Chapter 9

Discussion
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The main results of the studies presented in this thesis contribute to the measurement qualities of Functional Capacity Evaluations (FCEs). The studies are focused to test FCE aspects of safety, reliability, validity, practicality, utility and to establish normative values. The results are relevant for rehabilitation, occupational and insurance medicine and contribute to better understanding and applicability of FCE. In this general discussion, the contribution of the studies presented in this thesis will be discussed. Firstly, the contribution of this thesis to measurement qualities will be discussed. Furthermore, the work load and capacity model will be discussed and clinical implications, theoretical considerations and recommendations regarding future research are presented.

Measurement qualities of FCE

In the years during the construction of this thesis FCE research has further evolved. With respect to reliability and validity of FCE, one additional systematic review is performed [1]. The authors of this study concluded that throughout the years, studies to validity and reliability are performed dependent of which FCE-protocol was used. Extensive research to the additional value of FCE should, however, be performed. In a state of the art study, an expert review is conducted that classified measurement qualities in hierarchic order [2]. These are safety, reliability, validity, practicality and utility. This thesis focused on these measurement qualities of FCE and are outlined in figure 2 of the Introduction. The contribution of the studies in this thesis to FCE, are discussed in the section below.

Safety

In Chapter 2, experts have consented on a definition of safety. Safety is defined as ‘a situation that, given the known characteristics of the person, the procedure should not be expected to lead to injury’, in which injury was defined as ‘damage or harm done to or suffered by a person or thing’. This operational definition of injury remains vague because it is unclear what exactly is meant by “harm” and “damage”. Chapter 5 and 6, however, were written before the expert study, therefore, it is decided that FCE was considered safe, when pain responses after FCE follows a pattern which resembles physiology of delayed onset muscle soreness. The criteria for safety in FCE used in this study were: when the FCE does not lead to injury and when a pain response increased within the first 24 hours following FCE, peaked between 24 and 72 hours and subsided and disappeared within 5 – 7 days after the FCE. The results of this study indicate that if this criterion of safety is applied, the FCE could be administered safely. Looking back, starting with study 2 would have improved the other studies in this thesis. There appeared to be a high percentage of subjects who reported a pain response following FCE. A pain response was reported in 82% of all healthy subjects. Comparison of the pain response between healthy workers and patients with Chronic Low Back Pain (CLBP) are made and it is concluded that pain responses
appear similar in duration and intensity. A pain response may be expected and may be considered a normal response of the musculoskeletal system and disappears within 5 days in 95% of all cases. This pattern resembles that of delayed onset muscle soreness. If this data is compared to other research on muscle soreness then the studies presented in this thesis differ in methodology. Most research into muscle soreness is performed by using blood samples to analyze creatine kinase activity and myoglobin concentration. An advantage of these studies is that these measurements provide reliable and objective data. The reason why it is decided not to use blood samples was because of practical reasons and because pain has a multidimensional character in which a persons’ pain experience gains additional and extra information concerning muscle soreness. It is concluded that a pain response is common after FCE and that this is no sign of pathology. Furthermore, no relevant ‘at risk’ groups are identified as being more sensitive for obtaining muscle soreness. Age and gender do significantly contribute to a higher pain intensity and longer duration, but their contribution to pain intensity and duration is at most 11%. It is recommended to practitioners to take this into account and to inform patients that a pain response can be expected. The results in this thesis provide evidence for safety in the WorkWell FCE if all standard safety procedures are applied.

Reliability
Reliability refers to the extent to which a measurement is consistent and free of error. Reliability is therefore a pre-requisite for any test. Any test which is insufficiently reliable (intraclass correlation coefficient < 0.75) should not be used. All tests addressed in this thesis therefore, are tested previously on test-retest reliability and are found sufficiently reliable for clinical testing [3-5]. Chapter 4 of this thesis presents a study which confirms that the FCE-protocol, specifically designed for upper limb disorders, is sufficiently reliable for clinical testing. A total of 23 out of 26 test items were found to have Intra Class Correlation Coefficients over 0.75. This study only researched one protocol for upper limb disorders and it is recommended that more reliability studies are performed to different protocols.

