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Understanding Linkages between Perceived Causative Impairment and Activity Limitations among Older People Living In the Community:

A Population-Based Assessment

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Abstract

Objective—To better understand linkages between impairment and activity limitation among groups of elderly community-living persons.

Design—US population-based complex survey with weights used to make accurate population prevalence estimates from the 1994 NHIS-D. Included were 2,429 persons 70 years of age or older with one or more ADL or IADL-only activity limitations. Limitations were addressed according to the impairment(s) perceived to be causing them.

Results—Musculoskeletal impairments accounted for over 1/3 of all perceived causes. The odds of having any ADL limitations for persons whose limitations were attributed to musculoskeletal impairments and to brain or behavioral impairments were 2.12 times (95% CI 1.63–2.76) and 3.00 times (95% CI 2.23–4.03) the odds for the reference group of cardiopulmonary and hematology impairment

Conclusions—While musculoskeletal impairments were the most common cause of activity limitation, impairments associated with brain or behavioral disturbance were perceived as most disabling.

Keywords

Activities of Daily Living; Brain disease; Aging; Classification; ICF

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Costs associated with management of disability in the elderly population represent a substantial burden to the healthcare system, family and the individuals themselves, and are expected to increase over the coming decades.^{1, 2} The population of elderly persons with functional disability due to physical and cognitive impairment in the United States is expected to triple by 2049.^{3, 4} Consequently, assessment of the causes of disability is crucial to physical medicine and rehabilitation (PM&R) in preparation for developing guidelines and treatment planning, and in the evaluation of the relative benefits of various preventative and interventional strategies.³

The World Health Organization, through its recent development of the International Classification of Functioning, Disability and Health (ICF), defined disability as a multidimensional construct that distinguishes among impairment, activity limitation and participation restrictions.⁵ Impairments are problems with body function or structure. Activity limitations refer to difficulties encountered by the person when trying to perform a task. Participation restrictions relate to problems an individual encounters when trying to engage in life situations. Activity limitations have profound adverse consequences for the quality of life in elderly populations, and are strongly associated with increased mortality and further decline in functional status.⁶ More severe activity limitation is associated with increased healthcare utilization, including hospitalization, use of rehabilitation services, use of formal and informal home care, and admission to nursing homes.^{7–10}

Activity limitations are typically divided into those involving basic activities of daily living (ADL)¹¹ and those involving more complex instrumental activities of daily living (IADL).¹² ADL and IADL limitations distinguish between more and less severe activity limitations, respectively,¹³ and are classified in the “self care” and “domestic life” chapters of the ICF.⁵ In addition to the types of activities limited (i.e. ADL versus IADL) the ways in which those activities are limited will influence how and the degree to which people living in the community are able to participate in life situations.¹⁴ The need for physical help versus supervision determines the amount and type of support the person requires, which, in turn, also potentially impacts the extent to which care givers are able to participate in their own lives.^{15, 16}

A deeper understanding of the impairments people themselves or their close household contacts perceive as most limiting of activity could facilitate clinical care, policy and research. Such basic knowledge could support guidelines as well as intervention development for disability management, and provide a broad framework for studying the functional prognosis of populations of people with particular types of impairments. This work was stimulated by recognizing that the detailed classification of impairments by specific pathologic causes, illnesses or injuries would be too complex. Such an approach would lead to too many groups that were too small for statistical comparisons making the classification inoperable to research and clinical guideline development. A more sensible approach to classification would reduce numerous pathology-related conditions into functionally-associated classes of impairments that share similar features regarding the origin of the impairment and its possible association with specific types and qualities of activity limitation. Along these lines, a number of core datasets are being developed or have been developed, primarily in Europe, based on ICF concepts relevant for specific diagnoses and settings.^{17–18}

This paper builds on the ICF core dataset concept by presenting a generic “perceived causative impairment classification system” intended to be relevant across the full population of community-dwelling elderly people with disabilities in the US. The system is intended to characterize activity limitations and impairments caused by particular types of conditions. Based, in part, on the body system structural impairment chapters defined by the

ICF (Table 1), the causative impairment classification system organizes health conditions perceived as limiting activities into impairment categories using one or more of the following criteria. First, conditions can be caused by similar types of body system damage, such as impairments caused by injuries in the brain secondary to trauma, stroke or tumors. Second, conditions affecting multiple body systems may be grouped if they share common pathways to impairment, such as heart and lung injuries reducing energy. Third, they may be grouped if they lead to similar activity limitations, such as vision and hearing deficits that primarily influence people's abilities to gather information from the environment and tend to lead to more complex IADL limitations. IADLs depend more heavily than do ADLs on interacting with, moving through and gathering information from the physical and social environments.

