Functional capacity evaluation
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Chapter 3

Basis for an FCE Methodology for Patients With Work-Related Upper Limb Disorders

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Abstract

A reported reduction in work-related functional capacity in Work-related Upper Limb Disorders (WRULD) patients is among the most common problems in WRULD. The extent to which this reduction in functional capacity can be objectified remains unknown. A validated instrument to test functional capacity in this patient group is unavailable. The objective of this study was to design a Functional Capacity Evaluation (FCE) for WRULD patients working with Visual Display Units (VDU) and provide evidence for content validity. A review of epidemiological literature was conducted to identify physical risk factors for VDU-related WRULD. The results indicate that physical risk factors were related to repetition, duration, working in awkward and static positions and forceful movements of the upper extremity and neck. An FCE was designed based on the risk factors identified. Eight tests were selected to cover all risk factors: the overhead lift, overhead work, repetitive reaching, handgrip strength, finger strength, wrist extension strength, fingertip dexterity, and a hand and forearm dexterity test. Content validity of this FCE was established by providing the rationale, specific objectives and operational definitions of the FCE. Further research is needed to establish reliability and other aspects of validity of the WRULD FCE.
Abstract
A reported reduction in work-related functional capacity in Work-related Upper Limb Disorders (WRULD) patients is among the most common problems in WRULD. The extent to which this reduction in functional capacity can be objectified remains unknown. A validated instrument to test functional capacity in this patient group is unavailable. The objective of this study was to design a Functional Capacity Evaluation (FCE) for WRULD patients working with Visual Display Units (VDU) and provide evidence for content validity. A review to epidemiological literature was conducted to identify physical risk factors for VDU-related WRULD. The results indicate that physical risk factors were related to repetition, duration, working in awkward and static positions and forceful movements of the upper extremity and neck. An FCE was designed based on the risk factors identified. Eight tests were selected to cover all risk factors: the overhead lift, overhead work, repetitive reaching, handgrip strength, finger strength, wrist extension strength, fingertip dexterity, and a hand and forearm dexterity test. Content validity of this FCE was established by providing the rationale, specific objectives and operational definitions of the FCE. Further research is needed to establish reliability and other aspects of validity of the WRULD FCE.

Introduction
Work-related Upper Limb Disorders (WRULD) among Visual Display Unit (VDU) employees have become a major problem in the industrialized world, both socially and scientifically. VDU work is characterized by seated computer-related work with the arms in prolonged static posture, often in a stressful environment. Office work in general, has been proposed as a source of WRULD. A significant percentage of office workers experience discomfort at work and specifically, computer-related upper extremity disorders accounted for 11–17% of all Liberty Mutual WRULD claims in 1993 in the United States [1]. WRULD is an umbrella term for several medical syndromes that develop as a result of repetitive movements, awkward postures, and force [2]. Terms as cumulative trauma disorders, occupational cervicobrachial disorders, repetitive strain injury, or upper extremity musculoskeletal disorders are used worldwide to describe the same syndrome. It is estimated that 80% of all WRULD is non-specific [3,4]. Non-specific WRULD is characterized by an absence of a clear injury.

In WRULD, symptoms such as a reduced strength, coordination, postural tolerance or sensibility in the neck, shoulder, elbow, wrist, or hand can be present [5]. A reduced functional capacity is assumed. There is, however, a paucity of validated tests for measuring functional capacity. Functional capacity is defined as the difficulty of a person to perform activities [6]. Most research about functional capacity or disability on WRULD patients is performed with questionnaires. Hansson et al. [7] compared direct technical measurements with a questionnaire at a group of office workers. It was concluded that the WRULD group rated their exposure to movements higher than those without complaints but with the same measured mechanical exposure. Validity of the questionnaire was low, concluding that questionnaires and direct measurements measure different constructs. Functional Capacity Evaluations (FCEs) are used to measure work-related functional capacity and they are commonly used in work rehabilitation programs, for disability detection and return to work recommendations. No FCEs, however, have published evidence of reliability and validity specific to WRULD patients.

