



# Construction of the Upper Limb Vocational Ability Assessment System: Based on ICF

Feng Lanfang\*, Liu Xiaomin, Lu Xunwen, Zhong Wei, Qiu Ziyu, Zhang Dongsheng

Occupational Rehabilitation Department, Guangdong Work Injury Rehabilitation Center, Guangzhou, China

## Email address:

15011818773@163.com (Feng Lanfang), strawbetty236@126.com (Liu Xiaomin), xunwenlo@126.com (Lu Xunwen),

51961780@qq.com (Zhong Wei), 421417197@qq.com (Qiu Ziyu), 372064383@qq.com (Zhang Dongsheng)

\*Corresponding author

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**Abstract:** *Objective:* To initially construct a comprehensive assessment system for upper extremity occupational competence based on the International Classification of Functioning, Disability and Health (ICF), and to provide a reference for the development of comprehensive intervention programs covering physiology, psychology, function and social participation for patients with upper extremity injuries. *Methods:* Taking the comprehensive ICF core set for vocational rehabilitation as the basic framework, using the Delphi expert correspondence method, after a two-round email-based survey with experts who are experience in clinical, vocational rehabilitation, rehabilitation, nursing. Combined with the statistical results and expert opinions, the index of the ICF upper limb vocational ability evaluation system was finally established. *Results:* The effective recovery rates of the two rounds of expert correspondence were 95% and 100%; the expert authority coefficients (Cr) were 0.807 and 0.805, and the Kendall coordination coefficients were 0.290 and 0.374 ( $P < 0.001$ ). The average importance value ranged from 3.52-4.48. The variation coefficients ranged from 0.103-0.222, The ICF upper limb vocational ability assessment system include 4 first-level indicators and 41 second-level indicators. *Conclusion:* The construction process of the ICF upper limb vocational ability assessment system is scientific and reliable, which promotes the clinical application and promotion of the brief version of the ICF core combination, and provides reference for the formulation of the ICF assessment combination for other diseases.

**Keywords:** International Classification of Functioning, Disability and Health (ICF), Upper Extremity, Vocational Ability Assessment, Occupational Rehabilitation

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## 1. Introduction

Hand and upper limb injury is a high-incidence injury, accounting for 6.6%-28.6% of all trauma [1]. Hand and upper limb injuries are most common in work, followed by family and traffic accidents. Most of the injured people are young and middle-aged people engaged in manual labor [2]. More than 90% of the activities of life and work are realized by the hands. The injury of the upper limbs of the hands will not be life-threatening, but it can lead to life-long disability, loss of the ability to work and live, and seriously affect the individual [3]. At the same time, due to the occurrence of upper limb injury group is mainly 20-40 years old people [4], the injury may lead to a long sick leave, or due to the lack of

professional evaluation, the injured can not determine their ability to work, resulting in difficulties in returning to work, or even if the return to work is not placed in a suitable position, the injury again. How to determine whether a worker with upper limb injury can safely return to work is a challenge for both doctors and employers [5]. Although some Chinese scholars have developed vocational ability assessment tools for persons with disabilities [6, 7], they are all targeted at physical persons with disabilities and are not combined with the characteristics of work, so they cannot effectively guide patients to complete employment matching.

The International Classification of Functioning, Disability and Health (ICF) is a theoretical framework and classification system for describing health and related conditions formally promulgated by the World Health

Organization (WHO) at the World Health Assembly in 2001 [8], which constructs the theoretical framework and classification system from the perspective of the influence of diseases, disability and other health conditions on human body structure and function, activity ability and participation ability; Taking dysfunction as the starting point, it integrates biology, psychology, society and environment, which is more consistent with the core goal of improving and restoring functions of modern rehabilitation medicine, and has positive significance for strengthening the discipline construction of rehabilitation medicine and improving rehabilitation services [9]. Many international experts and scholars have built a multidisciplinary evaluation system for various diseases based on ICF [10, 11].