The primary hypothesis was that particular causative impairments would be associated with IADL only versus ADL limitations, and with different qualities of dependency, i.e., physical help versus need for supervision. We anticipated that those whose activity limitations were attributed primarily to brain function or behavior rather than to other types of conditions would be more likely to have one or more ADL limitations as opposed to IADL limitations only. Also, they would be more likely to need a second person for help when performing ADL. In contrast, people with conditions impairing the cardiopulmonary or hematological systems, which primarily affect energy rather than the ability to move, would be more likely to have IADL limitations only.

METHODS

Study Sample

To obtain all variables needed for this analysis, we merged three linkable datasets including the baseline of the Longitudinal Survey of Aging II (LSOA II), the 1994 National Health Interview Survey (NHIS), and the 1994 National Health Interview Survey on Disability (NHIS-D), Phase I¹⁹ The collection of these data were initially catalyzed by the Americans with Disabilities Act (ADA), signed into law in July 1990, in recognition of the lack of national-level information regarding people with disabilities. Developed as a supplement to the NHIS, NHIS-D merged efforts of 16 federal agencies to develop a series of questionnaires that balanced between the medical, social, and administrative considerations involved in disability management. Question development involved extensive input from multiple federal agencies and consultants in the research community. Also, an outside panel of experts reviewed questionnaire drafts. Once questions were developed they were field tested by the National Center for Health Statistics (NCHS) questionnaire design research laboratory prior to use. Detailed instructions provided to interviewers and the Code Book of questions are available.^{20,21} A survey with this depth of information has never been attempted previously.

The LSOA II is a prospective study involving a nationally representative sample comprised of 9,447 non-institutionalized civilians 70 years of age and older at the time of their baseline interviews, which were conducted in 1994.²² All 9,447 sample persons (SP) were included in the 1994 NHIS but only 8,861 were also included in the 1994 NHIS-D survey. Among the 8,861 patients, only those with ADL and/or IADL limitations (n=2,632) were asked to identify the primary disease or medical condition that they considered as causing their activity limitations. Among these 2,632 persons, an additional 203 were further excluded from our analysis because they could not attribute the limitation to particular health conditions (n=187) or did not answer the question about needing help or supervision (n=16). The final sample consisted of 2,429 persons. Among the 2,429 persons, information was provided by the SPs themselves 77.0 % of the time and by proxy 23.0% of the time.

Demographic information was obtained from the NHIS core. Questions applied to generate the perceived causative impairment, ADL limitations and IADL limitations were from NHIS-D Phase I. Sample weights from the LSOA II baseline were applied to all variables since the objective was to represent the elderly population. There was an 11-digit identifier generated for each person in the core, which allowed merging of data from these multiple sources.

This study was approved by the IRB of the University of Pennsylvania.

Variables

Predictor—Perceived Causative Impairment Classification System

The perceived causative impairment classification was based on the condition(s) named by the individual or close household proxy as most responsible for limiting the individual subject's activities. The question asked was "What was the main problem or condition that causes you [or the sample person, if by proxy] trouble in [the activities indicated as limited]?" The conditions listed by respondents were classified according to ICD codes. The Perceived Causative Impairment Classification system was generated by grouping those conditions to reflect the ICF body structure chapters. We made some refinements to the ICF body structure chapters based on the logic shown in Table 1. Diagnostic conditions were grouped into the impairment categories by consensus of the three physician-authors (1 psychiatrist, and 2 physiatrists) using the criteria stated in the table. Each classified the list of conditions separately. Discussions reconciled disagreements. The objective was to group the impairments secondary to cognitive, mental, or physical health conditions that the respondent (self or proxy) perceived to be primarily causing the sample person's activity limitations. An impairment, according to the ICF definition, is the adverse effect of the health condition on the physiological, psychological, or anatomical parts or functions of the body.⁵ Thus the rules in Table 1 were intended as a guide to place health conditions expected to cause similar limitations in the same impairment category according to anatomical parts or functions of the body. It was anticipated that certain categories of impairments might be predictive of certain types of limitations or the qualities of assistance needed.