The objective of this study was to develop an FCE, which is content valid for determining functional capacity in WRULD patients. To determine content validity it is necessary to establish the rationale for the test, to provide operational definitions of the test variables and identify the specific objectives of the instrument [8]. A review of the literature was conducted to define the rationale of the test. Epidemiological literature on WRULD was examined to evaluate the strength of the evidence with respect to causal relations of VDU work and WRULD. VDU work in this study is work, related to data entry tasks (e.g. type tasks, numeric key rating tasks), mouse tasks or work with a visual display terminal, a visual display unit or computer aided design. Identified physical risk factors will be the basis for a WRULD specific FCE and functional tests will be selected which cover the included risk factors. Besides physical risk factors, non-physical factors such as cultural and societal factors, psychological and personality
traits, health beliefs, environmental and social circumstances at work and at home, coping resources, mood, and psychopathology are potentially important in the development of WRULD [9]. Non-physical risk factors such as job stress, pain [1], workstyle or ergonomic stressors [10] are proven to play an individual role in the onset of WRULD. However, the focus of this study was to identify physical risk factors only, because a cause-response and a dose-response relation between psychosocial risk factors and a reduced work-related physical capacity is often difficult to measure in an objective and valid performance-based way. Physical risk factors are those physical features of work that are frequently cited as risk factors for WRULD including rapid work pace and stereotyped repetition of motion patterns, insufficient recovery time, forceful manual exertions, anatomically non-neutral body postures and mechanical stress concentrations [11].

Methods

Literature Review
A search of physical risk factors for WRULD was collected by searches in Medline, Embase, and the Cochrane Library up to 2003. Keywords used were repetitive strain injury (and RSI), visual display units (and VDU), cumulative trauma disorders (and CTD), musculoskeletal disorders (and MSD), upper extremity musculoskeletal disorders (and UEMSD), occupational cervicobrachial disorders and work-related upper limb disorders (and WRULD). Relevant studies in reference lists were also included. The criterion for selection of studies was: a study found a causal relationship between physical risk factors and VDU-related WRULD. Studies were excluded when the study did not meet the specific condition of the inclusion criterion or when they were reports or abstracts. Relevant identified studies that were already included in systematic reviews were not included to avoid bias. After identifying relevant physical risk factors, the different risk factors were categorized in the main anatomical regions of the upper extremity for classification. These regions are the hand and wrist (A), the forearm and elbow (B), the upper arm and shoulder (C), and the neck (D).

Test Design
An FCE was designed which covers the physical risk factors as they were categorized in the different regions of the upper extremity. The evidence of causal relationships of risk factors for WRULD depends on factors such as study design and the methodology used in the study. In this study, a test-item was included in the FCE when one systematic review or three nonsystematic reviews, case control, cross-sectional, prospective or retrospective cohort studies conclude a variable to be a risk factor for WRULD. When all risk factors of different regions are included, different functional tests will cover the risk factors for each anatomical region.
Test Selection
Tests were included in the FCE when they could cover one or more of the included risk factors. Preferably, test items, which could measure on a functional level, were selected. Test selection was based on the guidelines as presented by Hart et al., 1993 [12]. The issues, presented in hierarchical order, are:

1. Safety: given the known characteristics of the evaluatee, the procedure should not be expected to lead to injury,
2. Reliability: the test score should be dependable across evaluators, evaluatees, and the date or time of test administration,
3. Validity: the interpretation of the test score should be able to predict or reflect the evaluatee’s performance in the target work setting,
4. Practicality: the cost of the test procedure should be reasonable and customary,
5. Utility: the usefulness of the procedure is the degree to which it meets the needs of the evaluatee, referrer, and payer.

Results
Literature Review
Based on inclusion criteria, 16 studies were included [11,13–27]. Four were reviews, seven were case control studies, one was cross-sectional, three were prospective cohort studies and there was one retrospective cohort. Results of the literature search are described in Table I. The risk factors for each region were classified in numbers 1–5. These are (1) duration, (2) repetition, (3) awkward positions, (4) forceful movements, and (5) static contractions. The following risk factors were found for the different regions:

A. Hand and Wrist. Hand and wrist symptoms are frequently described to be related to duration of exposure in hours per day or in total years working with a VDU (1), repeated movements (2), working in awkward positions (3) and forceful movements (4). There were prospective studies, case control studies and reviews which show sufficient evidence for a cause-response relationship between these risk factors and hand and wrist symptoms. Risk factors of the regions, which were included in the FCE, were A1, A2, A3, and A4.

