Third International FCE Research Conference
September 29, 2016 Heliomare - Wijk aan Zee
The Netherlands

The third International FCE Research Conference endorsed by

Heliomare and Vroege Interventie

WELCOME

3nd International FCE Research Conference
September 29, 2016 – Wijk aan Zee – Netherlands.

We are pleased to welcome you to the 3nd International Functional Capacity Evaluation (FCE) Research Conference in Wijk aan Zee - September 28 (evening) to September 29, 2016. The 3nd International FCE Research Conference will serve as an international forum for research and knowledge implementation related to work assessment and FCEs, across all causes of work incapacity. Participants include leading international experts in the field – scientists, clinicians, and other users of FCE information.

The International FCE Research Conference is an informal, non-profit research symposia organized by Michiel Reneman and Doug Gross. The meetings provide an opportunity to gather with a small group of researchers, clinicians and other stakeholders with a special interest in work assessment and FCE to discover and discuss new research findings, novel assessment techniques and strategies, and other policy or related issues facing the field.

Following a successful conference in Groningen (The Netherlands – 2012), and Toronto (Canada – 2014), we will offer an exciting program at Wijk aan Zee, the Netherlands. We received a large response for abstracts featuring the most recent scientific developments in the FCE field, as well as thought provoking discussions and workshops with leading FCE researchers and clinicians from around the world.

We hope you will enjoy this international conference, meet your colleagues and make new connections.

Enjoy the conference and your stay in Wijk aan Zee.

Sincerely yours,

Douglas Gross, Professor in Physical Therapy, University of Alberta, Canada
Michiel Reneman. Professor in Rehabilitation Medicine. University Medical Center Groningen, The Netherlands
Michel Edelaar, Heliomare & Vroege Interventie

A special thank you to Rehabilitation Center Heliomare for their generous support in hosting this event.

Contents

		Pag.
Welcome		1
Contents	PDF - 3rd International FCE Research Conference	2
Program	Functional Capacity Evaluation Research Conference	3
Information	Conference Organizers	4
Title	Presenting authors	5
Information	Rehabilitation Center Heliomare	6
Abstracts	Scientific contributions International FCE Conference	
	1. Grip Strength as a Predictor of Work Ability: A Scoping Review Lisa Fitzpatrick	9
	2. ACPOHE Functional Testing Toolkit - Catherine Albert	10
	3. Functional Capacity Evaluation: Performance of Patients with Chronic Non-specific Low Back Pain Without Waddell Signs Peter Oesch	11
	4. Comparison of two methods for interpreting lifting performance during Functional Capacity Evaluation - Peter Oesch	12
	5. Development and validation of a pain behavior assessment in patients with chronic low back pain - Jan Kool	13
	6. Development of a modified version of the Spinal Function Sort (M - SFS): A mixed method approach - Maurizio Trippolini	14
	7 Development and reliability testing of a qualitative score for rating compensatory movements in upper limb prosthesis wearers during execution of 4 FCE-tests. - Sietke Postema	15
	8. Development of a functional capacity evaluation measurement for individuals with upper limb reduction deficiency or amputation.- Sietke Postema	16
	9. Do Wearable Fitness Devices Correlate With Performance-Based Tests of Work-Related Functional Capacity Jesse Karpman & Douglas Gross	17
	10. ICF as the conceptual framework for FCE. Linking FCE tests to the ICF Comprehensive Core Set of Vocational Rehabilitation Marika Lassfolk	18
	11. Associations of lifted weight and self-rated return-to-work prognosis - Mattias Bethge	19
	12. Sustainable return to work among construction workers on sick leave due to musculoskeletal disorders: what is the added value of action versus a question? - Paul Kuijer	20
	13. The predictive validity of a workplace-specific and strain-related short-form Functional Capacity Evaluation in patients with musculoskeletal disorders - David Bühne	21
	14. Upper Limb Isokinetic Strength Assessment Applicability in Work Injury Patients - Quim Chaler	22
	15. Proposed Inclusion of Work Physiology in FCE Testing – Heart Rate Reserve Method - Theodore Becker & Whitney Ogle	23
PDF	Conference summary: the first international functional capacity evaluation research meeting	24
	Conference summary: the second international functional capacity evaluation research meeting	26
Participants	Third International FCE Research Conference	28

Program 3rd International FCE Research Conference	
28 September	Conference dinner, Wijk aan Zee
29 September	Conference session, Wijk aan Zee, Heliomare
08.00 AM	Registration
08.45 AM	Opening & Welcome
	Update since last conference – Doug Gross and Michiel Reneman
09.10 AM	**Keynote A**: Michiel Reneman and Jone Ansuategui Echeita, Spain / The Netherlands - Functional Capacity Evaluation in different societal contexts: Results of a multi-country study
10.00 AM	The predictive value of grip strength using dynamometry relative to work ability - Lisa Fitzpatrick, USA
10.15 AM	ACPOHE Functional Testing Toolkit - Catherine Albert, UK
10.30 AM	Break
11.00 AM	Functional Capacity Evaluation: Performance of Patients with Chronic Non-specific Low Back Pain Without Waddell Signs - Peter Oesch, Switzerland
11.15 AM	Comparison of two methods for interpreting lifting performance during Functional Capacity Evaluation - Peter Oesch, Switzerland
11.30 AM	Development and validation of a pain behaviour assessment in patients with chronic low back pain - Jan Kool, Switzerland
11.45 AM	Development of a modified version of the Spinal Function Sort (M – SFS): A mixed method approach - Maurizio Trippolini, Switzerland / USA
12.00 PM	Lunch + photo
01.00 PM	**Keynote B:** Jill Galper, USA. Practical Issues in FCE Administration and Interpretation: Lessons Learned From Thousands of Cases
01.45 PM	Development and reliability testing of a qualitative score for rating compensatory movements in upper limb prosthesis wearers during execution of 4 FCE-tests - Sietke Postema, The Netherlands
02.00 PM	Development of a functional capacity evaluation measurement for individuals with upper limb reduction deficiency or amputation. - Sietke Postema, The Netherlands
02.15 PM	Do Wearable Fitness Devices Correlate With Performance-Based Tests of Work-Related Functional Capacity - Jesse Karpman & Douglas Gross, Canada
02.30 PM	ICF as the conceptual framework for FCE. Linking FCE tests to the ICF Comprehensive Core Set of Vocational Rehabilitation - Marika Lassfolk, Finland
02.45 PM	Break
03.15 PM	Associations of lifted weight and self-rated return-to-wok prognosis and self-rated return-to-work prognosis - Mattias Bethge, Germany
03.30 PM	Sustainable return to work among construction workers on sick leave due to musculoskeletal disorders: what is the added value of action versus a question - Paul Kuijer, The Netherlands
03.45 PM	The predictive validity of a workplace-specific and strain-related short-form Functional Capacity Evaluation in patients with musculoskeletal disorders - David Bühne, Germany
04.00 PM	Upper Limb Isokinetic Strength Assessment Applicability in Work Injury Patients - Quim Chaler
04.15 PM	Discussion: Proposed Inclusion of Work Physiology in FCE Testing – Heart Rate Reserve Method - Theodore Becker & Whitney Ogle - USA.
04.35 PM	What's next? Doug Gross and Michiel Reneman
04.45 PM	Closing

Information 3rd International FCE Research Conference

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Presenting authors	Title	
Key notes		
Michiel Reneman and Jone Ansuategui Echeita, Spain / The Netherlands	Functional Capacity Evaluation in different societal contexts: Results of a multicountry study	A
Jill Galper, USA	Practical Issues in FCE Administration and Interpretation: Lessons Learned From Thousands of Cases	B
Scientific contributions		
Lisa Fitzpatrick, USA	The predictive value of grip strength using dynamometry relative to work ability	1
Catherine Albert, UK	ACPOHE Functional Testing Toolkit	2
Peter Oesch, Switzerland	Functional Capacity Evaluation: Performance of Patients with Chronic Non-specific Low Back Pain Without Waddell Signs	3
Peter Oesch, Switzerland	Comparison of two methods for interpreting lifting performance during Functional Capacity Evaluation	4
Jan Kool, Switzerland	Development and validation of a pain behavior assessment in patients with chronic low back pain	5
Maurizio Trippolini, Switzerland / USA	Development of a modified version of the Spinal Function Sort (M – SFS): A mixed method approach	6
Sietke Postema, The Netherlands	Development and reliability testing of a qualitative score for rating compensatory movements in upper limb prosthesis wearers during execution of 4 FCE-tests	7
Sietke Postema, The Netherlands	Development of a functional capacity evaluation measurement for individuals with upper limb reduction deficiency or amputation.	8
Jesse Karpman & Douglas Gross, Canada	Do Wearable Fitness Devices Correlate With Performance-Based Tests of Work-Related Functional Capacity	9
Marika Lassfolk, Finland	ICF as the conceptual framework for FCE. Linking FCE tests to the ICF Comprehensive Core Set of Vocational Rehabilitation	10
Mattias Bethge, Germany	Associations of lifted weight and self-rated return-to-wok prognosis and self-rated return-to-work prognosis	11
Paul Kuijer, The Netherlands	Sustainable return to work among construction workers on sick leave due to musculoskeletal disorders: what is the added value of action versus a question	12
David Bühne, Germany	The predictive validity of a workplace-specific and strain-related short-form Functional Capacity Evaluation in patients with musculoskeletal disorders	13
Quim Chaler	Upper Limb Isokinetic Strength Assessment Applicability in Work Injury Patients	14
Whitney Ogle, USA	Proposed Inclusion of Work Physiology in FCE Testing – Heart Rate Reserve Method	15

The official language of the congress is English.
Presentation: 15 minutes; 10 min presentation , 5 min discussion

Heliomare
Heliomare supports (potentially) disabled people. In this context, it employs approximately 1,600 staff and has about 40 locations throughout the province of Noord-Holland.
The degree of support provided, depends on the requirements and the physical and mental capabilities of the client. A variety of services is offered, including medical rehabilitation, special needs education, vocational rehabilitation, independent living programmes and training, daily occupation and sports. These services can be provided either separately or as a combined package.

Heliomare rehabilitation

The rehabilitation centre offers specialised medical rehabilitation for children, youngsters and adults with a physical and/or multiple disability or a traumatic brain injury. Rehabilitation supports them in their pursuit of maximum independence. The rehabilitation centre (115 beds) provides clinical support for the province of Noord-Holland, with the exception of the regions of Amsterdam and Het Gooi. In addition, Heliomare rehabilitation provides services to special client groups within a wider area, and an outpatient service for the regions of Midden- and Zuid-Kennemerland.

Heliomare vocational rehabilitation
The institute for vocational rehabilitation is responsible for developing comprehensive reintegration packages for individual clients with an employment disability. In this area, autonomy, respect, openness and clarity are of the utmost importance.
People with a high risk of developing a disability often have great difficulty in finding a job on the labour market. How can they ensure that they retain their current position, or go about finding a suitable new working environment? Within Heliomare vocational rehabilitation, these are fundamental questions.
In order to provide the answers, Heliomare vocational rehabilitation works closely with other agencies/ institutions including the Ministry for Social Affairs and Employment, and there is an increasing trend towards working directly with employers.
The area, for which Heliomare vocational rehabilitation provides cover, includes the provinces Noord-Holland, Flevoland and Zuid-Holland and Leiden. Moreover, Heliomare vocational rehabilitation offers its services, in the area of vocational education, job coaching, assessments and physical training, to other organizations experiencing problems with the coaching of clients.

Heliomare education
Heliomare offers special education to children with complicated learning difficulties (ZML), with physical disabilities (LG) and multiple disabilities (MG). In secundary education for, ZML, LG, MG and chronic ill students (LZ cluster 3).
All education activities are concentrated within Heliomare educqation

There are 4 locations
•De Alk, school for special education and secundary special education (SO/VSO), located in Alkmaar
•Heliomare education, school for SO/VSO, located in Wijk aan Zee

•De Ruimte, school voor SO located in Bergen
•De Zevensprong, school voor SO/VSO, located in Beverwijk .

Ambulante support
Apart from the education at the locations above, 'Ambulante Begeleiding'offers support to students that follow regular education, including professional training (MBO). The region of this Heliomare education service is the province of Noord-Holland.

Observation class
This is a class in which children between 6 and 20 year old with traumatic history like encephalitis, accident or other problems, show divergent learning behaviour and achievements. Heliomare helps to put them back on 'education track' again.

Heliomare Living/housing
Heliomare living/housing provides several living arrangements to children, youngsters and adults with a physical and/or multiple disability, a brain injury or an autistic disability. The aim is learn to live on their own and how to participate in society.
The methods it uses are strongly orientated towards the individual. Heliomare has several housing locations in the region, such as a children's home, a housing for adult clients with brain injuries, a training centre for practical living skills, apartments with supported living, guesthouses and holiday homes.

Heliomare daily occupation
The purpose of the activity centres of Heliomare daily occupation is to help disabled people to use their time in a meaningful way. Obviously, the definition of 'meaningful' will be different for each individual and therefore, the requirements, wishes and capabilities of each client are of the greatest importance. There are 4 activity centres, and 6 so called work centres that provide services for the regions of Kennemerland, Zaanstreek/Waterland, Amstelland/De Meerlanden and Amsterdam/Diemen.
At the work centres clients produce for instance art, graphic products, pottery and wooden garden furniture.

Heliomare sports
The promotion of active participation in sports and the offer of active movement to clients is the central philosophy of Heliomare sports. It services the inpatients of the Rehabilitation centre as well as individual outpatients and groups in the province of Noord-Holland. Apart from that there is the so called Sport Medic Consult, a combination of sport and rehabilitation. It also offers services to Paralympic athletes.

Research and Development
Research and Development on all aspects of the services of Heliomare is a constant demand. The R&D department works together with several universities. Test results and new knowledge are not only offered to Heliomare itself but also to other stakeholders

Network
The different business units that constitute Heliomare form a network and a linking chain, which can provide answers to all of the client's questions. There is a high degree of cooperation between the different units, especially when this is necessary for the client.
To create as much synergy as possible, the business units are striving to achieve even closer cooperation. In order to do this, treatment programmes are tailored to fit one another

and more knowledge and experience can be exchanged between the different business units. This exchange results in optimal cohesion between these units and allows the client to obtain an even better service. In the treatment of a child, for example, the cooperation between a rehabilitation specialist and the teachers will result in a better integration of the medical rehabilitation and the special education process. As part of this 'expanded cohesion', the client is aware that all the business units are operating under the wings of 'Heliomare'. This reassures and helps creating an atmosphere of peace and certainty.

Client centred
Today's clients are increasingly involved. They know what they want and are presented with more options than ever before. At Heliomare, the clients are of the utmost importance. Their needs are accommodated, by working within a question-driven environment, by ensuring that the business units cooperate, and by delivering the best possible quality. Considering the varied character of Heliomare's services, its target group is not easily reduced to one common denominator. Patient, parent, pupil, resident or participant, the precise identity of the client will differ depending on the unit. Yet the clients frequently demand that their questions receive a cohesive response, which may involve a number of departments.
All of Heliomare's business units strive to develop a more question-driven approach to clients. Each unit of Heliomare has proven expertise in its own particular area. The enormous amount of knowledge and experience within the separate units is too valuable for internal utilization only.
Consequently, the units cooperate as much as possible. Thus the mutual strengths are used to greater effect. Heliomare is working hard to achieve synergy. Not just by working together internally, but also by cooperation with external agencies.

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Abstracts 3rd International FCE Conference

Title 1

Grip Strength as a Predictor of Work Ability: A Scoping Review

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Background: Work-related musculoskeletal disorders are costing employers approximately 20 million dollars in direct medical costs, and these costs are continuing to increase at an unsustainable rate. Many measures are used to assess an injured worker's ability to return to work. One specific measure, the grip strength measure that is taken by hand-held dynamometer, is frequently used as a stand-alone measure or in conjunction with other physical measures such as a functional capacity evaluation for assessing work ability. To this date, a review of the literature has not been performed to assess the predictive value of grip strength relative to work ability. *Objective:* Research question: What is the predictive value of grip strength using dynamometry relative to work ability?

Methods: A scoping review was conducted to examine the evidence in 15 peer-reviewed research articles that addressed the relationship between grip strength and work ability, work performance, specific job tasks, and work environment.

Results: Limited evidence supports that grip strength loss is a predictor for time to return to work (17%) as a stand-alone measure. Grip strength was weakly to strongly associated with work ability; however, when multivariate analyses were performed other variables often proved to be better predictors of work ability, return to work, and time loss from work than was grip strength.

Conclusion: The findings of this study suggest that grip strength has a mild to strong positive relationship with work ability and work performance. However, the literature does not yet provide sufficient evidence on the extent to which grip strength predicts work performance or work ability. Additionally, the research that was performed in this area included variables of similar characteristics (i.e. grip strength and pinch strength). Therefore, when a regression analysis was performed, it appears that grip strength was not included as a significant variable for predicting return to work due to the colinearity between variables. Given that there is paucity in the literature on this topic and that the quality of what exists tends to be lower, more quality research is needed in this area to further evaluate the predictive value of grip strength.

Title 2

ACPOHE Functional Testing Toolkit

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Background: An important role of Occupational physiotherapists in the UK is to give advice on a person's fitness for the physical demands of their work, in line with existing guidelines. Many physiotherapists use functional testing to do this but there are numerous functional tests available with varying methodologies. ACPOHE (Association of Chartered Physiotherapists in Occupational Health and Ergonomics) want to encourage its members to use standardised functional testing as a routine part of physiotherapy clinical assessment in occupational health.

Objective: To develop an evidence based Functional Testing Tool Kit which encourages clinical reasoning and routine standardised functional testing leading to robust evidence-based fitness for work recommendations by physiotherapists.

Methods: ACPOHE evaluated functional tests within the evidence base and included in the toolkit those which were considered to be robust and clinically useful. A selection criteria included strength of validity and reliability, availability of normative data, practicality and cost The critical appraisal skills programme (CASP) tool was used as the initial framework to critically appraise each functional test. CASP provided guidance to the group and ensured a standardised approach to the appraisal process. If considered suitable for potential inclusion in the toolbox a further in-depth analysis of validity and reliability was undertaken. This included inter-rater reliability, test-retest reliability, concurrent, construct, and predictive validity. Assessment in terms of practicality was also considered and included cost, ease of administration and scoring, time taken and equipment required. The final summary consisted of the strength and weaknesses of each test.

Results : The final Function Testing toolkit comprises of 22 tests. The toolkit includes a test summary, test procedure, reference, normative data and scoring sheet.

Conclusions : The functional testing toolkit provides a set of evidence based functional tests that Occupational physiotherapists can use in routine clinical assessments. This will provide objective outcomes and support fitness to work recommendations.

Title 3

Functional Capacity Evaluation: Performance of Patients with Chronic Non-specific Low Back Pain Without Waddell Signs

Authors & affiliations
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Background: There is evidence that not only physical but also psychosocial factors influence Functional Capacity Evaluation (FCE) results. Such non-organic-somatic-components (NOSC) identified by Waddell signs (WS) testing showed consistent independent prediction for performance during four FCE tests. Within a comprehensive FCE, WS may serve as a validation tool separating results into FCE's reflecting physical capacity and FCE influenced by WS.

Objectives: The primary objective of this study is to evaluate the effect of Waddell signs (WS) on a comprehensive FCE in patients with chronic non-specific low back pain (CNSLBP) undergoing fitness for work evaluation. If an effect is observed, the secondary objective is to report performance of patients without WS in a comprehensive 1day FCE protocol.

Methods: Survey of patients with CNSLBP as their primary complaint, referred for fitness for work evaluation, age between 20 and 60 years. Main outcome measures were WS and performance during manual handling assessed with lifting from floor to waist, waist to crown, horizontal and one handed carry; grip strength with Jamar hand held Dynamometer; ambulation with stair climbing and six minute walking test; work postures with elevated work, forward bend standing, kneeling, and sitting.

Results: 145 male with a mean age of 44.5 years (±10.1), and 53 females with a mean age of 43.6 years (±11.0) were included. Mean days off work were in male 658 (±1,056) and in female 642 (±886). 33 % of all patients presented positive WS. FCE performance in male and female patients with positive and negative WS differed significantly in all comparisons except grip strength of the dominant hand and sitting in female. Performance of patients with negative WS indicated a mean physical capacity corresponding to light-medium work in females and medium work in males for both age groups.

Conclusions: WS should be assessed for interpretation of FCE results. Despite long work absence, patients with CNSLBP with negative WS demonstrated a physical capacity corresponding to substantial physical work demands.

Title 4

Comparison of two methods for interpreting lifting performance during Functional Capacity Evaluation

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Background: Functional Capacity Evaluation (FCE) requires an effort determination by observation of effort indices for performance interpretation. 'Waddell signs' have shown to be associated with decreased functional performance. The question arises whether effort determination by observational criteria and 'Waddell signs' testing can be interchangeably used to interpret lifting performance.

Objectives: To assess the concurrent validity of 'submaximal-effort' rating and positive 'Waddell signs' and whether these contribute independently to lifting performance.

Methods: 130 patients with chronic nonspecific low back pain referred for fitness-for-work evaluation were included. Physical effort determination based on observational criteria was performed during FCE of lifting from 'floor to waist', 'waist to crown', and 'horizontal'. A second tester conducted 'Waddell signs' testing. Concurrent validity of 'Waddell signs' with 'submaximal-effort' was assessed by calculating sensitivity and specificity. Hierarchical regression analysis was used to determine the contribution of 'Waddell signs' and 'submaximal-effort' to lifting performance. Age and gender were covariates.

Results: Low sensitivity of 'Waddell signs' for 'submaximal-effort' determination by the FCE assessor was found. Between 53%-63% of the patients classified as showing 'submaximal-effort' presented positive 'Waddell signs'. 'Waddell signs' and 'submaximal-effort' were independent contributors to lifting performance. The contribution of 'submaximal-effort' was higher than that of 'Waddell signs', shown by 20 – 29% higher explained variation in lifting performance if 'submaximal-effort' was added to the model' compared to 3 – 6% higher explained variation if 'Waddell signs' were added.

Conclusions: In patients with chronic nonspecific low back pain, 'Waddell signs' testing and determination of physical effort by observational criteria should not be interchangeably used for interpreting lifting performance during FCE. Despite promising results for the validity of the observational criteria applied during FCE, further research on 'physical effort evaluation' is needed.

Title 5

Development and validation of a pain behavior assessment in patients with chronic low back pain

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Background: High levels of pain behavior adversely affect the success of multidisciplinary rehabilitation of patients with chronic nonspecific low back pain (CNSLBP). Functional capacity evaluation (FCE) assessment should detect high levels of pain behavior to prevent the inclusion of unsuitable patients to functional rehabilitation programs.

Objectives: The aim of this study was to develop a Pain Behavior Assessment (PBA) and to evaluate its construct validity.

Methods: The PBA was developed by experts in the field and is literature-based. Inclusion criteria for participants of the validation study were: CNSLBP, age 20–60 years, referral for fitness-for-work evaluation. The PBA was applied by physiotherapists during FCE. Rasch analysis was performed to evaluate the construct validity of the PBA. Internal consistency was indicated by the person separation index (PSI), which corresponds to Cronbach's alpha.

Results: 145 male (72.5 %) and 55 female patients were included. Rasch analysis removed 11 items due to misfit and redundancy, resulting in a final PBA of 41 items. Item mean fit residual was -0.33 (SD 1.06) and total item Chi square 100.39 (df = 82, p = 0.08). The PSI value was 0.83. DIF analysis for age and gender revealed no bias.

Conclusions: The PBA is a valid assessment tool to describe pain behavior in CNSLBP patients. The high PSI-value justifies the use of the PBA in individuals. The PBA may help to screen patients for high levels of pain behavior.

Title 6

Development of a modified version of the Spinal Function Sort (M - SFS): A mixed method approach

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Background: The Spinal Function Sort (SFS) consists of 50 depicted items which are linked to demonstrable, specific work-related tasks which involve the spine. The SFS has shown to be useful in addition to Functional Capacity Evaluations. The SFS has been translated and validated in different languages and is used in several countries. However, several studies indicated that practicality and measurement properties of the SFS could be improved.

Objectives: To develop a modified version of the Spinal Function Sort (M – SFS) measuring work related self-efficacy beliefs in patients with chronic low back pain.

Methods: A mixed method design consisting of three different methods (M) was performed. In interviews, participants were asked how often they perform the activities of the 50 SFS items in one week, and in semi-structured interviews which spinal postures and movements were associated with their back pain (M 1). Quantitative analysis of previously obtained SFS data investigated internal consistency, unidimensionality, item response, and floor and ceiling effect (M 2). Experts rated the SFS items based on their relevance (M 3). The findings from these methods were used within a final scoring system for item reduction.

Results: From semi-structured interviews with 17 participants, eight new items emerged (M 1). Quantitative analysis of 565 data sets (M 2) revealed very high internal consistency of all items (Cronbach's alpha = 0.98) indicating item redundancy, unidimensionality of the SFS was supported by Principal Component Analysis (PCA), good item response was confirmed by Rasch analysis, and a floor effect of four items depicting very heavy material handling was found. Experts agreed on 8 out of the 50 SFS as relevant (M 3). From the original SFS, 12 items met the predefined summary score of 9.

Conclusions: A modified version of the SFS and a new picture catalog have been developed. The feasibility, reliability and validity of this modified version was tested with a separate population of 60 patients. The results will be presented at the FCE conference 2016 in Wijk aan Zee, the Netherlands.

Title 7

Development and reliability testing of a qualitative score for rating compensatory movements in upper limb prosthesis wearers during execution of 4 FCE-tests.

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Background: Musculoskeletal complaints (MSC) are twice as prevalent in persons with an upper limb defect compared to the general population. Overuse of the sound limb or compensatory movements of the affected limb may explain this difference.

Objectives: To develop 1) a qualitative scoring system for rating compensatory movements in upper limb prosthesis wearers during the performance of functional capacity evaluation tests adjusted for one handed individuals (FCE-OH), and to determine 2) the inter- and interrater reliability and 3) the feasibility of the scoring system.