The perceived causative impairment classification consisted of the following mutually exclusive and exhaustive groups involving conditions impairing: 1) brain structure or behavior; 2) cardiopulmonary or hematologic function; 3) the digestive system, metabolic or endocrine system; 4) the musculoskeletal system; 5) ears or eyes; 6) peripheral nerves or the spinal cord; 7) other, and 8) multiple (Table 1). The "other" category included conditions too infrequent as causes for activity limitations to be classified, such as diagnoses involving the skin and genitourinary organs. The "multiple" category was applied when the respondent could not assign a single primary causative condition. The cardiopulmonary or hematology impairment group was selected as reference for modeling purposes because although such conditions may cause subtle cognitive impairments, conditions affecting the heart, lungs or blood were believed less likely than many of the other types of conditions to cause structural impairments expected to create a need for help or supervision from a second person for ADLs. The detailed lists of diagnoses included in each impairment category are available from the first or corresponding authors.

Outcomes—ADL limitation was determined based on respondents (self or proxy) reporting difficulty, need for physical help, or need for supervision or a reminder in performing one or more of the following activities: bathing and showering, dressing, eating, getting in and out of bed or a chair, toileting, or getting around inside the home. IADL limitation was determined by reports of difficulty, need for physical help or need for

supervision or physical help in one or more of the following activities: preparing meals, shopping, managing money, using the telephone, doing heavy work around the house, or doing light work around the house. All patients in this analysis had at least one activity limitation in ADL/IADLs with the latter considered less severe.

Outcomes in the study were established based on answers to three questions about each ADL and IADL. These questions were, “Because of a health or physical problem: 1) do you have ANY difficulty?, 2) “Do you receive hands-on help from a second person?” and 3) “Do you have someone who supervises you or stays nearby?” We formulated answers to these questions into 3 outcomes that related to the type(s) of limitation (ADL/IADL) and the type(s) of ADL assistance needed from a second person (if any) as described below.

1. Types of Activity Limitations: We categorized activity limitations into two types: the presence of one or more ADL limitation (with or without IADL limitations) and IADL limitation only. The presence of IADL limitation only is considered to be less severe. ADL limitation has important implications to how a person is able to participate in their own self-care. With ADL limitations one has difficulty or needs assistance with highly personal bodily tasks, in contrast to IADLs where the tasks involve manipulations of the environment rather than one’s own body.

2. Need for Physical Help with ADLs: Need for physical help in any ADL was defined by a respondent’s report of the subject’s needing physical help when performing one or more of the six ADL items. The reference category was no need for physical help when performing any of the six ADLs. The need for physical help was seen as a marker of greater severity than stated difficulty. The need for physical help with ADLs requires intense periods of assistance in circumstances for which a second person is needed, often lifting, supporting or touching the person’s body in the process of helping him or her perform an activity.

3. Need for Supervision with ADLs: The need for supervision was defined by a respondent’s report of the subject’s needing a reminder or someone close by in performing any of the six ADLs. The reference category was no need for supervision when performing any of the six ADLs. This type of need was additionally considered to mark greater severity than difficulty only and as also signaling loss of autonomy. In contrast to the need for help, the need for reminders from a second person to do a task or for supervision, suggests a need for less intensive assistance but potentially over a longer period of time. The need for help and supervision with ADL suggests a high care burden, relative to those with problems with IADL only, or those who only experience difficulty.

Confounders—Candidate confounding factors included in the analysis were age, sex, and race. To address the possible presence of a non-linear relationship between the study outcomes and age, we grouped the sample into the following age categories: 70–74, 75–79, 80–84, 85–89, and over 90 years of age. Racial groups were simplified into black, white and other.

