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## Relevance of grasp types to assess functionality for personal autonomy

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## ABSTRACT

*Study Design:* Cross-sectional research design.*Introduction:* Current assessment of hand function is not focused on evaluating the real abilities required for autonomy.*Purpose of the Study:* To quantify the relevance of grasp types for autonomy to guide hand recovery and its assessment.*Methods:* Representative tasks of the International Classification of Functioning, Disability and Health activities in which the hands are directly involved were recorded. The videos were analyzed to identify the grasps used with each hand, and their relevance for autonomy was determined by weighting time with the frequency of appearance of each activity in disability and dependency scales. Relevance is provided globally and distinguished by hand (right-left) and bimanual function. Significant differences in relevance are also checked.*Results:* The most relevant grasps are pad-to-pad pinch (31.9%), lumbrical (15.4%), cylindrical (12%), and special pinch (7.3%) together with the nonprehensile (18.6%) use of the hand. Lumbrical grasp has higher relevance for the left hand (19.9% vs 12%) while cylindrical grasp for the right hand (15.3% vs 7.7%). Relevancies are also different depending on bimanual function.*Discussion:* Different relative importance was obtained when considering dependency vs disability scales. Pad-to-pad pinch and nonprehensile grasp are the most relevant grasps for both hands, whereas lumbrical grasp is more relevant for the left hand and cylindrical grasp for the right one. The most significant difference in bimanual function refers to pad-to-pad pinch (more relevant for unimanual actions of the left hand and bimanual actions of the right).*Conclusions:* The relative importance of each grasp type for autonomy and the differences observed between hand and bimanual action should be used in medical and physical decision-making.*Level of Evidence:* N/A.

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## Introduction

Performance of activities of daily living (ADL) is critical to ensure a full and autonomous life.<sup>1</sup> Most movements in ADL require object manipulation with a stable handgrip.<sup>2</sup> Therefore, a decrease in the grasp capabilities arising from pathologies of the hands can generate a loss of functionality. In the occupational field, hand disorders represent one-third of all injuries at work.<sup>3</sup> As a

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consequence, the study of the ability to grasp has been a permanent concern in biomechanics<sup>4-7</sup> and rehabilitation.<sup>8-10</sup>

However, current assessment of hand function in clinical practice lacks a deep evaluation of the grasp ability. Some assessment methods are based on tests or scales that are usually validated for specific pathologies.<sup>11-13</sup> They are highly subjective,<sup>14</sup> including sometimes self-rated scales. Other more general methods are based on objective data such as active ranges of motion, tactile sensing, or grasp strength, although these methods are still under research.<sup>10,15-19</sup> Few methods evaluate the performance of some types of grasps, but they do not consider their relative importance for developing normal life.<sup>13,20</sup>

The International Classification of Functioning, Disability and Health (ICF) of the World Health Organization was developed as a framework for evaluation.<sup>21</sup> The ICF provides a standard language and a common framework to compare by using a common metric:

the impact on the functioning of the individual. The ICF considers positive functioning as the situation where the body is functional and with structural integrity, thus allowing the normal performance of activities and participation. The ICF develops these activities in its “part d. Activities and Participation.” The terms disability and dependency are often used interchangeably in the literature.<sup>22</sup> Some works<sup>23</sup> point out the lack of international consensus on the definition of concepts such as disability, functioning, autonomy, sufficiency, or dependency. According to ICF,<sup>24</sup> functioning and disability are related domains of a single health construct. Functionality, as opposed to disability, is the capability to perform a specific activity. Some authors<sup>23</sup> propose that autonomy (equivalent to sufficiency) and dependency are also part of another single construct. In this construct, dependency can be defined as a loss of autonomy and the need of support by a third person for ADL, especially self-care. A high grade of disability leads inevitably to dependency, but disability can exist without dependency. Full autonomy or sufficiency is reached when a person can develop all the necessary ADL for total functionality. In this sense, personal habits, roles, and responsibilities of one person may influence the perception of autonomy of an individual. However, the scales used to rate both disability and dependency are common and general.