Methods: The scoring system was developed in three subsequent steps following an international guideline for instrument development. Twelve (inter-) national FCE-experts, 6 physiotherapists, 12 upper limb prosthesis wearers, and 20 healthy controls were involved in the development. During reliability testing the raters scored videotapes of participating upper limb prosthesis wearers and controls, performing 4 FCE-OH tests two times (two weeks apart), using the developed scoring system. Feasibility was determined by using a questionnaire.

Results: Kappa value for intrarater reliability was 0.77. Kappa values for interrater reliability in the first and second rating sessions were κ=0.54 and κ=0.64, respectively. Feasibility was rated as good to excellent.

Conclusions: A feasible scoring system was developed to assess compensatory movements in upper limb prosthesis wearers when executing FCE-OH tests. Intrarater reliability was good, interrater reliability was satisfactory in most instances. The standardized scoring system for assessing compensatory upper limb movements during performance of FCE-OH tests may provide clinicians with useful information for prevention and treatment of MSC in upper limb prosthesis wearers.

Title 8

Development of a functional capacity evaluation measurement for individuals with upper limb reduction deficiency or amputation.

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Background: Functional capacity evaluations (FCEs) are developed for two-handed individuals. Due to the general young age of individuals with upper limb absence (ULA), which means that they have many working years ahead of them, and their high risk on musculoskeletal complaints, an FCE for these is individuals warranted.

Objectives: Objectives of this study were to develop and pilot test a functional capacity evaluation (FCE) for individuals with ULA, due to an upper limb reduction deficiency or amputation, and to compare test results with matched controls.

Method: An existing FCE, based on risk factors for work-related upper limb disorders, was adapted for use in one-handed individuals, with or without a prosthesis. The adapted FCE was pilot tested by 20 individuals with ULA (of which 10 with a below elbow ULA and 10 with an above elbow ULA; 17 males, and a mean age of 46.3 (SD: 10.5)), and 20 controls matched for sex, age, height and weight.

Results: The adapted FCE was named FCE – one-handed (FCE-OH) and consisted of the following tests: overhead lifting one-handed and two-handed, overhead working, repetitive reaching, fingertip dexterity and hand grip strength. Changes to tests were kept as small as possible, in order to allow future comparison with reference data for the working population. Individuals with ULA lifted significantly less compared to the matched controls. No differences for the other tests were found. Prosthesis users, performed the repetitive reaching test faster with their unaffected hand and placed more pins with this hand in the fingertip dexterity test, compared to the prosthesis hand.

Conclusion: The FCE-OH allows to test the functional capacity of the upper extremities of one-handed individuals, with or without a prosthesis, in a standardized environment. The FCE will enable rehabilitation physicians and therapists to objectively assess the physical capacity of an individual with ULA and give them substantiated advice regarding suitable work, and return or continuation of work. Results of the overhead lifting test were significantly influenced by the one-handedness of the participants. Now that the FCE-OH has been developed, further research on the relationship between the test results and MSC is in place.

Title 9

Do Wearable Fitness Devices Correlate With Performance-Based Tests of Work-Related Functional Capacity

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Background: The use of wearable accelerometers in conjunction with Functional Capacity Evaluation (FCE) may provide additional useful information about day-to-day function or maximum performance in workers. However, little research has been conducted to compare FCE performance with accelerometer output.

Objective: The objectives of this study were to: (1) Determine the magnitude and direction of correlation between participant performance on five exercises taken from a FCE and scores from Actigraph activity monitors; and (2) Compare the results of two different placements of Actigraph devices.

Method: We used a cross-sectional design and convenience sampling to collect data from 46 healthy participants. Each participant completed 5 exercises selected from the WorkWell FCE protocol while wearing 2 Actigraph devices, 1 on the dominant side waist and 1 on the non-dominant wrist. The exercises included 5-repetition maximum lifting (floor-to-waist, overhead and front carry), a sustained overhead work endurance task, and the 6-minute walk test. Analysis included calculating Pearson regression coefficients between maximum FCE item performance and Actigraph vector magnitudes (VM) along with Intraclass Correlation Coefficients (ICC) to compare VM activity counts derived from the Actigraphs on the waist and wrist.

Results: Thirty-Nine (84.8%) participants had complete data and were included in analysis. Participants were predominantly young (x=23.73), males (54.30%). Findings indicate Actigraph VM data from the device worn on the waist correlated positively with maximum lift performance ($r = 0.39 - 0.64$, $p < 0.001$ to 0.08) and 6-minute walk distance ($r = 0.66$, $p < 0.001$) Actigraph data from wrist placement was not significantly correlated with FCE performance except when comparing average VM data and waist to crown lift ($r = 0.44$, $p < 0.001$). There was no significant correlation in either Actigraph placement for VM and overhead work time. ICCs between the two Actigraph placements ranged from poor to acceptable agreement (ICC =0.24-0.70, $p < 0.001$ to 0.19).

Conclusions: Actigraph device output correlated moderately with maximum performance on FCE lift and ambulation tests. Waist placement appears more suitable than wrist during performance-based tests. Actigraph devices may be useful during FCE evaluations and add another quantitative indicator of performance.

Title 10

ICF as the conceptual framework for FCE. Linking FCE tests to the ICF Comprehensive Core Set of Vocational Rehabilitation

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Backgroud: Due to inconsistent terminology, experts agreed on using the International Classification of Functioning, Health and Disability (ICF) as the conceptual framework for Functional Capacity Evaluations (FCE). The objectives of the study were to translate the Spinal Function Sort questionnaire into Finnish and Swedish, link FCE tests to the comprehensive ICF core set of vocational rehabilitation and to evaluate how precisely it is possible to describe the level of functioning of a person with low back pain using this core set.

Methods: The Spinal Function Sort (SFS) was translated into Finnish and Swedish using the 3-step cross-cultural adaptation. SFS and FCE tests (Complete Minnesota dexterity test, grip strength, lifting, carrying, pushing and pulling) were linked to the vocational rehabilitation core set by two independent raters during spring 2016. Results, including inter-rater agreement (Kappa Index) will be available to present in Wijk aan Zee, The Netherlands, September 29, 2016.

IMPLEMENTATION OF THE RESULTS AND SIGNIFICANCE OF THE STUDY

Future steps: Twenty subjects suffering from low back pain will be recruited through the occupational health services in Pietarsaari and Kokkola area, Finland 1.9.2016-31.5.2017. Participants will perform the FCE tests after being evaluated by the occupational health doctor. The results will be described using items from the vocational rehabilitation core set. After that the researcher will evaluate, according to the set criteria, whether or not the vocational rehabilitation core set is accurate enough to describe the participants' functional capacity.

This research will provide a Finnish and Swedish translation of the Spinal Function Sort. The ICF linked FCE tests can be added to the TOIMIA – database (www.thl.fi). ICF linked FCE tests will provide a common language to facilitate communication among evaluators from different disciplines, make it possible to compare data, both between countries and between different institutions as well as over time.

Title 11

Associations of lifted weight and self-rated return-to-work prognosis

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Background: In Germany, work-related medical rehabilitation (WMR) is an intervention to improve and to restore work ability in patients with an increased risk of permanent work disability. Functional capacity evaluation (FCE) is a major component of WMR. The current WMR guideline recommends a short FCE at admission in order to establish the rehabilitation plan. We examined how lifting floor-to-waist results (premature test termination, lifted weight) were associated with the self-rated return-to-work-prognosis.

Methods: Data come from the German arm of an ongoing international FCE study. In case of lifted weight, receiver operating characteristic (ROC) curves were analyzed in order to determine how the lifted weight differed between patients according to self-rated return-to-work-prognosis.

Results: The current sample includes 90 patients (50% women, mean age 46.8 years). 43.3% of the tests were terminated prematurely. Test terminations were most frequently due to the patient's decision (18.9%). However, reasons for test terminations were not well documented (15.6% not documented). While premature test termination was only slightly associated with self-rated return-work prognosis, there was a clear association between lifted weight and self-rated return-to-work prognosis. The area under the ROC curve of 0.728 (95% CI 0.623-0.833, $p<0.001$) indicated that the lifted weight differed substantially between patients with poor and good return-to-work prognosis. Patients with a poor return-to-work prognosis had significantly lower lifting scores. Moreover, multivariate analysis showed that lifted weight was a stronger predictor of a poor return-to-work prognosis than pain and self-rated work ability.

Discussion: FCE adds clinical meaningful data in order to understand a poor return-to-work prognosis even if a test is terminated prematurely. Documentation of test terminations needs to be improved in German rehabilitation centers.

Title 12

Sustainable return to work among construction workers on sick leave due to musculoskeletal disorders: what is the added value of action versus a question?

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Objective: This study aims to evaluate whether performance-based tests have additional prognostic value over self-reported work ability for sustainable return to work (RTW) in physically demanding work.

Methods: A one-year prospective cohort study was performed among 72 construction workers on sick leave for six weeks due to musculoskeletal disorders. The Work Ability Index (WAI) question regarding “current work ability” was used. Three dynamic lifting tests were used from a Functional Capacity Evaluation (FCE). Sustainable RTW was the number of days on sick leave until the first day of returning fully to work for a period of ≥4 weeks. Regression models were built to calculate the prognostic values.

Results: Self-reported work ability alone predicted sustainable RTW (R=0.31, R2=0.09, P=0.009). In combination with one lifting test, the explained variance (R2) increased to 0.16 (P=0.001).

Conclusion: Combining self-reported work ability and a lifting test nearly doubled the explained variance for sustainable RTW in physically demanding work, although the strength remained modest.

Title 13

The predictive validity of a workplace-specific and strain-related short-form Functional Capacity Evaluation in patients with musculoskeletal disorders

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Background: In Germany, Functional Capacity Evaluation (FCE) is most commonly used within the work-related medical rehabilitation to assess the physical capacity of a patient in relation to a specific workplace. Even so, there is still less evidence concerning the predictive validity of FCE.

Objective: The aim of the study was to determine the ability of a short-form FCE, in which the selection of specific FCE-tests is based on the subjective workplace-related strain, to predict sustainable return to work (RTW).

Methods: In this multicentric prospective cohort study, patients with musculoskeletal disorders filled in questionnaires at admission and three month after discharge. An FCE was performed at admission and discharge. Sustainable RTW was defined as a combination of employment at 3-month follow-up with less than 1.5 weeks sick leave because of musculoskeletal disorders within the follow-up period. As predictive FCE information, the work-related physical capacity, assessed by therapists (very good to very poor), was analyzed. Logistic regression models (crude and adjusted for the concurrent predictors employment, sick leave at admission, patients' prognosis of expected work disability, vocational education, kind of occupation and patient's prognosis of RTW) were created to predict RTW.

Results: Complete data were obtained for 198 patients (34% female, mean age 48 years, 82% working at least 3h/day at admission). The mean number of selected FCE-tests was 3.5. At follow-up, sustainable RTW was judged as failed for 41.0%. Discriminating between a positive (moderate to very good) and negative (rather poor and very poor) FCE-rating at discharge, RTW was correctly predicted for 145 of 198 patients (73.2%), with a high sensitivity (94.9%) and a poor specificity (42.0%). The FCE-information predicted RTW in the crude as well as in the adjusted regression model. Integrating the FCE-information at admission into the reference model led to a significant increase from 44.5% to 46.5%.

Conclusions: Sustainable RTW can be predicted by using a workplace-specific and strain-related short-form FCE in patients with musculoskeletal disorders.

Title 14

Upper Limb Isokinetic Strength Assessment Applicability in Work Injury Patients

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Background:
Work related upper limb injuries (WRULI) are a major concern in rehabilitation settings. Isokinetic strength assessment may be a central part of rehabilitation process as well as permanent impairment evaluation. However, maximality of effort should be assured.

Objective:
The first aim of the present study is to examine the applicability of the isokinetic difference eccentric to concentric (DEC) parameter for identifying submaximal effort in healthy volunteers and workers with potential weakness of upper limb muscles (namely shoulder external rotators (SER), wrist palmar flexors (WPF) and wrist dorsal flexors (WDF)). The second aim of the study is to explore isokinetic test parameter usefulness in WRULI assessments.

Methods:
1st objective: Two groups of seventeen and Twenty healthy male volunteers aged 20-40 years without prior history of upper limb injury were instructed to exert maximal effort and then simulate weakness of SER muscles and the WF and WE muscles respectively. The muscular output was mechanically measured using isokinetic dynamometry and a well-established test protocol. DEC was calculated for all actions.
2nd objective: A cross sectional study of seventy-four (33 female and 41 male) patients who claimed compensation for work-related shoulder injury was designed. SER muscle isokinetic strength was tested and DEC and deficits calculated. Finally, a prospective study including sixty-eight (22 female and 44 male) patients who claimed compensation for work-related chronic forearm injury was designed. Study consisted in forearm muscle isokinetic test performance, DEC parameter calculation, isokinetic parameters (strength deficits and WPF/WDF ratios) and analysis and prospective evaluation of patient final functional outcome and injury relapse within the first year after discharge.

Results:
Both shoulder and wrist muscles (namely SER, WPF and WDF) submaximal effort DEC values were significantly higher than their maximal effort counterparts. Thus DEC cutoff levels could be set above which a particular effort could be submaximal (SER: 0.81; WPF: 0.015; WDF: 0.14). Sensitivity and sensibility were 100%/100%; 65%/65% and 80%/85% for SER, WPF and WDF respectively.
Application of DEC in real shoulder injury patient SER maximality of effort revealed a 45 % and 17% prevalence of submaximal effort in women and men respectively. Such difference of proportions was highly significant. In forearm injury patients, application of DEC in WPF showed a submaximal effort prevalence of 22.7 and 18.2% for women and men respectively. Finally, WDF submaximal effort prevalence was 4.55% and 18.2 % for women and men respectively. Proportion of submaximal effort comparison between genders did not show significant differences.

Both shoulder injury patient with previous shoulder surgery and with permanent disability showed significantly higher deficits that the non-surgical/ non-disability counterparts. Significant differences, however, could only be demonstrated in the disability/non-disability group comparison.
Regarding forearm injury patients, women with previous surgery showed significantly higher PF and DF strength deficits than non-surgical ones, whereas palmar FP/DF ratios did not differ between surgical and non surgical patients. In men, surgery did not implied significantly different deficits. Regarding final functional outcome, men with some kind of permanent impairment showed a significantly lower PF/DF muscle ratio whereas deficits did not show any significant relationship. Finally, men, which suffered a relapse within a year after the test performance, showed significantly higher PF/DF ratios and significantly lower PF and DF strength deficits.

Conclusion:
The findings support that the DEC is an efficient parameter to assess SER, WPF and WDF muscle maximality of effort. The application of the DEC for isokinetic test performance evaluation in WRULI patients can also be backed. In terms of SER status in male worker injury, the results support the application of isokinetic tests both in the clinical and medicolegal sense. However, the gender discrepancy deserves further research. Regarding WPF and WDF in both female and male workers, the results support the clinical and medico-legal applicability of isokinetic test parameters and, particularly, WPF/WDF ratios might have predictive validity of injury relapse.

Title 15

Proposed Inclusion of Work Physiology in FCE Testing – Heart Rate Reserve Method

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Abstract:
Analysis of heart rate response to activity is not a standard method in the determination of full time work tolerance in FCE protocols. A recent pilot study revealed a lack of physiological data in current FCE practice in the United States. The purpose of this guided discussion is to spark a conversation about the use of heart rate data in determining full time work tolerance during FCE testing. The current utility of work physiology measures in commercial FCE methods will be reviewed and rationale for the inclusion of HRR method will be provided with examples. During the guided discussion, participants will consider and propose study designs to test the utility and reliability of the HRR method for the determination of full time work tolerance during FCE protocols.

PDF articles Conference summary: the first and second international functional capacity evaluation research meeting in the Journal of Occupational Rehabilitation

2012 = The 1st conference was held in 2012 in the Netherlands, with 48 participants from 8 countries attending. An article summarizing the original conference has been published:
Reneman MF, Soer R, Gross DP. Developing research on performance-based functional work assessment: report on the first international functional capacity evaluation research meeting. *Journal of Occupational Rehabilitation.* 2013;23(4):513-5.

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Developing Research on Performance-Based Functional Work Assessment: Report on the First International Functional Capacity Evaluation Research Meeting

M. F. Reneman · R. Soer · D. P. Gross

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Abstract *Introduction* Research on Performance-Based Work Assessment, also known as Functional Capacity Evaluation (FCE), has evolved substantially over the past decades. Although this field of research has developed, the use of FCE has been an object of discussion and debate internationally. Unfortunately, there has been no platform or infrastructure available for FCE researchers to present their research, discuss, and collaborate. *Methods* An International FCE Research Meeting was held in Haren, The Netherlands on October 25, 2012, with 48 participants from eight countries. The meeting consisted of presentation of new research, two debates, and an open discussion that aimed at creating an overview of gaps in research as identified by the participants. *Results* The discussion resulted in the identification of 17 research needs, which are listed in this paper. Important categories were: further validation of FCE across settings, jurisdictions and patient groups; additional impact and cost-effectiveness evaluation of FCE compared to alternatives; and the use of ICF as guiding framework. *Conclusion* Researchers, clinicians, and other professionals in the FCE area are interested in improving the quality and content of FCE research by setting a common set of priorities and creating an international peer network.

Keywords Functional capacity evaluation · Work assessment · Disability evaluation · Knowledge transfer

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Background

Research on Performance-Based Functional Worker Assessment, also known as Functional Capacity Evaluation (FCE), has evolved substantially over the past decades. A brief PubMed search from 1990 to September 2012 reveals over 130 papers published in peer-reviewed literature written in English (Key-words: functional capacity evaluation, and the names of key authors). Of those papers, 73 % provided new original data, 18 % were opinion papers, and 9 % were (systematic) reviews. FCE research producing countries were: the Netherlands (38 % of the publications), Canada (17 %), USA (20 %), Australia (12 %), Germany (4 %), Switzerland (4 %), Hong Kong/China (3 %), South Africa (1 %) and Israel (1 %). The papers were published in 33 Journals, of which the most frequent (≥5 %) were: Journal of Occupational Rehabilitation (29 %), WORK (17 %), Archives of Physical Medicine and Rehabilitation (7 %), and Disability & Rehabilitation (6 %). Over 90 % of the articles have been published since the year 2000.

Although this field of research has evolved, FCE results and its clinical applicability have been subject to diverse interpretations leading to discussions in international literature related to prognostic value of FCE and use in sincerity-of-effort determinations [1–6]. Different theoretical frameworks, developed and adapted by clinicians, researchers and commercial parties, have led to substantial controversies. This includes whether FCE results should be

PDF articles Conference summary: the first and second international functional capacity evaluation research meeting in the Journal of Occupational Rehabilitation

2014 = The 2nd conference was held in 2014 in Toronto, Canada, with 54 participants from 9 countries attending. An article summarizing the original conference has been also published:

James CL, Reneman MF, Gross DP. Functional Capacity Evaluation Research: Report from the Second International Functional Capacity Evaluation Research Meeting. *Journal of Occupational Rehabilitation.* 2016;26(1):80-3.

J Occup Rehabil
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Functional Capacity Evaluation Research: Report from the Second International Functional Capacity Evaluation Research Meeting

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Abstract *Introduction* Functional capacity evaluations are an important component of many occupational rehabilitation programs and can play a role in facilitating reintegration to work thus improving health and disability outcomes. The field of functional capacity evaluation (FCE) research has continued to develop over recent years, with growing evidence on the reliability, validity and clinical utility of FCE within different patient and healthy worker groups. The second International FCE Research Conference was held in Toronto, Canada on October 2nd 2014 adjacent to the 2014 Work Disability Prevention Integration conference. This paper describes the outcomes of the conference. *Report* Fifty-four participants from nine countries attended the conference where eleven research projects and three workshops were presented. The conference provided an opportunity to discuss FCE practice, present new research and provide a forum for discourse around the issues pertinent to FCE use. Conference presentations covered aspects of FCE use including the ICF–FCE interface, aspects of reliability and validity, consideration of specific injury populations, comparisons of FCE components and a lively debate on the merits of 'Man versus Machine' in FCE's. *Future directions* Researchers, clinicians, and other professionals in the FCE area have a common desire to improve the content and quality of FCE research and to collaborate to further develop research across systems, cultures and countries.

Keywords Functional capacity evaluation · Work assessment · Disability evaluation

Background

Functional capacity evaluation (FCE) is a performance-based measure of ability to inform decisions about a worker's capacity for participation in work activities. FCEs are often used in occupational and vocational rehabilitation to screen potential employees as pre-employment assessments, to assess physical rehabilitation needs, to determine work readiness and job placement following injury, to facilitate return to work, and to determine a person's functional capacity for compensation or litigation reasons [1–7].

The field of FCE research has continued to grow with over twenty articles specific to FCEs published since the 1st International FCE Research Conference in September 2012 (search via Medline and PubMed). This new research builds on existing literature specifically investigating the use of FCE with particular populations or injury groups [8–13]; examines reliability and validity of various FCEs or components thereof [14–21]; explores the use of normative data in FCE [22–24]; and compares FCE with other clinical assessment components used to determine function [25–28].

Despite new research published to inform the use of FCE, there continues to be variation in FCE practice due to differences in systems and cultural contexts in which clinicians operate. There is no internationally common

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Streibelt	M	German Federal Pension Insurance	Germany	dr.marco.streibelt@drv-bund.de
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Wierper	D	Ergatis	The Netherlands	wierper@ergatis.nl
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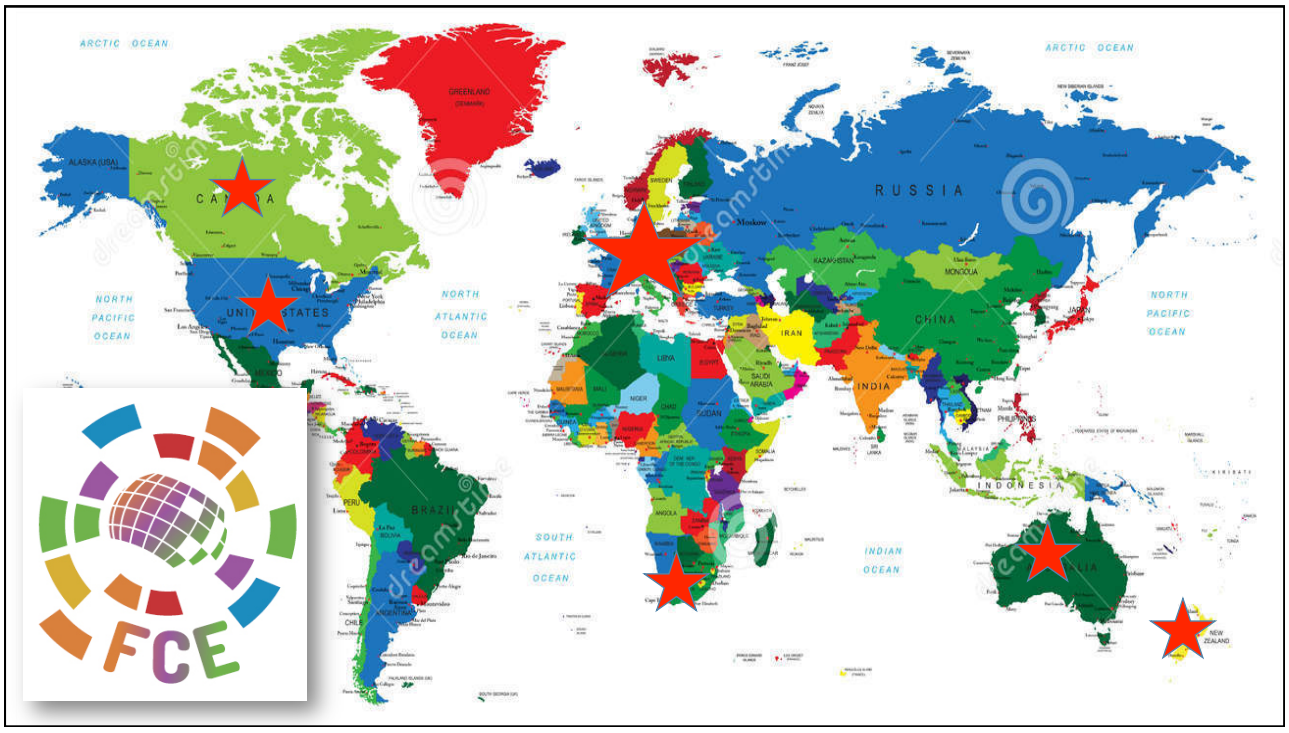
3nd International FCE Research Conference

WELCOME

September 29, 2016

Wijk aan Zee – Netherlands



Update since last symposium in Toronto

- Paper published JOR
- ICF Keynote – presented today
- Multicounty study – presented today
- Observation comensatory movements – presented today
- …
- …

Thanks

- LOC – Michel Edelaar
- Scientific Committee – Carole James
- All who have submitted an abstract
- All presenters
- All active participants
- Heliomare and Vroege Interventie

- Scientific platform – informal
- Presenters: time = time

Functional Capacity Evaluation in different societal contexts:

Results of a multicountry study

3rd International FCE Research Conference
September 29th, 2016 – Wijk aan Zee (NL)

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Project Team

- *D.P. Gross*
- *J. Kool*
- *P. Oesch*
- *M.F. Reneman*
- *M.A. Trippolini*
- *B.J. van Holland*
- *J. Ansuategui Echeita*

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- **Background**
- Methods
- Results
- Discussion
- Conclusion

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Factors in FCE research

- Delphi studies within ICF framework → BPS model
- Relative small sample size & limited number of countries → unstable models & limited generalizability!
- A systematic review: Focus on Bio and Psycho and limited Social

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(Soer et al. 2008; Lakke et al. 2012; van Abbema et al. 2011)

Between countries

FCE activity	Mean (SD) Netherlands	Canada	Switzerland
Floor-to-waist lift (kg, $n = 564$)	28 (12.9)*	13 (10.4)	16 (6.5)
Waist-to-overhead lift (kg, $n = 564$)	16 (6.1)*	11 (6.1)	13 (4.6)
Horizontal lift (kg, $n = 564$)	34 (15.6)*	17 (9.8)	20 (7.7)
Right-handed carry (kg, $n = 491$)	24 (10.2)*	15 (8.5)	17 (5.7)
Left-handed carry (kg, $n = 490$)	23 (9.7)*	15 (8.4)	16 (5.5)
Front carry (kg, $n = 373$)	33 (13.6)*	17 (10.1)	Not tested

*Statistically significant difference between the Dutch and both other samples ($p < 0.01$).