Statistical Analysis

Because the NHIS (and hence NHIS-D and LSOAII, which used the same samples) uses a multistage sample design, design information such as sampling weights, stratification and clustering of the sample must be used to make accurate population estimates from the NHIS data. To obtain the correct variance estimates, we took into account the clustering and stratification in the sample design. The domain statement was also used in all analyses to ensure the correctness of variance estimates as our sample is only a subset of the NHIS sample. All statistical analyses were performed on SAS 9.1(SAS Institute) using the proper

commands to account for the complex sampling, including weight, clustering and stratification as recommended by the NHIS.^{23,24}

In order to test the association between causative impairment and the three activity limitation outcomes, bivariate analyses were carried out using the PROC SURVEYFREQ procedure. The association between the different causative impairment categories and the three dichotomous outcomes after adjusting for other covariates was further tested with the PROC SURVEYLOGISTIC procedure. Odds ratios with 95% confidence intervals were reported. All P-values presented are 2-tailed; $P < 0.05$ was considered statistically significant.

RESULTS

Of the 2,429 persons included in this analysis, over half (56.6%; all proportions reported are weighted unless noted otherwise) had IADL limitations only ($n=1,442$) (Table 2). The remaining 987 had ADL limitations (with or without IADL limitations). There were 666 (27.9%) persons who needed help and/or supervision to carry out one or more ADLs. Of these persons, 618 (26.0%) needed physical help in carrying out one or more ADL activity, while 300 (12.5%) needed supervision. The remaining 321 (13.4%) with ADL limitations who did not need help or supervision described difficulty performing one or more of those tasks. There were 750 (31.4%) persons who were male and 1,679 (68.6%) who were female.

The most common impairments attributed by the respondents as being the primary cause of ADL and/or IADL limitations were musculoskeletal, accounting for 864 (35.3 %) subjects (Table 2). The second most frequent impairment group was brain or behavioral, with 538 (22.0%). Impairments of the cardiopulmonary or hematological system accounted for 365 (14.8%), ranking third, while multiple impairments accounted for 327 (14.2%), ranking fourth.

Among the 2,429 individuals with impairment of sufficient severity to cause ADL and/or IADL limitations, 987 (41.4%) had one or more ADL limitations, and 1,442 (56.6%) had IADL limitations only. In general, IADL limitations were more common than ADL limitations, consistent with earlier onset or less severe disability. However, there was a disparity in the proportion of subjects across causative impairment types who had one or more ADL versus IADL limitations only. As shown in Table 3, those with brain or behavioral impairment and those with multiple impairments were the most likely to experience ADL limitations (51.7% and 49.9%, respectively), compared with other groups ranging from 23.5% to 39.7%. In contrast, respondents with cardiopulmonary or hematology (76.2%) or eye or ear (76.5%) impairments were more likely to experience IADL limitations only.

The proportions of subjects who needed help and/or supervision for ADLs for each of the causative impairment type are presented in Table 3. This showed a statistically significant association between the attributed type of impairment and the need for physical help or the need for supervision with ADLs ($P < 0.0001$). As anticipated, individuals whose activity limitations were attributed to impairments of brain and behavior, and those who described multiple causative conditions were the most likely to need help with ADLs (39.1% and 35.7%, respectively). By comparison, between 16.2 and 25.3% of those with other types of impairments needed ADL help. Among individuals with brain and behavior impairments, 25.9% can be expected to require supervision, which was by far the highest proportion. For all impairment types, the percentage of subjects needing help was higher than the percentage needing supervision. For example, in patients with brain impairments, 39.1% needed help and 25.9% needed supervision; 35.7% of subjects with multiple impairments needed help while 15.1% needed supervision.

As shown in Table 4, weighted logistic regression analysis after adjustment for sex, race and age continued to demonstrate that subjects with brain or behavioral impairments or with multiple impairments as their primary cause of ADL and/or IADL limitation were still statistically significantly more likely to need help or supervision in carrying out their ADLs. The reference group in the logistic regression was chosen to be the cardiopulmonary and hematology group because, according to the bivariate analyses, people in that category had the lowest likelihood of needing help. The odds of needing help in ADLs in persons with attributed brain or behavioral impairment, and in those with multiple impairments was 2.6 times (95% C.I. 1.85–3.69) and 2.4 times (95% C.I. 1.7–3.4) the odds in the cardiopulmonary or hematology group. Similarly, the ratio of odds of needing supervision were 5.2 (95% C.I. 3.3–8.1) in respondents with attributed brain impairments, and 2.7 (95% C.I. 1.7–4.5) in those with multiple impairments comparing to the cardiopulmonary or hematology group.

