

# Exploring the Relation Between Impairment Rating by AMA Guide and Activity and Participation Based on ICF in the Patients with Hand Injuries

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**Abstract** The aim of this paper is to analyze the relation between components of disability with distinguished score of impairment, activity and participation questionnaire based on clinical data of persons with hand injuries. Impairment was evaluated by use of AMA guide 6th edition and disability by DASH questionnaire on Convenience sample of patients ( $N=117$ ), with chronic hand injuries. Linking and allocating items of the DASH were done based on the ICF Core Set for Hand Conditions and the opinions of a group of experts from different related fields. Data was analyses by using Kappa index, Chi square test and a set of Pearson, Part and Partial correlations coefficient. Most of the DASH items were allocated to the activity; one to four of the items could not be classified and 0 to 22 were classified as having overlap. Participation and activity scores correlated positively with each other ( $r>0.80$ ). Impairment had high correlation with activity and participation scores ( $>73$ ). With controlling the effect of each or both

construct, this relation between them with impairment diminished but still significant between activity and impairment. There is a huge overlap in definition of activity and participation. The most effecting item in relation of disability and impairment is activity restriction. Participation had no relation with impairment.

**Keywords** ICF · Hand injuries · DASH · Disability · Link · AMA guide

## Introduction

Many of the hand and upper extremity injuries lead to permanent impairment [1]. Severe impairments can lead to functional disability and even effect on returning to work. These restrictions are considered as disability.

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The relation between impairment (such as restricted in range of motion, loss of sensation) and disability remains both complex and difficult [2]. Only a few studies support low to moderate correlation between impairment and disability [3, 4]. This reported relation might be due to the way of measuring disability and its definition mostly [5].

Several models and theoretical basics have been developed to define disability [6, 7]. Recently, International Classification of Function, disability and health (ICF) were developed based on bio-physcosocial models [8]. According to the ICF, *Impairments* (I) refer to problems (i.e. significant deviation or loss) in body functions and body structures. Further, *activity* is defined as the execution of a task or an action by an individual and *activity limitations* (A) capture difficulties an individual may have in executing these tasks [9]. In addition, participation refers to being involved in a life situation while *participation restrictions* (P) are problems an individual may experience with being involved in specific life situations [10]. To comprehensively describe functioning and disability of individuals with hand conditions, ICF Core Set for Hand condition were also developed [11].

Any loss or deviation in body structure and body function is considered as impairment [2, 12]. Disability is how the impairment affects the individual. It is more subjective and better evaluated by the self-reported questionnaires. It is believed that activity limitation can be the consequence of any impairment, but participation may or not be restricting under influence of personal or environmental factors. [13, 14].

Many authors, also believe that they are two entities with separate constructs and criticize the ICF for capturing them in one component (4, 15–18) [15]. Given the authors' arguments, activity must be correlated with impairment level. Participation (i.e. involvement in social situations), however, may or may not be limited depending on personal or environmental factors. Therefore, one might expect that impairment correlates with a person's activity level and has no or low correlation with his or her participation level.

The primary focus of hand therapy interventions mostly on diminishing activity limitation, and lessen restriction in participation is the goal of rehabilitation [4]. Disability measures mostly have both activity and participation items and can't give a separate score for each. So the level of disability, which is being measured by them, is not pure activity or participation level of the patients. the relationship of impairment and disability (if considered as participation restriction) is important to the treatment plan [14]. More disability than expected can be due to personal and environmental effect on participation and may respond to treatments based on cognitive behavioral therapy [16].

But as activity limitation and participation restriction express two meanings of disability, personal level (capacity) and environmental level (performance), it is better to evaluate them separately.

The most commonly used upper extremity specific disability questionnaires is the Disabilities of the Arm, Shoulder and Hand (DASH) [17, 18].

There are some reports in distinction the items of DASH to activity, participation or body structure and body function [12]. Also some reports try to develop new outcome measure to evaluate either activity or participation separately in the patients [19, 20].

In this study, we investigate the relation between impairment scores (quantified using the AMA guide, 6th edition) and disability scores (measured using DASH questionnaire with separated scoring in activity, participation and body structure and body function) in patients recovering from hand and upper extremity impairment after injury. Specifically we addressed the primary null hypothesis that there is no relation between participation score and impairment. Secondary study questions addressed the relation between activity score with impairment. And also determine the relation between objective and subjective impairment.

## Materials and Methods

### Recruitment Procedures and Participants

Patients recovering from hand and upper extremity problems referred by a hand surgeon to the outpatient hand therapy clinic during 6 month (Aug. 2014 to Feb. 2014) were eligible. Patients were referred after confirmation of the diagnosis by the same hand surgeon. The minimum time from injury was 2 months. Inclusion criteria were: age 18 years or greater. Exclusion criteria were: Patients who (1) were unable to read or write, (2) had cognitive dysfunction, (3) had neurologic disease, (4) and those who declined were excluded from the study.