In order to facilitate the use of clinical professionals, WHO developed ICF core sets [12] with the purpose of establishing core classification templates for different diseases for making rehabilitation plans and assessing rehabilitation functions and outcomes [13]. The core sets of ICF vocational rehabilitation are one of them. A total of 90 items are included in the ICF core set for occupational rehabilitation, including physical functioning (17), activity and participation (40), and environmental factors (33), which can be used for working-age people with limited work-related functional ability or limited work participation [14]. The ICF vocational rehabilitation core sets can provide a complete and interdisciplinary evaluation framework for vocational rehabilitation workers. However, there is still a lack of relevant research on its applicability to vocational rehabilitation population in China. Moreover, there are many items in the core sets of ICF vocational rehabilitation, and some items are not applicable to patients with hand and upper limb injuries. Therefore, it is necessary to screen the assessment content based on ICF vocational rehabilitation combination to adapt to clinical use. The purpose of this study is to take ICF as the basic framework, ICF vocational rehabilitation core sets as the reference content, through the Delphi method to construct a set of occupational ability assessment system items suitable for patients with hand and upper limb injury, so as to use ICF as the vocational rehabilitation assessment index for patients with hand and upper limb injury.

## 2. Methods

### 2.1. The Delphi Method

To survey expert's opinion, we used the Delphi technique which involves a group of experts making private, independent ratings of agreement with a series of statements [15]. A summary of group ratings is feedback to the panel members who then complete a second round of rating. They can choose whether to change or maintain their original ratings. Several rounds may be required, depending on the desired level of consensus.

The team members including 1 doctor, 2 senior therapists, 1 senior social worker, 3 therapists, and 1 nurse, all of whom

have more than 5 years of work experience in occupational rehabilitation fields. Four team members are responsible for literature review, questionnaire preparation and confirmation of the inquiry list; The other 4 members are responsible for distributing and collecting questionnaires, sorting out and analyzing data.

### 2.2. Panel Formation

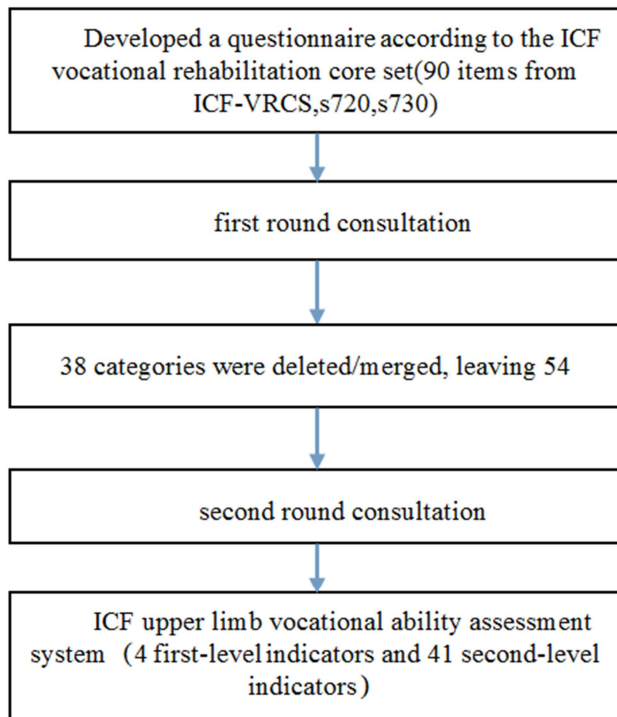
22 experts with rich experience in practical or management experience in the field of clinical, rehabilitation therapy, and social work were invited, covering most cities in China. Expert selection criteria: Bachelor degree or above; Associate senior title or above; or working years  $\geq 10$  years; Familiar with the ICF. All the experts gave informed consent and were willing to participate in this study.