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(Reneman et al. 2006)

Within a country

FCE tests (unit), Mean (SD)	German		Non-German		p value*
	Males n = 69	Females n = 83	Males n = 112	Females n = 50[a]	Language differences
Hand grip strength right (kgF)	45.9 (12.1)	26.0 (8.1)	37.3(12.9)	18.4 (8.2)	<0.001
Lifting waist to overhead (kg)	14.8 (6.4)	10.3 (4.0)	11.9 (6.0)	7.3 (3.7)	<0.001
Overhead working (s)	228.2 (90.0)	222.3 (94.9)	157.8 (95.9)	141.4 (92.0)	<0.001
Repetitive reaching right (s)[a]	76.9 (20.3)	70.7 (25.2)	88.4 (28.1)	84.63 (28.8)	<0.001

FCE tests	Pain now (NRS 0–10)		Functional ability (SFS 0–200)		Disability (NDI 0–50)		Anxiety (HADS A 0–21)		Depression (HADS D 0–21)	
	German	N-German	German	N-German	German	N-German	German	N-German	German	N-German
Hand grip strength right (kgF)[a]	−0.24*	−0.26	*0.26*	*0.43*	−0.16*	−0.32	−0.24	−0.27	−0.18*	−0.27
95 % CI	−0.38 to −0.08	−0.40 to −0.11	*0.10–0.40*	*0.30–0.55*	−0.31 to 0.00	−0.45 to −0.17	−0.38 to −0.08	−0.40 to −0.12	−0.33 to −0.22	−0.40 to −0.12
Lifting waist to overhead (kg)[a]	−0.41	−0.33	*0.50*[c]	*0.64*[c]	−0.34	−0.40	*−0.12*[b,d]	*−0.32*[d]	−0.19*	−0.32
95 % CI	−0.53 to −0.26	−0.46 to −0.19	*0.37–0.61*	*0.54–0.73*	−0.47 to −0.19	−0.52 to −0.26	*−0.27 to 0.04*	*−0.45 to −0.18*	−0.34 to −0.03	−0.45 to −0.18
Overhead working (s)[b]	−0.39	−0.28	0.60	0.52	−0.42	−0.40	−0.20*	−0.30	−0.26	−0.35
95 % CI	−0.52 to −0.25	−0.41 to −0.13	0.48–0.69	0.40–0.63	−0.54 to −0.28	−0.52 to −0.26	−0.35 to −0.04	−0.43 to −0.15	−0.41 to −0.11	−0.48 to −0.20
Repetitive reaching right (s)[b]	0.28	0.27	−0.42	−0.36*	0.39	0.29	0.17*	0.19*	0.30	0.26
95 % CI	0.13–0.42	0.12–0.41	−0.54 to −0.28	−0.49 to −0.21	0.25–0.52	0.14–0.43	−0.41 to −0.11	0.04–0.34	0.14–0.44	0.11–0.40

Cultural differences confirmed because ES ≤0.20 in 18 of 20 comparisons

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(Trippolini et al. 2014)

Within a country

Variable	Level	# and (%) of Participants	Valid	Invalid	χ^2	*p* value	φ
Age (total=69)	Ages 29- 50	35 (51%)	21 (60.00%)	14 (40.00%)	χ^2 (1, 68) = .4365	*p* =.51	φ = -.08, a small effect size
	Over the age of 50	34 (49%)	23 (67.65%)	11 (32.35%)			
Gender (total=69)	Female	23 (33.33%)	12 (52.17%)	11 (47.83%)	χ^2 (1, 68) = 2.0073	*p* =.16	φ = -.17, a small effect size
	Male	46 (66.67%)	32 (69.57%)	14 (30.43%)			
Ethnicity (total=68)	White/ Caucasian	50 (73.53%)	36 (72.0%)	14 (28.0%)	χ^2 (1, 67) = 6.2	*p* =.01	φ = -.30, a medium effect size
	Non-White	18 (26.47%)	7 (38.9%)	11 (61.1%)			
Language (total=68)	English	57 (83.82%)	40 (70.2%)	17 (29.8%)	χ^2 (1, 67) = 7.3	*p* =.01	φ = -.33, a medium effect size
	Spanish	11 (16.18%)	3 (27.3%)	8 (72.7%)			

Measured as Sincerity of Effort

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(Rutherford-Owens and Jones-Wilkins 2014)

Clinician

Variable	Group A	Group B	*P*	Mean Difference Between Groups (95% CI)
Lifting capacity, kg				
All participants	32.1 (13.6), n=124	39.6 (16.4), n=132	.000	7.4 (3.7, 11.2)
Kinesiophobic[b]	28.0 (12.1), n=16	43.6 (21.2), n=20	.01	15.7 (3.6, 27.8)
Nonkinesiophobic	32.6 (13.8), n=107 Missing, n=1	38.9 (15.4), n=112	.02	6.2 (2.3, 10.1)
Borg CR-10 Scale[c]				
Examiners	8.4 (2.0)	8.9 (2.2)	.06	0.51 (0.0, 1.0)
Participants	8.2 (2.2)	9.3 (2.4)	.000	1.1 (0.5, 1.6)

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(Takke et al. 2015; Weir et al. 2013)

Study aim

To evaluate the factors influencing **FCE results** across **multiple countries** and with a variety of **biopsychosocial factors** in patients with painful musculoskeletal conditions.

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- Background
- **Methods**
- Results
- Discussion
- Conclusion

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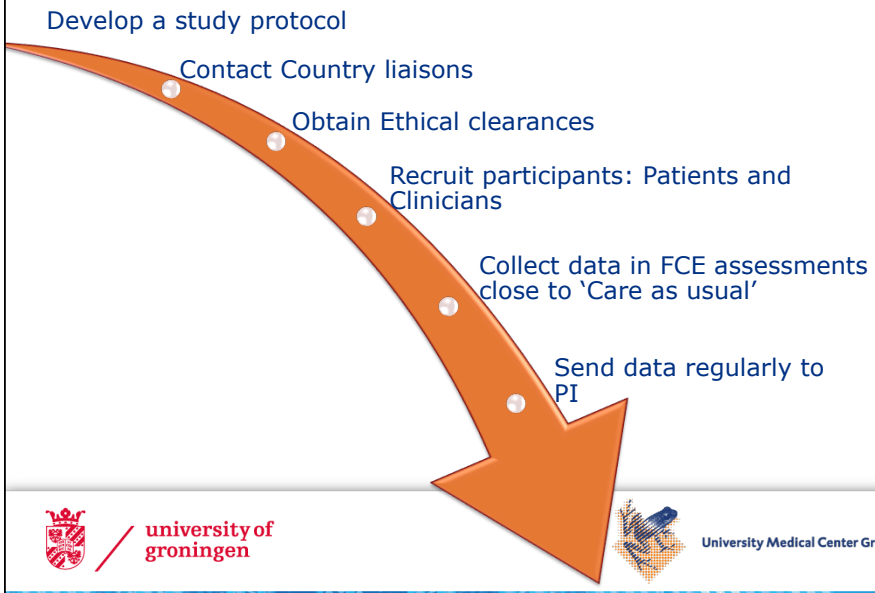
Procedure



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Participants

- Patients:
  - Adults tested with FCE
  - Non-specific sub-acute/chronic musculoskeletal pain
  - Language skills to follow instructions
- Clinicians:
  - FCE assessor with 1 year experience and >20 FCEs
  - English knowledge

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Measurements

FCE:

- Floor-to-Waist Lift:
  - WorkWell
  - WEST-EPIC
  - Blankenship
- Six Minute Walk Test: *'Walk as far as possible for 6 minutes'*
- Handgrip Strength: *'Squeeze as hard as possible 3 times'*

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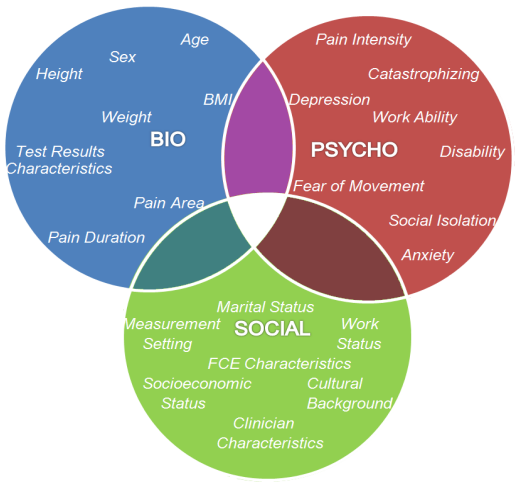
Measurements

Biopsychosocial



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Statistical analyses

- Simple and Multiple regression models:
  - Dependent: FCE test results
  - Independent: Biopsychosocial factors

  Confounders: Measurement country (& Type of protocol)

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- Background
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Sample

- 372 patients
- 54 clinicians
- 18 facilities
- 8 countries

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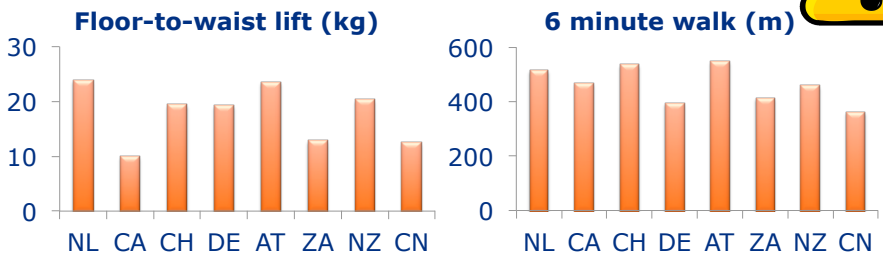
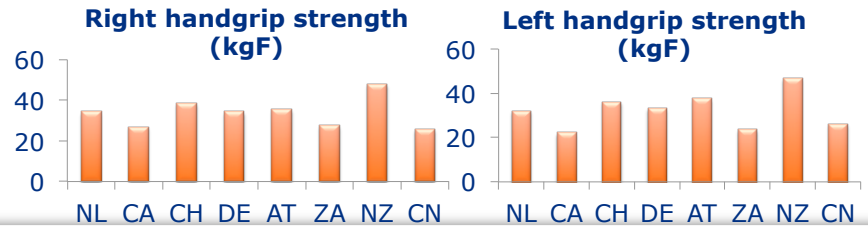
FCE Performance





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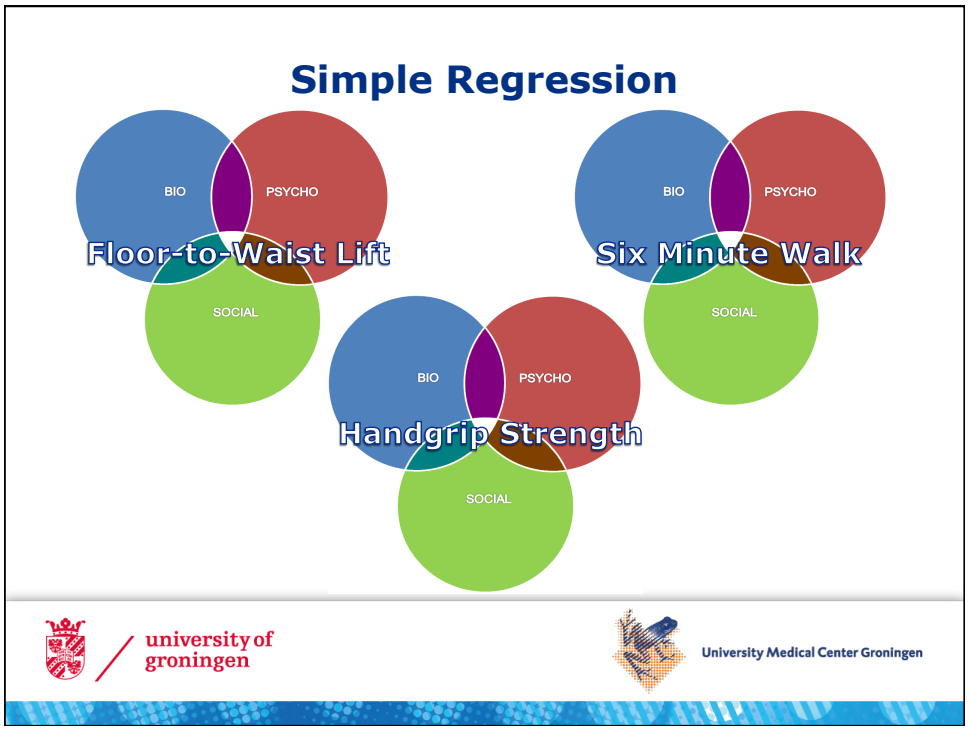
Simple Regression
BIO
PSYCHO
SOCIAL
Floor-to-Waist Lift
BIO
PSYCHO
SOCIAL
Six Minute Walk
BIO
PSYCHO
SOCIAL
Handgrip Strength
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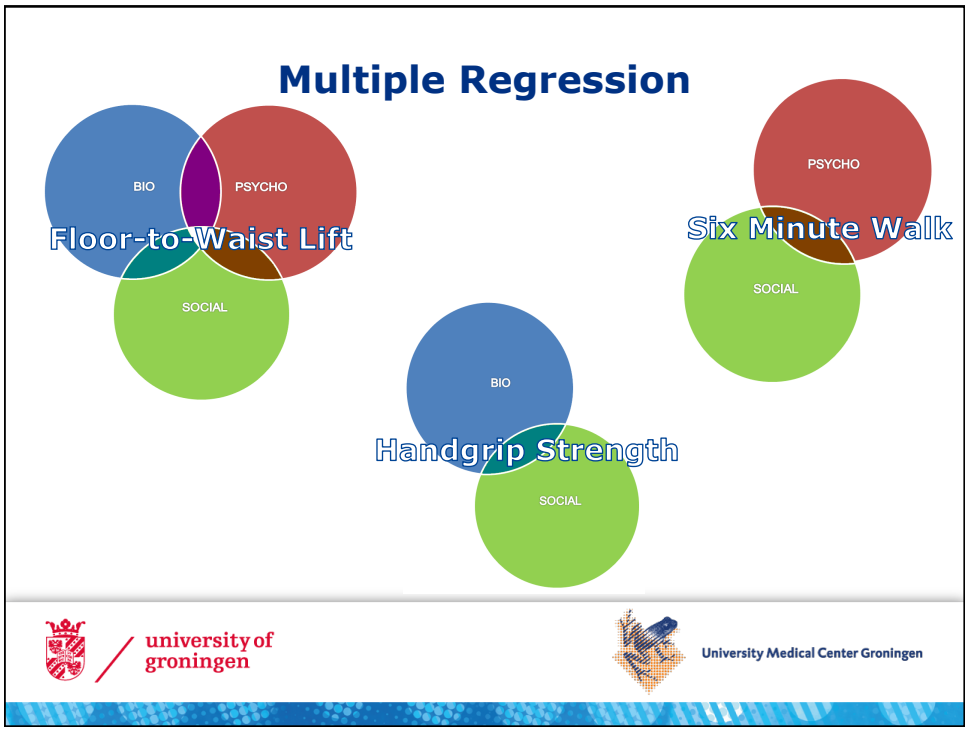
Multiple Regression
BIO
PSYCHO
SOCIAL
Floor-to-Waist Lift
PSYCHO
SOCIAL
Six Minute Walk
BIO
SOCIAL
Handgrip Strength
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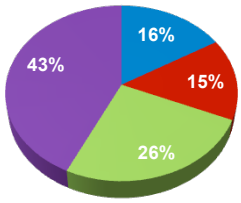
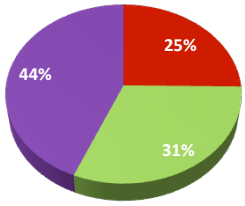
Multiple Regression (R^2)

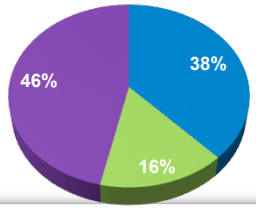
Floor-to-Waist Lift



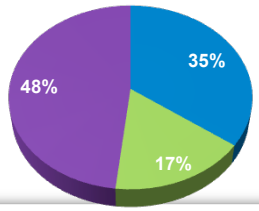
Six-Minute Walk Test



Right Handgrip Strength



Left Handgrip Strength



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Bio Psycho Social Unknown

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Floor-to-Waist Lift

Patient's

Sex (male/female)

Height (cm)

Patient-Reported

Disability (PDI)

Pain Intensity (NRS)

Social Isolation

Clinician's

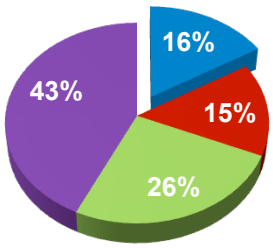
Observed Physical Effort during Lift Test

FCE

Measurement Country

Test Ended Prematurely (yes/no)

Reason for Ending the Test



Bio Psycho Social Unknown

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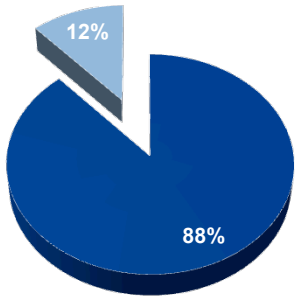
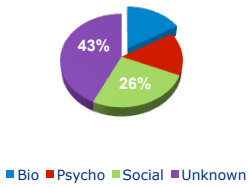
Floor-to-Waist Lift

- **Bio**





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Floor-to-Waist Lift

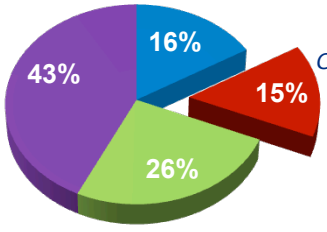
Patient's *Sex (male/female)*

Height (cm)

Patient-Reported **Disability (PDI)**

Pain Intensity (NRS)

Social Isolation



Clinician's *Observed Physical Effort during Lift Test*

FCE *Measurement Country*

Test Ended Prematurely (yes/no)

Reason for Ending the Test

Bio Psycho Social Unknown

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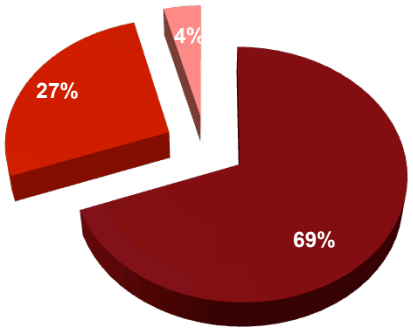
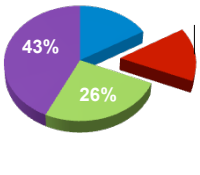
Floor-to-Waist Lift

- **Psycho**





Pain Intensity (NRS) Disability (PDI) Social Isolation

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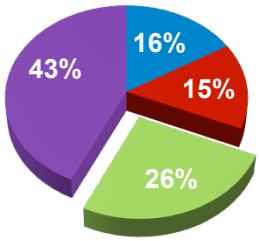
Floor-to-Waist Lift

Patient's	*Sex (male/female)*
	Height (cm)
Patient-Reported	*Disability (PDI)*
	Pain Intensity (NRS)
	Social Isolation
Clinician's	**Observed Physical Effort during Lift Test**
FCE	**Measurement Country**
	Test Ended Prematurely (yes/no)
	Reason for Ending the Test



Bio Psycho Social Unknown

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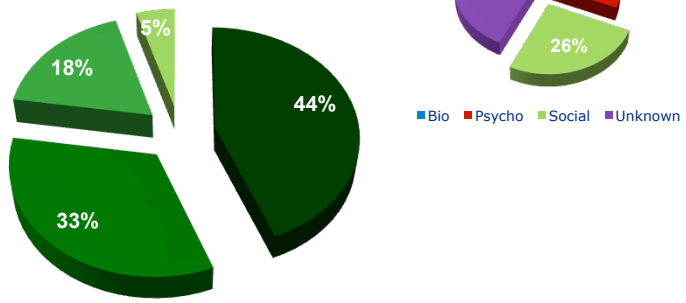
Floor-to-Waist Lift

- **Social**



Reason for Ending the Test
Measurement Country
Observed Physical Effort
Test Ended Prematurely

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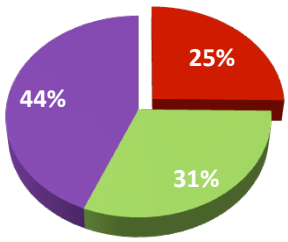
Six Minute Walk

Patient-Reported

Patient's
FCE

Pain Intensity (NRS)
Effort during FCE Test (Borg CR-10)

Days Off Work
Measurement Country
Reason for Ending the Test



Psycho
Social
Unknown

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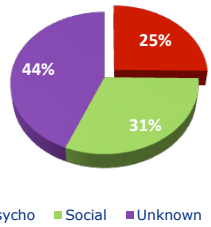
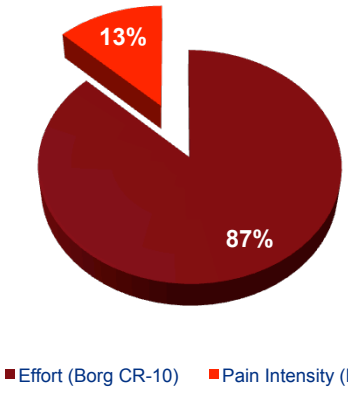
Six Minute Walk

- **Psycho**





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Six Minute Walk

Patient-Reported

Pain Intensity (NRS)

Effort during FCE Test (Borg CR-10)

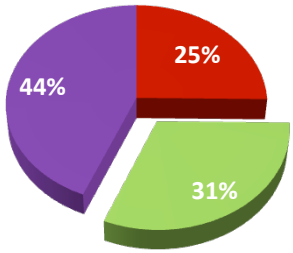
Patient's

Days Off Work

FCE

Measurement Country

Reason for Ending the Test



Psycho Social Unknown

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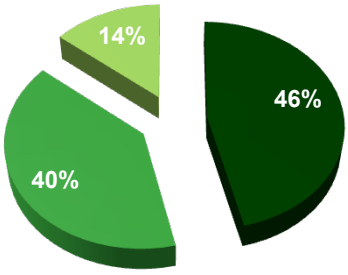
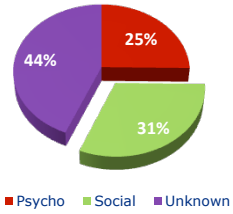
Six Minute Walk

- **Social**





Measurement Country
Reason for Ending the Test
Days Off Work

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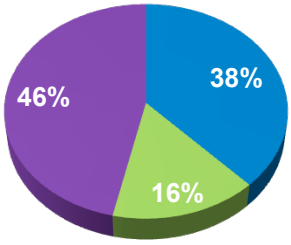
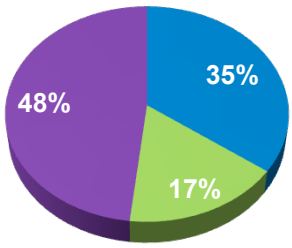
Handgrip Strength

Right



Left



Bio
Social
Unknown

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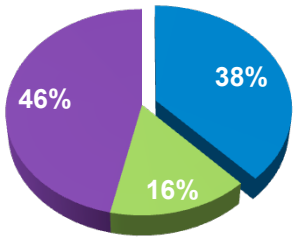
Right Handgrip Strength

Patient's **Sex (male/female)**
Height (cm)
Pain Area
Patient's FCE *Physical Work Demands (DOT)*
Measurement Country



Bio Social Unknown

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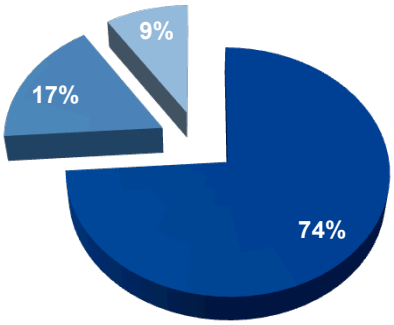
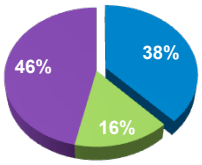
Right Handgrip Strength

- **Bio**



Sex Pain Area Height



Bio Social Unknown

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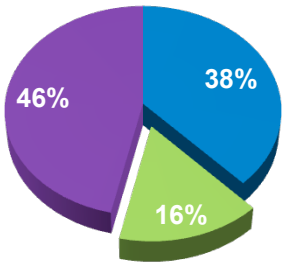
Right Handgrip Strength

Patient's *Sex (male/female)*
Height (cm)
Pain Area
Patient's **Physical Work Demands (DOT)**
FCE **Measurement Country**



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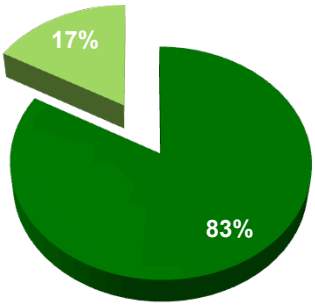
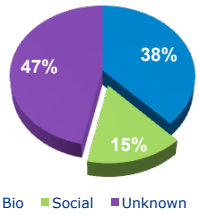
Right Handgrip Strength

- **Social**





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- Background
- Methods
- Results
- **Discussion**
- Conclusion

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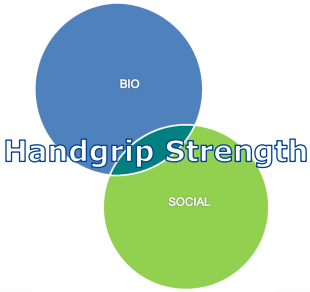
Findings



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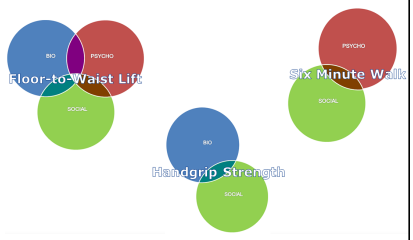
Compared to Previous Research

- Social factors in all!
  - Cultural background
  - Lift: Clinician's fear-beliefs
- Bio factors in 6MWT?
- Psycho factors:
  - In handgrip?
  - Previously…: *Pain intensity, Disability, Anxiety, Social isolation, Catastrophizing, Depression, Fear of movement, Work ability, Secondary gain or Motivation*



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Relevance

- Large sample size
- Variety of factors

} Large models

- Heterogeneity of participants → Generalizability
- >50% of explained variance in all models

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- Background
- Methods
- Results
- Discussion
- **Conclusion**

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Take Home Message

- FCE results and various biopsychosocial factors are associated, **but** the identified factors differ from previous studies performed within a societal context.
- Patients should be considered from a **biopsychosocial framework**.