Informed consent was obtained from all participating patients at their first visit. Data were collected on the day of the patient's initial visit by a team of specialist occupational therapist who were experienced in hand rehabilitation and use of AMA guide for impairment rating. The DASH, questionnaires respectively were completed by the patients.

All individuals gave research authorization to participate in this study. The Medical Ethics Committee of the University of Welfare Science and Rehabilitation approved the study protocol. Five-hand therapists gathered the clinical data.

There were 77 men and 30 women with an average age of 34 years (range 18 to 69 years). The average time from the onset of their problem was 12.4 months (range 2 to 73 months). Most of the patients had heavy manual job, 49 (46 %). The most diagnosis that entered the study was fracture, nerve and tendon. Demographic characteristics are shown in Table 1.

**Table 1** Demographic characteristics of the samples

Variable	<i>n</i>	%	Variable	<i>n</i>	%
Gender			Kind of injuries		
Male	77	72	Fracture	29	12
Female	30	28	Spaghetti wrist	20	8
Injured hand			Nerve	25	10
Right	73	68	Tendon	26	10
Left	34	32	Others	7	0.06
Job					
Heavy worker	49	46			
Fine work	26	24	Cause of injury		
Other	32	30	Non traumatic	25	23
			Traumatic	82	77

## Measures

### AMA Physical Impairment Rating

An impairment rating attempts to quantify objective pathophysiology (e.g. objective measurements like sensation and range of motion) [21, 22]. The American Medical Association (AMA) publishes a guide to assist with the quantification of permanent impairment) to give a total impairment range ranging from 0 % (no impairment) to 100 % (severe total body impairment)(18). Scores are between 0 and 100 as 1–13 interpret mild impairment, 14–25 as moderate, 26–49 as severe and upper than 50 considered as very severe impairment. Stiffness, amputation, and loss of sensation are quantified and combined resulting in a score for the finger that can be translated to the hand, the upper limb, and the whole person [23, 24].

The AMA Impairment Guidelines, 6th edition, were used to quantify the percentage of upper extremity impairment based on tables and formulas using the loss of sensation (two-point discrimination), loss of motion at each joint (goniometer), and loss of strength and also clinical studies and functional history [25, 26]. Diagnosis based impairments are provided for each region of upper extremity.

### Dash Questionnaire

The DASH questionnaire is a 30-item self-reported questionnaire to assess upper extremity symptoms and disability. Good reliability and validity has been reported. Each item is ranked on a 5-point Likert scale ranging from “no difficulty” to “unable.” A composite score is calculated from the completed responses, and the score cannot be calculated if more than three items are missing. The score is scaled between zero (no symptoms or disability) to 100 (maximum symptoms and disability) [27]. The full version of DASH with two optional modules were used [28].

## Linking to ICF and Distinction

“ICF coding system is divided into two parts. The first part deal with the process of functioning and disability; b (body functions), s (body structures) and d (activities and participation). The second part deals with environmental and personal factors; e (environmental factors).” And then we have classified the DASH questionnaires into b, s and d. The distinctions of DASH items to activity, participation or body structure and body function, were conducted by gathering the expert opinion. Ten specialists (Master of public health, Rehabilitation medicine, Occupational therapist, Hand therapist, and Psychologist) from *University of Munich, Oxford Brookes, Denver Craig Hospital Colorado, and Iran*, who were familiar with ICF and linking rules and also had experience in this area, were asked to distinct the DASH items, to either: activity or participation, body structure and body function based on ICF Core Set for Hand condition. We considered the extracted score of body structure and body function as subjective impairment.

## Statistical Analysis

A power analysis indicated that a sample size of 100 patients would provide 80 % statistical power (beta 0.20, alpha 0.05) to detect a small correlation ( $r=0.03$  or greater) of the DASH score with impairment rated using the AMA guides.

Bivariate analyses were performed to measure the associations between response (total DASH score) and explanatory variable (Impairment score).

Discriminative content analysis on DASH was done using Kappa statistics agreement. The items considered to be either activity, participation or body structure and body function when take more than 60 % percent of agreement on each . The score of each component was calculated through the original formula in scoring the DASH [18]. The extracted scores were under linking DASH items to ICF. Higher score in activity was considered as increase in activity limitation and a higher score in participation as increase in restricted participation.

To measure association between activity, participation and body structure function together and each of them with Impairment score as well, bivariate analyses (Pearson correlation) were performed.

To study pure association of each separated score from DASH with impairment, a set of part and partial correlation was conducted. (Extract the relation between impairment and participation, while controlling the effect of activity and vice versa). Correlation was categorized as low ( $r=0.10$ – $0.29$ ), medium ( $r=0.30$ – $0.49$ ), or high ( $r=0.50$ – $1.00$ ) [29].