Validity
Validity concerns the ability to measure what it is intended to measure. Validity of FCE has been addressed in different studies and may encompass content-, construct-, criterion-related-validity and also responsiveness. Validity is a measurement property of a test and is sensitive to a changing context. Prior to the question: “is this test a valid test”, one has to ask him or herself the apparently obvious question, “What do I aim to measure?” It was exactly that question which seemed never thoroughly investigated in FCE. A sound theoretical framework and clear operational definitions are of critical importance and are addressed as content validity of a test. This content validity is studied in Chapter 2 of this thesis. Chapter 2 has specifically focused on reaching consensus among researchers on abovementioned definitions and theoretical framework. The International Classification of Functioning, Disability and Health (ICF) is consented upon
among researchers to serve as a useful guide to within classify domains of capacity and performance of functioning [6]. A ground theoretical basis is found in the biopsychosocial model which may allow practitioners as well as research to further expand their knowledge about functional capacity. Remarkable is that a definition of FCE was not consented upon. This has implications for further research into FCE because it may hinder comparison of data and testing of other aspects of validity. Researchers should provide the definitions they use in future research. Based on the ICF terminology, we recommend using the following definition of FCE:

*A Functional Capacity Evaluation is an evaluation of capacity of activities that is used to make recommendations for participation in work while considering the person’s body functions and structures, environmental factors, personal factors and health status.*

In Chapter 3 of this thesis, content validity was established for an FCE-protocol for measuring work related upper limb disorders (WRULD). A literature review to risk factors for WRULD was performed and based on the results of this review, an FCE-protocol was constructed. The term of work related upper limb disorders was, however, chosen rather careless because in these non-specific symptoms it is unclear whether a disorder with patho-physiological substrate is present and whether an individual’s pain can be classified as work-related or not. Recommended is to use the term CANS; Complaints of Arm, Neck and Shoulder.

In Chapter 7, normative values are constructed for Functional Capacity of healthy subjects which contribute to the known groups validity of the FCE. The known groups validity is a form of criterion-related validity and refers to the quality in which two or more different groups can be identified based on test results. In Chapter 7, known groups validity is established for 4 groups of healthy workers working in different job demand categories. It is concluded that this normative data improves clinical decision making concerning work ability and return to work. Implications of this research are discussed extensively under the header of “Work load and Work capacity which is addressed on page 138.

Chapter 8 of this thesis contributes in research to criterion validity of FCE. Two lifting assessment protocols were compared to each other. It is concluded that both protocols appear to measure different constructs and can not be used interchangeably. Because of the absence of a gold standard for Functional Capacity, no hard evidence can be provided with respect to concurrent validity of these tests.

If the above mentioned definition of FCE is applied, then evaluation of capacity means that activities should be measured. Activities are described within the ICF as ‘the execution of a task or action by an individual’ [6], and may encompass both work-related and non work-related tasks. These tasks are divided in 9 biopsychosocial domains: learning and applying knowledge, general tasks and demands, communication, mobility, self-care, domestic life, interpersonal
interactions and relationships, major life areas and community and social and civic life. FCE focuses in majority on the ‘mobility’ domain which measures: changing and maintaining body positions, carrying, moving and handling objects and walking and moving. Other barriers or facilitators should be identified to make recommendations for participation in work. In this way, the gap between capacity and performance, which reflects the difference between activities in a real life situation and uniform environment, can be closed. It is of importance that these tasks should be measured in a standardized environment which is similar for all persons in all countries to allow international comparisons. One problem however is that different FCEs measure different constructs and cannot be used interchangeably, which makes standardization of FCE challenging. As stated by the ICF, standardization in quantification of activities should be further developed and the World Health Organization may be an organization which is capable of development of a gold standard for aspects of measuring capacity.

**Practicality**

Practicality refers to costs and time expense involved with the tests. The construction of shorter FCE-protocols such as presented in Chapter 3 for CANS, explicitly contribute to the practicality of FCE. Shorter and more specific FCE-protocols enable practitioners to screen for potential disbalance between work load and work capacity and are less time consuming and expensive. It is recommended that, besides protocols for low back pain [7], neck pain [8] and the present study of CANS, FCE-protocols are developed for pain syndromes such as fibromyalgia, hand disorders, lower extremity disorders or pelvic pain. Institutions as well as private practices may profit from this because it may enable to screen capacity of patients in 30 minutes. We applaud for the development of multiple short protocols. Furthermore, additional research is necessary to test different aspects of validity and responsiveness of the FCE-protocol for CANS.

**Utility**

Utility concerns the usefulness of the procedure and the degree to which it meets the needs of the patient, referrer, and payer. Shorter, more specific FCE-protocols to specific disorders or professions enable referrers and practitioners to increase the quality of their decision making. For patients, shorter protocols are less demanding. The study presented in Chapter 3, therefore, contributes to utility of FCE.

Normative data contribute to the utility of FCE for practitioners, because Work Place Assessments (WPA) are usually too expensive and time consuming and therefore frequently an inappropriate assessment method. The advantage of comparing patient’s Functional Capacity (FC) to normative values instead of to workload is that it enables practitioners to screen for potential disbalance between work load and work capacity without performing a WPA and to gain additional information concerning FC of patients in relation to a relevant norm group.
The Work Load and Work Capacity model.