B. Forearm and Elbow. Duration (1), repetitive movements (2), working in awkward positions (3) and forceful movements (4) were described as risk factors for WRULD. Risk factors included in the FCE were B1, B2, B3, and B4.

C. Upper Arm and Shoulders. Static muscle contractions (5) and working in awkward positions (3) for a prolonged time (1) were concluded to be associated with WRULD in shoulder and upper arm symptoms. The FCE will cover the regions C1, C3, and C5.
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D. Neck. Symptoms may occur when awkward positions (3) are adapted for a long time (1) (e.g., neck flexion or rotation). Region D1 and D3 will be included in the FCE.

Test Design
An FCE was designed to cover the included risk factors per anatomical region. Table 2 lists the different tests and the risk factors they cover. These tests were selected because: 1. there are no reports of unsafety, 2. the reliability of most of the tests has been established in previous studies [28–35]. Tests were modified when they proved to be unreliable in previous studies, 3. costs were low and tests were easily available, 4. test procedures were easy to learn and administer. The tests which were included were: the overhead lift test, overhead worktest, repetitive reaching test, hand and finger grip strength test, wrist extension strength test, the Purdue Pegboard task, and the Complete Minnesota Dexterity test. The operational definitions (procedures) and the specific objectives (objectives) of the different tests, needed to determine content validity [8] are described next.

Overhead Lift Test
Objective: Functional strength of shoulder and arm musculature. Materials: Plastic receptacle (40 x 30 x 26 cm). A wall mounted system with adjustable shelves and weights of 1.0, 2.0, and 4.0 kg. Procedure: Five lifts from table to crown height v.v. within 90 s in standing position. Four to five weight increments were used until maximum amount of kg was reached. Test–retest reliability: Intraclass Correlation Coefficient (ICC) in low back pain (LBP) patients was 0.87 [32], and 0.89 in healthy subjects [35]. The risk factors of the regions that were covered by this test were A4 and B4.

Overhead Worktest
Objective: Static holding time of shoulder and neck musculature. Materials: Aluminum plate adjustable in height with 20 holes, bolts and nuts and two cuff weights of 1.0 kg each. Procedure: Standing with hands at crown height, manipulating nuts and bolts wearing cuff weights around the wrists. The time that position is held will be measured (s). Test–retest reliability without cuff weights: ICC = 0.36 in LBP patients [34]. ICC = 0.58 in healthy subjects [35]. The risk factors of the regions, which were covered by this test were A1, A2, A3, B1, C1, C3, C5, D1, and D3.

Repetitive Reaching Test
Objective: Fast repetitive movements of the upper extremity. Materials: 30 marbles and two bowls with a 14-cm diameter positioned at table height. Procedure: Sitting with bowls on wing span, remove marbles horizontally at table height from left to right v.v. with left/right arm as fast as possible. Time needed to remove 30 marbles is scored (s). Test–retest reliability: ICC = 0.45–0.64 in LBP
Chapter 3

D. Neck.

Symptoms may occur when awkward positions (3) are adapted for a long time (1) (e.g., neck flexion or rotation). Region D1 and D3 will be included in the FCE.

Test Design

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Static holding time of shoulder and neck musculature.

Materials:
Aluminum plate adjustable in height with 20 holes, bolts and nuts and two cuff weights of 1.0 kg each.

Procedure:
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Repetitive Reaching Test

Objective:
Fast repetitive movements of the upper extremity.

Materials:
30 marbles and two bowls with a 14-cm diameter positioned at table height.

