken (d)

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OBJECTIVES

To establish inter- and intra-rater reliability of observations in a functional capacity evaluation

BACKGROUND

Functional capacity evaluations are used to assess a person’s functional capacity as it relates to work. Lifting and carrying are important aspects of a functional capacity evaluation. An evaluator determines a client’s levels of effort through standardized observations. However, questions remain with regards to the reliability of these observations.

METHODS

Four healthy subjects were videotaped while performing two lifts and four carries with progressing loads. The videotape was scrambled randomly and viewed twice by 3 physical therapists and 2 occupational therapists. The evaluators determined the amount of effort it required (light, medium, heavy, and maximum). The inter- and intra-rater reliability of the observations was expressed in percentage agreement.

RESULTS

Inter-rater reliability ranged from 87 to 96%, intra-rater reliability ranged from 93 to 97%.

CONCLUSION

The results indicate that by means of standardized observations, therapists can reliably determine the effort level during lifting and carrying in healthy subjects, and thus affirm the findings of previous studies of similar design.

15. **Functional Capacity Evaluation: Ecological Validity of Three Static Endurance Tests**

(Work 16, 2001, 227-234)

M.F. Reneman (a), C.I. Joling (b), E.L. Soer (b) and L.N.H. Goeken (c)

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BACKGROUND AND PURPOSE

Functional Capacity Evaluations (FCEs) are designed to measure the functional capacity of injured workers. Static endurance tests are integrated aspects of FCEs. Little is known about the validity of the tests.

SUBJECTS AND METHODS

In this study, three static endurance tests (overhead work, crouching, and kneeling) of the Isernhagen Work Systems FCE are studied for ecological validity. By manipulating the environment in an experiment using three different conditions (normal, loud noise, high production requirement), the ecological validity of the tests was investigated.

RESULTS

The different conditions did not seem to influence the holding times, the perceived exertion and the productivity of the subjects.

DISCUSSION AND CONCLUSION

The results are discussed and it is concluded that the three static endurance tests meet conditions of ecological validity. In order to be able to state that the tests of the IWS FCE are ecologically valid, more research is needed to enable a generalization.

16. **The Relationship between Kinesiophobia and Performance in a Functional Capacity Evaluation**

(Journal of Occupational Rehabilitation, Vol 13, No 4, 2003, pp. 277-285)

M.F. Reneman, W. Jorritsma, S.J. Dijkstra, P.U. Dijkstra

INTRODUCTION/OBJECTIVES

Fear of movement and (re) injury (kinesiophobia) has been postulated to play an important role in the performance in a Functional Capacity Evaluation (FCE). This study was performed to analyze the relationship between kinesiophobia and performance in an FCE.

METHODS

Kinesiophobia and FCE performance of 54 male and 10 female patients (mean age 38.0) suffering chronic low back pain (mean length of episode 9.9 months, 93% off work) were assessed. Kinesiophobia was assessed using the Dutch Version of the Tampa Scale for Kinesiophobia (scale 17-68). A lifting task and an FCE were operationalizations of avoidance. FCE results were transformed into a single measure using the classification of the Dictionary of Occupational Titles (FCE-DOT, scale 1-5). Correlations between the variables were calculated.

RESULTS

Kinesiophobia mean 41.6 (sd. 7.3), lifting mean 29.5 kg (sd. 11.6), FCE-DOT mean 3.6 (sd. 0.6). Correlations between kinesiophobia and lifting was $r=0.01$ ($p=0.93$) and between kinesiophobia and FCE-DOT was kinesiophobic, yet they were able to lift a mean of 29.5 kg and were physically able to perform moderate to heavy work.

CONCLUSION

The strength of the correlations was very low. The relationship between kinesiophobia and avoidance, operationalized as lifting and an FCE, could not be confirmed in this study.

17. **Concurrent Validity of Questionnaire and Performance Based Disability Measurements in Patients with Chronic Non-Specific Low Back Pain**

(Journal of Occupational Rehabilitation, 2002, 12, 119-129)

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OBJECTIVE

To investigate the concurrent validity of two approaches (self report and performance based) of measuring disability in patients with chronic non-specific low back pain (CLBP). It was hypothesized that, when they are measuring the same construct, the instruments would lead to similar disability results and would correlate strongly ($r > 0.75$).

STUDY DESIGN

Compare results of self-reported and performance based measures of disability.

PATIENTS

A cohort of 64 patients with CLBP, mean age 38.0 years, mean duration of current episode of back pain 9.9 months, 90% off work due to CLBP.

MAIN OUTCOME MEASURES

Self report measures: Roland Disability Questionnaire (Roland), the Oswestry Disability Questionnaire (Oswestry), and the Quebec Back Pain Disability Questionnaire (Quebec).

Performance measure: Isernhagen Work Systems Functional Capacity Evaluation (FCE).

Performance was classified according to the Dictionary of Occupational Titles.