A fundamental concept of FCE is matching work load and work capacity. The concept of matching between work load and work capacity is described in figure 1. Capacity specific to the work demands should be tested and thus, to make valid recommendations concerning work ability, information concerning job demands is required [9]. Job analyses performed by work place assessments are, however, for many practitioners inappropriate, because of the time consuming process and absence of sufficient support concerning validity and reliability. Based on this model presented in figure 1, successful job placement is established by matching functional capacity and job demands into a balance between worker and job. If FC and Work Load are not compatible, then Work Capacity can be increased (i.e. increase in aerobic or mechanic capacity) or Work Load can be decreased (i.e. work place interventions or time management). One of the main challenges of this model, however, is how to make a valid individual match. Evaluation of capacity usually takes place in a standardized context but successful job placement may be contextually facilitated by having good relations with colleagues or a well paid job or hindered by anger, claims or other motivational aspects. Two studies are conducted in the past years to match FCE activities to physical demands and to make predictions concerning sustained work ability and return to work after rehabilitation of patients suffering from chronic pain [10;11]. It is concluded that work ability and RTW can only be minimally predicted. These results confirm the contradictory evidence of the load and capacity model. In a recent thesis, physical capacity is tested in relation to exposure to physical factors [12]. An imbalance between physical capacity and exposure to work-related physical factors is found not to be predictive for future musculoskeletal pain. If we look at the complexity of barriers or facilitators in a real life context, it can be imagined that successfully predict job placement as well as musculoskeletal pain is insufficient when we look at the physical part of a client solely. Making a functional analysis in which contextual and personal factors are being edited to the physical domain may be necessary to make proper decisions. FC is assumed as a pre-requisite for successful participation. FC can be measured with FCE, thus, measuring FCE with FCE, may contribute to determining participation at work in a biopsychosocial evaluation.

With the establishment of normative values for FCE it has been attempted to partly close the gap between work load and work capacity and matching these two constructs into recommendations for return to work. The results, gathered from an FCE and compared to these norm values can form a prerequisite for work [2]. If practitioners want to screen the physical part of capacity in respect to participation in daily life, an FCE can be administered and compared to these norm values. If capacity of the client is above the lowest valid norm, then the physical part of capacity is most likely sufficient to perform work successfully. Furthermore,
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**Clinical implications**

For practitioners working in rehabilitation, occupational and insurance medicine, the main results of this thesis contribute to making better recommendations with respect to functional capacity and return to work. In rehabilitation, knowing that FCE can be performed safely, clinical testing and assessment can be further developed. Implications for rehabilitation are that practitioners may use FCE as an instrument to test capacity to perform activities as a point of departure for rehabilitation treatment. Based on the results, practitioners and patients can set up a plan for rehabilitation. FCE can identify possible barriers or facilitators with respect to participation in daily life. If physical factors, such as limited lifting capacity, aerobic condition or insufficient coordination, form a barrier for functioning in daily life, then goals for rehabilitation may be to increase these parts of capacity. If psychological factors such as fear of movement limit de
person to function, a graded exposure program may be appropriate to restore functioning.

For occupational medicine, FCE may contribute in objectification of functional capacity. Reintegration programs can be developed based on these data. For occupational physicians, it is of importance to know whether physical aspects limit the subject or whether other factors, such as conflicts at work, limit a successful RTW. Using the normative references to compare FCE scores of disabled workers enhance occupational physicians to make a quick first screening of capacity. If the disabled worker scores above the lowest valid cut-off point of the normative values, then capacity to perform activities is most likely sufficient to defy their workload. If a worker scores below, then WPA may be necessary in order to make good recommendations. Also, when highly specific tasks should be performed which are not simulated in FCE, WPA needs to be performed. A second application of FCE for occupational physicians is on prevention basis. In many countries, FCEs or derivatives are used as pre-employment test to identify workers whose capacity is insufficient to defy the work load. Comparing results of these healthy subjects to the normative values may provide insight with respect to successful job placing. Future research should be performed to test this hypothesis.

The utility of FCE for the insurance physician (IP) has previously been studied [14;15]. It was concluded that FCE may provide additional information to IPs with respect to work disability claims. Until now, IPs were not able to compare patients results to normative data, therefore it could always be argued whether a patient capacity was sufficient or not to return to his/her former job or whether a worker should search for other jobs matching his or her capacity. A comparison to the normative data can be objective support to IPs in their decision whether a patient is able to defy their work load and thus, whether he or she may be eligible for financial compensation.