After controlling for impairment type, race and gender, respondents over 90 years of age were statistically significantly more likely to need help in ADL than the youngest age group of 70–74, with an odds ratio of 2.3 (C.I. 1.7–3.3). The same age group also showed higher likelihoods of needing supervision than the age group of 70–74, with an odds ratio of 1.7 (C.I. 1.1–2.5). The age group of 85–90 also showed an increased likelihood of needing help with ADL, with an odds ratio of 1.6 (95% C.I. 1.2–2.1).

The effect size of needing supervision was higher than that of needing help in the subjects with brain, multiple, and other impairments. In contrast to those with brain and multiple impairments, those with sensory limitations did not show an increased need for help or supervision in carrying out ADL. Moreover, the odds ratio of needing help or supervision was not increased in those with spinal/nerve impairments compared to the reference cardiopulmonary/hematology group.

DISCUSSION

As a major feature of population-based studies, a sleek classification system of impairments would simplify the process of clinically projecting functional limitations associated with specific impairments. With a more operationally friendly system, we would expect to provide clinicians with tools for determining patients' likely functional needs as they attempt to remain living in their communities.

The Perceived Causative Impairment Classification system has implications for understanding likely types of activity limitation (ADL vs. IADL) as well as the nature of assistance required for elderly people living in the community with particular types of conditions. Consistent with the findings of others, we found that chronic illnesses affecting the musculoskeletal, brain or behavioral, or cardiovascular systems represent the major perceived causes of functional loss in elderly populations.^{25, 26} All persons in this study by definition had health conditions of sufficient severity to cause activity limitations, yet patterns of activity limitation, the severity and the types of assistance needed differed across the impairment categories in clinically logical ways.

Although musculoskeletal impairments were the most common cause of activity limitations in the US population, those involving brain or behavioral impairments were the most disabling, highlighting the importance of PM&R to maintaining and building future professional capacity in the area of managing impairments associated with brain disorders. After adjusting for age, gender and race, elderly persons with perceived causative impairments involving the brain or behavior and those who could not identify a single causative condition were approximately 3 times more likely than those with

cardiopulmonary or hematological impairments to have ADL limitations. Since ADLs depend on the more fundamental body movements, balance and cognitive sequencing (executive function), it is not surprising that those with brain or behavioral, and multiple impairments were more likely than those with other types of impairments to experience ADL problems. Conversely, IADLs are more dependent on endurance, energy and the ability to interact intellectually at higher levels with others and with the environment. Thus, impairments that limit energy such as those involving the cardiopulmonary or hematological systems or impairments that limit the capacity of the person to obtain important sensory information from the environment such as vision or hearing would logically tend to primarily interfere with IADL functioning.

The associations between impairment and the need for physical help or supervision with ADLs were also clinically intuitive. As expected, respondents whose limitations were attributed to health conditions classified in the brain or behavioral impairment category were also the most likely to need supervision or physical help when performing ADLs. This strong association is consistent with our hypothesis that people with these types of impairments would be more likely than those with other types of impairments to be seen as requiring help and/or supervision in carrying out ADLs. Brain or behavioral impairment can be associated with any combination of mental disturbances, paralysis, movement disorders, or sensory loss. These manifestations logically translate into the most severe activity limitations, i.e., those needing a second person to be available when performing ADL. In contrast, elderly people whose activity limitations are attributed to impairments of the cardiopulmonary or hematological systems, because they experience fatigue, will logically have difficulties performing the most energy-demanding IADL, but will be less likely to require a second person to help them perform the simpler and less energy-demanding ADLs.

Those with musculoskeletal conditions, the most common perceived causative impairment, were more likely than those with cardiopulmonary or hematological conditions to require a second person when performing ADL, but they were less likely than those with brain or behavioral impairments to require a second person. People with musculoskeletal conditions likely experience pain or difficulty with performance, rather than complete loss of physical strength or cognitive impairment, where help or supervision would be required.

Because earlier research has shown that functional limitations are more prevalent in women^{27,28} and the elderly,^{29,30} we controlled for gender and age in our models. The association between perceived causative impairment and activity limitations remained statistically significant after removing the effects of these demographic differences. Only a very advanced age of 85 years and older remained independently associated with an increased likelihood of needing a second person in performing ADL after adjustment for causative impairment.³¹

Findings from this study have implications for understanding patient and caregiver participation in the experiences of disability, as well as for research, clinical practice, and healthcare policy. The perceived causative impairment classification may give clinicians a quick picture of the patient's or close proxy's perceptions of the conditions underlying activity limitations, and facilitate the planning of appropriate interventions. ADL and/or IADL limitation may be considered a final common pathway resulting from clinically significant impairments as caused by myriad types of illnesses and injuries. Yet the pharmacological treatments, physical or occupational therapies, environmental modifications, as well as the caregiver infrastructure and support systems required will all depend on the impairment and its prognosis.