**Table 2** Results of linking and allocating DASH items

Item	A/P/B	
1) Open a tight or new jar	A	
2) Write	AP	
3) Turn a key	A	
4) Prepare a meal	AP*	
5) Push open a heavy door	A	
6) Place an object on a shelf above your head	A	
7) Do heavy household chores (e.g. wash walls, wash floors)	AP	
8) Garden or do yard work	AP	
9) Make a bed	AP	
10) Carry a shopping bag or briefcase	AP	
11) Carry a heavy object (over 10 lbs.)	A	
12) Change a light bulb overhead	AP	
13) Wash or blow dry your hair	–	
14) Wash your back	A	
15) Put on a pullover sweater	A	
16) Use a knife to cut food	A	
17) Recreational activities, which require little effort (e.g. card playing, knitting, etc.)	AP*	
18) Recreational activities, in which you take some force or impact through your arm, shoulder or hand (e.g. golf, hammering, tennis, etc.)	AP*	
19) Recreational activities in which you move your arm freely (e.g. playing Frisbee, badminton, etc.)	AP*	
20) Manage transportation needs (getting from one place to another)	AP**	
21) Sexual activities	AP*	
22) During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbors or groups?	P	
23) During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	AP	
24) Arm, shoulder or hand pain	B	
25) Arm, shoulder or hand pain when you performed any specific activity	B	
26) Tingling (pins and needles) in your arm, shoulder or hand	B	
27) Weakness in your arm, shoulder or hand	B	
28) Stiffness in your arm, shoulder or hand	B	
29) During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?	B	
30) I feel less capable, less confident or less useful because of my arm, shoulder or hand problem	–	
31) Using your usual technique for your work?	AP*	
32) Doing your usual work because of arm, shoulder or hand pain?	AP	
33) Doing your work as well as you would like?	AP*	
34) Spending your usual amount of time doing your work?	AP*	
35) Using your usual technique for playing your instrument or sport?	AP*	
36) Playing your musical instrument or sport because of arm, shoulder or hand pain?	AP*	
37) Playing your musical instrument or sport as well as you would like?	AP*	
38) Spending your usual amount of time practicing or playing your instrument or sport?	AP*	
Total	N	Percent
A (Activity)	8	21
P (Participation)	1	0.3
A/P (activity and participation)	22	58
B (Body structure and body function)	6	16
None	1	0.3

Linking and allocating DASH items to either activity, participation or body structure and body function with the ICF Core Set for Hand Conditions based on specialists' agreement

\* Agreement degree is >0.60, \*\* agreement degree is >0.80

## Results

Mean of DASH score was 57.1(26.3). In bivariate analysis, DASH scores correlated with impairment ( $r=0.38$ ;  $p<0.001$ ).

Based on expert distinction on DASH items, 8 (21 %) items were considered as activity, one item (item number 22, *During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbors or groups?*) as participation and 6 (16 %) items as body structure and body function. There was no agreement on allocating 22 (57 %) items of the DASH to either activity or participation. In data analysis we considered each item in a category of activity or participation when it was 60 % agreement on allocating it. Most of the experts claimed that they could consider as both. The most agreement on overlapping was on the items; 4,17,18,19 (60 %). (Tables 2 and 3).

In bivariate analysis, Impairment correlated with activity ( $r=0.41$ ;  $p<0.001$ ) and also had weak correlation with participation ( $r=0.40$ ;  $p<0.005$ ). The activity and participation scores had extremely high correlation ( $r=0.85$ ;  $p<0.001$ ) (Table 4).

By part correlation the effect of activity and/or participation was controlled. Impairment had no correlation with activity ( $r=0.09$ ;  $P<0.05$ ) and with participation ( $r=0.08$ ;  $P<0.05$ ).

By partial correlation the effect of activity and/or participation was controlled from both variables. Impairment had no correlation with activity ( $r=0.18$ ;  $P<0.05$ ) and with participation ( $r=0.18$ ;  $P<0.05$ ).

In bivariate analysis, subjective impairment (body structure and body function score) correlated with activity ( $r=0.74$ ;  $P>0.01$ ) and with participation ( $r=0.61$ ;  $P>0.01$ ). Table 5.

## Discussion

The results of distinction of the DASH items indicated that most of them are measuring activity. It can be deduced that the total DASH score is mostly presented the activity level of patients, so its association with impairment level is justifiable.