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Special Thanks to:

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  - M. Streibelt (DE)
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  - C. Osman (US)
  - T. Buys (ZA)
  - M. Spavins (ZA)

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Thank you for your attention

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expand

University of Alberta Edmonton-Alberta-Canada

Rehaklinik Bellikon Der Name für UnfallReha

Boston Mutual Life Insurance Company - 1891 -

Kliniken Valens

University Medical Center Groningen

PRACTICAL ISSUES IN FCE ADMINISTRATION & INTERPRETATION

Lessons Learned From Thousands of Cases

Jill Galper, PT
IMX Medical Management Services

Philadelphia, PA: Skyline

PRESENTATION GOALS

- Describe IMX's FCE Network and types of cases reviewed
- Discuss issues identified from report review
- Share my wonderings based on what I've reviewed and generate discussion.

IMX MEDICAL MANAGEMENT SERVICES

- National (US) provider of IME, FCEs, peer and medical reviews and case management
- IMX's FCE Network:
  - ~1000 credentialed providers in continental US, Alaska, Hawaii, Puerto Rico & Canada
  - PT or OT involved in performing the FCE
  - Commercial FCE models in our network: Workwell, Matheson, Blankenship, ErgoScience, Worksteps, Workability, BTE/Hanoun, Arcon, Joule, Occucare, J-Tech, DSI
  - "Best Practice"/Blended or facility specific model

2775 FCES DONE FROM 2006-2015

- 38% (1062): Worker's Compensation cases
- 62% (1713): Long Term Disability cases (LTD)
  - 99.9% were general test of abilities
  - 78%: 1-day FCE; 22%: 2-day FCE
    - 2-day tests trended downward:
      - 30% 2006-2008
      - 10% 2013-2015
- Q/A Process: All FCE reports were reviewed by IMX (Jill) prior to release

NETWORK DEVELOPMENT & ADMIN CHALLENGES

- Identifying skilled/experienced evaluators
  - Use a vetting process-not foolproof
- Obtaining report within timeframe-occasionally difficult
- Obtaining requested revision/correction-occasionally difficult
  - 70-80% of FCE reports needed some type of revision, or conclusions were questioned

OVERVIEW OF REVISION REQUESTS (N=406)

- 2%: Capabilities form (caps) missing
- 39%: Revision/corrections needed
- 11%: Report data did not match caps form
- 41%: Additional information requested
- 21%: Evaluator's conclusion was questioned

- One report might have multiple requests

REVISION REQUESTS-406 REPORT SAMPLE

- Revisions/Corrections needed: 39%
  - PDL was identified-carrier didn't want this
  - Treatment recommendations had to be deleted
  - Some reports conclusions exceeded test scope:
    - Vocational recommendations were made
    - Report discussed cognitive or psychological status (e.g., "the client was anxious")
  - Typographical errors, wrong name or pronoun in report

REVISION REQUESTS-CONT'D

- Report did not match the caps form: 11%
- Additional information was requested: 41%
  - No test endpoints listed in report
  - No clinical exam findings were in report
  - If evaluee used assistive device, this wasn't stated
  - For 2-day test, no comparison made between test days. (some providers sent a report for each test date)
  - Purpose of FCE not stated or unclear (e.g., The purpose of FCE was "to prove or disprove the presence of organic pathology.")

ADDITIONAL INFO REQUESTS-CONT'D

- Functional limitations were identified without rationale. Examples:
  - Clinical exam was normal but very low abilities listed
  - Bending, twisting, crawling & climbing were "occasional" but report said evaluee "met the performance criteria with no issues"
  - Report identified limitations; little about abilities-report stated walking is limited but didn't state what evaluee could do.
  - If FCE was limited in intensity ("sedentary FCE"), report didn't state that.

ADDITIONAL INFO REQUESTS-CONT'D

- No rationale to support conclusion that evaluee cannot work 8-hour day.
- A limitation was reported without supporting data or observation.
- Job match condition listed as "never", but hard to understand in view of test data or evaluee's reported statements:
  - Stairs "never" but evaluee lives in 2-story home.
  - Sitting "never" but how did evaluee travel to facility?

ADDITIONAL INFO REQUESTS-CONT'D

- Report did not identify a medical diagnosis, the evaluee's symptoms/activity report or medical history.
- General FCE was requested but evaluator did not test all job match conditions, based on diagnosis. (e.g., if primary diagnosis was hip OA, no upper body testing was done)

REVIEWER QUESTIONED REPORT CONCLUSIONS: 21%

- Reported abilities exceeded what the test data supported. Examples:
  - Evaluee was using oxygen and short of breath, but walking was "frequent".
  - Evaluee had carpal tunnel syndrome with symptoms, but hand use was "constant".
  - Evaluee was morbidly obese with poor aerobic fitness but stair climbing was "frequent".

REVIEWER QUESTIONED CONCLUSIONS-CONT'D

- Reported ability seemed to be more limited than what data suggested:
  - Fine motor skills were reported as "normal', hand motion/strength was normal-ability listed as occasional.
  - Evaluee's standing & walking were occasional, but constant lifting/carrying abilities were reported.
- Conflicting statement were in report:
  - Evaluee could perform firm grasp but not simple grasp.

REVIEWER QUESTIONED CONCLUSIONS-CONT'D

- Conflicting statements-cont'd
  - Test data had wide variability between trials but was reported as consistent
  - Evaluator stated that there was "no competitive test performance" and this reflected effort during FCE.
  - Evaluee's performance was labeled "maximal", but report stated symptoms limited performance and low activity levels were reported.
- Fingering abilities were based on comparing performance to Purdue Pegboard norms-low norm score = evaluee unable to perform

CONCLUSIONS QUESTIONED-CONT'D

- Evaluator used submax YMCA step test to assess aerobic fitness in subject with lower extremity dysfunction.
- Evaluator did not test evaluee using the lumbar support, single point cane and implanted spinal cord stimulator he typically wore because he felt this would overestimate the evaluee's functional abilities.
- Evaluee with poor standing ability performed dexterity/reaching in standing versus sitting.

MY QUESTIONS & OBSERVATIONS:

- Team evaluators: is this approach optimal?
- There is variability between evaluators & models:
  - The extent of the evaluee interview, clinical exam, how data is reported and correlated with functional performance.
  - Inclusion of rationale for determinations. Is this important?
  - Criteria for acceptable BP and HR
  - Inclusion of submax aerobic test & test type
    - Is a step test a good test for people with LE injury, high pain focus or who have been sedentary?
  - Lifting tests vary between models: # of reps, acceptable posture, how frequent lift ability is determined & whether constant ability is even included.

MORE QUESTIONS & OBSERVATIONS

- How movement and positional tolerances are assessed is widely variable. What is most appropriate?
  - Example: The criteria for sitting tolerance. ErgoScience monitors for 5 min. and counts positional adjustments versus having evaluee sit for longer time.
- Test sequence is variable. Does it matter? Would starting with a less provocative activity be worthwhile?
- Variability in how full versus part-time work ability is determined. What criteria should be used?

MORE QUESTIONS

- What does "maximal" effort mean? Should "maximal" be used to reflect a person's tolerable abilities?
- Is it meaningful to state a person's "physical behaviors correlated with his subjective complaints of pain?" Is this stating the obvious? Does this reflect acceptable performance effort?
- Some evaluators did not have the updated version of a commercial FCE model.

MORE QUESTIONS…

- Who is best qualified to perform FCEs?
- What type and amount of training is optimal?
  - How do we ensure evaluators have the most current information and test version?
- Is there value in developing a generic best practice model to ensure consistency in methodology, interpretation and reporting?

WHAT ARE YOUR THOUGHTS?

- How do we (or do we) make FCE as effective, reliable and valid across models?

THANK YOU

BOAT HOUSE ROW, PHILADELPHIA

A SCOPING REVIEW OF GRIP DYNAMOMETRY AS A PREDICTOR OF WORK ABILITY

Lisa Fitzpatrick DrOT, CHT, CAE, CEAS

Background…

- Aging of workforce (BLS, 2013)
- MSD increase with age (Badley & Crotty, 1995)
- WRMSD-therapists use grip dynamometry (GD) with or without FCE to determine work ability (Innes, 1999)
- To date, no comprehensive review of 1.) relationships between GD and work ability or 2) predictive validity of GD pertaining to work ability.

Rationale

- Average cost of WRMSD is increasing-critical to ensure adequate measures are being used for assessing work ability as part of the return-to-work process (Bhattacharya, 2014).
- Grip strength-clinically used to predict and assess work abilities (Chan, Tran, & Koh, 2000; Hollak et al., 2014; Sluiter, 2006)
  - Necessary to explore the validity of grip strength as a predictor of work ability

Research Question(s)

- 1. Is grip strength related to work ability?
- 2. Does grip strength predict work ability?

- **Work ability** = "having general health, **basic competence**, and basic occupational virtues for completing some type of work within an acceptable environment" (Tengland, 2011)

Methods

- Scoping Review of 15 articles (Initially 141 articles)
- Broken down into 3 themes
- Articles evaluated for rigor, emerging themes, and gaps
- Selected based on methods from Joanne Briggs Institute.
- Studies critically appraised using SEQES (Structured Effectiveness Quality Evaluation Scale)
  - Grip strength predict return-to-work or work ability
  - Relationship between grip strength and specific job demands or work tasks
  - Relationship between grip strength and force requirements

Results

- 3 high quality
- 11 moderate quality
- 1 lower quality
- GD predicting RTW (n=7)
- Relationship between GD and job demands or work tasks (n=4)
- Relationship between GD and force requirements (n=4)
- 12 of 15 used a correlation coefficient to assess relationship
  - 7 out of 15 did not use regression analysis

Theme 1: Predicting work ability

- Greater grip strength=faster time to work (n=2)
- Grip strength predicting work ability did not show any predictive relationship between grip strength and work ability (n=3)
- Grip negative predictor of time RTW (n=2)
- Overall, GD has variable relationship with predicting work ability

Theme 2: an indicator of specific job demands and job types

- All studies reported **moderate to strong association between GD and specific job demands**
- GD was demonstrated to be a **significant positive predictor of vocational performance** (n=2)
- **GD thresholds** necessary to complete specific work tasks were determined (n=2)

Theme 3: GD as an estimator of task-specific force requirements

- Moderate to strong positive correlations between GD and forces necessary for completing tasks (n=2) – no multivariate analysis
- Significant associations between GD and force applied during specific work task; no association strength (n=1)
- Significant between subject differences in GD when it was used as an estimate of task-specific hand force demands (n=1)

Meaning to Therapy

- Little current literature and low quality evidence on this topic, more research is needed
- When determining work ability, GD may be useful but reasoning is required
  - Well defined job descriptions and other "non-grip" essential functions are needed
  - Grip threshold "essential functions" are largely unavailable
- Consider using force matching If gripping is essential
  - Normalizing these values relative to MVC strength

QUESTIONS OR COMMENTS

Thank you!

ACPOHE Functional Measurement Toolkit

ACPOHE Fitness for Work Assessment Group
Catherine Albert

Introduction

- ACPOHE Fitness for Work Assessment Group
- Steering group of experienced OH Physios and ACPOHE members with research backgrounds
- The brief **'To develop a toolkit of functional tests to support Occupational Physiotherapists in the provision of objective advice on an employees fitness for the physical demands of their work'**

FMT Toolkit - Objectives

- To encourage functional testing as a routine part of OH physiotherapy
- To improve the reliability and consistency of assessments of functional testing
- To improve evidence base of OH Physio recommendations for fitness to work assessments.

Background

- On-going Professional Development for OH Physios
- Guidelines for OH Physios on the use of FCE and FM for the Assessment of Fitness to Work 2014
- Recommended Physios use reliable and validated functional test during Fitness to Work Assessments.
- 2014 FCE & Psychosocial Screening Tools

1. Step – Literature Review

- Tests with set protocols
  - Modified FCEs
  - short FCEs (Gross 2007)
  - job specific FCEs (Gouttebarge 2009),
  - injury–specific FCE (Trippolini 2012)
- Tests with evidence of validity and reliability
- To identify range of functional tests

Functional Categories

- Match impairment to job demands - (King 1998) (Gouttebarge 2010)
- Standard FCE components
  - Dynamic Strength
  - Postural Tolerance
  - Mobility
  - Aerobic Capacity
  - Balance
  - Hand Dexterity

2. Step – Clinically Useful

- Tests with evidence based
- Evaluated in terms of usefulness in clinical practice
- Based on experience of the steering group – peer review
- Considered practicality in terms of cost & time

3 Step - Critical Appraisal

- Critical Appraisal Skills Programme (CASP)
  - Guidance and framework
  - Checklist for various types of research RCT, systematic reviews, qualitative research
- Standardised approach to evaluating the research of each test

FMT Toolkit

- 18 Functional Tests - 8 ACPOHE
  - 10 (Soer 2009)
- Strong reliability –inter-rater and intra-rater
- Strong validity in terms of work demands (Hoozamanas 2001)

FMT Toolkit

• Chester Step Test	▪ Sykes K & Roberts A (2004)
• 6 Minute Walk Test	▪ American Thoracic Society ▪ Butland et al (1982)
• Maximum Grip Strength	▪ Mathiowetz (1984)
• Back Performance Scale	▪ Strand & Nilssen (2002) ▪ Magnusson et al (2004)

FMT Toolkit

• One-legged Stance	▪ (Berg 1989)
• MTAP	▪ (Mayer, Mooney & Matheson 2005)
• Timed Sit-Stand	▪ (Csuka M & McCarty D, 1985)
• Single Leg Loading	▪ (Almangoush ,2014) ▪ (Herrington & Munro, 2014)

Functional Measurement Tests

ACPOHE	(Soer 2009)
• Chester Step Test	• Lifting Low
• 6 Minute Walk Test	• Lifting High
• Maximum Grip Strength	• Carrying
• Back Performance Scale	• Static Overhead Work
• One-legged Stance	• Static Bent Work
• MTAP	• Repetitive Bending
• Timed Sit-Stand	• Repetitive Side Reaching
• Single Leg Loading	• Finger Grip Strength
	• Perdue Peg Board
	• Minnesota Manual Dexterity

4. Final Step – Five Star Rating

- Final summary –tests were graded on overall strengths and weaknesses.
- Considered evidence base and practicality
- Graded between 3-5 stars
  - Price
  - Practicality – equipment, duration, ease of use <10 mins
  - Normative values
  - Validity
  - Reliability

Five Star Summary

Test	Star Rating	Reliability	Validity	Normative Data	Practicality	Cost <£100
Chester Step test	4	Yes	Yes	Yes	10 min	Moderate
6 Min Walk Test	5	Yes	Yes	Yes	<10 min	Minimal
Hand Grip Strength	4	Yes	Yes	Yes	<10 min	High
Back Performance Scale	4	Yes	Yes	N/A	<10 min	Minimal

FMT Toolkit – (Soer 2009)

Awaiting CASP analysis

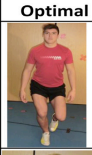
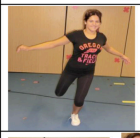
- Lifting low
- Lifting high
- Carrying
- Overhead working
- Forward bending

- Good inter-rater reliability
- Good intra-rater reliability
- 5 Test have good validity when matched to work demands (Hoozemanas 2001)

FMT Toolkit Content

- Critical Appraisal
- Analysis of Validity and reliability
- Test Protocol
- Normative data
- Scoring Sheet
- References

- Equipment Need
- Approx cost
- Approx time
- Strengths
- Weaknesses

QASLS		Optimal	Sub-optimal
Arm strategy	Excessive arm movement to balance		
Trunk alignment	Leaning in any direction		  
Pelvic plane	Loss of horizontal plane		 
	Excessive tilt or rotation		
Thigh motion	WB thigh moves into hip adduction		

Next Steps..

- Promote the Toolkit to OH Physios in the UK
- Gain feedback regarding usefulness
- Critical appraisal of 10 tests (Soer 2009)
- Provide training & courses to support the FMT Toolkit and the use of standardised protocols
- Develop video footage to support the manual

Research and Development

- To develop a database of UK normative values
- Currently only available on research carried out in the Netherlands & US i.e. MTAP – US
- Allow for comparison during analysis
- Continued development and evaluation of tests suitable for inclusion in the toolkit

Summary

- ACPOHE FCE Special interest group developed a Functional Measurement Toolkit
- Based on research and clinical evidence
- Encourage standardised, evidence practice
- Promotes functional assessment within clinical practice

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How To Find Out More..

www.acpohe.org.uk

Catherine@workfuture.co.uk

Functional Capacity Evaluation – Performance of patients with chronic non-specific low back pain without Waddell signs

Oesch P, Meyer K, Jansen B, Kool J
J Occup Rehabil. 2015 Jun;25(2):257-66

Peter Oesch PhD PT | Direktor Therapien

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Background

FCE purport to measure work related physical capacity
(Isernhagen 1988)

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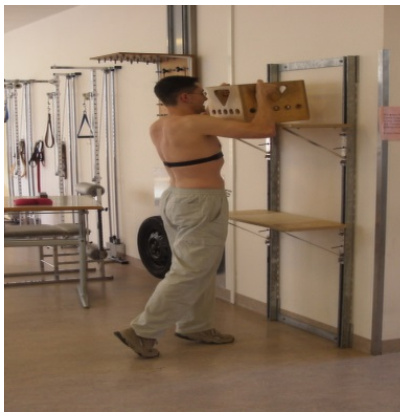

- FCE is influenced by perceived disability and pain intensity

  (Hart 1998, Reneman 2002, Gross 2003)

- Age & gender explained only little of the variation in FCE performance

  (Gross 2005)

Nonorganic-phyiscal-signs
Waddell, 1980

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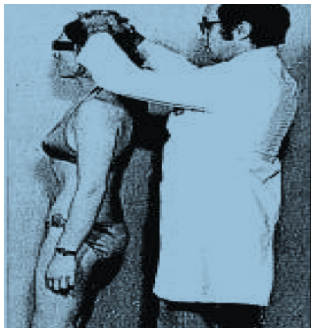

"By helping to separate the physical from the nonorganic, they clarify the assessment of purely physical conditions"

Waddell

Behavioural response to examination
(Main et al, 1992)

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Spine

SPINE Volume 37, Number 4, pp E243–E250

OCCUPATIONAL HEALTH/ERGONOMICS

What Is the Role of Waddell Signs Components" in Functional Capacity Evaluations in Patients With Chronic Nonspecific Low Back Pain Undergoing Fitness for Work Evaluation?

Peter Oesch, MSc,*† Kathrin Meyer, MPH,¶ Beatrice Jansen, MSc,§ Petter Mowinckel, MSc,‖ Stefan Bachmann, MD,*†‡ and Kare Birger Hagen, PhD‖**

Influences on FCE

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FCE tests	Adj. R2	Final model	Unstd. Coeff.	Sig.
Lifting from floor to waist (kg)	**0.54**	Perceived functional ability	0.11	<0.001
		Gender (male)	4.73	0.001
		Waddell Signs	-0.95	0.009
Forward bend standing (sec)	**0.42**	Waddell Signs	-20.49	<0.001
		Days off work	-0.03	<0.001
		Perceived functional ability	0.31	*0.065
Grip strength dominant hand (kg)	**0.58**	Gender (male)	15.97	<0.001
		Perceived functional ability	0.11	<0.001
		Waddell Signs	-1.53	0.003
		Age	-0.25	0.005
Six minute walking distance (m)	**0.52**	Waddell Signs	-27.13	<0.001
		Salary previous job	0.01	0.002
		Pain intensity	-11.65	0.018
		FAB work activities	-2.50	0.014
		Age	-1.90	0.025

* Not significant, but a confounder

Conclusions

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- Waddell Signs are consistent independent predictors for FCE performance
- Further research should:
  - Investigate the effect of Waddell Signs during a standardized one day protocol in patients with CNSLBP undergoing fitness for work evaluation.
  - Report performance of patients with negative Waddell Signs during a standardized one day FCE protocol.

Methods

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- Analytical cross-sectional study
- 3 Rehabilitation center
- Patients with chronic non-specific LBP referred for Fitness for Work Evaluation
- Measurements

Assessor I
Waddell Signs

Assessor II
FCE

- Descriptive analysis

Results

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Patients

- 1181 FCE's performed from Jan. 2009 – Dec. 2012
- 318 patients with low back pain
  - 40 suffered from specific back pain
  - 28 relevant comorbidity affecting work ability
  - 11 excluded because of language problems
  - 21 subjects did not give informed consent
  - 4 older then 60
  - 16 were missed for inclusion
- **198 patients with chronic NSLBP**

Weight Capacity in patients with negative and positive Waddell signs

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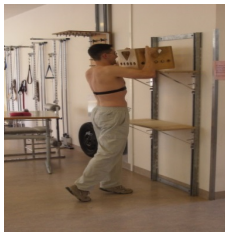
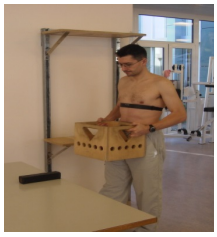
Lifting
Floor - Waist



Lifting
Waist - Crown



Lifting
Horizontal

Lifting
One handed

Weight Capacity in patients with negative and positive Waddell signs

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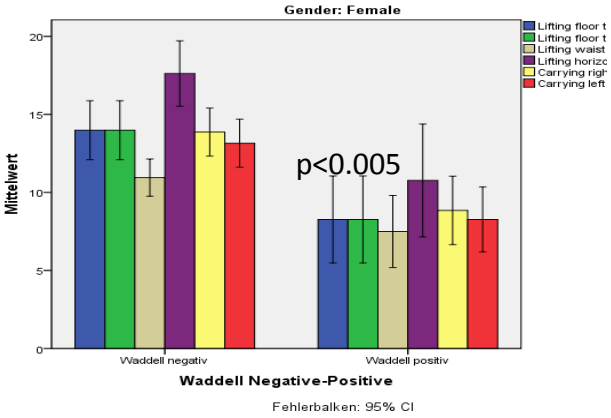

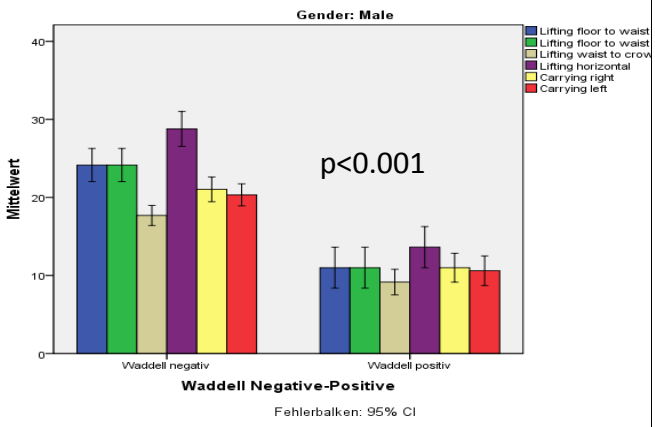

FCE – Performance of patients with CNSLBP without Waddell signs 11

Hand Capacity in patients with negative and positive Waddell signs

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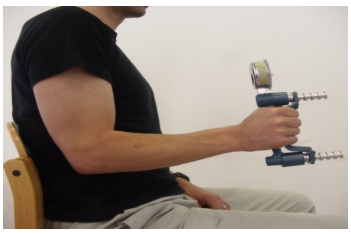
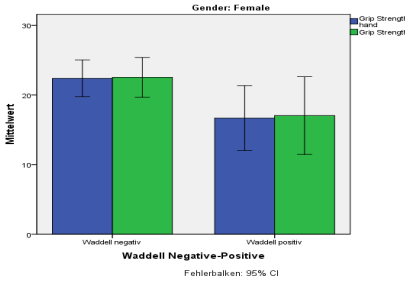
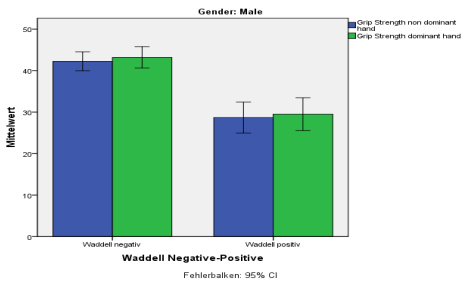


Hand Capacity



Female p<0.05



Male p<0.001

FCE – Performance of patients with CNSLBP without Waddell signs 12

Ambulation in patients with negative and positive Waddell signs

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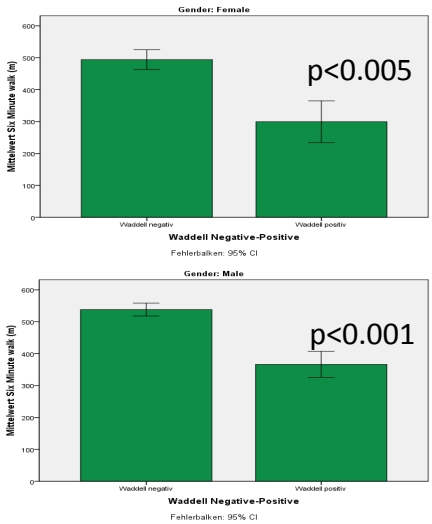

Work postures in patients with negative and positive Waddell signs

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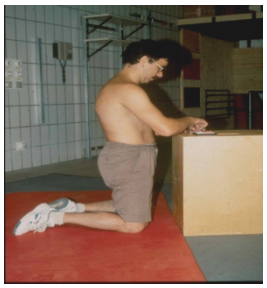
Elevated work