**Theoretical considerations**

To understand the exact place of FCEs within a theoretical framework, it is of importance to look at the way human functioning has been explained throughout the years. The view to functioning is inextricable related to the way FCE has been interpreted. Since FCEs were firstly described in about the 1970’s [16], increased measurement has taken place. FCE has, as a measurement tool, evolved from two different theoretical paradigms: the biomedical model on the one, against the biopsychosocial model on the other hand. As a result, the understanding of FCE and its related terminology followed two paths. Confusion and discussion of researchers and practitioners to ‘what is being measured’ was the result of these differences in interpretation models. In 1980, the World Health Organization published the International Classification of Impairments, Disability and Handicap (ICIDH). This biopsychosocial approach to a different understanding of human functioning was constructed to; provide a scientific basis for understanding and studying health and health-related states, outcomes and determinants; to establish
a common language for describing health and health-related states in order to improve communication between different users; to permit comparison of data across countries, health care disciplines, services and time; to provide a systematic coding scheme for health information systems. The entrance of the biopsychosocial model has clearly changed the way that FCEs are applied. The biopsychosocial model focuses on multifactor causation of physical or psychological diseases, and it is inherently assumed that once found the cause, the disease will disappear. An underlying philosophical basis of this model is that everything significantly deviating from ‘normal’ is assumed to be a disease [17]. In the past years, a gradual shift has taken place in which this multicausal paradigm is increasingly being questioned upon. The introduction of noncausal contextual models of chronic pain gains support quickly [18]. Acceptance and Commitment Therapy [19] is one example of the appliance of contextual theory. While modern Western psychology has typically operated under the "healthy normalcy" assumption which states that by their nature, humans are psychologically healthy, ACT assumes that psychological processes of a normal human mind are often destructive. ACT differs from traditional cognitive behavioural therapy in that rather than trying to teach people to better control their thoughts, emotions and other private events, ACT teaches them to accept their private events, including the aversive ones [20]. ACT has proven to be effective in a range of clinical conditions, such as depression, OCD, workplace stress, anxiety, schizophrenia and also chronic pain [20]. Within the treatment for chronic pain it was found that ACT contributes to fewer sick days at work and fewer medical treatment [18]. Functional Capacity Evaluation may be incorporated within this contextual model. Within ACT, the role of avoidance to negative experiences such as pain or negative emotions is to be identified. FCE can serve as an experiential test because it is performance based. From an ACT point of view searching for functional barriers or facilitators is an essential step in which the function of avoidance should be identified. An important step for future research will be to study the content validity of the FCE within a contextual theory and its relation to successful return to work, work ability or physical barriers or facilitating factors regarding RTW or work ability.

**Recommendations for Further research**

In this thesis, a contribution was made with respect to measurement qualities of FCE. While evidence is provided, other gaps in research should be closed and expanding research should focus on the following issues:

- In this thesis, consensus among experts concerning FCE terminology was reached in many definitions. No consensus is reached about a definition of Functional Capacity Evaluation. Furthermore, confusion in evaluation methods between Work Performance Evaluations, Physical Capacity Evaluation, Functional Performance tests should still be clarified. It is necessary to know which instrument is able to measure which construct
and future research should study the differences and similarities of these different evaluation constructs.

- For validity purposes, it should be strived that a gold standard for capacity evaluation is developed.
- To improve FCEs utility, short form FCE-protocols should be developed and tested on reliability and validity. FCE-protocols are already developed for low back pain [7], upper limb disorders and neck disorders [8]. Protocols should be developed for fibromyalgia, lower extremity pain and osteoarthritis.
- Studies should be performed to identify determinants of performance to gain insight in which factors are of main concern in explaining performance or non-performance. Personal and environmental factors may be studied with qualitative study designs. Research to persons with chronic pain who do function in daily life successfully, may provide additional insight.
- In this thesis, normative values for FCE are presented. It is unclear, however, which is the lowest valid value in this research. The normative values should be investigated on validity by comparing the normative values to data gathered from WPA. Furthermore, with respect to the Dictionary of Occupational Titles (DOT), it is necessary to study how these normative values are compared to the values of the DOT and whether classification in these DOT categories is (still) valid for different professions.
- For generalization purposes, the normative values established should be investigated and validated for other populations and other countries.
- In the present days, workers may be required to work longer until retirement, the ageing working population in Western society increases. Normative data of functional capacity with regards to age may provide insight in the work ability of the ageing society. Objective data in functional capacity in relation to work demands may be critical in this group. The normative values presented in his thesis focused on working subjects from 20 to 60 years of age. Normative values for workers from 60 and older may provide this information.

References

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References


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