RESULTS

Self reports: Roland mean 13.5 (scale 0-24), Oswestry mean 28.2 (scale 0-100), Quebec mean 37.8 (scale 0-100), indicating moderate to severe disability. Mean performance based disability: the subjects were considered able to work at a physical intensity level of moderate to heavy.

Spearman rank correlations: Roland-FCE -0.20 ($p > 0.05$), Oswestry-FCE -0.52 ($p < .01$), Quebec-FCE -0.50 ($p < .01$).

CONCLUSION

Results of questionnaire and performance based disability measurements differ substantially. The correlations do not meet the required level. It is recommended that both methods are used to get a comprehensive picture of the disability of patients with CLBP.

18. **Basis for an FCE Methodology for Patients with Work-Related Upper Limb Disorders**

(Journal of Occupational Rehabilitation, Vol. 15, No. 3, September 2005)

M.F. Reneman, R. Soer, and EHJ Gerrits

INTRODUCTION

A reported reduction in work-related functional capacity in Work-related Upper Limb Disorders (WRULD) patients is among the most common problems in WRULD. The extent to which this reduction in functional capacity can be objectified remains unknown. A validated instrument to test functional capacity in this patient group is unavailable.

OBJECTIVE/SUBJECTS

The objective of this study was to design a Functional Capacity Evaluation (FCE) for WRULD patients working with Visual Display Units (VDU) and provide evidence for content validity. A review to epidemiological literature was conducted to identify physical risk factors for VDU-related WRULD.

RESULTS

The results indicate that physical risk factors were related to upper extremity and neck. An FCE was designed based on the risk factors identified. Eight tests were selected to cover all risk factors: the overhead lift, overhead work, repetitive reaching, handgrip strength, finger strength, wrist extension strength, fingertip dexterity, and a hand and forearm dexterity test.

CONCLUSION

Content validity of this FCE was established by providing the rationale, specific objectives and operational definitions of the FCE. Further research is needed to establish reliability and other aspects of validity of the WRULD FCE.

19. **Therapists' Ability to Identify Safe Maximum Lifting in Low Back Pain Patients During Functional**

Capacity Evaluation

(JOSPT Vol 19, No 5, May 1994)

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This study was partially funded by the Montana Chapter of the American Physical Therapy Association.

BACKGROUND AND PURPOSE

Functional capacity evaluation (FCE) of an injured worker's ability to lift weight guides the determination of whether he or she is capable of handling the physical demands of a job. The purpose of this study was to examine the inter-rater and intra-rater reliability in determining the safe maximum floor-to-waist lift for patients with low back pain during FCE testing.

SUBJECTS AND METHODS

Twenty-one patients with low back pain were evaluated. Patients were videotaped lifting weight in progressive increments using a kinesio-physical approach. Five experienced physical therapists viewed the videotape and judged the lifts for body mechanics safety.

RESULTS

Safety reliability was high, indicating that therapists can accurately judge safe lifting methods during FCE. As lifting loads increased, body mechanics deteriorated, indicating the patient was approaching or had reached a biomechanical end point.

DISCUSSION AND CONCLUSION

Therapists can reliably judge safety of lift. However, additional clinical information is needed, in addition to visual observations, to accurately determine when maximum lift capacity is reached.

20. **Test-Retest Reliability of the Static Push/Pull Tests for Functional Capacity Evaluations**

(Phys Ther 1988, 68, 824)

D.L. Hart

PURPOSE

The purpose of this study was to determine if there was a difference in the variability of submaximal and maximal forces generated by patients with chronic pain while performing standing static arm lifts.

SUBJECTS/METHOD

92 patients with chronic pain who were being tested for their functional capacities performed three maximal vertical pulls on a static strain gauge with elbows in 90 deg flexion and wrists supinated. For the submaximal pulls the patients were asked to produce one pull between 10-90% of their maximal pull, and then match that force twice for a total of three pulls. Data consisted of each of the three maximal and three submaximal forces. The data sets were analyzed with random effects Intraclass Correlational Coefficients (ICC) (within subject ANOVA model), one for the maximal efforts and one for the submaximal efforts ($p < .05$).

RESULTS

The average forces per subject were different during both the maximal (73.02 ± 37.98 lbs.) and submaximal (40.76 ± 22.01 lbs.) pulls thus supporting the need for the within subject ANOVAs. During the maximal effort, there was no difference in the forces between repetitions, but during the submaximal efforts, there was a significant difference between the repetitions, although the difference was small clinically (means between repetitions were 39.3, 40.5 and 42.5 lbs. demonstrating a consistent upward trend). The ICC for the maximal effort was .97 and .94 for the submaximal effort. Even though there was more variability between the submaximal forces as compared to no variability between the maximal forces, both submaximal and maximal efforts were performed with good test retest reliability.

