Validation of the Developed Eating Activities Questionnaire in Working People with Disabilities: A Cross-Sectional Study

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Abstract: Objectives: There are only a few functional evaluations that non-medical personnel can perform and interpret without guidance. Here, we have created a questionnaire that focused on eating activities, which can be used to evaluate motor function easily because most people could relate to eating activities. This study aimed to verify the reliability and validity of the developed questionnaire by comparing it with clinical evaluations for upper extremity function.

Methods: This was a cross-sectional study. Patients who have cerebrovascular disease history with disabilities in the upper limb were included in the study. The questionnaire on eating activities was answered by the patients themselves. Upper extremity function was evaluated with the Fugl-Meyer Assessment (FMA). Work efficiency was evaluated with the General Aptitude Test Battery. Reliability of the questionnaire was assessed by test-retest reliability. Validity was evaluated using a correlation analysis.

Results: The study included 16 participants. The results indicated that all items had sufficient reliability. The correlation between the questionnaire score of the hand and the FMA score of the wrist, hand, and arm was statistically significant.

Conclusions: The developed questionnaire was reliable and significantly related to clinical evaluation of upper extremity functions. This questionnaire is of great value to patients with stroke to understand their functions.

Keywords: patient-based questionnaire, patient-based medicine, eating activities questionnaire, fugl-meyer assessment, upper extremity function, work efficiency

Introduction

According to a WHO study, more than a billion people or about 15% of the world’s population are estimated to live with some form of disability [1]. The number of people with disabilities is increasing. This is because people are aging, and chronic health conditions with disability are rising. Of patients with stroke, 70% have disabilities in the upper limbs and 40% in the chronic phase [2, 3]. Most people with brain injury want to live a normal everyday life after the injury, such as returning to work, earning their subsistence and participating in society [4]. Impairments after stroke often interfere with activities of daily living (ADLs). Patients may have difficulties caring for themselves such as in dressing, eating, and other daily tasks [5]. Work disability is often associated with personal suffering and loss of income, diminished productivity, increased medical and societal costs, and can be addressed through vocational rehabilitation [6, 7]. This results in limited actions and has an impact on the level of activity and participation in different life areas [8].

To understand patient’s disabilities, medical staff
uses clinical evaluations, expertise, and International Classification of Functioning, Disability and Health (ICF) concept. Since the aspects of impairments, activities, and participation limitations together with contextual factors are incorporated into the same conceptual framework, the multidimensional model of the ICF can be used [9]. In actual rehabilitation scenes, the medical team follows the clinical pathway and mainly works on exercise such as muscular strength training, Range of motion (ROM) exercise, and walking. The ICF participation item (hobbies and work), which can be demand or hope, may be restricted because the medical team cannot tackle them after patients are discharged. After discharge, patients return to society, and their activities can be restricted because they do not sufficiently understand how much motor function they have. The crucial problem is that patients cannot understand their own functions.

The idea of Patient-Centered Medicine (PCM) is the key to solving this problem. PCM is a concept of capturing an individual, not a disease [10, 11]. In other words, medical staff should understand the characteristics of each patient treat and care so as to suit the person and improve the therapeutic effect. To increase the therapeutic effect, it is important for not only the medical staff but also patients themselves to understand the state of their own body. There are few functional evaluations (e.g., Patient-Based Questionnaire) that general people who are not medical personnel can monitor and understand by themselves [12–14]. Moreover, most Patient-Based Questionnaires ask about symptoms, pain, or feeling. There are no questionnaires for patients to understand their function by themselves. For this reason, we have developed a function evaluation tool that anyone can easily perform.

In order to be evaluated by everyone, we developed the assessment tool based on the ADLs. This includes walking, transferring, and dressing, but we especially focused on eating. We assumed that motor functions of the upper extremities could be evaluated, besides ADLs, as they rely on various tools (forks, spoons, chopsticks) and the hands for eating. Kinematic analysis is generally used in the clinical research to evaluate the effects of the intervention [15–17] or research motor function recovery after stroke [18–20]. Kinematic movements evaluated in the previous studies were limited to pointing or reaching, but in one case a drinking task was also evaluated to determine natural movement performance in daily living [21]. People can easily imagine these movements, but expertise and special tools are necessary for evaluations. In order to evaluate without expert knowledge and special tools, we developed an evaluation tool using a questionnaire, assigned scores for each function of the upper extremities, and created a conversion table so that the person with disabilities can visualize their own motor function. Anyone can evaluate their motor functions using the questionnaire if its contents and scores are related to the clinical evaluation. Additionally, from the viewpoint of vocational rehabilitation, there is a possibility of finding work by easily evaluating motor function in a patient-oriented manner.