### 2.3. Questionnaire Development

Based on discussion and literature review, the initial questionnaire was formulated by referring to the ICF core sets of vocational rehabilitation, including three parts: (1) Questionnaire description, including research background, letter to experts and description of filling in the form; (2) Expert information collection form, including gender, age, educational background, professional title and other general information, as well as experts' familiarity with the content of each indicator and judgment basis. The level of familiarity and the assigned value were very familiar (1.0), relatively familiar (0.8), generally familiar (0.5), not very familiar (0.2) and unfamiliar (0). The judgment basis includes four dimensions: theoretical analysis, practical experience, reference to domestic and foreign literature, and subjective feeling [16]. (3) the content of the questionnaire in ICF core sets of vocational rehabilitation for reference, including 4 first-level indicators, 92 measures of secondary. The panel members were asked to rate each questionnaire item on a 5-point scale according to how important they believed it was as a potential assessment standard for upper limb vocational ability, including quite unimportant, unimportant, moderately important, relatively important, very important, assign 1-5 points respectively. A new column or a modified column is attached for experts to put forward the items or modified opinions that are not included.

### 2.4. Answer the Questionnaire

From June to July 2022, team members in Guangdong Work Injury Rehabilitation Center distributed the questionnaire through wechat and email, explaining the purpose, significance and filling requirements of the study to the experts. After collecting the questionnaires, they sorted out and analyzed the items of the questionnaire in the first round by means of group discussion and expert consultation, and then carried out the second round of consultation. When the opinions of the experts were basically consistent, the consultation was finished. The construction methods and process of ICF upper limb vocational ability assessment system see figure 1.



**Figure 1.** Construction methods and process of ICF upper limb vocational ability assessment system.

## 2.5. Analysis of Results

Questionnaire star was used to issue questionnaires and collect preliminary statistical data. The EXCEL tables were exported and SPSS 22.0 was used for statistical analysis. The importance score was expressed as ( $\bar{x} \pm s$ ), the greater the importance score, the higher the importance, and the average importance value of indicators  $\geq 3.5$  was acceptable. The enthusiasm of the experts was expressed by the effective recovery rate of the questionnaire. Expert's authority coefficient (Cr) can be determined by means of coefficient of judgment (Ca) and coefficient of familiarity (Cs). The expert's authority coefficient  $\geq 0.70$  indicates high authority [17]. The coordination of expert's opinions is reflected by coefficient of variation (CV) and Kendall's coefficient of coordination,  $CV \leq 0.25$ , and  $P < 0.05$  indicates that expert's opinions are well coordinated. The weight of each index is obtained by means of importance method [18].

## 3. Results

### 3.1. General Information of Experts

In this study, a total of 22 experts were selected and consulted by email or wechat, aged 35-55 years old, with 10-25 years of working experience, all with bachelor's degree or above, intermediate or above professional titles. Among them, 2 are clinicians, 6 are engaged in occupational therapy, 7 are engaged in vocational rehabilitation, 5 are physiotherapists, 1

is a nursing manager, and 1 is a social worker. Among them, 1 physical therapist withdrew from the consultation due to personal reasons.

### 3.2. Experts' Enthusiasm and Authority Level

In the first round of consultation, 22 questionnaires were sent out, and 21 valid questionnaires were recovered. One expert withdrew from the study due to personal reasons, with an effective recovery rate of 95%. In the second round consultation, 21 questionnaires were sent out and 21 were effectively recovered with an effective recovery rate of 100%, indicating that the experts were highly motivated. The expert authority coefficient (Cr) was determined according to the judgment basis coefficient (Ca) and familiarity coefficient (Cs). The results showed that  $Cr \geq 0.70$ , indicating high authority of experts, as shown in Table 1.

**Table 1.** Degree of expert authority.

Round	Ca	Cs	Cr
Round 1	0.929	0.686	0.807
Round 2	0.910	0.700	0.805

### 3.3. Degree of Coordination of Expert' Opinions

The coordination of experts' opinions is reflected by the coefficient of variation (CV) and the Kendall's coordination coefficient. See table 2.