Procedure:
Sitting with bowls on wing span, remove marbles horizontally at table height from left to right v.v. with left/right arm as fast as possible. Time needed to remove 30 marbles is scored (s). Test–retest reliability: ICC = 0.45–0.64 in LBP [9].

| Region                  | Risk factor          | references | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Item included |
|-------------------------|----------------------|------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--------------|
| A Hand and Wrist        | duration             | SR         | SR | SR | CC | CC | CC | CC | RC | PC | CS | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | repetition           | SR         | SR | SR | CC | CC | CC | CC | RC | PC | CS | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | awkward positions    | SR         | SR | SR | SR | SR | SR | SR | SR | R  | R  | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | forceful movements   |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | Yes          |
|                         | static contractions  |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | No           |
| B Forearm and Elbow     | duration             | SR         | SR | SR | PC | PC | PC | PC | PC | PC | PC | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | repetition           | SR         | SR | SR | PC | PC | PC | PC | PC | PC | PC | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | awkward positions    | SR         | SR | SR | SR | SR | SR | SR | SR | R  | R  | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | forceful movements   |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | Yes          |
|                         | static contractions  |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | No           |
| C Upper arm and Shoulder| duration             | SR         |     |     | RC | RC | RC | RC | RC | PC | PC | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | repetition           | SR         |     |     | RC | RC | RC | RC | RC | PC | PC | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | awkward positions    | SR         |     |     | RC | RC | RC | RC | RC | R  | R  | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | forceful movements   |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | Yes          |
|                         | static contractions  |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | No           |
| D Neck                  | duration             | SR         |     |     | RC | RC | RC | RC | RC | PC | PC | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | repetition           | SR         |     |     | RC | RC | RC | RC | RC | PC | PC | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | awkward positions    | SR         |     |     | RC | RC | RC | RC | RC | R  | R  | R  | R  | R  | R  | R  | R  | R  | Yes          |
|                         | forceful movements   |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | Yes          |
|                         | static contractions  |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | No           |

1= computer work-related to amount of hrs/week; 2= risk factor found only in females; R= non systematic review; SR= systematic review; CC = Case control; PC = Prospective cohort; RC = Retrospective cohort; CS = Cross sectional; Grey cells: described as a risk factor.
Table 2. Content of the FCE based on included risk factors per region

<table>
<thead>
<tr>
<th>Test</th>
<th>Hand and wrist</th>
<th>Forearm and elbow</th>
<th>Upper arm and shoulder</th>
<th>Neck</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Overhead lift</td>
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<tr>
<td>Overhead worktest</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Repetitive reaching</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handgrip strength</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finger strength</td>
<td></td>
<td></td>
<td>√</td>
<td></td>
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<tr>
<td>Wrist extension strength</td>
<td></td>
<td></td>
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<td>√</td>
</tr>
<tr>
<td>Fingertip dexterity</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross movement coordination</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

√-marked cell: coverage of the risk factors by the different tests; 1: duration; 2: repetition; 3: awkward positions; 4: forceful movements; 5: static muscle contractions.
patients [34]. ICC = 0.54–0.72 in healthy subjects [35]. The risk factors of the regions that were covered by this test were A2, B2.

**Handgrip Strength Test**  
*Objective:* Isometric grip strength. *Materials:* A hand dynamometer (Jamar PC 5030, Preston Corporation, 1994). *Procedure:* In a seated position, the subjects held their shoulder adducted and neutrally rotated, elbow flexed at approximately 90º and the forearm and wrist in neutral position [36]. Grip strength of the right and left arm was measured in a three trial procedure in five different handgrip positions. Average amount of kgF was scored. ICC > 0.93 [13]. The test is sufficient reliable for clinical testing [31]. The risk factors of the regions, which were covered by this test were A4 and B4.

**Finger Strength Test**  
*Objective:* Isometric tip, key and palmar pinch strength. *Materials:* A pinch-grip dynamometer (Preston Pinch Gauge; J.A. Preston Corporation). *Procedure:* In a seated position, the subjects held their shoulder adducted and neutrally rotated, elbow flexed at approximately 90º, the forearm horizontally pronated and wrist in neutral position [36]. Strength of right and left fingers was measured in a three trial procedure. Average amount of weight was scored. The test is sufficient reliable for clinical testing [31]. Forceful movements of the hand and wrist (A4) were covered by this test.