Thus, this study aimed to verify the reliability and validity of the developed questionnaire by comparing it with the clinical evaluation of motor function. In addition, the upper limb function and work efficacy were also analyzed together.

**Methods**

**Study design**

This was a cross-sectional study.

**Subjects**

We targeted physically handicapped persons who mainly have upper limb dysfunction. In July 2018, at a place where many persons with physical disabilities work without utilizing cognitive function, the facility manager invited all staff with disabilities of the upper limbs and obtained measurements of those who provided consent. Measurements were carried out within the facility. The ethics committee of Kyoto University approved the study (No. R1612). Informed consent was obtained from all participants before enrollment. The eligibility criteria included (1) impairment in the upper limbs and (2) a history of cerebrovascular disease. The exclusion criteria included (1) inability to use the fingers and upper limbs on both sides, (2) severe neurological disease, (3) severe cardiovascular disease, and (4) significantly low cognitive function.

**Measurement item**

The following measurement items were evaluated:

1. Basic information (age, sex, past medical history).
2. Eating Activities Questionnaire (the questionnaire on movements in eating).
3. Fugl-Meyer Assessment (FMA, clinical assessments of upper extremity function).
4. General Aptitude Test Battery (GATB, work efficiency).

**Basic information**

Data on age, sex, past medical history, and strength of disabilities were self-reported by the participants (Appendix 1). Data on the dominant hand and paralyzed side were also reported.
Eating Activities Questionnaire

An orthopedic surgeon, a physical therapist, and a factory manager working with persons with disability created this questionnaire. We analyzed the necessary upper limb functions and observed their eating behavior related to the action. The upper limb functions required for each dietary movement were analyzed and weighted with points. The researchers filled out the questionnaire as they listened to the responses of the subjects.

Questions about various daily meal actions can be answered with can or cannot. The contents of the questionnaire are about drinking, eating with a fork or chopsticks, and so on (Appendix 1). In each question, we extracted the necessary upper limb functions and independently weighted point (a) (Appendix 2). Moreover, point (b) is 1 if the answer to each question was “Yes”, and it was 0 if the answer was “No.” By multiplying (a) and (b), the score is calculated. The maximum score is 80 points for the total items about the fingers, 37 points for the total items about the arm, and 17 points for the total items about the trunk. The minimum score is 0 for each part.

We asked the questionnaire again one week after the first measurement for test-retest reliability.

Clinical assessments of upper extremity functions

We evaluated the upper extremity functions by the Fugl-Meyer Assessment (FMA) [22]. The test on the upper limb consists of four parts (A, arm; B, wrist; C, hand; and D, coordination). The score is based on the ability to perform isolated movements within and out of synergy patterns. There are 33 items, and each item is graded from 0 to 2 points. The maximum score is 66 points. We measured not only the paralyzed side but also the healthy side to compare with that in the Eating Activities Questionnaire.

Work efficiency

Work efficiency was evaluated using the General Aptitude Test Battery (GATB) [23], which was developed in the USA and revised for the Japanese population by the Ministry of Health, Labor and Welfare. There are 12 paper tests and 4 apparatus tests, but we conducted only the apparatus tests in this time. It can evaluate two functions: (1) arm dexterity and (2) hand dexterity. Arm dexterity is evaluated by two tests with a peg board, and hand dexterity is evaluated by two tests with a finger dexterity board (Takei Scientific Instruments, Niigata, Japan) (Fig. 1).

1-1: The number of rods that were replaced from the upper row to the lower one with their paralyzed upper extremity in 15 s is counted. After performing the test three times, the best score is converted to the final score using a conversion table. The maximum score is 139, and the minimum score is -67.

1-2: The number of rods that were turned over with their paralyzed upper extremity in 30 s is counted. After performing the test two times, the best score is converted to the final score. The maximum score is 156, and the minimum score is -104.

2-1: Subjects combine nails and washers and pierce the pairs into a hole with their paralyzed arm. An observer counts the pairs they combined and pierced in 1 min 30 s. They can try the test only once, and the score is converted to the final one.
The maximum score is 156, and the minimum score is -30.