**Table 2.** Degree of coordination of expert' opinions.

Round	Kendall's coefficient	$\chi^2$	P
Round 1	0.290	541.321	<0.001
Round 2	0.374	408.815	<0.001

### 3.4. Determining Items

The first round of experts' consultation questionnaires included 92 second-level indicators, including body structure (2 items), body functions (17 items), activities and participation (40 items), and environmental factors (33 items). As a result, with the mean of importance assignment  $> 3.5$  and the coefficient of variation  $< 0.25$  was used as the standard to screen the initial items. 38 items were deleted/merged in the first round, and the remaining 54 categories were subject to the second round consultation. Then after the second round of consultation, the experts' opinions on each item were coordinated to a high degree, and the Kendall's coordination coefficient was 0.374, indicating that the experts' opinions tended to be consistent, so the consultation was over.

Based on the results of the second round of consultation and statistical data, the indicators of the ICF upper limb vocational ability assessment system containing 4 first-level indicators and 41 second-level indicators are finally formed. The importance scores and weighting coefficient are shown in Table 3.

**Table 3.** Consultation result of ULVAAS indicators (Second Round).

first-level indicators	second-level indicators	Importance score ( $\bar{x} \pm s$ )	CV	weighting coefficient
Title	Title			
body structure (2)	s720 structure of shoulder region	3.56 $\pm$ 0.63	0.153	0.016
	s730 structure of upper extremity	3.81 $\pm$ 0.78	0.172	0.018
Body functions (11)	b117 Intellectual functions	3.52 $\pm$ 0.51	0.145	0.017
	b130 energy and drive functions	3.57 $\pm$ 0.60	0.168	0.018
	b140 attention functions	3.62 $\pm$ 0.60	0.138	0.018
	b160 thought functions	3.62 $\pm$ 0.50	0.138	0.018
	b164 higher-level cognitive functions	3.81 $\pm$ 0.75	0.197	0.019
	b210 seeing functions	4.10 $\pm$ 0.63	0.152	0.020
	b280 sensation of pain	4.14 $\pm$ 0.57	0.138	0.020
	b455 exercise tolerance functions	4.29 $\pm$ 0.56	0.131	0.021
	b730 muscle power functions	4.48 $\pm$ 0.51	0.114	0.022
	b740 muscle endurance functions	4.43 $\pm$ 0.51	0.114	0.022
activities and participation (21)	b810 protective functions of the skin	4.33 $\pm$ 0.48	0.112	0.021
	d155 acquiring skills	4.24 $\pm$ 0.54	0.127	0.021
	d160 focusing attention	4.00 $\pm$ 0.45	0.112	0.020
	d175 solving problems	3.67 $\pm$ 0.58	0.157	0.018
	d210 undertaking a single task	4.19 $\pm$ 0.51	0.122	0.021
	d220 undertaking multiple tasks	4.10 $\pm$ 0.44	0.106	0.020
	d230 carrying out daily routine	4.33 $\pm$ 0.43	0.112	0.021
	d410 changing basic body position	3.81 $\pm$ 0.68	0.178	0.019
	d415 changing basic body position	3.76 $\pm$ 0.63	0.166	0.019
	d430 lifting and carrying objects	4.29 $\pm$ 0.56	0.131	0.021
	d440 fine hand use	4.43 $\pm$ 0.60	0.135	0.022
	d445 hand and arm use	4.43 $\pm$ 0.51	0.114	0.022
	d465 moving around using equipment	4.00 $\pm$ 0.71	0.177	0.020
	d475 driving	3.62 $\pm$ 0.74	0.204	0.018
	d530 toileting	3.90 $\pm$ 0.83	0.213	0.019
	d540 dressing	4.00 $\pm$ 0.78	0.194	0.020
	d570 looking after one's health	4.10 $\pm$ 0.54	0.131	0.020
	d825 vocational training	4.10 $\pm$ 0.44	0.106	0.020
	d840 apprenticeship (work preparation)	3.52 $\pm$ 0.60	0.171	0.017
	d845 acquiring, keeping and terminating a job	4.29 $\pm$ 0.56	0.131	0.021
	d850 remunerative employment	4.29 $\pm$ 0.46	0.108	0.021
	d870 non-remunerative employment	4.24 $\pm$ 0.44	0.103	0.021
environmental factors (7)	e115 products and technology for personal use in daily living	3.62 $\pm$ 0.50	0.138	0.018
	e135 products and technology for employment	3.95 $\pm$ 0.50	0.126	0.020
	e355 health professionals	3.76 $\pm$ 0.77	0.204	0.019
	e430 individual attitudes of people in positions of authority	3.86 $\pm$ 0.48	0.124	0.019
	e450 individual attitudes of health professionals	3.86 $\pm$ 0.73	0.188	0.019
	e550 legal services, systems and policies	3.62 $\pm$ 0.81	0.222	0.018
	e590 labour and employment services, systems and policies	3.52 $\pm$ 0.51	0.145	0.017