There was not fully agreement on 57 % of the DASH items to be considered as activity or participation by the experts. It

**Table 3** Descriptive statistics and internal consistencies of the studied components scores

Components	Range of scores	Mean	SD	$\alpha$
Activity score	0–100	39.76	32.36	0.93
Participation score	0–98	44.03	32.24	0.90
Body structure and body function	0.0–100	39.44	27.43	0.90

\*\* $P<.01$ . \* $P<.05$ . Separated activity, participation and body structure and body function scores based on experts agreement body structure and body function scores considered as subjective impairment

**Table 4** Correlations between study variables

Components	1	2	3	4
1 Impairment				
2 Subjective impairment	0.23*			
3 Activity score	0.41**	0.74**		
4 Participation score	0.40*	0.61*	0.85**	

Body structure and body function scores considered as subjective impairment

1: Impairment score rated by AMA guide, 2: Subjective impairment, 3: Activity and 4: Participation score

\*\* $P<.01$ . \* $P<.05$

seems that the most important problem was related to conceptualization of the components. There is no agreement in their definition, especially on the participation. [30].

We investigated that Impairment (scored by AMA guide 6th edition) had a medium correlation with disability (scored by DASH) in patients with hand and upper extremity injuries. Our finding of a medium correlation of AMA impairment rating with DASH is partly in agreement with the findings of prior studies [5, 14, 31].

The correlation was increased with separated score of participation and this relation was stronger by just activity score. In other word, impairment had correlation with activity level of the patients and a minimum relation with participation level.

The results of relation between activity, participation and impairment are in contaminant with other as juvenile idiopathic arthritis [32], ankylosis spondylitis (15) and RA (41). Some authors [33–35] argued that activity limitation do not necessarily resulted in participation restriction. They rationalized that participation is mostly under effect of personal and environmental factors. Participation is considered as satisfaction in doing or as having a subjective dimension [36, 37].

In addition, the results of part and partial correlations conducted that, after controlling the effect of activity level (score), the relation between impairment and participation decreased severely or no significant relation was founded. Accordingly, it can be deduced that there is no relation between impairment

**Table 5** Partial and part correlations between subjective and objective impairment with activity and participation

Components	Controlled by activity		Controlled by participation	
	Partial	Part	Partial	Part
Objective impairment	0.18	0.09	0.19	0.08
Subjective impairment	0.20*	0.10	0.52**	0.27**

Body structure and body function scores considered as subjective impairment

\*\* $P<.01$ . \* $P<.05$



and participation and most of the reported relation was due to affect of activity score. Many authors (11, 13) also found significant associations between impairment with activity and participation, in patients with different kinds of injuries. However, Pollard and colleagues [38] – who developed a structural equation model and used a general measure of activity and participation – found that the path coefficient between impairment and participation was not significant (12).

Based on the results, activity limitation has association with severity of impairment and it has no relation with participation level. It can be in concomitant with Nagi models of disability [39] that consider participation restriction as handicapping and also other models which define participation more dependent to personal and environmental factors than activity does [40, 41].

As some of the DASH items categorized as Body structure and body function based on ICF by the experts, we considered the score of these items as subjective impairment. The relation between objective and subjective impairment showed that the objective impairment (scored by AMA guide) had significant but weak correlation with activity and participation scores, while the relation between subjective impairment and activity, participation score was high. It indicates that the severity of impairment doesn't relate notably to activity limitations and participation restrictions but when the impairment reported by the patients, it is more related to the severity of impairment. Thus, it can be said that there is a difference between the impairment that is being evaluated by a therapist in clinic with the intrinsic and subjective feeling of impairment felt by a patient. This difference can be due to overestimation of the problems by patients or influence of multiple personal or environmental factors.

Assessing disability inadequately, which might be due to not including participation and activity discretely in most available outcome measures [19, 42] can be the main problems with finding the relation between impairment and disability. Knowing the distinct score of each components of disability can help us to better interventions, As activity restriction must be addressed in acute phases of treatment but increasing participation must be considered in chronic phases. This, impresses the need to revise the available outcome measures or develop a new one to better estimate disability level of the patients [42].

### Limitation

The current study acknowledges a few limitations that should be considered in interpreting and generalizing of the results. The inter-rater reliabilities that measured the experts' allocation did not show the high homogeneity of the data. Nevertheless, according to accepted criteria our kappa coefficients were moderate. The different diagnosis in our patients was the other limitation of our study. Despite these limitations, our

findings can inspire future studies to discover the relationships between disability components, to clear their underlying conceptual basics, and to develop the instruments and outcome measures in order to assess health components separately.

### Conclusion

In summary, different results in reporting the relation between impairment and disability can be due to using an inappropriate instrument for evaluating disability or inconsistency in defining it. Based on our results, participation has a different relation with impairment than activity and must be evaluate separately. But the wide overlapping in meaning of activity and participation components doesn't allow evaluating patient's disability status appropriately based on ICF. Defining the two distinct constructs properly is essential. Also,

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**Conflict of Interest** The authors declare that they have no conflict of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Declaration of Interest** There is no deceleration on interest for this work and the authors also don't report any declaration of interest.

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