Forward bending



Kneeling

Sitting

Work postures in patients with negative and positive Waddell signs

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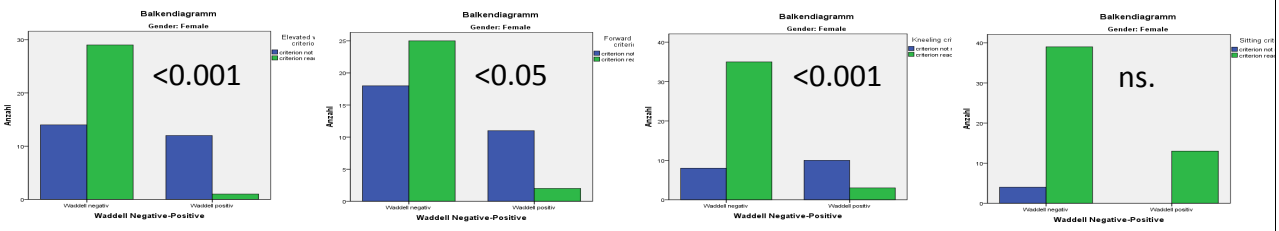

Elevated work | Forward bending | Kneeling | Sitting

FCE Performance in patients with neg. WS

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Age	FCE test (SD)	Female (n = 23)						Male (n = 46)						Diff.
		Mean (SD)	Percentiles					Mean (SD)	Percentiles					Sign.[a]
			Min.	25th	50th	75th	Max.		Min.	25th	50th	75th	Max.	
20–45	Lifting floor to waist (kg)	15.4 (7.2)	2.5	12.5	15.0	22.5	27.5	25.3 (10.7)	0.0	15.0	23.8	35.0	45.0	<0.001
	Lifting waist to crown (kg)	11.1 (5.0)	5.0	7.5	11.3	13.1	27.5	18.7 (6.1)	5.0	14.4	20.0	22.5	30.0	<0.001
	Lifting horizontal (kg)	17.9 (8.2)	5.0	12.5	15.0	22.5	40.0	30.9 (11.5)	10.0	20.0	30.0	40.0	60.0	<0.001
	Carrying right (kg)	14.6 (6.0)	7.5	10.0	15.0	15.0	35.0	22.0 (8.0)	7.5	15.0	20.0	28.1	40.0	<0.001
	Carrying left (kg)	14.3 (6.2)	5.0	10.0	12.5	17.5	35.0	21.0 (7.1)	5.0	15.0	20.0	25.0	40.0	<0.001
	Grip Strength non dominant (kp)	22.7 (9.0)	5.5	18.2	24.1	29.8	39.1	45.3 (9.4)	19.3	38.6	46.1	51.5	69.4	<0.001
	Grip Strength dominant (kp)	23.6 (10.0)	4.9	14.6	28.0	30.8	43.4	47.0 (11.2)	23.1	40.4	45.5	51.8	74.9	<0.001
	Stair climb (sec)	145.1 (56.9)	82	108	130	176	323	137.3 (48.3)	74.0	101.5	127.5	152.5	284.0	ns
	Six Minute walk (m)	519.8 (104.2)	297	420	552	603	650	552.9 (96.2)	325.0	481.5	565.0	603.5	760.0	ns
	FCE test	Female (n = 18)						Male (n = 45)						Diff.
		Mean (SD)	Percentiles					Mean (SD)	Percentiles					Sign.[a]
			Min.	25th	50th	75th	Max.		Min.	25th	50th	75th	Max.	
45–60	Lifting floor to waist (kg)	13.1 (4.2)	5.0	10.0	13.8	17.5	20.0	23.0 (9.7)	7.5	15.0	22.5	31.3	45.0	<0.001
	Lifting waist to crown (kg)	10.7 (1.9)	7.5	10.0	10.0	12.5	12.5	16.7 (6.1)	7.5	12.5	15.0	20.0	35.0	<0.001
	Lifting horizontal (kg)	17.6 (5.0)	10.0	14.4	17.5	20.6	27.5	26.7 (9.6)	7.5	20.0	25.0	32.5	50.0	<0.001
	Carrying right (kg)	13.3 (3.3)	7.5	12.5	12.5	15.6	20.0	20.1 (7.2)	5.0	15.0	20.0	25.0	42.5	<0.001
	Carrying left (kg)	11.9 (2.4)	7.5	10.0	12.5	15.0	15.0	19.7 (6.5)	7.5	15.0	20.0	22.5	37.5	<0.001
	Grip Strength non dominant (kp)	22.1 (8.4)	8.2	14.7	20.7	29.2	41.1	39.1 (11.6)	10.5	31.8	38.6	46.8	64.6	<0.001
	Grip Strength dominant (kp)	21.3 (8.4)	6.7	16.3	21.1	26.0	40.2	39.3 (12.4)	9.3	30.7	38.6	46.8	66.7	<0.001
	Stair climb (sec)	183.6 (58.8)	128.0	138.5	156.5	218.3	340.0	153.8 (59.0)	68.0	117.5	141.0	169.5	360.0	ns
	Six Minute walk (m)	461.6 (93.6)	262.0	375.0	492.5	531.3	595.0	522.6 (96.6)	309.0	443.0	521.0	605.8	664.0	<0.05

Diff. Performance difference of female and male patients

J Occup Rehabil. 2015 Jun;25(2):257-66

Conclusion

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- Waddell Signs should be assessed for interpretation of FCE results.
- Despite long work absence, patients with CNSLBP with negative Waddell Signs demonstrated a physical capacity corresponding to substantial physical work demands.

Thank you for your attention

Peter Oesch PhD PT | Direktor Therapien

Comparison of two methods for interpreting lifting performance during functional capacity evaluation

Oesch P[1], Meyer K, Bachmann S, Hagen KB, Vøllestad NK.
J Phys. Ther. 2012 Sep;92(9):1130-40

Peter Oesch PhD PT | Direktor Therapien

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Background

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- Physical effort determination is attempted during FCE.
  (Isernhagen 1988)
- Observational criteria for effort level determination are used.
  (Isernhagen 1992)
- Waddell Signs have been used as a mean for effort determination.
  (Kaplan 1996, Lechner 1998, Lemstra 2004)

Observational criteria for physical effort determination during manual handling tests

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Maximum

Light

Heavy

Observational criteria for physical effort determination during manual handling tests

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Criteria	Observations at the Following Weight Load:		
	Maximal	Heavy	Light to Moderate
Muscle recruitment			
Prime movers	Bulging	Bulging	Normal recruitment
Accessory muscles	Bulging	Distinct recruitment	No or only slight muscle recruitment
Base of support	Very wide base	Distinctly increased	Natural stance
Posture	Substantial counterbalance	Distinctly increased counterbalance	No or only slight counterbalance in extension
Heart rate and respiration	Substantial increases in heart rate and respiration	Distinct increases in heart rate and respiration	No or minimal increases in heart rate and respiration
Control and safety	Still safe but unable to maintain control with the addition of any more weight	Increasingly controlled movement; might begin to use momentum; execution with difficulty but not yet at the limit	Smooth movements
Pace	Very slow (an increased pace would affect stability and control)	Distinctly slower; very deliberate movements	Moderate/comfortable pace

(Isernhagen 1992)

Reliability - Observational criteria

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J Occup Rehabil (2014) 24:361–369
DOI 10.1007/s10926-013-9470-9

Reliability of Clinician Rated Physical Effort Determination During Functional Capacity Evaluation in Patients with Chronic Musculoskeletal Pain

M. A. Trippolini · P. U. Dijkstra · B. Jansen · P. Oesch · J. H. B. Geertzen · M. F. Reneman

Waddell Signs

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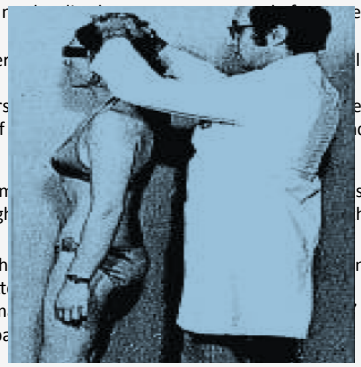
Tenderness	**1. Superficial:** The skin is tender to light pinch over a wide lumbar area. A localised band in a posterior primary ramus distribution may be caused by nerve irritation and should be discounted. **2. Deep:** Tenderness is felt over a wide area. It is r… …ends … sacrum, or pelvis.
Simulation Tests	**3. Axial Loading:** Low-back pain is …orted on ver… …ll by … Neck pain is common and … …ounted. **4. Rotation:** Back pain is r… …oulders … …e pla… relaxed with the feet toge… …ence of … …d sh…
Distraction Test	**5. Straight Leg Raising:** Straight leg …aising is the m… …se b… component shows marked improvement in straigh… …h fo…
Regional disturbances	**6. Sensory:** Sensory disturbances include diminish… …met… fitting a "stocking" rather than a dermatomal patt… **7. Weakness:** Weakness is demonstrated on form… …of … cannot be explained on a localised neurological ba…
Overreaction	**8. Overreaction** during examination may take the form of disproportionate verbalisation, facial expressions, muscle tension and tremor, collapsing, or sweating. Judgements should, however, be made with caution, minimising the examiner's own emotional reaction; there are considerable cultural variations, and it is very easy to introduce observer bias or to provoke this type of response unconsciously.



Reliability Waddell Signs

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The Reliability of Nonorganic Sign-Testing and the Waddell Score in Patients With Chronic Low Back Pain

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Jos W.R. Twisk, PhD,†‡ and Gustaaf J. Lankhorst, MD, PhD§

Study objectives

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To determine the concurrent validity of Waddell signs and submaximal effort and to assess the contributions of Waddell signs and submaximal effort to lifting performance during FCE in people with CNSLBP.

Material and methods

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- Analytical cross-sectional study
- Measurements

Assessor I

Assessor II

- Statistical analysis
  - Logistic regression
  - Sensitivity and specificity

Study flow / Characteristics

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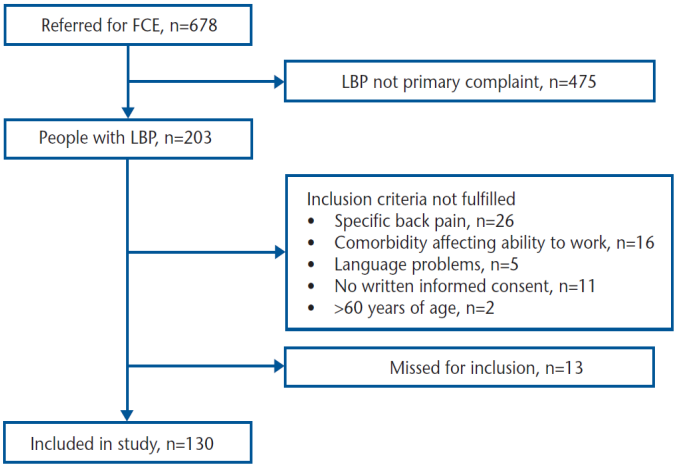

Patient Characteristics	
Male / Female	97 / 33[+]
Age (years)	44 (10)*
Days out of work	670 (1031)*
Self-rated ability for work tasks (SFS)	95.6 (51.2)*
Fear avoidance belief – work (FABQ)	32.8 (9.0)*
Pain (NRS 0–10)	5.1 (2.2)*

[+]n / *mean (SD)

Concurrent validity of 'Waddell Signs' and Effort determination

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Parameter	Value for:					
	Lifting From Floor to Waist		Lifting From Waist to Shoulder		Horizontal Lifting	
	Maximal Effort	Submaximal Effort	Maximal Effort	Submaximal Effort	Maximal Effort	Submaximal Effort
Waddell signs (no. of participants)						
Negative (87)	59	28	69	18	68	19
Positive (43)	11	32	12	31	12	31
Total (130)	70	60	81	49	80	50
% Sensitivity (95% CI)		53 (40–66)		63 (48–77)		62 (47–75)
% Specificity (95% CI)	84 (74–92)		85 (76–92)		85 (75–92)	
Positive LR[b] (95% CI)		3.4 (1.9–6.1)		4.3 (2.4–7.5)		4.1 (2.3–7.3)
Negative LR[c] (95% CI)	0.6 (0.4–0.7)		0.4 (0.3–0.6)		0.5 (0.3–0.6)	

Contribution of 'Waddell Signs' and 'submaximal-effort' to lifting performance

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	Adj R2	Final model	Unstd. Coeff.	Sig.
Lifting from 'floor to waist'	**.48**	Submaximal effort	-10.4	<.001
		Gender (male)	8.2	<.001
		Waddell Signs	-5.9	<.001
		Age	-.1	.103
Lifting from 'waist to crown'	**.60**	Submaximal effort	-8.2	<.001
		Gender (male)	6.4	<.001
		Waddell Signs	-3.2	.002
		Age	-.1	.005
Lifting 'horizontal'	**.64**	Submaximal effort	-14.9	<.001
		Gender (male)	10.7	<.001
		Waddell Signs	-5.3	.001
		Age	-.2	.007

Conclusion

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- Waddell signs' testing and determination of physical effort by observational criteria should not be interchangeably used for interpreting lifting performance during FCE.
- A comprehensive assessment to screen for high levels of pain behavior should include different aspects of pain behavior such as:
  - pain perception and description by the patient
  - the behavior of the patient perceiving pain
  - the patient's effort to perform physical tests
  - patient's consistency of behavior

J Occup Rehabil (2016) 26:103–113
DOI 10.1007/s10926-015-9593-2

Development and Validation of a Pain Behavior Assessment in Patients with Chronic Low Back Pain

Katharina Meyer[1] · Andreas Klipstein[2,3] · Peter Oesch[4] · Beatrice Jansen[5] · Jan Kool[4,6] · Karin Niedermann[6]


Thank you for your attention
15

Development and validation of a pain behavior assessment in patients with chronic low back pain

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3rd International FCE Research Conference
Heliomare, Wijk aan zee, Netherlands

September 29th, 2016

Jan Kool, PhD, PT
Rehabilitation Centre Valens, Switzerland

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Development and Validation of a Pain Behavior Assessment in Patients with Chronic Low Back Pain

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zh aw Gesundheit Institut für Physiotherapie
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Introduction

Chronic Low Back Pain

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… is a problem …

Does FCE performance display work related capacity?

During FCE we observe
- Pain perception
- Overt pain behavior
- Effort
- Consistency

Assuming you don't want to ignore this info,

How to sum it all up

Pain Behavior (PB)

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- Previous research used
  - exaggerated pain behavior
  - sincerity of effort
  - symptom magnification
- These terms are criticized for suggesting intention of patients (Lemstra 2004)

→ We used "pain behavior"

Pain behavior scale (41 items)

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- Pain perception
  - Widespread pain
  - High pain intensity
- Overt pain behavior
  - rubbing, sighing, grimacing
- Effort below minimal performance
  - grip strength, walking speed, lifting
- Inconsistency
  - flexibility of the back during clinical examination and dressing
  - ROM back during clinical examination / tandem walking
  - Spinal Function Sort is below 100 points
  - Pseudo strength test

Importance

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- Association with poor prognosis for RTW
- Patients with high levels of PB may require more intensive or different rehabilitation
- FCE to determine work-related capacity
  - Performance = work related capacity?
  - Criteria for lifting are available, but not for most other FCE tasks
- If we observe PB during FCE
  - Work capacity is judged higher then FCE performance in case

Scientific basis for this decision is weak

Aim

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- To evaluate construct validity and unidimensionality of the PBA

Methods

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- Cross-sectional study
- Inclusion
  - nsCLBP (> 6 mts.)
  - FCE to determine work ability

  Exclusion
  - Co-morbidity limiting work ability
  - Pregnancy
- Analysis
  - Rasch, person separation index, exclude misfitting and redundant items

Logits

Logarithm of Odds Ratio (OR)

OR = p(+)/p(-)

Examples

90/10 = 9
Ln(9) = 2.2

95/5 = 19
Ln(19) = 2.9

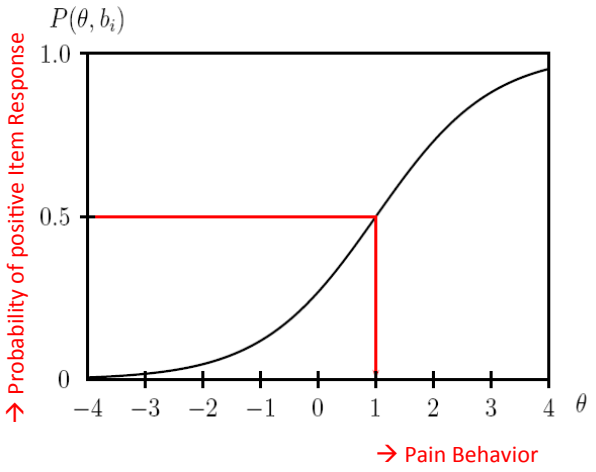
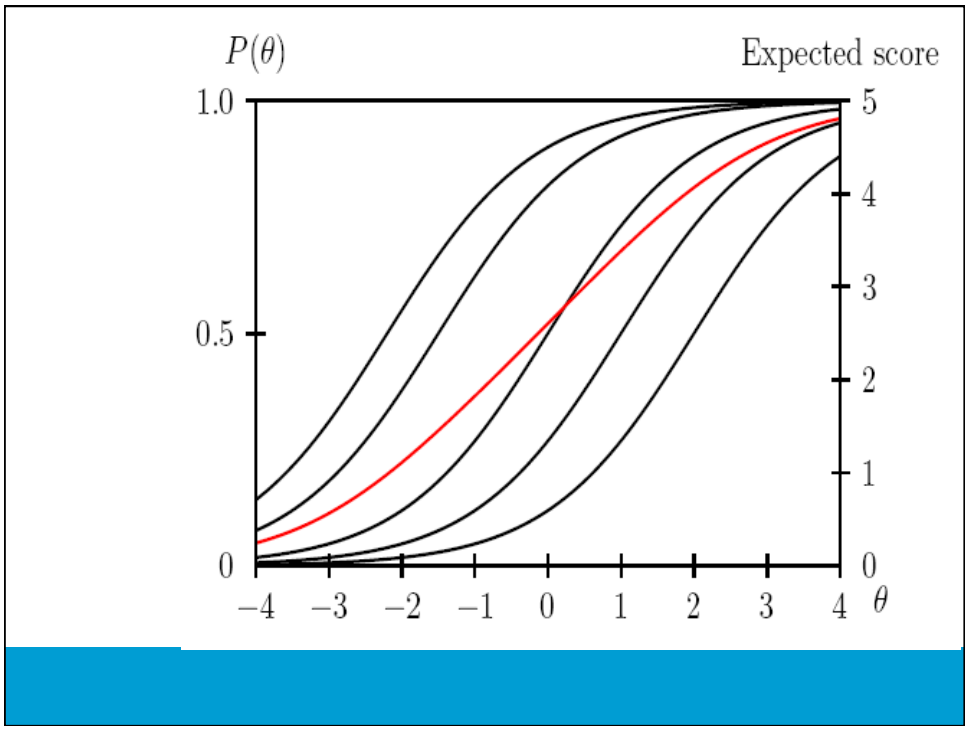


Figure 4: Locating the difficulty of an item on the ability / difficulty axis

www.uni-jena.de/svw/metheval/irt/VisualIRT.pdf



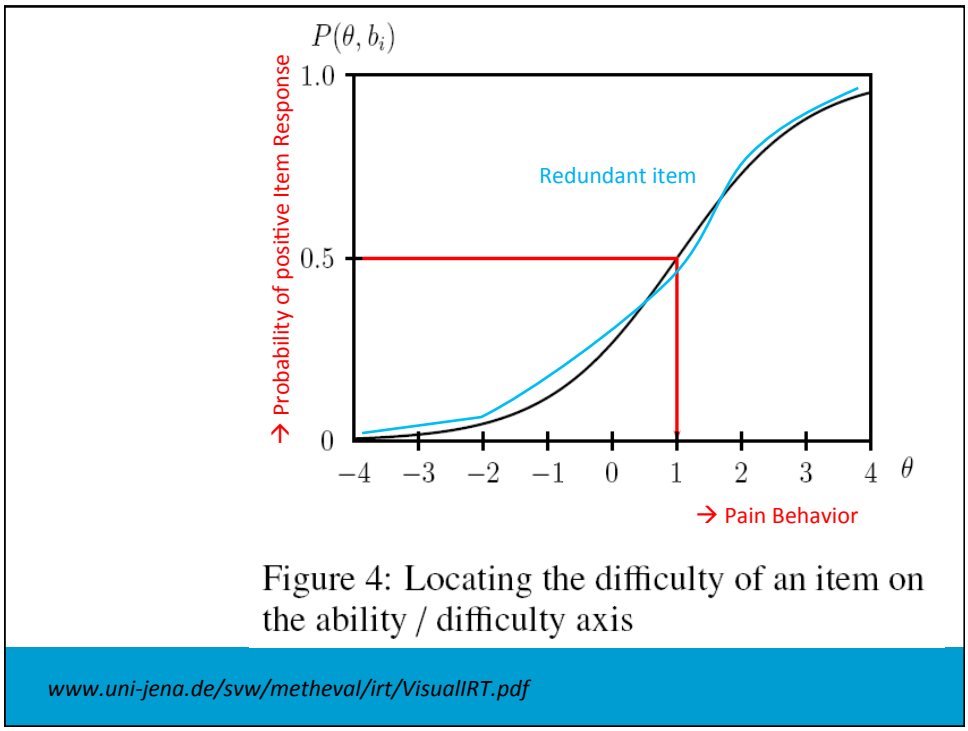


Figure 4: Locating the difficulty of an item on the ability / difficulty axis

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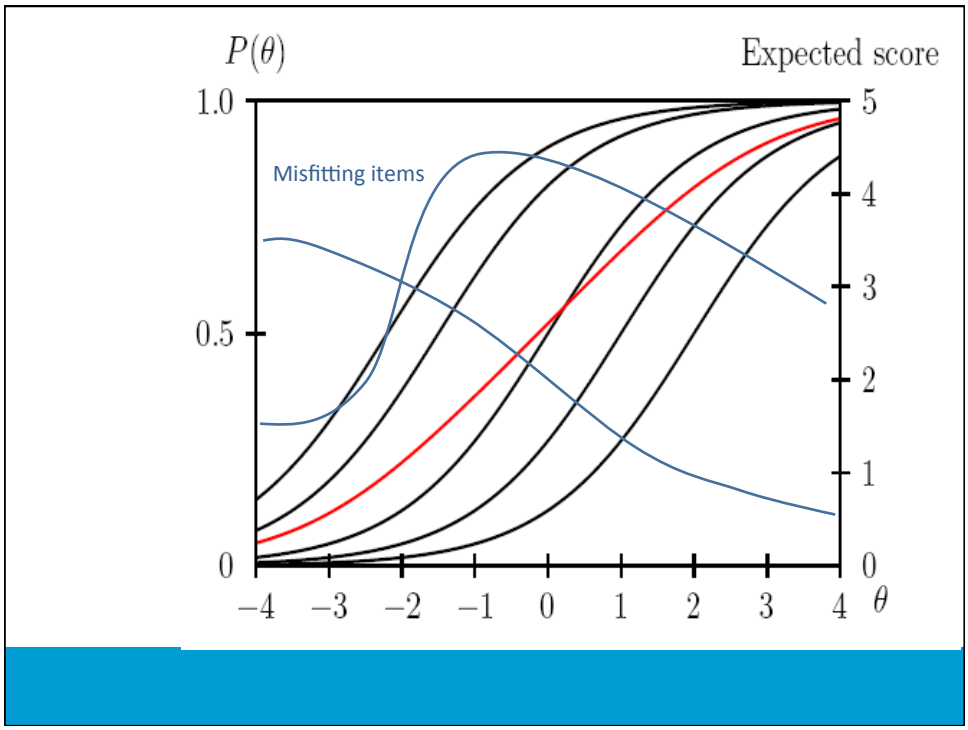

Results

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Population (n=200)	
male, n (Prozent)	145 (72.5)
age, years (SD)	43.3 (16.5)
duration , months (IQR)	34.4 (12-100)
Work Ability Index (SD)	21.3 (7.4)
Fear Avoidance Beliefs - Activity	19.2 (4.6)
Fear Avoidance Beliefs - Work	32.1 (9.6)
Oswestry Disability Index	43.3 (16.5)

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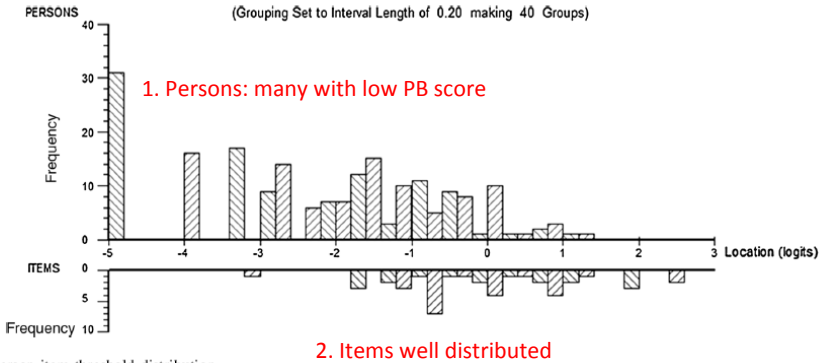

1. Persons: many with low PB score

2. Items well distributed

Fig. 2 Person-item threshold distribution

Construct validity

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- 11 items removed
- Unidimensionality confirmed (Item Mean Fit 0.0 (SD 1.26)
- No bias for age, sex, WAI, FABQ, pain duration
- Person Separation Index (PSI): 0.83 (allows individual interpretation)

→ PBA is valid

→ Total score = sum of 41 items (0/1 scored)

Interpretation

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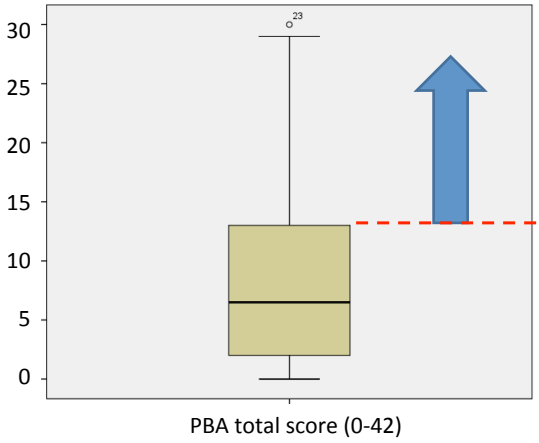

Suggestion: > 13 points = 'high level of pain behavior'

75. percentile = 13

Conclusion

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- PBA is valid
- PBA can be used with FCE
- FCE conclusions taking PB into account are legally more robust

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Measurement properties of the modified Spinal Function Sort (M-SFS)

Maurizio Trippolini, PhD.; Svenja Janssen, MSc; Roger Hilfiker, MSc; Peter Oesch, PhD

Rehaklinik Bellikon
Der Name für UnfallReha

Hes·so VALAIS WALLIS

KLINIKEN VALENS

Content

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1. Background
   a. Development of the Modified Spinal Function Sort (M-SFS)
2. Methods
   a. M-SFS: a picture-based questionnaire
   b. In- and Exclusion Criteria
   c. Test Retest Design & Analyses
3. Results
4. Discussion & Conclusions

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Background

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J Occup Rehabil (2015) 25:527–536
DOI 10.1007/s10926-014-9559-9

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Measurement Properties of the Spinal Function Sort in Patients with Sub-acute Whiplash-Associated Disorders

M. A. Trippolini · P. U. Dijkstra · J. H. B. Geertzen · M. F. Reneman

Conclusions of studies:

- Perceived functional ability for work tasks can be validly assessed with the SFS in a European rehabilitation setting in patients with non-specific low back pain, and is predictive for future work status.
- However..,
  - Item redundancy (“same results with half of the items”)
  - Floor effect on items with heavy lifting (50 kg)
  - Common activities such as sitting, walking were missing
  - Time consuming (for patient and practitioner)
  - Outdated images?