ULVAAS: Upper Limb Vocational Ability Assessment System

## 4. Discussion

### 4.1. Innovative

At present, there is not a practical vocational ability assessment system in China, especially the lack of matching tools for the workers' characteristics and work characteristics for the employment of patients with upper extremity disabilities. Based on the ICF concept for the first time, this study created a standardized upper limb vocational ability evaluation system to evaluate the vocational ability of patients with upper limb injury, which can more effectively and comprehensively know the basic work ability and vocational ability matching degree of patients with upper limb disability, which is of great significance for increasing the employment probability of patients with upper limb

disability and guiding their employment.

### 4.2. Scientific

Based on literature review and group discussion, with ICF core sets of vocational rehabilitation as the basic framework, this study selected 21 experts from ten cities including Beijing, Shanghai, Guangdong, Hunan, Jiangsu, Hubei, Shandong and Sichuan. After two rounds of experts' consultation and group discussion, a category of upper limb vocational ability assessment system was constructed, including 4 first-level indicators and 41 second-level indicators. The experts covered many fields such as clinical, physical therapy, occupational therapy, vocational rehabilitation, rehabilitation nursing and social rehabilitation, reflecting a wide range of multidisciplinary perspectives. All the experts who participated in the consultation have worked

in this field for more than 10 years, and some of them have worked in this field for more than 20 years, which indicates that the experts have a deep understanding of this subject. The effective recovery rates of the two rounds of expert consultation were 95% and 100% respectively, and the expert authority coefficients are 0.807 and 0.805, both above 0.70, indicating that this research has high enthusiasm and authority of experts. the Kendall's coefficient was 0.374, and the coordination consultation results were well coordinated. Therefore, the construction of the ICF upper limb vocational ability assessment system is scientific and reliable.

#### **4.3. Contents of the ICF Upper Limb Vocational Ability Assessment System**

The ICF Comprehensive Core set of vocational rehabilitation includes three first-level indicators: physical function (17), activity and participation (40), and environmental factors (33). However, the indicator of physical structure (s) is not included. Consideration of the body structure, especially the integrity of the upper limb structure has a significant impact on the assessment of upper limb occupational ability. Therefore, after literature review and group discussion, our team added the categories of body structure in the first round questionnaire, including s720 structure of shoulder region and s730 structure of upper extremity, so that the first round questionnaire included a total of 4 first-level indicators and 92 second-level indicators. After two rounds of expert consultation, the two categories of body structures have not been deleted, indicating that the experts and our team have the same opinions.