**Wrist Extension Strength Test**  
*Objective:* Isometric wrist extension strength. *Materials:* A dynamometer (type Chatillon, CSD 200) and a self designed apparatus to fix the dynamometer in a vertical position above the wrist. *Procedure:* Wrist was fixed with the forearm horizontally pronated and wrist in neutral position. The dynamometer measured wrist strength perpendicular and directly proximal to the third caput metacarpale. Average amount of weight was scored over three trials. Reliability is unknown. Forceful movements of the wrist (A4) and forearm (B4) were covered by this test.

**Fingertip Dexterity Test**  
*Objective:* Fingertip dexterity. *Materials:* Purdue Pegboard (Model #32020, Lafayette IN). *Procedure:* Sitting subject in front of the pegboard, placing pins with left and right hand as fast as possible in a 30 s trial. Average number of pins placed in 30 s over three trials in both hands was scored. Test–retest reliability in three trial score ranged from ICC = 0.82–0.91 [30]. This test covered repetitive movements of the hand and wrist (A4) and of the forearm (B4).

**Hand and Forearm Dexterity Test**  
*Objective:* Gross movement coordination of fingers, hands and arms. *Materials:* A Complete Minnesota Dexterity Test (Lafayette, IN). *Procedure:* Sitting subject displacing 59 blocks in a predetermined way as fast as possible. Total displacing time needed to perform four trials with both hands was scored. Four trial reliability ranged from 0.93 to 0.98 [29]. ICC = 0.79–0.87 [33]. This test covered
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repetitive movements of the hand and wrist (A2), repetitive movements of the forearm and elbow (B2) and working in awkward positions with the forearm (B3).

Discussion

The objective of this study was to design an FCE, which was content valid for measuring the functional capacity of patients with WRULD, specifically for WRULD related to VDU work. A literature search was conducted to reveal underlying mechanisms, which independently or in combination with each other can be a risk factor for WRULD. The authors are aware that besides physical factors, non-physical factors are important contributors to the WRULD problem. To closely meet the demands of functional capacity measurement and to identify dose-response relationships the focus was to identify physical risk factors for VDU-related WRULD.

The selection of the literature resulted in sixteen relevant studies. These studies were included and filled the content of the FCE. A limitation of the review is that there was no systematic grading of the quality in selection of studies. Consequently, an even amount of importance was given to all selected studies, whether it was a review, a case control, a prospective cohort or cross-sectional study design and whether it was of good or bad methodological quality. Bias may have occurred because the results from low quality studies could have been overestimated, and results of high-quality studies may have been underestimated. To obviate this problem partially, physical risk factors were only included when three studies found the same risk factor for WRULD. An exception was made for systematic reviews. When they were of good quality, a risk factor was included. Another methodological weakness is that cross-sectional designs do not identify causal relationships. Studies could have been selected in which a cause response relationship was assumed, but not proven. The purpose of this study, however, was not to make a perfect review but to identify physical risk factors as a basis for an FCE for WRULD patients.

The four anatomical regions, in which the risk factors in this study were classified, are not strictly separate regions. That means that the risk factors were not solely a risk factor for that specific region, because usually it concerns an interaction of the different regions. The same problem is present for the different risk factors. Risk factors are always in interaction with each other. For example, repetitiveness will always be in interaction with duration and duration will always be a combination of duration on a day (e.g. >4 h/day) and total time on the job (e.g., 2 years). Furthermore, there were studies that identified relevant risk factors for WRULD in VDU work, but did not specify the location of the complaints, often just by naming it a “musculoskeletal disorder.” The physical risk factors of the upper extremity however were split up in regions A–D. This was done to test the different physical risk factors per anatomical region, to create a test which included all variables and to simplify and order the different risk factors as they
were found. The FCE is equal for men and women. Whenever a risk factor was found to be present in one of the genders, the risk factor was included to ensure that all factors were included.