(2)-2: Subjects disassemble the combined nails and washers, insert the nails into the hole on the upper stage, and attach the washers to the stick with their paralyzed hand. An observer counts the pairs they disassembled in 1 min, and the result is converted to the final score. The maximum score is 91, and the minimum score is -34.

Sample size

The sample size in the correlation analysis was calculated using the G*Power 3 program (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). A sample size of test-retest reliability of 10, 7, and 5 for detecting the value of ICC of 0.7, 0.8, and 0.9, respectively, involved two observations. A sample size of 13 was necessary for the analysis, with a planning value of correlation of 0.61, $\alpha = 0.05$, and power = 0.8 [24].

Statistical analysis

To confirm the reliability of the Eating Activities Questionnaire, the total scores of both arms, both hands, and trunk were compared between the first and second results of the questionnaire. We filled the questionnaire again 1 week after the first measurement for test-retest reliability, which was estimated by intraclass correlation coefficient (ICC) [25, 26]. ICC was calculated using the SPSS version 20.0 software (SPSS, Chicago, IL, USA).

The validity was investigated by correlation analysis [24]. Results on the paralyzed side were used for analysis in consideration of the ceiling effect. The Spearman’s rank correlation coefficient was calculated with the questionnaire results, FMA, and GATB. The correlation analysis was performed using JMP Pro version 12.2 (SAS Institute, Cary, NC, USA), with a P-value < 0.05 considered as significant.

Results

The total number of subjects was 16. Of the 16 subjects, 10 (62.5%), who were available for measurement for the second time, retested the questionnaire after 7 days. Basic information (age and sex), questionnaire results, and FMA and GATB scores are shown in Table 1.

Reliability

Test-retest reliability is shown in Table 2. The ICC value was 1.00 (95% confidence interval [CI], 1.00 to 1.00) for the right arm, 0.869 (95% CI, 0.526 to 0.969) for the left arm, 0.994 (95% CI, 0.974 to 0.999) for the right hand, 0.883 (95% CI, 0.570 to 0.972) for the left hand, and 1.00 (95% CI, 1.00 to 1.00) for the trunk.

Overall, these results indicated that all items had sufficient reliability [27].

Validity

The correlations among the questionnaire, FMA, and GATB scores for the hand are shown in Fig. 2. A significant correlation was found between the questionnaire score of the hand and FMA score of the wrist ($r = 0.746$) and hand ($r = 0.847$). However, there was no correlation ($r = 0.136$) between the questionnaire score of the hand and the GATB score of hand dexterity and between the FMA score of the wrist ($r = 0.372$) or hand ($r = 0.443$) and the GATB score of hand dexterity.

The correlation among the questionnaire, FMA, and GATB for the arm is shown in Fig. 3. There was a significant correlation ($r = 0.858$) between the questionnaire score of arm and the FMA score of arm. There was no correlation ($r = 0.310$) between the questionnaire score of arm and the GATB score of arm dexterity, but a weak correlation ($r = 0.593$) was found between the FMA score of arm and the GATB score of arm dexterity.

Discussion

In this study, the Eating Activities Questionnaire was examined along with the traditional clinical assessment (FMA) and work efficiency assessment (GATB). The test-retest reliability of the Eating Activities Questionnaire was confirmed, and upper limb functions per the questionnaire and FMA were significantly correlated. There was no significant correlation between the questionnaire and work efficiency.

Table 1 Subjects’ characteristics*

| Variables | Subjects ($n = 16$) |
|-----------|--------------------|
| Age (years) | 48.75 ± 10.33 |
| Men (%) | 13 (81.3) |
| Dominant hand (right) | 9 (56.2) |
| The Questionnaire (point) | |
| Arm | 13.88 ± 15.39 |
| Hand | 28.56 ± 31.60 |
| Trunk | 12.5 ± 5.63 |
| Fugl-Meyer Assessment (point) | |
| Arm | 19.81 ± 12.55 |
| Wrist | 4.31 ± 4.21 |
| Hand | 6.44 ± 6.43 |
| Work efficiency (point) | |
| Test 1 | −60.25 ± 5.29 |
| Test 2 | −89.31 ± 11.64 |
| Test 3 | −13.44 ± 13.86 |
| Test 4 | −18.19 ± 12.32 |
| Arm | −149.56 ± 16.00 |
| Hand | −31.63 ± 25.70 |

* Values are mean ± SD or percentage.
To evaluate reliability, test-retest reliability is commonly used. As shown in Table 2, since the ICC between the questionnaires given twice was significantly higher [28], its reliability was certain [29]. People with disabilities could easily understand questions and sentences of the developed questionnaire, and there was always no influence on interpretation. The confidence interval was wide in the upper left limb, probably because of a large number of right-handed subjects in the study.