In fact, there are 2 issues to be considered when rating disability or dependency by assessing the capability to perform ADL: the selection of ADL and the relevance of the selected activities for autonomy. There is no consensus in which ADL must be considered for autonomy.<sup>20,25,26</sup> In fact, the scales often consider for autonomy only some basic activities such as those of self-care, so that a person might be assessed as autonomous although he/she requires assistance to carry out activities such as cooking, shopping, or going outside. All ICF activities should be considered when using the ICF to assess autonomy, and a key question is establishing the importance of each activity for personal autonomy. In this regard, a worth mentioning study by Querejeta<sup>22</sup> collects a review of ratings applied by several European countries and organizations, summarized in 2 ratings that will be used in this work. The first rating measures the importance of each ICF activity for disability, computed from the frequency of appearance (appearance coefficient, in %) of each ICF activity in 23 scales used to globally rate disability, as Barthel Index, Functional Independence Measure, or Katz Index. The second rating takes into account the importance of the activities for dependency, estimated through the frequency of appearance of the activities in several sociological surveys of public health in Spain. Both scales are not equivalent: the scales of disability give more importance than the surveys of dependency to transferring oneself or speaking and less importance to household tasks (preparing meals and doing housework), the acquisition of goods and services, moving around, and using transportation or recreation and leisure. Obviously, this dependency rating of the ICF activities has to be seen as a general rating, which may differ somewhat from particular individual's perceptions, affected by the personal habits, roles, and responsibilities.

Knowledge of the daily frequency of usage of the different grasp types, along with time of hands working in unimanual or bimanual tasks, has been emphasized as essential to establish rehabilitation strategies.<sup>27,28</sup> Daily frequencies of different grasp types while performing ADL were provided in a previous work by the authors.<sup>27</sup> Nevertheless, that work was not focused on assessing disability but on daily time of use. The most commonly used grasps throughout the day are not necessarily the most important ones for autonomy; at least, there is no evidence of it to date. Knowledge of the most needed grasps for autonomy would be a valuable reference in decision-making for medical and physical rehabilitation to reinforce the capacity to perform these grasps. In fact, 97.5% of therapists feel that ADL-based strategies are important in hand therapy

practice.<sup>29</sup> However, assessing the capability to perform different grasp types is not a common practice to assess functionality. Light et al.<sup>20</sup> attempted to assess functionality through the capability to perform different grasp types by assigning a unique grasp type to each activity, although different grasp types are usually required to complete a given ADL. They used a limited set of ADL as representative of the grasp types most commonly used, but they did not weight the activities for autonomy. No previous work has attempted to establish the relevance of the different grasp types for assessing functional recovery or disability.

The objective of this work was to present the relevance of the different grasp types for disability assessment, within the framework of the ICF. A field study has been performed on healthy subjects to identify the grasps used during normal hand function by means of a thorough analysis of videos recorded while performing a set of activities selected according to the ICF. The importance of each grasp for autonomy is estimated using weighting coefficients obtained from the work of Querejeta.<sup>22</sup>

## Material and methods

The experiment was approved by the ethical committee of the university. Thirty-two right-handed subjects (16 males and 16 females) participated in the experiment (age,  $32.4 \pm 12.5$  years; hand length,  $180 \pm 13$  mm; and hand breadth,  $81 \pm 9$  mm). All the participants were free of pathologic conditions.

First, a set of ICF activities in which the hands are directly involved was selected. Then, representative tasks accounting for each of these ICF activities were video recorded. The videos were subsequently analyzed to identify the different grasps being used, and finally, the importance of each grasp type for autonomy was determined.

### Selection and recording of tasks

From the ICF “part d. Activities and Participation,” the activities of the third level (subclass of the ICF up to a third level, coded as d followed by 3 figures) were used in this study (Table 1), named as 3-figure code ICF activities (3FC-ICF activities), although we have looked into the activities of the fourth level, (subclass of the ICF up to a fourth level) if they existed, to select the representative tasks.

ICF chapters where the hands are not involved were not considered and neither were those referring to cognitive activities (how to learn, how to manage relationships, and so forth). In all, chapters 3 (communication), 4 (mobility), 5 (self-care), 6 (domestic life), and 9 (community, social and civic life) were considered. Within these chapters, 23 3FC-ICF activities in which the hands are directly involved for grasping were identified by the authors. Some 3FC-ICF activities were not considered, such as d340 Producing messages in formal sign language, as no grasp is required; d480 Riding animals for transportation because it is only used in

**Table 1**  
Chapters of the ICF

Chapters of the ICF		
d1	Chapter 1	Learning and applying knowledge
d2	Chapter 2	General tasks and demands
d3	Chapter 3	Communication
d4	Chapter 4	Mobility
d5	Chapter 5	Self-care
d6	Chapter 6	Domestic life
d7	Chapter 7	Interpersonal interactions and relationships
d8	Chapter 8	Major life areas
d9	Chapter 9	Community, social and civic life

ICF = the International Classification of Functioning, Disability and Health.

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