The implications of activity limitation will depend on the type and nature of limitation. IADL limitations suggest early or more mild disability compared to ADL limitations. IADL activities, unlike ADL activities, are often routinely performed by others such as a spouse and, if not, can be more easily taken over by others. Conversely, once an individual needs ADL assistance from a second person s/he loses the ability to participate autonomously in managing intimate personal care. Once supervision is necessary, privacy is lost. Whether physical help is needed or supervision is necessary shapes the individual's participatory experiences. The need to wait for physical help reduces spontaneity. From the caregiver's perspective, the nature of assistance required by the individual will bear on opportunities to participate in other desired life occupations and activities. The nature of assistance needed also has bearing on the capacity or willingness of the caregiver to provide essential care. Need for physical help may require physical lifting, while need for supervision may require less physical strength but a greater time commitment, sometimes around the clock.

There were a number of study limitations. First, the study was based on the survey of respondents' perceptions regarding the health conditions they believed were causing their activity limitations. Their perceptions may or may not concur with a clinician's impression based on an objective medical evaluation. It is important to recognize such potential disparities when communicating with patients and formulating treatment plans. Future studies are needed to examine concordance between the causes of activity limitation as identified by respondents versus health care professionals. Our perceived causative impairment classification is in line with and builds on the general movement towards the patient reporting of disability concepts as reflected in the major NIH-funded patient-reported outcomes measurement information system (PROMIS) initiative.³² That initiative focuses on patient-reported outcomes such as pain, fatigue and function. It does not include patient-reported diagnoses or impairments. Second, this cross-sectional survey study is foundational to our ongoing efforts. The predictive power of the causative impairment and activity limitation will need further assessment in longitudinal studies, part of these ongoing efforts. Age of the 1994–1995 NHIS-D data may be of the greatest concern. We selected these data because we could find no other source of population-level data that characterized the type of medical conditions people believed to be causing their activity limitations. It would not have been possible to address the basic question about linkages between perceived causative impairment and activity limitation at the population-level without using these data. There is no reason to believe that linkages between perceived causative impairment and activity limitation would change greatly over time. This assumption will need to be tested as data become available.

This study advances our understanding of linkages between impairments and activity limitations. While brain or behavior impairments and multiple impairments were shown to be associated with the most severe activity limitations, other types of impairments such as cardiopulmonary or hematology, or musculoskeletal conditions, may prove relatively more important in distinguishing among respondents with regard to other subjective constructs, such as the perceptions of poor health. Future studies will be necessary to explore additional clinical implications. Also, such research needs to incorporate a broader biopsychosocial paradigm acknowledging that surrounding structures in the built and human-made physical environments as well as expectations and supports from social environments can limit activity and restrict participation as much as impairment.^{33,34} Finally, future work will be essential to determine prognostic differences with regard to risks of mortality or further functional decline among elderly persons, whose activity limitations are caused by different types of impairments.

SUMMARY

The 54th World Health Assembly endorsed the ICF for international use and it is fast becoming disseminated worldwide. The ICF offers a classification scheme for impairment that consists of the chapters described in Table 1. We presented one strategy for populating the ICF body structure chapters appropriate to understanding and tracking perceived causative patterns of disability in the US population. Designed to be appropriate for elderly people living in the community, this strategy is based on classifying the diagnostic conditions that elderly people themselves or their close proxies believed are causing their activity limitations. Without populating the ICF impairment chapters with diagnostic conditions, the linkage of impairment to other health-related concepts and their practical use remains obscure.

Clinical heterogeneity within the impairment categories is expected, as it offers relatedness only at the organ level, i.e., “Anatomic parts of the body such as organs, limbs and their components.”⁵ Each impairment category can be repeatedly subdivided ultimately into hundreds of individual diagnoses which, even at the diagnostic level, will continue to be heterogeneous. Clinical classifications are intended to be fluid and modified as knowledge and needs evolve. We offer the perceived causative impairment system to PM&R and other related professions as a potential foundation for understanding linkages between perceived causative impairment and activity limitation. We invite additional changes to this system as it is applied and subjected to further study and use.