Functional Capacity Evaluations aim to measure a person’s work-related functional capacity. In scientific literature however, WRULD is usually defined by its multidimensional nature, implying that WRULD will always be expressed by a combination of physical and non-physical factors [4]. Non-physical risk factors such as job stress, pain [1], workstyle [9] or ergonomic stressors are proven to play an individual role in the onset of musculoskeletal disorders [10]. In spite of the evidence for those factors, which are assumed to play a significant role in the development of WRULD, the objective of this study was to research physical risk factors only. However, for clinical use, it is recommended that this WRULD FCE be used in conjunction to a medical and psychosocial evaluation.

Eight tests were chosen to cover all risk factors. Nevertheless, functional tests meeting the criteria as used by Hart et al. [12] were scarce. Therefore some tests were included that more closely measured impairments than functions (wrist extension strength). Although measuring on impairment level has been done with highly standardized procedures, the shift to functional capacity was sometimes more indirect. The tests that did measure on a functional level, cover multiple risk factors at the same time (e.g., overhead worktest). Previous reliability studies with the overhead lift however showed low ICCs [34,35]. Previously, it has been suggested that this test had a strong psychological component and the presence of a ceiling often limited subjects to perform maximally. The overhead test as is used in this study is adjusted. Patients were asked to wear two cuff-weights of 1.0 kg each around both wrists to make the test more physical of nature and remove the ceiling.

**Content Validity of the FCE**

Content validity is that kind of validity, which measures the degree to which test items represent the performance domain the test is intended to measure [8]. In this study, the FCE was designed based on the knowledge of present understanding concerning non-specific VDU-related WRULD. Despite of the fact that content validity is usually gathered by an expert panel [8], a literature search was preferred over an expert panel to determine physical risk factors for WRULD. This was done because only scientific and objective based information was gathered. Content validity is established by providing operational definitions of the test variables, identification of the objective and establishment of the rationale for the test [8]. Usually, content validity of FCEs is based on the physical demands of the Dictionary of Occupational Titles (DOT). Even though the DOT taxonomy is widely used, it has not been validated for physical capacity measurement of the upper extremity and specifically for WRULD patients. Post hoc comparison of the content of the FCE and the DOT, showed that the risk factors for WRULD in VDU-related tasks, as they were identified in this study, matches the physical demands needed for work as described in the DOT, on the factors lifting, reaching,
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handling, fingering and feeling [37]. Although the majority of the tests are also described in the DOT as a physical demand, the DOT does not mention the factor of duration as it was identified in this study.

External validity is often an argued point in FCEs. For example, the time needed to complete an FCE is usually several hours, where WRULD is usually described to be an overuse syndrome, developing as a result of long periods of minor overuse (Cinderella hypothesis). This theory proposes that the development of chronic muscular pain is due to an overuse of fibers belonging to low-threshold motor units. Although several studies have supported this theory, it is debatable whether sustained activation of low-threshold motor units can explain the genesis of pain [38] or a reported decrease in functional capacity. A possible manner to take this factor of duration into account is with work samples. In these evaluations, a patient is expected to work for days in an artificial environment to be examined for his/her workability. However, it has not been proven that work samples have greater external validity than an FCE. Ecological validity has been tested on three static endurance tests of the Isernhagen FCE and was found to be sufficient [39]. When a controlled situation is created, as it is with these standardized tests in this FCE, internal validity tends to be higher. This will however always come along with a decrease in external validity. Validation of this WRULD FCE has started with this study. The content validity is the basis of validity and is considered a prerequisite for criterion-related and construct validity [8]. Next steps in test development of this WRULD FCE will be determining test–retest reliability and construct and criterion-related validity. Specifically, the ability of this FCE to determine aspects of return to work, work productivity, work absence, workability or work-related disability needs to be studied.

Conclusion

The literature review in this study revealed that there is sufficient evidence that physical risk factors may contribute in the development of VDU-related WRULD. These physical risk factors were related to repetition, duration, forceful movements and working in awkward and static positions of the upper extremity. The FCE which is designed based on this review provides evidence for the content validity. A first step in validation of the WRULD FCE is made. Further research is needed to test reliability and other aspects of validity.

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References