CONCLUSION

Therefore, patients with chronic pain are capable of producing consistent submaximal efforts, thus casting doubt on the use of higher variability scores during maximal effort testing as a means of identifying symptom magnification.

21. **Work Status and Chronic Low Back Pain. Exploring the International Classification of Functioning, Disability and Health.**
(Disabil Rehab, accepted)
Kuijer W, Brouwer S, Schiphorst Preuper HR, Groothoff JW, Geertzen JHB, Dijkstra PU
22. **Test-Retest Reliability of an RSI Functional Capacity Evaluation in Healthy Adults**
(WORK, accepted)
Reneman MF, Soer R, Gerrits EHJ
23. **Functional Capacity Evaluation in Patients with Chronic Low Back Pain: Reliability and Validity**
(Doctoral Thesis, June 2004)
Reneman, MF
24. **Factors Influencing Results of Functional Capacity Evaluations in Workers' Compensation Claimants with Low Back Pain**
(Physical Therapy, 2005 Apr., 85 (4): 315-22)
Gross DP, Battie MC
Department of Physical Therapy, University of Alberta, 2-50 Corbett Hall, Edmonton, Alberta, Canada T6G 2G4

BACKGROUND AND PURPOSE

Physical and psychosocial factors are hypothesized to influence performance-based assessment. The purpose of this study was to evaluate the association between performance on the Isernhagen work system Functional Capacity Evaluation (IWS FCE) and various clinical and psychosocial factors.

SUBJECTS

The sample consisted of 170 workers' compensation claimants who were undergoing functional capacity evaluations (FCEs) for low back injuries.

METHODS

In this cross-sectional study, claimants completed a battery of work-related measures, including the IWS FCE, the Pain Disability Index (PDI), a workplace organizational policies and practices scale, and a recovery expectations questionnaire. Functional capacity evaluation performance indicators were the number of tasks in which subjects did not meet work demands and weight lifted on the floor-to-waist lift. Analysis included multivariable regression.

RESULTS

Only the PDI, pain intensity, age, and sex independently contributed to floor-to-waist lift performance. The PDI, pain intensity, and duration of injury contributed to floor-to-waist lift performance. The PDI, pain intensity, and duration of injury contributed to the number of failed tasks.

DISCUSSION AND CONCLUSION

The results indicate that performance on FCEs is influenced by physical factors, perceptions of disability, and pain intensity. However, perceptions of workplace organizational policies and procedures were not associated with FCE results for workers' compensation claimants with chronic back pain disability. Functional capacity evaluations should be considered behavioral tests influenced by multiple factors, including physical ability, beliefs, and perceptions.

25. **The Prognostic Value of Functional Capacity Evaluation in Patients with Chronic Low Back Pain: part 1: timely return to work. And part 2: sustained recovery**

Letters to the Editor

(Spine (30) 10: 1233-1234, May 15, 2005)

Gross D; Battie, M; Cassidy D

(Spine (30) 10: 1232-1233, May 15, 2005)

Oliveri, M; Jansen T; Oesch P; Kool J

26. **Reliability and Validity of Grip and Pinch Strength Evaluations**

J Hand Surg [Am]. 1984 Mar;9(2):222-6.

Mathiowetz V, Weber K, Volland G, Kashman N.

PURPOSE/METHOD

Twenty-seven college women participated in a study to evaluate the reliability and validity of four tests of hand strength: grip, palmar pinch, key pinch, and tip pinch. Standardized positioning and instructions were followed.

RESULTS

The results showed very high inter-rater reliability.

CONCLUSION

Test-retest reliability was highest in all tests when the mean of three trials was used. Lower correlations were shown when one trial or the highest score of three trials were utilized. The Jamar dynamometer by Asimow Engineering and the pinch gauge by B&L Engineering demonstrated the highest accuracy of the instruments tested.

27. **Grip and Pinch Strength: Normative Data for Adults**

(Arch Phys Med Rehabil, Vol 66:69-72, February 1995)

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PURPOSE/METHOD

The primary purpose of this study was to establish clinical norms for adults aged 20 to 75+ years on four tests of hand strength. A dynamometer was used to measure grip strength and a pinch gauge to measure tip, key, and palmar pinch.

SUBJECTS

A sample of 310 male and 328 female adults, ages 20 to 94, from the seven-county Milwaukee area were tested using standardized positioning and instructions. Right hand and left hand data were stratified into 12 age groups for both sexes. This stratification provides a means of comparing the score of individual patients to that of normal subjects of the same age and sex.

RESULTS

The highest grip strength scores occurred in the 25 to 39 age groups. For tip, key, and palmar pinch the average scores were relatively stable from 20 to 59 years, with a gradual decline from 60 to 79 years.

CONCLUSION

A high correlation was seen between grip strength and age, but a low to moderate correlation between pinch strength and age. The newer pinch gauge used in this study appears to read higher than that used in previous normative study. Comparison of the average hand strength of right-handed and left-handed subjects showed only minimal differences.