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Table 1

The Perceived Causative Impairment Classification Based on ICF Chapters

Perceived Causative Impairment	ICF Chapters (body structure)	Illness or Injury Involving	Further Explanations of Logic
Brain/behavior	1a. Structures of the nervous system (brain)	Structure of the brain, cranial nerves, cerebellum	According to the ICF, the body is intended to represent the human system as a whole. Mental or psychological functions are included under body, i.e., structure of the brain. Individuals who have this type of perceived causative impairment might experience paralysis, sensory loss, thought or affective disturbance, or cognitive impairment.
Peripheral nervous system and spine	1b. Structures of the nervous system (peripheral nervous system and spine)	Spinal cord, spinal nerves	We split the ICF chapter 1 into two sub-sections brain/behavior, and peripheral nervous system and spine, recognizing that impairments of the peripheral and central nervous system have fundamentally different affects on the ability of people to perform activities. Individuals might experience paralysis, and sensation loss, but not disturbances in thinking or cognition.
Eye and ear	2. The eye, ear and related structures	Eyeball, structures around the eye, extra-ocular muscles, external and middle ear	Vision and hearing deficits will have very different impacts on activities when compared to the other categories. People will not have paralysis but will have difficulty receiving information from the physical and social environments.
Cardiopulmonary or hematology	4. Structures of the cardiovascular, immunological and respiratory system	Heart, immune system, arteries, veins, lymphatics	The linking concepts in this pathologically heterogeneous group are energy reduction, shortness of breath, limited endurance and fatigue.
Digestive, metabolic or endocrine	5. Structures related to the digestive, metabolic and endocrine systems	Salivary glands, esophagus, intestine, pancreas, liver, gall bladder, endocrine (pituitary, thyroid etc.)	The linking concepts are nutritional, energy reduction and general debility with fatigue.
Musculoskeletal	7. Structures related to movement	Bones, joints, ligaments, and muscle	The linking concepts are expected pain associated with activity, restricted range of motion, joint instability and possibly general mild weakness.
Skin, genitourinary or other	3. Structures Involved in Voice and Speech 6. Structures related to the genitourinary and reproductive systems 8. Skin and related structures	Nose, mouth, pharynx, larynx Skin, sweat glands, nails, Urinary, pelvic floor, reproductive systems	These impairments were too infrequent in the data to separate out. Consequently, several ICF chapters are combined. They will lead to general debility.
Multiple	No ICF category corresponding		Persons unable to attribute a single impairment to causing their activity limitations will be more likely than others to have more severe deficits due to multiplicity of conditions.
Unable to assign cause	No ICF category corresponding		

Table 2

Characteristics of the Study Participants.

			unweighted Frequency	Weighted Percent
Impairment	Brain or behavioral		538	22.0
	Cardiopulmonary or hematology hHeHHHhematologyCPH		365	14.8
	Digestive, metabolic or endocrine		73	3.1
	Musculoskeletal		864	35.3
	Eye or ear		100	4.2
	Peripheral nervous system or Spine		34	1.5
	Multiple		327	14.2
	Skin, genitourinary or Other		128	5.0
Categories of Activity Limitation	Any ADL limitation		987	41.4
	IADL limitation only		1442	56.6
Types of Assistance needed	Need help	Yes	618	26.0
		No	1811	74.0
	Need supervision	Yes	300	12.5
		No	2129	87.5
Sex	Male		750	31.4
	Female		1679	68.6
Race	White		2093	89.0
	Black		300	9.4
	Other		36	1.6
Age	70–74		513	20.5
	75–79		626	26.0
	80–84		587	24.4
	85–89		424	17.7
	90+		279	11.3

Table 3

The number and weighted percentage distribution of type of activity limitation and types of assistance needed as a function of causative impairment classification