Development of the Modified Version (M-SFS)

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J Occup Rehabil
DOI 10.1007/s10926-015-9611-4

CrossMark

Development of a Modified Version of the Spinal Function Sort (M-SFS): A Mixed Method Approach

Svenja Janssen[1] · Maurizio A. Trippolini[1] · Roger Hilfiker[2] · Peter Oesch[3]

Conclusion

- Based on the results of a mixed methods approach, a modified SFS requiring less administration time was developed. It consists of 12 items of the existing SFS and 8 new items including patient's beliefs of back pain causing postures and movements.
- Measurement properties of the M-SFS need to be explored in future studies before it can be used in clinical practice.

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Methods

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Modified Spinal Function Sort (M-SFS)

		Able	Restricted			Unable
1	Place or retrieve a 2.5 kg can between waist and overhead	1	2	3	4	5
2	Lower a 10 pound milk crate from a bench to the floor	1	2	3	4	5
3	Lift a 5 kg milk crate from the floor to eye level	1	2	3	4	5
4	Load a 10 kg grocery bag into the trunk of an automobile	1	2	3	4	5
5	Lower a 10 kg milk crate from eye level to the floor	1	2	3	4	5
6	Unload two 5 kg grocery bags from the trunk of an automobile	1	2	3	4	5
7	Carry two 5 kg sacks of groceries for 30 m	1	2	3	4	5
8	Lift a 25 kg tool box from the floor to a bench	1	2	3	4	5
9	Wash dishes at a sink	1	2	3	4	5
10	Load or unload a dishwasher	1	2	3	4	5
11	Push and pull a vacuum cleaner	1	2	3	4	5
12	Get into an automobile driver's seat	1	2	3	4	5
13	Stand for a prolonged time	1	2	3	4	5
14	Walk for a prolonged time	1	2	3	4	5
15	Stand bent forward over for a prolonged time	1	2	3	4	5
16	Crouch for a prolonged time	1	2	3	4	5
17	Sit bent forward for a prolonged time	1	2	3	4	5
18	Bend forward repeatedly	1	2	3	4	5
19	Sit on a chair for a prolonged time	1	2	3	4	5
20	Sit with whole body vibration for a prolonged time; e.g. a bus journey	1	2	3	4	5

(Janssen, Trippolini, Hilfiker, Oesch, JOOR, 2015)

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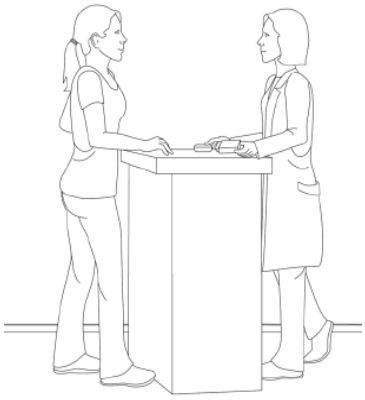
Modified Spinal Function Sort (M-SFS)

3. Sitzend arbeiten



4. Längere Zeit stehen

Gehen Sie die Bilder rasch durch und verweilen Sie nicht zu lange an einer Frage. Ihr erster Eindruck ist oft der beste.

Inclusion and Exclusion criteria

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Inclusion criteria

- Patients with chronic (> 3 months), unspecific msk pain
- Ages between 18 to 65
- Retest after 2 days is feasable
- Signed Informed consent

Exclusion crieteria

- Pregnancy
- Acute co-morbities (cardio-pulmonary, psychiatric, neurologic or internal medical)
- Medically determined FCE limit < 25kg
- Insuficcient proficiency in the German language

Test- Retest Design

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Results

Patient characteristics

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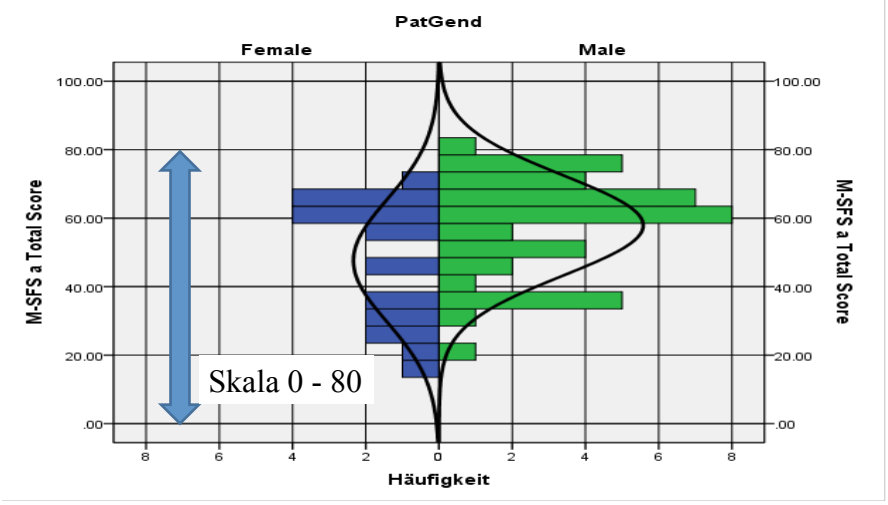
62 Patients (41 M / 21 F) with chronic (> 3 Months), unspecific pain were included

	MW (SD)
Age (J)	38 (12)
Work (T)	173 (157)
SFS (0-200)	127 (44)
M-SFS (0-80)	54 (16)
ODI (0-50)	15 (6)
Lifting low (Kg)	19 (8)
Lifting high (Kg)	12 (6)
Horizonal Lifting (Kg)	22 (10)

Distrubution of the scores M-SFSa



Range (min-max) 16 - 79

Interal consistency

Cronbach's alpha (Cα) = 0.94

0.98
Oesch et al 2010
Borloz, Trippolini et al 2012
Trippolini et al 2015

Interpretation:

- Cα ~ 0.70 - 0.90 = good internal consitency
- Cα < 0.70 = items measure different constructs

Streiner DL & Norman GR, 2008

CAVE: more items ⇨ Cronbach α –value ⇧

Items-clusters

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Principal Component Analysis, Varimax rotated

- 4 Factors identified, which explain 73% of the variance
  1. Lifting tasks (items 1,5,6,10,11,13,14…)
  2. Tasks with spine bended (items 9,17,18,20,22)
  3. Postural tolerance e.g. standing, sitting (item 3,4, 21, 25)
  4. Get into an automobile (item 12)

(2 items loading on multiple factors (vacuum cleaning 11, walking 21)

Test-Retest Reliability

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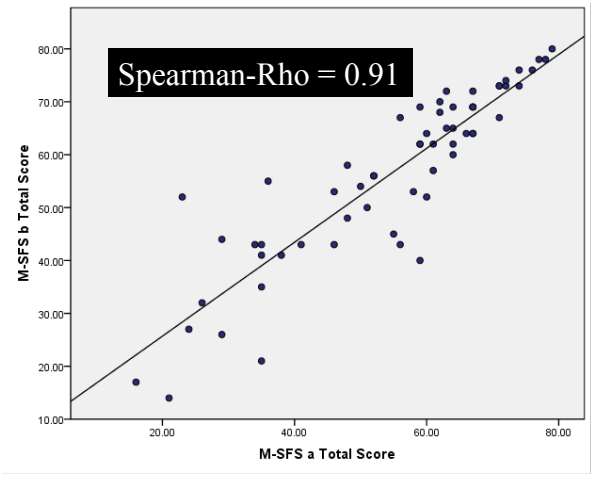


Spearman Rho = 0.91

Interpretation

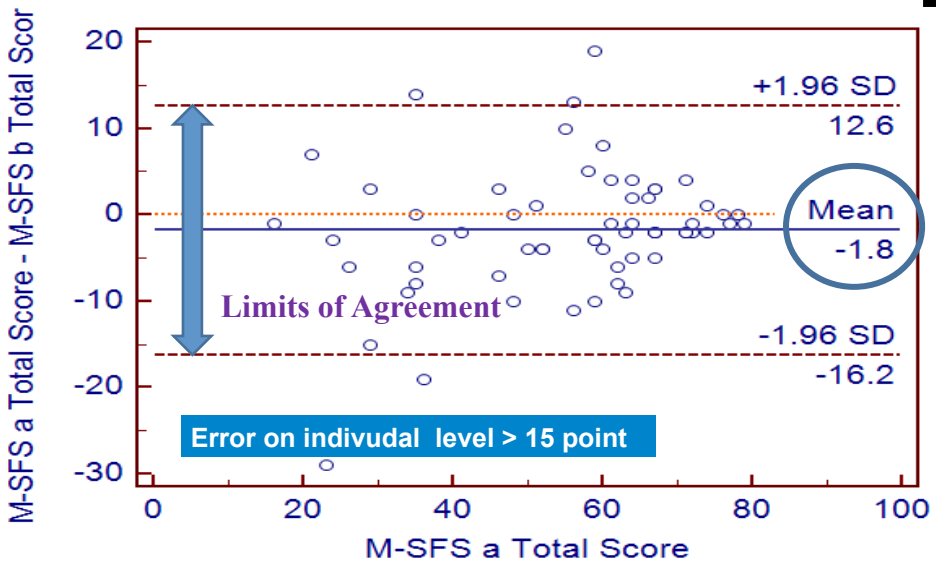
- Correlation 0.70-0.90 «strong correlation»
  Munro HB, 1998

ICC = 0.92

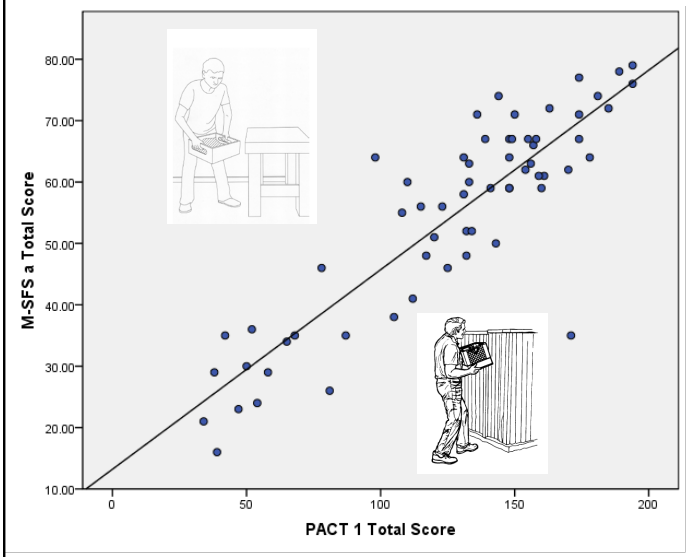
- ICC > 0.9 useful for taking decisions on a individual level
  Streiner DL & Norman GR, 2008

Messurement Error

Limits of agreement, Bland Altmann 1999



Construct validity: original SFS vs M-SFS



Spearman Rho = 0.83

Interpretation

- Correlation 0.70-0.90 «strong correlation»

  Munro HB, 1998

Construct validity: M-SFS and FCE tests & other self-reported measures

	M-SFS (n=62)
Functional Capacity Evaluation tests	
Lifting low	0.42*
Lifting high	0.46*
Lifting horizontally	0.53*
Self-reported beliefs	
Pain	-0.37*
Oswestry Disability Questionnaire (ODI)	-0.54*

*Correlations (Spearman) were significant at the 0.001 level

CLBP
0.44 – 0.55
Oesch et al 2010

0.61 – 0.70
Trippolini 2015

Neck injuries

0.33
Borloz-Trippolini 2015

CLBP and other MSK disorders

Diskussion & Conclusions

- Measurement properties of the 20-item M-SFS are:
  - "good":
    - Item score distribution (no ceiling or bottom effect)
    - Internal consistency and test-retest reliability
    - Construct-Validity with original SFS, other questionnaires & 4 factor structure
  - "acceptable":
    - Measurement error
    - Construct validity with FCE tests

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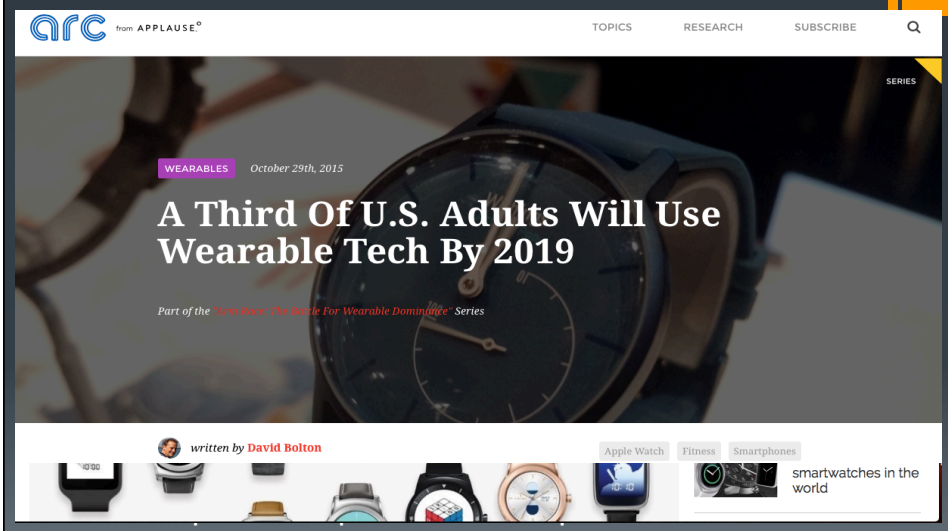
Do Wearable Fitness Devices Correlate With Performance-Based Tests of Work-Related Functional Capacity

Jesse Karpman MSc Student
Supervisor: Dr. Doug Gross
Committee: Trish Manns UofA, Christy Lane Mount Royal

Wearable Devices



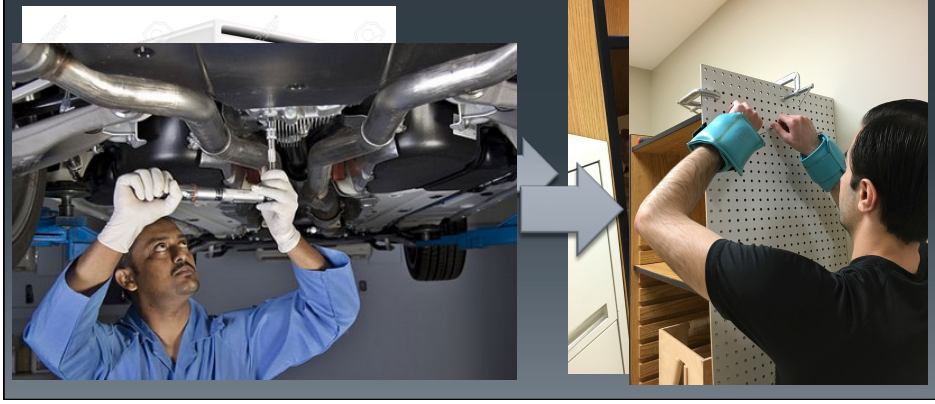
widespread acceptance, it is important to determine if, and how they should be introduced into clinical practice.

Actigraph Accelerometers

- In this study the Actigraph wG3TX-BT triaxial accelerometer was used
- Motion data is collected from horizontal right-left (X) , vertical (Y), and horizontal front-back (Z) axes
- Vector magnitudes (VM) can be calculated using all directions to show 3D motion
- Various studies have found this accelerometer to be valid for estimating energy expenditure, and tracking movements and exercise repetitions

What are Function Capacity Evaluations?

- FCEs can be used to determined recovery
- FCEs have been defined as "*an objective measurement of a person's ability to perform functional work activities" (Isernhagen, 1988)*



Specific Objectives

- Primary objective:
  - Determine the strength of correlation between Actigraph accelerometer Vector Magnitude data and 5 FCE items selected from the broader WorkWell FCE protocol.
- Secondary objective:
  - To compare correlations (ICC) between Actigraph Vector Magnitude data of two different placements on the body.

Design and Sampling

- A validation, cross sectional design was used
- Convenience sampling was used to enroll participants
- Subjects, either male or female, needed to be healthy individuals between the ages of 18-65 years
- Subjects were excluded if they were injured or had any physical limitations that would hinder their ability to complete certain exercise components from the FCE
- 46 total participants

Data Collection

- All participants were equipped with 2 Actigraph wGT3X-BT devices
- One device was worn on the non-dominant wrist and a second device was worn on the waist located on the anterior superior iliac spine on the dominant side using a belt style strap
- Participants were also asked to wear a Polar heart rate monitor, which was part of the FCE protocol for determining maximum heart rate levels.

Measures

- 5 total exercises
- Three lifting tasks: floor to waist (5-rep max), waist to crown level (5-rep max) and front carry (1-rep max) – assesses strength and mobility
- Weighted overhead work (timed) - assesses posture, and upper extremity endurance
- The 6-Minute Walk Test (distance) - assess walking capacity

Results

- 54.3% of the subjects were male and 89.1% were right handed
- The mean age of the sample was 23.7 years, the mean height was 170 cm and the mean weight was 73.2 kg
- The ages for the sample were between 19-40 years old, the heights were found to be between 152-194 cm and the weights between 43-135 kg

Results

Correlations between maximum weight lifted and vector magnitudes from waist and wrist Actigraph placements

	Peak Waist VM	Average Waist VM	Peak Wrist VM	Average Wrist VM
Floor to Waist	**0.40**	**0.45**	0.18	0.18
Waist to Crown	**0.39**	**0.39**	0.15	**0.44**
Front Carry	**0.57**	**0.64**	-0.13	0.24

- Values in red significant at P<0.01

Results

Correlations between Weighted Overhead Work time and average vector magnitudes from waist and wrist Actigraph placements.

	Average Waist VM	Average Wrist VM
Total Time	-0.07	-0.21

Correlations between Six-Minute Walk Test distance and total activity counts from waist and wrist Actigraph placements.

	Total activity counts - Waist	Total activity counts - Wrist
Total Distance	**0.66**	0.23

- Values in red significant at P<0.01

ICC Results

- Intraclass Correlation between waist and wrist placement of Actigraph Devices
- Data from the wrist expected to be higher than the waist therefore consistency agreement was used to analyze linear trend.
- ICC values ranged from 0.27 – 0.70
- Overall poor agreement
- Due in part to “noise” from the wrist placement

Conclusion

- Waist placement of the Actigraph device appears more optimal than the wrist placement due to stronger correlations observed with waist placement
- Average vector magnitudes were found to have a stronger correlation than peak vector magnitudes
- Agreement between device placement (waist and wrist) was poor overall.

Further Research

- Foundational study
- Similar design with an injured worker population
- Comparison between Actigraph recorded clinical data (during FCE) and Actigraph recorded workplace data

Thanks

jkarpman@ualberta.ca

THE ICF AS THE CONCEPTUAL FRAMEWORK FOR FCE

Linking FCE tests to the ICF Comprehensive Core Set of Vocational Rehabilitation

Marika Lassfolk

Institute of Public Health and Clinical Nutrition,
Faculty of Health Sciences, University of Eastern Finland

UNIVERSITY OF
EASTERN FINLAND

Background

- ✓ Functional Capacity Evaluations (FCE) lack common terminology and language (Soer et al 2008, Reneman et al. 2013)
- ✓ In 2008 experts agreed on using the ICF as the conceptual framework for Functional Capacity Evaluations (Soer et al 2008)

Objectives

TRANSLATE (1-3/16)	LINK (4-9/16)	PILOT STUDY (9/16 – 5/17)
• Spinal Function Sort Questionnaire (SFS) into Finnish and Swedish	• FCE tests to the Comprehensive ICF Core Set of Vocational Rehabilitation • *Spinal Function Sort Questionnaire* • *Complete Minnesota Dexterity* • *Grip Strength* • *Lifting and Carrying* • *Pushing and Pulling* • Results from linking	• Test 20 subjects • Evaluate, according to the set criteria, whether or not the Vocational Rehabilitation Core Set is accurate enough to describe functional capacity among subjects' suffering from low back pain

Results

	SFS	Grip	Minnesota	Lift	Carry	Push	Pull
Number of items linked (n)	50	3	13	4	1	1	1
Number of concepts (n)	102	3	28	8	2	2	2
Number of unique ICF categories/ component							
Body function (total 2nd level)	5 (3)	1 (0)	1 (0)	2 (0)	1 (0)	1 (0)	1 (0)
Activities and participation (total 2nd level)	25 (5)	3 (0)	4 (2)	4 (1)	3 (1)	2 (0)	2 (0)
Personal factors	0	0	1	0	0	0	0
Total number of ICF categories (total 2nd level)	30 (8)	4 (0)	5 (2)	6 (1)	4 (1)	3 (0)	3 (0)

ICF contents up to 2nd level categories of FCE tests and Questionnaire

ICF Category	SFS	Grip	Minnesota	Lift	Carry	Push	Pull
Body functions Chapter 2: Sensory functions and pain							
b235 Vestibular functions	x						
Chapter 7: Neuromusculoskeletal and movement–related functions							
b710 Mobility of joint functions	x						
b730 Muscle power functions	x						
Activity and Participation Chapter 1: Learning and applying knowledge							
d170 Writing			x				
Chapter 4: Mobility d430 Lifting and carrying objects	x			x	x		
d440 Fine hand use	x		x				
d445 Hand and arm use	x						
d449 Carrying, moving and handling objects, other specified and unspecified – dolley, trash barrel	x						
Chapter 6: Domestic life d640 Doing housework	x						

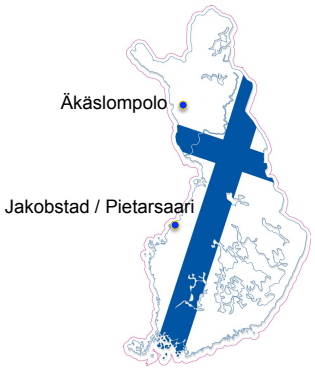
Overall percentage of agreement and Kappa coefficient

Questionnaire/tests	Overall percentage of agreement (%)	Kappa coefficient
SFS	90,7	0,23
Grip strength	66,8	0,22
Minnesota	73,7	0,25
Lifting	50	-
Carrying	16,7	-
Pushing	40	-
Pulling	40	-

Conclusions

- ✓ The linking of the Finnish, Swedish and English SFS was comparable
- ✓ Rater experience may have had effect on results
- ✓ The comprehensive Vocational Rehabilitation core set (2nd level) is not extensive enough to describe items in FCE tests and SFS questionnaire
- ✓ The results indicate that a new core set for FCEs may be needed

Thank you!