Considering that this research is mainly about the construction of upper limb vocational ability assessment system, d450 walking, d455 moving around and d465 moving around using equipment, these three categories have similar meanings. In order to avoid repetition, after the first round consultation, only d465 moving around using equipment was retained, and the other two items do not involve the function of upper limbs, so they were deleted. In the first round consultation, a total of 38 categories were deleted/merged based on the statistical results and experts' suggestion, leaving 54 categories for the second round consultation. In the second round consultation, 13 categories were deleted/merged again, and finally the upper limb vocational ability assessment system was formed, including 4 first-level indicators and 41 second-level indicators. At the same time, some explanations are made for some categories, such as "s720 structure of shoulder region", "s730 structure of upper extremity" is explained as the integrity and mobility of the corresponding structures of the upper limb; "b280 pain" is defined as pain in the hands and upper limbs, such as dull pain, stinging pain, numbness, and so on. Some categories are somewhat controversial, such as "d475 driving", some experts put forward that driving ability is very important for a specific industry (such as drivers), but for people who can take public transport is not necessary. Another example is "d410 changing basic body position", some experts believe that changing the body posture (sitting

to standing, standing to squatting) mainly use the function of the lower limbs, unless the patients with mobility difficulties may need to use the strength of the upper limbs to change the body posture, otherwise this item can be deleted. Combined with the results of the inquiry data and discussion, the importance score of this category >3.5, the difference coefficient <0.25, these two categories are reserved at the end. But they can be re-evaluated according to the actual situation of patients in application.

#### **4.4. Application**

The Core Set of ICF Vocational Rehabilitation is a reference framework for describing job functions for people of working age with limited work-related functional abilities. It provides a comprehensive and detailed cross-disciplinary assessment reference for vocational rehabilitation workers. It is important to link work ability tests to ICF and constructing a system of work-related functional tests that follow a biopsychosocial framework in selecting appropriate test methods when assessing work-related functions and recommending interventions [19].

However, there are many items in comprehensive ICF core set of Vocational rehabilitation, which takes a long time to use in clinical practice. In this study, an evaluation framework containing 41 items was constructed for patients with a specific disease type of hand and upper limb injury, which can be targeted for the evaluation of hand and upper limb vocational ability and effectively shorten the operation time.

However, both the ICF itself or the core set, as well as the various versions of the upper limb vocational ability assessment system in this study, are all "category lists" rather than rating scales. Therefore, when evaluating patients' health status or vocational ability, it is necessary to explain and quantify the evaluation content, evaluation method, evaluation criteria, functional degree and other aspects of each category of purpose [9], only by materializing each item, or directly developing corresponding operational items, can they be used in clinic to solve the operation problems for ICF purposes. Therefore, the next stage needs to materialize and link the 41 items to the corresponding assessment tools, so as to make the ICF upper limb vocational ability assessment system concrete and operational. At the same time, the assessment of vocational ability should be combined with different occupational requirements. In the corresponding assessment, it is necessary to consider the requirements of different occupations on the physical ability of workers, and fully combine the work analysis and other relevant assessment results before the vocational ability assessment. In addition, the indicators in the ICF vocational rehabilitation core set are all second-level indicators, which may not be specific enough to describe certain functional abilities. In order to describe occupational functions more specifically, the third-level indicators may be required.

#### **4.5. Limitations**

This study evaluates the content of the ICF upper limb

vocational ability assessment system from the perspective of experts. Although 21 experts have high level of expertise and rich clinical experience, considering that the vocational competency assessment belongs to the field of vocational rehabilitation, experts in the field of vocational rehabilitation are included in the assessment. Therefore, the professional titles of some experts are downgraded to intermediate, the content validity of the ICF upper limb vocational ability assessment system may require further clinical validation.

## 5. Conclusion

By means of literature search, Delphi method and group discussion, this study preliminarily constructed a category of ICF upper limb vocational ability assessment system including 4 first-level indicators and 41 second-level indicators. With a certain degree of scientific and practical. In the next stage, these categories need to be transformed to form concrete and operable evaluation standards. To promote the application and promotion of the simplified ICF core set in clinical practice, and provide reference for the formulation of ICF assessment system for other diseases.

## Ethics Approval

Ethical issues are not involved in this paper.

## Conflicts of Interest

All contributing authors declare no conflicts of interest.

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