	Type of Activity Limitation N (Weighted %)		Types of Assistance Needed N (weighted %)			
	Any ADL*	IADL only*	Need Help*		Need Supervision*	
			Yes	No	Yes	No
Brain or behavioral	276 (51.7)	262 (48.3)	210 (39.1)	328 (60.9)	139 (25.9)	399 (74.1)
Cardiopulmonary or hematology	86 (23.8)	279 (76.2)	62 (17.4)	303 (82.6)	20 (5.8)	345 (94.2)
Digestive, metabolic or endocrine	29 (40.5)	44 (59.5)	17 (25.3)	56 (74.7)	6 (9.5)	67 (90.5)
Musculoskeletal	345 (41.2)	519 (58.8)	162 (19.8)	702 (80.2)	65 (7.5)	799 (92.5)
Eye or ear	22 (23.5)	78 (76.5)	16 (17.0)	84 (83.0)	8 (7.8)	92 (92.2)
Peripheral nervous system or Spine	15 (43.3)	19 (56.7)	6 (16.2)	28 (83.4)	1 (2.5)	33 (97.5)
Multiple	165 (49.9)	162 (50.1)	116 (35.7)	211 (64.3)	49 (15.1)	278 (84.9)
Skin, Genitourinary or Other	49 (39.7)	79 (60.3)	29 (21.8)	99 (78.2)	12 (9.9)	116 (90.1)
Total	987 (43.4)	1442 (56.6)	618 (26.0)	1811 (74.0)	300 (12.5)	2129 (87.5)

* Rao-Scott Modified Chi-Square Test: P<0.0001

With "Any ADL" the individual must have difficulty, require supervision and/or require physical help from a second person on one or more ADL(s) in order to be considered limited. They may or may not have IADL limitations.

With "IADL only" the individual must have difficulty, require supervision and/or require physical help from a second person with one or more IADL(s) but they can have no limitations in ADLs.

"Need help" represents how activities are limited. It comprises those who need help with ADL compared to those who do not need help with ADL.

"Need supervision" represents a second way activities are limited. It comprises those who need supervision with ADL compared to those who do not need supervision with ADL.

Categories of activity limitation and types of assistance needed as a function of impairment group controlling for gender, race and age

Table 4

Parameter		Any ADL vs. IADL only		Need Help		Need Supervision	
		Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
Impairment	Cardiopulmonary or Hematology	Ref	--	--	--	--	--
	Brain or Behavioral	3.06	2.27 4.13	2.62	1.85 3.69	5.19	3.32 8.12
	Eye or Ear	0.86	0.51 1.45	0.81	0.46 1.43	1.25	0.50 3.10
	Digestive, Metabolic or Endocrine	2.09	1.36 3.22	1.53	0.85 2.78	1.64	0.66 4.09
	Musculoskeletal	2.12	1.63 2.76	1.07	0.78 1.46	1.28	0.82 2.01
	Peripheral Nervous System or Spine	2.41	1.16 5.04	0.88	0.38 2.02	0.41	0.05 3.18
	Multiple	3.00	2.23 4.03	2.42	1.72 3.41	2.74	1.66 4.53
	Skin, Genitourinary or Other	1.98	1.34 2.91	1.21	0.77 1.88	1.17	0.93 3.17
	Female	ref	--	--	--	--	--
	Male	1.05	0.87 1.72	1.03	0.82 1.28	1.33	1.03 1.72
Race	White	ref	--	--	--	--	--
	Black	1.31	1.02 1.68	1.32	0.98 1.76	1.31	0.84 2.04
	Other	0.64	0.26 1.53	0.98	0.41 2.33	0.56	0.17 1.85
	AGE	ref	--	--	--	--	--
AGE	70-74	1.05	0.82 1.33	1.13	0.84 1.51	1.00	0.68 1.48
	75-79	1.20	0.95 1.51	1.31	0.99 1.73	1.09	0.76 1.58
	80-84	1.37	1.07 1.75	1.55	1.17 2.05	1.37	0.97 1.92
	85-89	2.06	1.56 2.72	2.34	1.66 3.30	1.66	1.09 2.54
	90+						

* "Any ADL" represents the type of limitation. This group comprises individuals with ADL limitations most of whom also having IADL limitations. The IADL group is compared to those with IADL only. Any ADL and IADL limitation can constitute difficulty, need for help, and need for supervision.

"Need help" represents how activities are limited. It comprises those who need help with ADL compared to those who do not need help with ADL.

"Need supervision" represents a second way activities are limited. It comprises those who need supervision with ADL compared to those who do not need supervision with ADL.