To the people that made all this possible:

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Michiel Reneman, University of Groningen
Kimmo Räsänen, University of Eastern Finland
Mika Venojärvi, University of Eastern Finland

And to all the ones helping with the translations of the SFS

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Associations of lifted weight and self-rated return-to-work prognosis

Bethge M, Freier J, Streibelt M, Ansuategui Echeita J

IM FOCUS DAS LEBEN

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Institute for Social Medicine and Epidemiology | Rehabilitation and Work

1. Background
2. Methods
3. Results
4. Discussion

Work-related medical rehabilitation (I)

- German work-related medical rehabilitation (WMR): intervention to improve and to restore work ability in patients with strong limitations in work functioning and an increased risk of permanent work disability
- 4 major components
  - Demand-related diagnostic of work functioning
  - Intensified social counseling
  - Work-related psychological groups
  - Work-related functional capacity training

Bethge M. *Work-related medical rehabilitation*. Rehabilitation, in press

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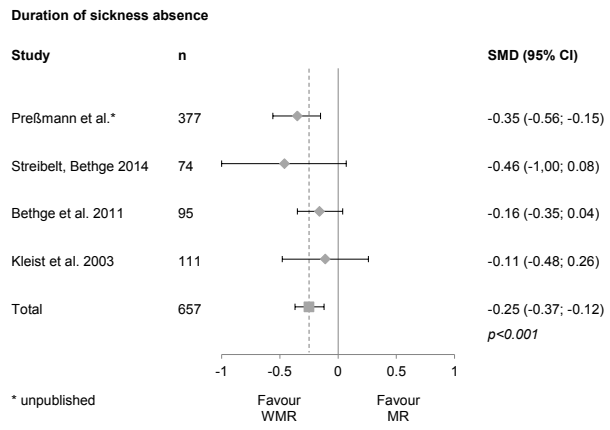
Work-related medical rehabilitation (II)



Bethge M. *Work-related medical rehabilitation*. Rehabilitation, in press

Functional capacity evaluation in WMR

- Short functional capacity evaluation (FCE) at admission in order to establish the rehabilitation plan
  - Guidance of functional capacity training
  - Support of sociomedical evaluation of work capacity
  - Clarification on job modification
- Exploring poor return-to-work (RTW) prognosis and identifying factors that contribute to poor RTW expectations
- *Objective:* Associations of lifting floor-to-waist results (early test termination, lifted weight) with self-rated RTW prognosis

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1. Background
2. Methods
3. Results
4. Discussion

Methods

- *Recruitment:* German arm of the international FCE study
- *Setting:* short WorkWell Systems FCE at the beginning of a WMR program 14 therapists from 6 rehabilitation centres
- *Inclusion:* participation in WMR program; job contract (in more detail: see also Reneman and Ansuategui Echeita)
- *Outcomes:* self-rated poor RTW prognosis (3-item scale; 0 to 3 points; higher scores = worse RTW prognosis;
  2 or 3 points = poor RTW prognosis)
- *Explanatory variables:* lifted weight and early test termination

7

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1. Background
2. Methods
3. Results
4. Discussion

8

Sample characteristics

	Mean (SD) or %
Age, mean (SD)	46.8 (11.8)
Sex, % female	46
Sickness absence, % ≥90 days	62
Work Ability Score, mean (SD)	4.3 (2.6)
% 0 – 5	68
% 6, 7	16
% 8 – 10	16
Self-rated RTW prognosis, % poor	49
Early test termination	46
Lifted weight, mean (SD)	19.1 (8.8)

n = 100; SD = standard deviation; RTW = return-to-work

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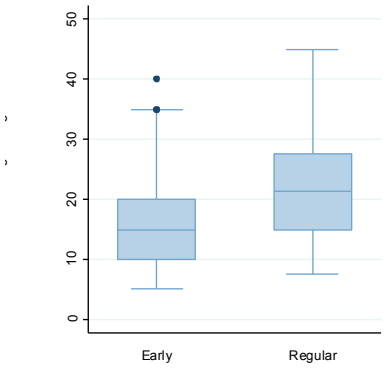
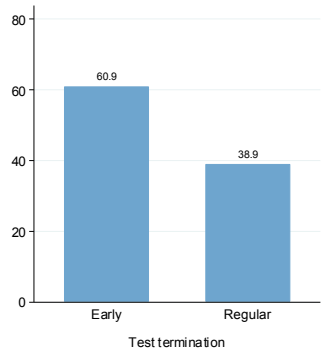
Test termination

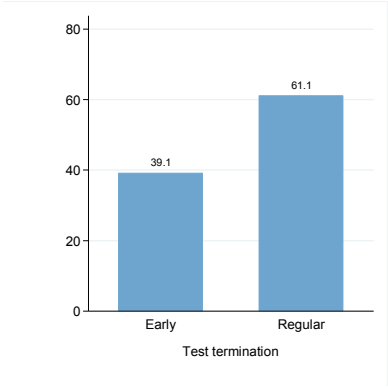


n = 100; 46 early test terminations

- Poor documentation of early test termination: reason not documented in 13 of 46 early terminations
- Mean difference in lifted weight: 5.4 (95% CI: 2.1-8.7); 61% of the standard deviation

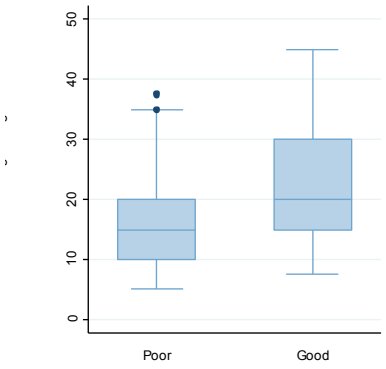
Test termination and self-rated RTW prognosis





n = 100; 46 early test terminations

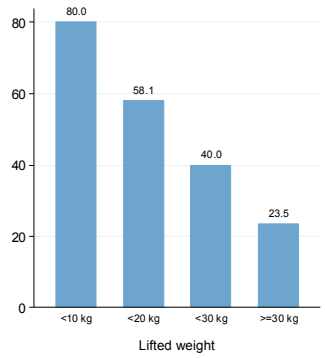
Self-rated RTW prognosis

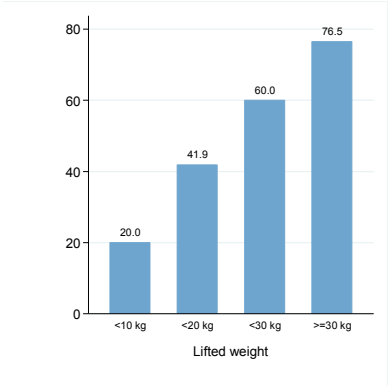


- Mean difference in lifted weight: 6.3 (95% CI: 3.1-9.6); 72% of the standard deviation

n = 100; 49 poor prognosis

Poor RTW prognosis according to lifted weight





n = 100; 49 poor prognosis

Additional effect of lifted weight in explaining poor RTW prognosis

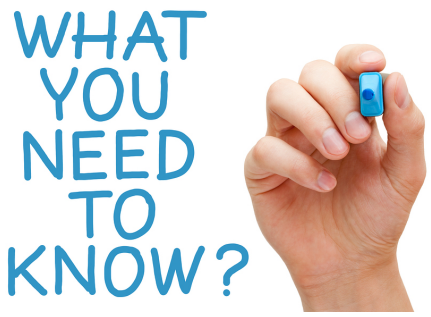
	OR	95% CI	p
Lifted weight (10 kg increase)	0.48	0.25; 0.90	0.022
Work Ability	0.86	0.72; 1.04	0.116
Age: 55 years and older	4.05	1.47; 11.12	0.007
Female	2.28	0.88; 5.93	0.091

n = 100; OR = odds ratio; CI = confidence interval

1. Background
2. Methods
3. Results
4. Discussion

Discussion

- Clinical meaningful data for understanding a poor RTW prognosis
- *Challenge:* better documentation of test terminations in German rehabilitation centers
- *Limitations:* sample size; heterogeneity of clinical experience



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Thanks for your attention!

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Sustainable return to work among construction workers on sick leave due to musculoskeletal disorders: what is the added value of action versus a question?

Paul Kuijer, Vincent Gouttebarge, Haije Wind, Cor van Duivenbooden, Judith Sluiter & Monique Frings-Dresen

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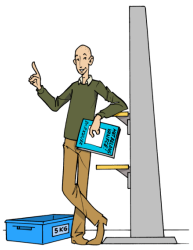


Improve the quality of work ability assessments

- Especially for occupations characterized by heavy physical work, like construction workers
- Time: Self-reports > FCE, however…
- Self-reports and FCE measure *different* aspects of work ability (Brouwer et al. 2005, Gross & Battié 2005, Gouttebarge 2009) …

Research Question

Is a self-report on work ability in combination with FCE a better predictor for sustainable RTW than a self-report only in construction workers on sick leave due to MSDs?

Methods: design & population

- Prospective cohort study, follow-up 12 months
- 72 male construction workers, performing physically demanding work & 6 weeks on sick leave due to MSDs
- 42 years, 186 cm, 82 kg; 17% UE, 30% BP, 28% LE, 25% Other

Day 1 sick leave due to MSDs

6 weeks sick leave (T0)

Work Ability Assessment:

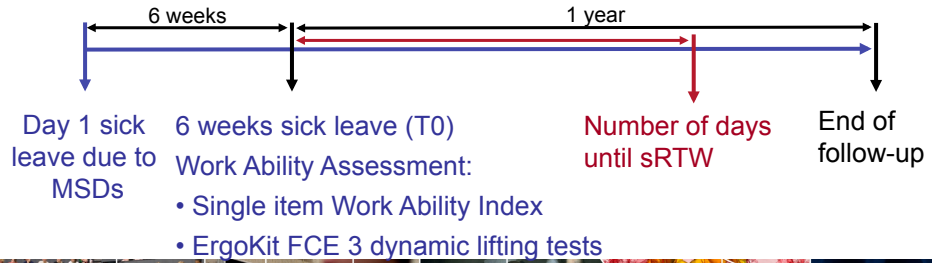
- Single item Work Ability Index
- ErgoKit FCE 3 dynamic lifting tests

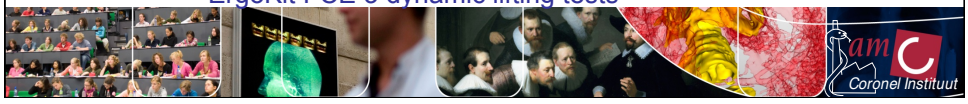
Methods: work ability

- Self-report: Work Ability Index
  - First question 'current work ability compared with lifetime best'
  - Scale from 0 to 10
- Three Ergo-Kit dynamic lifting tests:
  - Carrying lifting strength test, Lower lifting strength tests and Upper lifting strength test
  - Tests are reproducible in patients with MSDs
  - Number of kilograms (kg)

Sustainable Return to Work (sRTW)

- sRTW = the duration of work absenteeism due to MSDs in calendar days from 6 weeks after the first day on sick leave until the first day of returning fully to the worker's own work or other work for a period of ≥4 weeks throughout the 1-year follow-up period (T1)





Data: FCE, Work Ability & sRTW

At 6 weeks sick leave	Mean	SD	Min	Max
Work Ability Index (0-10)	4.8	2.8	0	10
Upper Lifting Strength Test (kg)	22	9	5	50
Lower Lifting Strength Test (kg)	33	13	0	75
Carrying Lifting Strength Test (kg)	36	13	10	75
Days until sRTW	150	104	42	365

Self report (+ FCE) = sRTW?

	Days until sRTW
Single-item Work Ability Index?	?
Single-item Work Ability Index + FCE?	?

r > .60 = Good, .30 ≤ r ≤ .60 = Moderate, r < .30 = Poor

Self report (+ FCE) = sRTW?

	Days until sRTW
Single-item Work Ability Index?	r = 0.31, p=0.009
Single-item Work Ability Index + FCE?	?

r > .60 = Good, .30 ≤ r ≤ .60 = Moderate, r < .30 = Poor

Self report + FCE = sRTW?

	Days until sRTW
Single-item Work Ability Index?	r = 0.31, p=0.009
Single-item Work Ability Index + FCE?	r = 0.44, p=0.001

The single-item Work Ability Index question is a moderate predictor for sRTW, with explained variance of 9% ('adjusted r^{2}').

Adding one dynamic lifting test (floor-hip) increases the explained variance from 9% to 16% for sRTW…

16%: Not bad & room for improvement

Short communication

Scand J Work Environ Health. 2012;38(6):600–603. doi:10.5271/sjweh.3302

Prognostic value of self-reported work ability and performance-based lifting tests for sustainable return to work among construction workers

by P Paul FM Kuijer, PhD,[1] Vincent Gouttebarge, PhD,[1] Haije Wind, MD, PhD,[1] Cor van Duivenbooden, MD,[2] Judith K Sluiter, PhD,[1] Monique HW Frings-Dresen PhD [1]

Freely available:
http://www.sjweh.fi/show_abstract.php?abstract_id=3302

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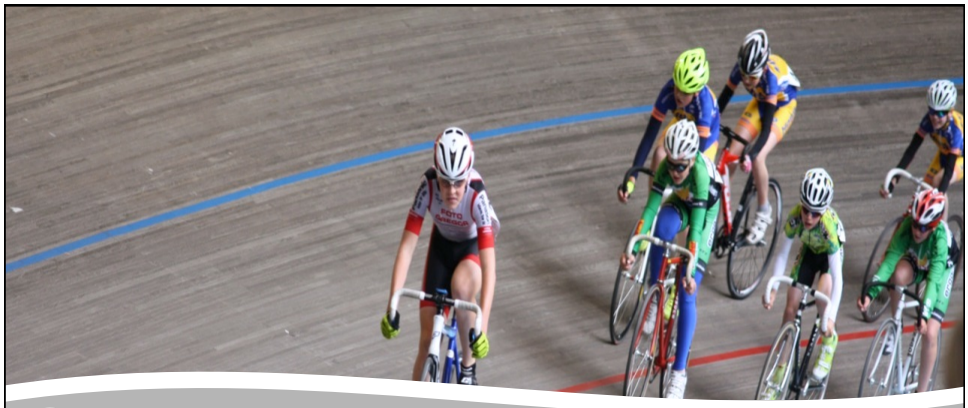

Deutsche Sporthochschule Köln
German Sport University Cologne

The predictive validity of a workplace-specific and strain-related short-form Functional Capacity Evaluation in patients with musculoskeletal disorders

David Bühne

Background

Deutsche Sporthochschule Köln
German Sport University Cologne

ELA

Einschätzung körperlicher **L**eistungs-fähigkeiten bei arbeitsbezogenen **A**ktivitäten

(Work-related Physical Functional Capacity Evaluation)

24 subtests and 4 dimensions

- posture — e.g. standing, sitting, bent posture
- locomotion — e.g. walking, climbing, crawling
- movement of body parts — e.g. squatting, reaching, handgrip strength
- complex categories — e.g. lifting, carrying, pushing

Background & Objective

Deutsche Sporthochschule Köln
German Sport University Cologne

ELA

- in Germany widely used within the work-related medical rehabilitation
- selection of tests is based on the workplace-related strain
- predictive validity has not been proven so far

Objective

(1) evaluation of the ability of a short-form FCE to predict sustainable return to work (RTW)

(2) evaluation of the gain of information towards patient self-reports

Method

Deutsche Sporthochschule Köln
German Sport University Cologne

Design	multicentric prospective cohort study (with four outpatient rehabilitation clinics in Cologne, Freiburg, Neuss & Viersen)
Participants	patients (N=198) with musculoskeletal disorders
Data collection	between September 2013 and January 2016
FCE-Indicator	overall FCE-rating (ability to cope with the physical work demands (positive vs. negative))
Outcome:	RTW: combination of employment at 3-month follow-up with less than 1.5 weeks of sick leave because of musculoskeletal disorders within the follow-up period

Results

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German Sport University Cologne

Patient Characteristics (N=198)	%	Mean ± SD
Age (years)		47.7 ± 10.0
Gender (men)	66.2	
Sick-listed at admission	80.3	
Employment status at admission (employed)	82.3	
Initial diagnosis (ICD-10-code M40-54)	52.0	
Time of sick-leave 1 year pre-admission (>100 days)	43.4	
Patients' prognosis of expected work disability (heavily limited)	25.3	
Expected duration till RTW (≤1 month)	62.6	
Work demands (equally physical and non-physical demanding)	64.1	
FCE-tests (per patient (admission & discharge))		3.5 ± 1.0
FCE-result at admission (≥"moderate" physical work ability)	61.6	
FCE-result at discharge (≥"moderate" physical work ability)	79.8	
RTW (employed & low level of sick-leave)	59.1	

Results

Deutsche Sporthochschule Köln
German Sport University Cologne

1) predictive validity of FCE-information at discharge

	$R^2_{Nagelkerke}$	AUC-ROC	CCR	Odds ratio (FCE)	Sensitivity	Specifity
Reference model*	0.285	0.777	70.7%	---	82.9%	53.1%
Crude (FCE-result positive vs. negative)	0.256	0.684	73.2%	13.4 (5.3 – 34.0)	92.9%	43.1%
Crude + baseline	0.270	0.716	73.2%	13.0 (5.1 – 33.2)	94.9%	42.0%
Adjusted*	0.425	0.825	78.8%	10.8 (4.0 – 29.5)	90.6%	61.7%

**Based on/adjusted for: age, gender, family status, vocational qualification, sick-listed at admission, sick leave 1 year preadmission, work demands, initial diagnosis & baseline* RTW=0, NRTW=1

Results

Deutsche Sporthochschule Köln
German Sport University Cologne

2) gain of information at admission

Sociodemographic data

- employment status
- vocational qualification
- gender & age
- family status

Health-related data

- sick-listed at admission
- initial diagnosis
- sick leave 1 year preadmission
- general health (SF-12 item)
- depression (PHQ-2)
- pain

Work-related data

- work demands
- expected duration till RTW
- patients' prognosis of expected work disability
- wish for retirement
- physical work ability (WAI-Item)
- job satisfaction

Results

Deutsche Sporthochschule Köln
German Sport University Cologne

2) gain of information at admission

Sociodemographic data

- employment status
- vocational qualification

Health-related data

- sick-listed at admission

Work-related data

- work demands
- expected duration till RTW
- patients' prognosis of expected work disability

Reference model

explained variance:
44,5%
correctly classified:
77,8%
AUC:
0,857

+ ELA

= improvement of the model?

Results

Deutsche Sporthochschule Köln
German Sport University Cologne

2) gain of information at admission

	$R^2_{Nagelkerke}$	AUC-ROC	CCR	Odds ratio (FCE)	Sensitivity	Specifity
Reference model*	0.445	0.857	77.8	---	88.0	63.0
Crude (FCE-result positive vs. negative)	0.128	0.656	67.2	3.8 (2.1 – 7.0)	74.4	56.8
Crude + baseline	0.144	0.681	67.7	3.7 (2.0 – 6.7)	82.1	46.9
Reference model + FCE-result	0.465	0.864	79.8	2.2 (1.1 – 4.8)	88.0	67.9

** Employment status, vocational qualification, sick-listed at admission, work demands, expected duration till RTW, patients' prognosis of expected work disability*
RTW=0, NRTW=1

Limitations/Conclusions

Deutsche Sporthochschule Köln
German Sport University Cologne

Limitations

- validity of test-selection questionable
- validity of physical work-demands-assessment questionable
- influence of contextual factors (e.g. employment rate)

Conclusions

- the study confirms the predictive validity of crude and adjusted FCE-information
- the gain of information towards patient self-reports is questionable

Deutsche Sporthochschule Köln
German Sport University Cologne

Thank you for your attention

Institut für Qualitätssicherung in Prävention und Rehabilitation GmbH an der Deutschen Sporthochschule Köln

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Upper Limb

Isokinetic Strength Assessment

Applicability in Work Injury Patients

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Egarsat | *Sociedad Española de Rehabilitación y Medicina Física* | *EUSES-Universitat de Girona*

Isokinetic dynamometry

- Dynamic muscle strength test.
- Good reliability.
- Feasible.
- Valid.
- Sincerity of effort parameters are defined.
- **Strength test "gold standard".**
  (Jarvela, Kannus, Latvala, & Jarvinen, 2002; Stark, Walker, Phillips, Fejer, & Beck, 2011)

Causes that can affect reliability

- The dynamometer (calibration)
- The procedure (poor patient fixation and positioning ...)
- The protocol (diferent rest times ...)
- The tester (differences in interaction with patient ...)
- Data process (Curve smoothing ...)
- **The patient (motivation, colaboration)**

(Dvir, 1995)

Measurement veracity

- Measurement results validity rely on a maximal effort
- Sincerity of effort is thus an important issue.
- The Coefficient of variation (CV) and generally parameters based on variability are not valid to assess sincerity of effort. *(Fishbain et al, 1999 and Dvir, 2004)*
- The DEC (difference between high and low velocity eccentric / concentric ratios) has been shown to be an efficient parameter to assess sincerity of effort:

DEC = (Ecc/Con) $_{\text{high velocity}}$ **- (Ecc/Con)** $_{\text{low velocity}}$ *(Professor Z. Dvir)*

- It measures the discrepancies between eccentric and concentric measurements. They may be due to a separated motor control *(Enoka, 1996)*

General Methods

- Healthy volunteer sample
- Maximal and submaximal isokinetic effort performance at high and low velocities (normally 1:4) in concentric and eccentric modalities.
- From PT registers calculation of:
  - Ecc/Conc ratio at high and low velocities
  - **DEC= (Ecc/Con) $_{\text{high velocity}}$ - (Ecc/Con) $_{\text{low velocity}}$**

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Clinical Rehabilitation 2007; **21**: 241–247

Identification of feigned maximal shoulder external rotation effort

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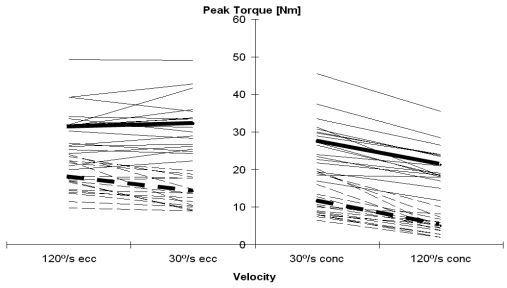
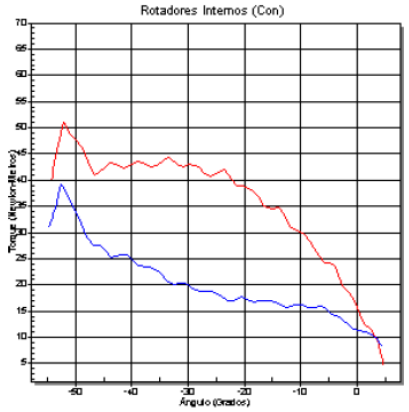
Received 17th March 2006; returned for revisions 31st May 2006; revised manuscript accepted 2nd August 2006.

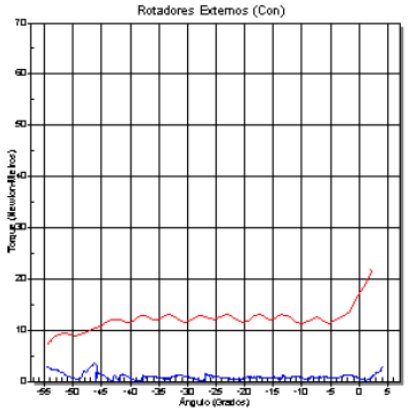
Healthy male volunteers.



Maximal effort		Confidence level	Tolerance or cut-off level	Submaximal effort	
Mean DEC	SD			Mean DEC	SD
0,311	0,175			2,925*	1,945
		95%	>0.810		

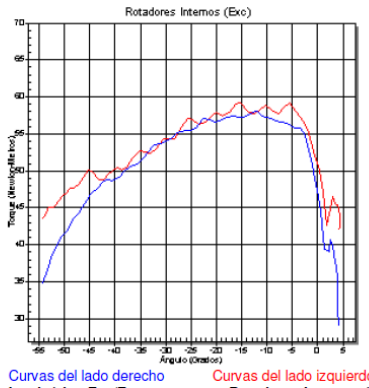
*p<0.001

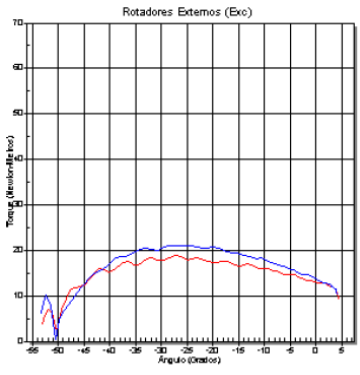




Curvas del lado derecho Curvas del lado izquierdo

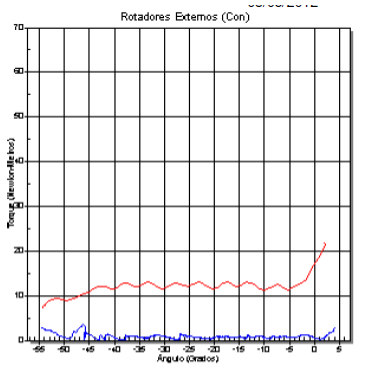
Isocinético Con/Con	Rotadores Internos (Con)			Rotadores Externos (Con)			
Velocidad 120/120 grad/seg. Repeticiones 1	Valor	Coef Var	%BW	Valor	Coef Var	%BW	Ratio
PARÁMETROS DE TORQUE							
torque máximo (Newton-Metros - Mejor repetición) - Zoom							
Derecha	39	0,00	42	5	0,00	6	14
Izquierda	52	0,00	57	22	0,00	24	42
Déficit	24			75			





Curvas del lado derecho Curvas del lado izquierdo

Isocinético Exc/Exc	Rotadores Internos (Exc)			Rotadores Externos (Exc)			
Velocidad 120/120 grad/seg. Repeticiones 1	Valor	Coef Var	%BW	Valor	Coef Var	%BW	Ratio
PARÁMETROS DE TORQUE							
torque máximo (Newton-Metros - Mejor repetición) - Zoom							
Derecha	58	0,00	63	22	0,00	24	37
Izquierda	60	0,00	66	19	0,00	21	32
Déficit	2			-13			



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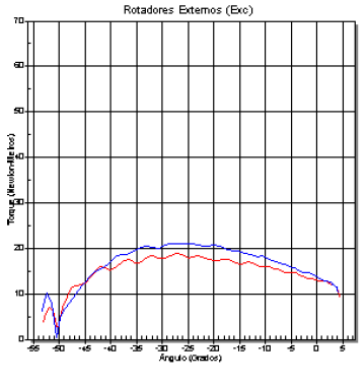

Rotadores Externos (Con)

Coef Var	%BW	ValorCoef Var	%BW
42	5	0,00	6
57	22	0,00	24
	75		

Rotadores Externos (Exc)

Coef Var	%BW	ValorCoef Var	%BW
63	22	0,00	24
66	19	0,00	21
	-13		

Concentric test

Eccentric test

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Maximality of shoulder external rotation effort in patients presenting with work related injury: The clinical applicability of the DEC parameter

Joaquim Chaler [a,b,*], Eduard Pujol [a], Carme Unyó [a], Salvador Quintana [c], Bertram Müller [a], Roser Garreta [a,d], Casimiro Javierre [e], Zeevi Dvir [f]

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Table 1. Baseline demographics diagnosis and work related outcomes. Comparison between genders. Note that, as expected, the only significant difference among groups is found in weight (*). Diagnosis proportion differences were not significant between genders.