In this study, upper limb functions per the questionnaire and FMA were significantly correlated. The research team independently evaluated the eating movements and constructed an algorithm for estimating upper limb function, but as a correlation was found with the index that has been used in the past, it may be sufficient for functional evaluation. Previous studies have shown the association between kinematic movements such as drinking task and FMA [17]. The drinking task also includes reaching, grasping, and lifting the glass from the table. Although the kinematic movement in the drinking task may be a subjective and qualitative assessment, the elements included in the kinematic movement are consistent with those of clinical assessments (FMA, ARAT). The correlation between kinematic movements and clinical assessments is due to this consistency. In this study, since the contents of the questionnaire are kinematic actions such as a drinking and grasping something to eat with the hand, it is thought that the relationship between the questionnaire and FMA was strong. From these results, it is possible to grasp the upper limb function of the patient with stroke from the questionnaire on the eating activities.

There was no significant correlation between the questionnaire and work efficiency because work efficiency includes elements of technology and speed; it may not have been dependent on simple functions. From the point of motion control, the movement is closely related to the individual, task, and environment. It has been also reported that the exercise of muscles of upper limb changes depending on the height of the desk [30] and in this study, the motor functions of the person with disabilities might not be fully measured under uniform conditions. Because it includes elements such as smoothness and time, it is thought that its association with motor function was low. This is why the questionnaire was not directly related to work efficiency. On the contrary, people with disabilities can determine their motor function from this questionnaire. Therefore, it is different from the previous questionnaire that they can assess themselves regarding daily life and social activities by understanding what they can presently do and what they are not good at. It is also possible to obtain the necessary abilities and circumstances to be able to work.

There are several limitations in this study. First, although a significant correlation was seen, the number of samples was small. In order to use the FMA index, the disease was limited to cerebrovascular disease; but the eating activities questionnaire created could be used to evaluate upper limb function regardless of the disease. Thus, the number of samples should be increased in the future studies.

Second, because GATB involves only assembling or replacing, the contents may not be insufficient as evaluation of work efficiency (e.g., typing). Third, there were few female subjects. Fourth, this was a cross-sectional study. Therefore, any cause-effect relationship among the questionnaire, FMA, and GATB remains unknown.

In the future, it is thought that the questionnaire will be the cutting edge for disabled persons’ return to society, employment support, and support for hobby activities. When generally used as a function evaluation tool, it is important to apply the questionnaire in not only functional evaluation but also a wide range of diseases (muscular dystrophy, multiple sclerosis, etc.) and fields (manufacturing, processing industry, desk work, etc.). It may also be used as an evaluation of rehabilitation [31].

In this study, the reliability of the developed questionnaire was confirmed, and the validity of that on motor function and work efficiency was investigated. The questionnaire was found to be significantly related to the clinical assessment of upper extremity functions in patients with stroke. Since the Eating Activities Questionnaire is a self-writing type questionnaire and can convert scores, it is possible to self-monitor the motor functions. Using this questionnaire, people can evaluate themselves and understand their functions.

Acknowledgments

The authors thank the staff and workers at Omron Kyoto Taiyo and Taiyo no Ie for their help with the data collection. We also thank Editage (www.editage.jp) for the English language editing.

Disclosures

Approval of the research protocol: This study was approved by Ethic Review Committee in this facility (approve No. R1612) regarding research protocol including the voluntary participation, do not harm, confidentiality, anonymity and only assess relevant components of this study. Informed consent: In this study, we explained about this research sufficiently in document and oral to those who would participate beforehand, then this
study targeted for only those who gained consent from the person’s free will. Explained items were following: the title and outline of this research including the objective, measurement items and its duration, disadvantages arising from becoming subjects, freedom of refuse to become subjects at any time, be able to withdraw consent from as required even after subjects and their family agree, protection of privacy and no reward is paid. Registry and the registration no. of the study/trial: N/A. Animal studies: N/A.

Author Contribution
YT wrote this paper. TH, HA, YY, NW conducted data collection. YT, YN, AY, YS analyzed data. All co-authors confirmed this research.

Funding
This study was supported by the Japan Agency for Medical Research and Development.

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