	Female	Male
No. of worker compensation patients included:	33	41
Mean age (yr±SD):	48.48±9.6	47.78±10.84
Mean weight (Kg±SD):	67.97±10.74	80.34±11.67*
Mean process duration (days±SD)	271.24±168.99	306.49±242.54
Diagnosis:		
Impingement/rotator cuff tendinosis	12	15
Arthroscopic surgery	10	4
Rotator cuff surgical reconstruction	7	8
Instability	1	7
Other	3	7
Outcomes (work related)		
Complete healing	20	22
Impairment, no disability	5	4
Impairment, partial disability	1	2
Impairment, total disability	7	13

New proposal: Normative DEC is uninvolved side's

	M	H
DEC > DEC uninvolved + 2SD	7	10
DEC within DEC uninvolved± 2SD	18	25
DEC < DEC uninvolved - 2SD	13	6

Women acceptable DEC : -0,83 – 2,25

Men acceptable DEC : -0,6 – 1,6

Clinical usefulness or validity

	30°/s conc	30°/s ecc	120°/s conc	120°/s ecc
Diagnostic groups:				
Impingement/rotator cuff tendinosis (n=9)	26.60 ± 38.35	16.43 ± 21.41	30.12 ± 33.58	13.51 ± 24.97
Surgically treated patients (decompression and Rotator cuff reconstruction (n=7)	47.98 ± 37.34	31.60 ± 23.32	41.16 ± 29.61	27.39 ± 23.52
Outcomes (work related):				
Complete healing (n=15)	19.22 ± 34.77	9.88 ± 18.24	19.62 ± 31.99	8.96 ± 20.89
Impairment (any degree) (n=10)	58.86 ± 17.65*	38.38 ± 21.31*	50.89 ± 15.82*	32.52 ± 19.75*

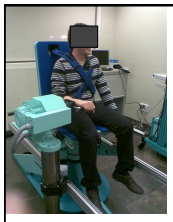
Conc: concentric contraction
Ecc: eccentric contraction
* impaired shoulder patient deficits significantly higher than "complete healing" patient ones

- Surgical patients showed a higher ER deficit (although not significant)
- Pacients with any degree of permanent impairment and work disability showed a significantly higher shoulder ER deficit in all measurements.

Long and Short RoM shoulder external rotator DEC Cutoff levels

Long ROM (60°) DEC values ± SD			Short ROM (20°) DEC values ± SD	
Maximal effort	Feigned Effort		Maximal effort	Feigned Effort
0.215 ± 0.126	0.556 ± 0.597[a]		0.014 ± 0.154	0.216 ± 0.292[b]
Cutoff		Confidence level	Cutoff	
<0.552		90%	<0.426	
<0.580		95%	<0.461	
<0.646		99%	<0.540	

ROM: Range of motion
[a] long ROM feigned effort DEC is significantly higher than its maximal effort counterpart p = 0.049
[b] short ROM feigned effort DEC is significantly higher than its maximal effort counterpart p = 0.028



DEC Wrist dorsal flexors

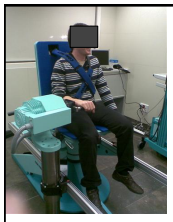
Maximal (max), Submaximal (submax) and cutoff level.
(male healthy volunteers; 28,5±2,1y)

Wrist extensors

DEC max	DEC submax
0.01(0.136)	0.44(0.41)*

Confidence level (%)	Cut-off DEC
90	>0.303
95	**>0.384**
99	>0.576

DEC: difference eccentric-concentric



DEC Wrist palmar flexors

Maximal (max), submaximal(submax) and cutoff level.
(male healthy volunteers; 28,5±2,1 y)

wrist flexors

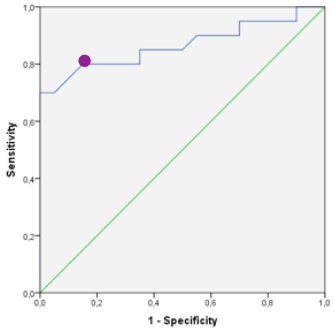
DEC max	DEC submax
-0.013(0,120)	0,20(0,32)*

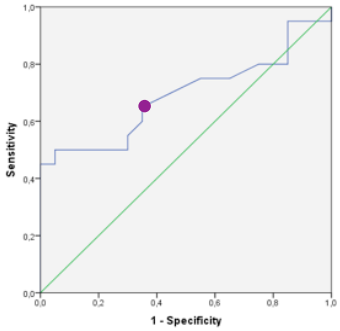
Confidencelevel (%)	Cut-off DEC
90	>0,245
95	**>0,317**
99	>0,486

DEC: difference eccentric-concentric

Wrist dorsal and palmar flexor DEC

ROC curve analysis derived cutoff level

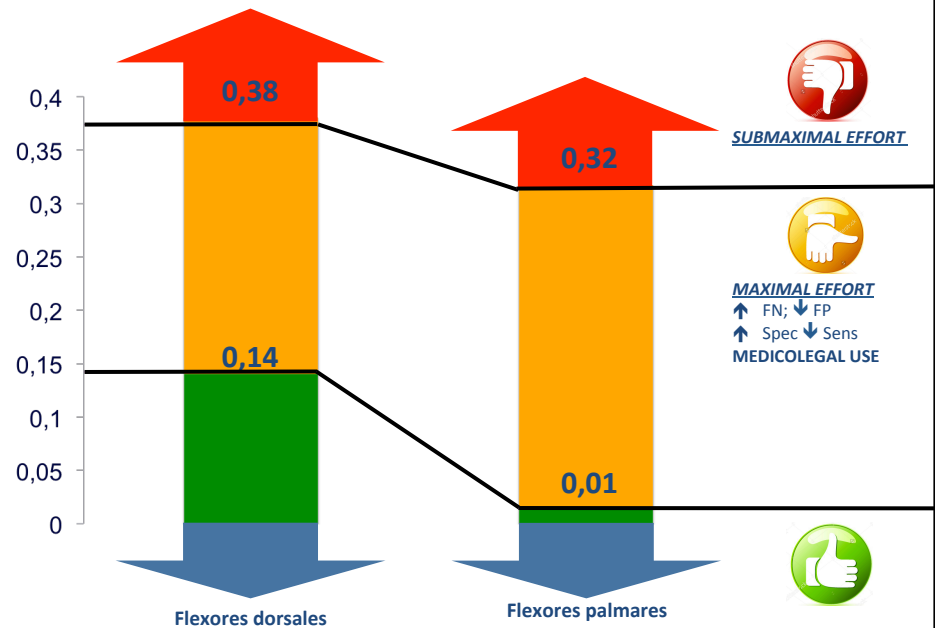




DORSAL FLEXOR.
Area below the curve: 0.866 (95%CI 0.744-0.988)
Cutoff level: 0.14 **<<<< 0,384**
Sensitivity: 80%; Specificity: 85%

PALMAR FLEXOR
Area below the curve: 0.691 (95%CI 0.520-0.862)
Cutoff level: 0.015 **<<<<<< 0,317**
sensitivity: 65%; Specificity: 65%

Wrist dorsal and palmar flexor DEC cutoff level



Sens: *Sensitivity;* ***Spec:*** *specificity;* ***FN:*** *false negative;* ***FP:*** *false positive*

Demographyc and Clinical Data

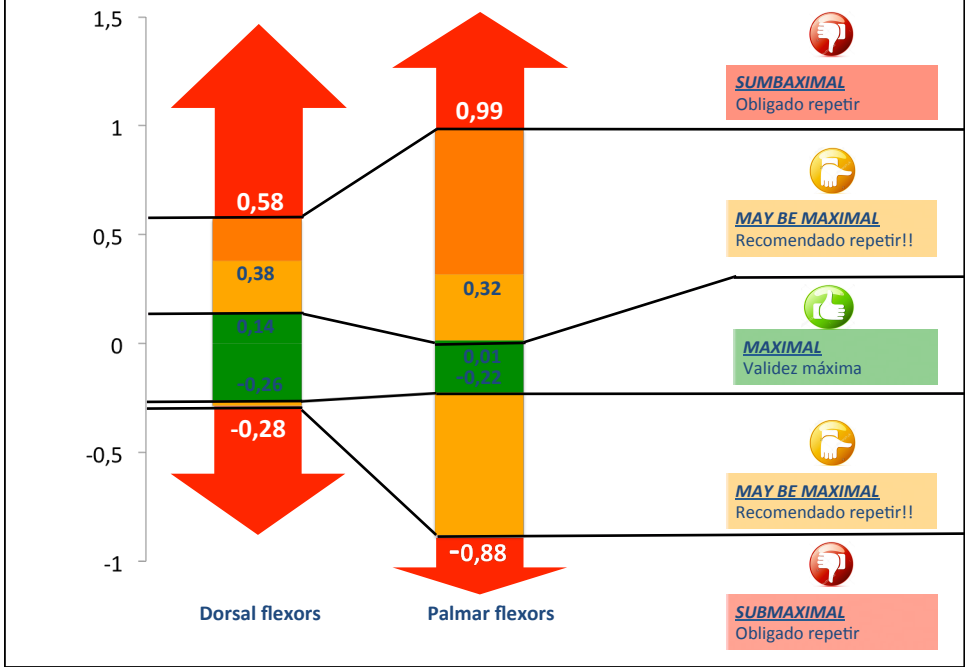
	Women	Men
N	22	44
Age (average ± SD)	48,5 ± 7,75	44,9 ± 8,16
Time of evolution (d) (average ± DE)	**270 ± 205,002**	**262 ± 193,04**
Diagnsosis (n/%)		
Lateral Epicondylitis	**11/50%**	**14/31,8%**
Medial Epicondylitis	2/9%	3/6,8%
Operated Epicondylitis	**8/36%**	**15/34%**
Other	1/4%	12/27%
Compensation(%):		
No compensation	62,5%	62,5%
Compensation	37,5%	37,5%
Relapse (%)	6,25%	**40%**

- DEC
- Strength deficits.
- Palmar flexor/Dorsal flexor ratios
- Permanent impairment.
- Relapse during the first year

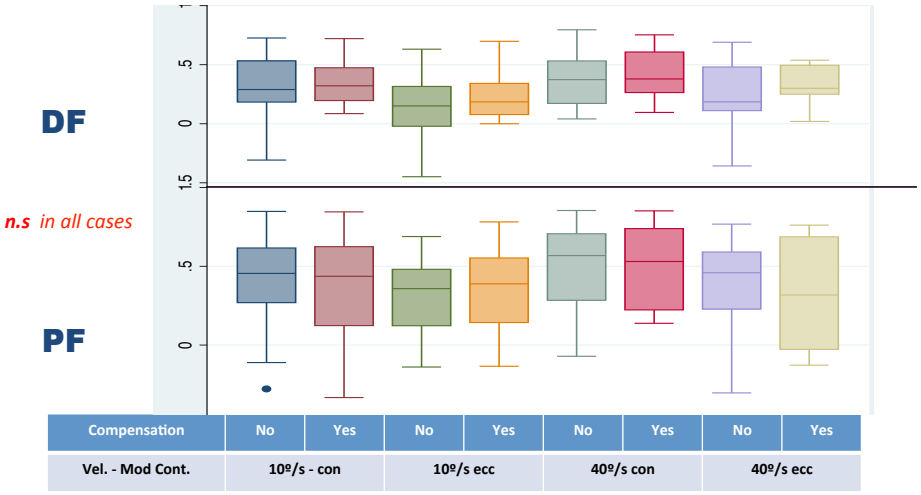
First result: new uninvolved side based normative DEC

Normative DEC	Women	Men
Dorsal flexors	**0,086 ± 0,296** *Range: (-0,506) – 0,678*	**0.146 ± 0,215** *Range: (-0,284) – 0,576*
Palmar flexors	**0,285 ± 1,09** *Range: (-1,89) – 2,46*	**-0,053 ± 0,467** Range: *(-0,881) – 0,987*

DEC cutoff levels: wrist dorsal and palmar flexors **(Men)**



Palmar flexor and dorsal flexor Deficits (RATIO)
Comparison of patients with and without compensation. *Men (n=29)*

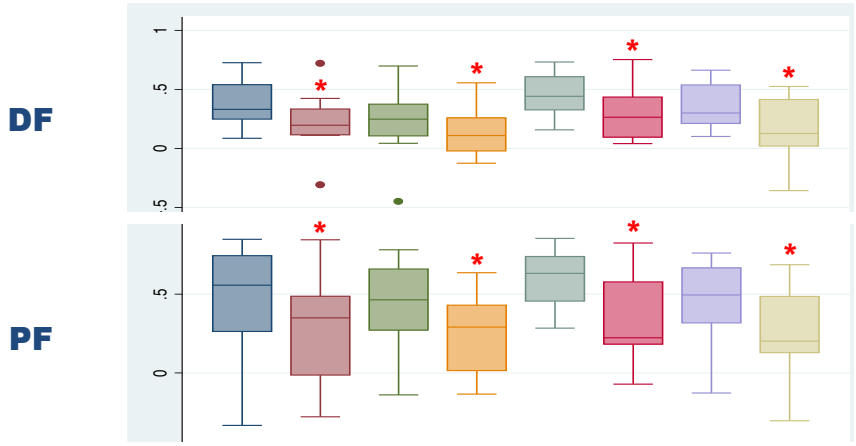


Compensation	No	Yes	No	Yes	No	Yes	No	Yes
Vel. - Mod Cont.	10º/s - con		10º/s ecc		40º/s con		40º/s ecc	

No significant difference regarding deficits in any case

Vel.: Velocity; **Mod. Cont.:** Contraction mode ; **con:** concentric; **ecc:** eccentric: **n.s.:** non significant

Palmar flexor and dorsal flexor Deficits (RATIO)
Comparison of patients with and without relapse. *Men (n=29)*

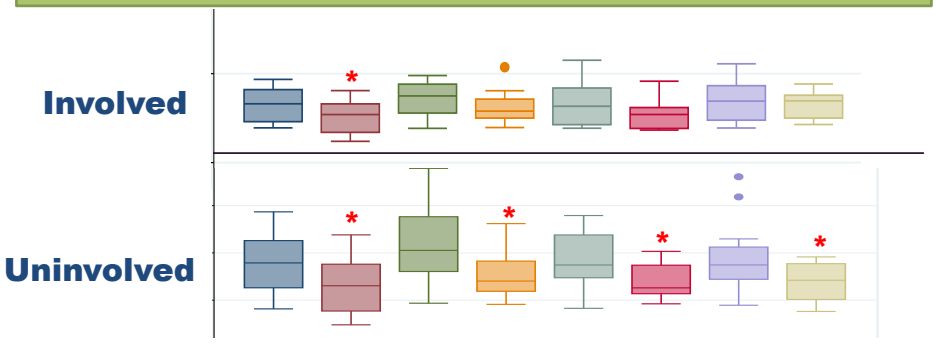


Relapse	No	Yes	No	Yes	No	Yes	No	Yes
Vel. - Mod Cont.	10º/s - con		10º/s ecc		40º/s con		40º/s ecc	

Patients suffering relapse showed significantly lower deficits than those without relapse

Vel.: Velocity; **Mod. Cont.:** Contraction mode ; **con:** concentric; **ecc:** eccentric: **n.s.:** non significant

Palmar flexor/dorsal flexor ratios
compensation-non compesation comparison. *Men (n=29)*

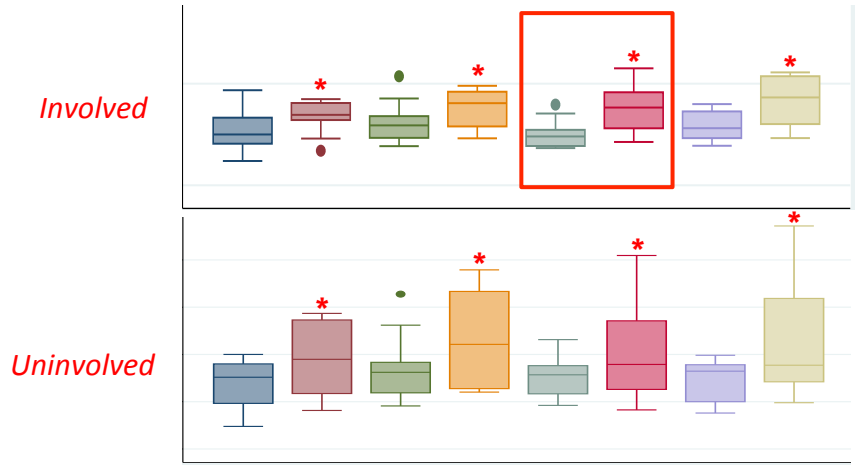


Compensation	No	Yes	No	Yes	No	Yes	No	Yes
Vel. - Mod Cont.	10º/s - con		10º/s ecc		40º/s ecc		40º/s ecc	

Men receiving compensation show significantly lower PF/DF ratios in all uninvolved side mesurments and 10º/s conc measurement at involved side

Vel.: Velocity; **Mod. Cont.:** Contraction mode ; **con:** concentric; **ecc:** eccentric: **n.s.:** non significant

Palmar flexor/dorsal flexor ratios relapse-non relapse comparison. *Men (n=29)*

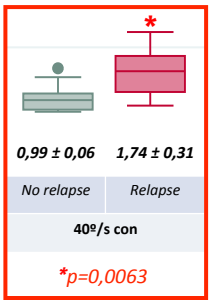


Relapse	No	Yes	No	Yes	No	Yes	No	Yes
Vel. - Mod Cont.	10º/s - con		10º/s ecc		40º/s con		40º/s ecc	

All patients with relapse showed significantly higher PF/DF than those without relapse. It was found in all measurements and in both sides: involved and uninvolved.

Vel.: Velocity; **Mod. Cont.:** Contraction mode ; **con:** concentric; **ecc:** eccentric: **n.s.:** non significant

PF/DF ration ROC curve analysis
Relapse prediction



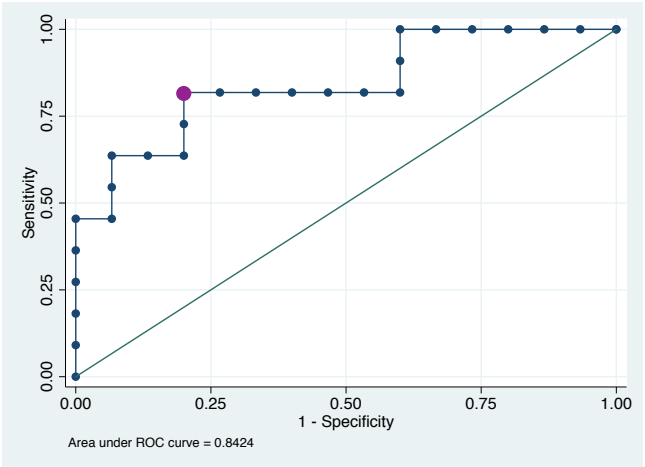
PF/DF ratio (40º/s con)

>1,121

Relapse predictor

Sensitivity: 81.82%

Specificity: 80%



PF: palmar flexors; **DF:** Dorsal flexors; **con:** concentric

Conclusions

- The DEC parameter may be useful in detecting submaximal shoulder external rotator, wrist extensor and wrist flexor efforts.
- Shoulder external rotator strength deficits are related to permanent impairment/ compensation shoulder injury patients.
- High wrist PF/DF strength ratios may be predictors of epycondilitis relapse.

Rehabilitació. Egarsat

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PROPOSED INCLUSION OF WORK PHYSIOLOGY IN FCE

HEART RATE RESERVE METHOD

Guided Discussion by
Theodore J. Becker PT, PhD
Whitney L. Ogle PT, DPT

Background

- A Functional Capacity Evaluation (FCE) should predict full time work tolerance
  - There are no universally accepted standards, methods, or procedures for predicting work time tolerance
- Commercial FCE protocols do not include scientific formulas for projection to an eight hour day (King, 1998)
  - Use of 85% heart rate max (HR_{max}) as cut off during FCE
- While some FCE reports mention heart rate responses during testing, we have found that FCE conclusions were not based on objective physiological responses during testing (Becker, 2015)

Background & Purpose

- Analysis of heart rate response to activity is not a standard method in the determination of full time work tolerance in FCE protocols at this time
- The purpose of this guided discussion is to spark a conversation about the use of heart rate data in determining full time work tolerance during FCE testing

Historical Perspectives

- Heart rate response can be used to determine if work can be maintained throughout working time (Bonjer, 1962)
- Heart rate has been established as the preferred determinant of full time work tolerance as is a well established indicator of work physiology response (Garg & Hagglund, 1983)
- There are formulas to predict full time work that are completely independent of exercise fitness testing (Davies, 1966)

Heart Rate & FCE Testing

- A work physiology test is designed to impose strain upon the individual that is correlated with the demands of their work environment and the worker's ability
  - Because typical day-to-day work is not performed at maximum aerobic capacity, there is no need to determine VO_{2max} for FCE
- Measuring the physiological response to required work tasks can assess the heaviness of a task and the sustainable capacity for the task completion
  - Heart rate is one of the best indexes for this assessment because of the linear relationship between heart rate and stress of task (Davies 1966, Booyens 1960)
  - Heart rate is also less invasive to test than VO_2

Physiological Strain and Work Duration

- Astrand (1960) reported that the upper limit of work tolerance for an eight hour work day is 50% of physical work capacity
  - Since industrial work may involve both high and low intensities throughout the day, the upper limit of work tolerance should be less than 50% of physical work capacity (Jiang, 1984; Kaudawitz 1998)

Workload	Percent Work	Work Duration	Heart Rate (bpm)
Moderate	<33%	8 hrs	90-110
Heavy	34-50%	1-8 hrs	111-130
Very Heavy	51-75%	20 min – 1 hour	131-150
Extremely Heavy	>75%	<20 min	>150

From Jiang (1984)

See also: Astrand (1960), Kodak (1986), AIHA (1971), Kroemer (2001), Williams (1964), Wilson (1995)

Heart Rate Reserve (HRR) Equations

- HRR = HR_{max} - HR_{rest}
- Ave HR_{job} = [(HR_{max} - HR_{rest}) × %Max for job] + HR_{rest}
- %Max for job = $\frac{(HR_{job} - HR_{rest})}{(HR_{max} - HR_{rest})} \times 100$

- Predicted HR_{max} = 208 – 0.7(age) (Tanaka, 2001)
- HR_{rest} : accounts for variability of physical fitness
- %Max for job: average 33% for 8 hour work day

- This HRR equation accounts for variability of physical fitness of subjects by including resting HR rather than simply a % Predicted HR_{max}

HRR Utility

- Have worker perform an individualized circuit matching the job demands and measure HR every 5 minutes
- The circuit should be longer than 5 minutes to ensure steady state heart rate
  - **If the circuit HR is at or below** the expected work heart rate, the worker meets the cardiorespiratory requirement of the job.
  - **If the circuit HR is above** the expected work heart rate or closer to max capacity, the shorter the length of time an individual can work

Implementation Example 1

- 34 year old plumber with a low back injury
  - Predicted HR_{max}= 208 - .7(34) = **184 bpm**
- Stand/walk/material handling time = 7 hours
- HR_{rest} = **57 bpm**
- Circuit heart rate range = **90-92 bpm**

- **HRR = 184 – 57 = 127 bpm**
- Ave HR for job = **127** x 0.33 + **57** = **99 bpm**

- Since subject's HR during circuit was less than the required average HR for work, he meets the needs of work demands

Implementation Example 2

- 59 y.o. production assembler with right shoulder injury
  - Age predicted HR_{max} = 208 – 0.7(59) = **167 bpm**
- Stand/walk/material handling time = 6 hours/day
- HR_{rest} = **79 bpm**
- Circuit heart rate range = **128-132 bpm**

- **HRR = 167 – 79 = 88 bpm**
- Ave HR for job = **88** x 0.33 + **79** = **108 bpm**

- The worker does not meet the cardiorespiratory requirements of the job since the circuit HR was above the expected work heart rate.

Conclusion

- FCE's should predict full time work tolerance
  - Average expenditure for 8 hour work day is 33%
- Heart rate response to activity during FCE's is not standard practice
  - BUT it is informative in making conclusions about work tolerance
- The HRR method takes resting heart rate into account (rather than simple %HR_{max}) so FCE conclusions are more reflective of the individual

Proposal of Research to Implement HRR

- What questions do you still have?
- What are your ideas for a study design to test the predictive ability of HRR?

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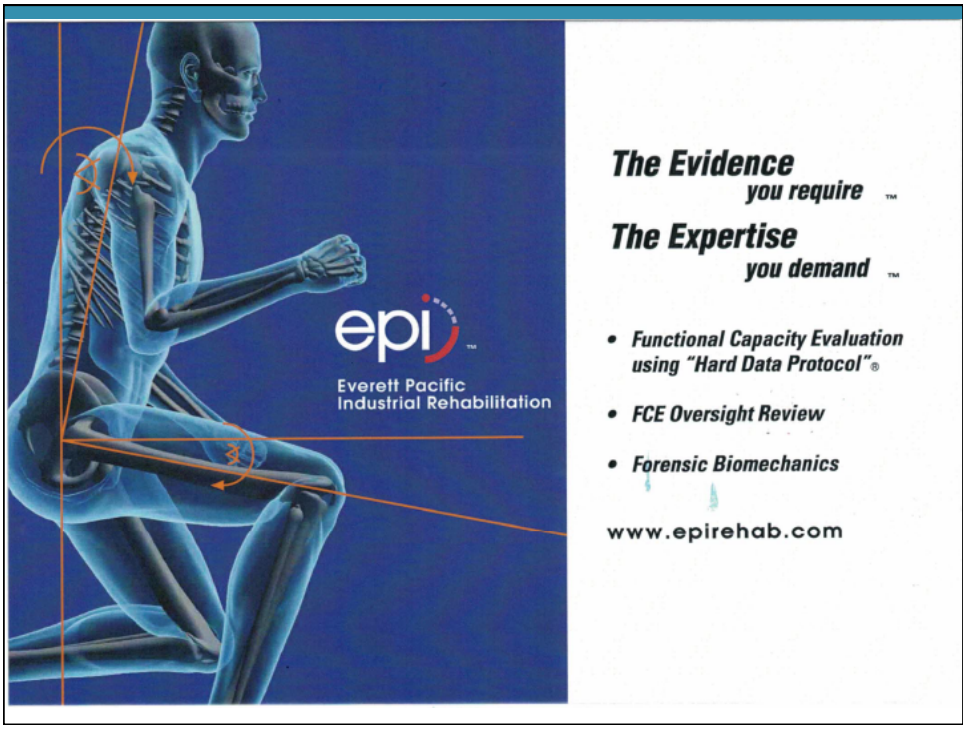
THANK YOU FOR YOUR KIND ATTENTION

THE END



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